DOCUMENT 2

RESEARCH AND DEVELOPMENT STRATEGY FOR TSHWANE UNIVERSITY OF TECHNOLOGY 2004 - 2008

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CHAPTER 1

INTRODUCTION

With the establishment of the Tshwane University of Technology, the first of such institutions in a democratic South Africa, it is necessary from the outset to provide a Research and Development (R&D) strategy. Such a strategy has to be seen to guide the R&D process and to effect the necessary commitment to relevance and competitiveness in pursuance of R&D. The philosophical basis comprises two parts:

- An R&D Strategy for the Tshwane University of Technology (set out in Chapter 2), and
- Guidelines for R&D management in the Tshwane University of Technology (set out in Chapter 3).

This document was generated from information provided by a number of sources:

- Various policy documents from the Technikon Pretoria, which evolved over the years to provide the foundation for an increasingly sophisticated research effort at that institution, of which the strategic directions and implications for becoming a University of Technology form an important part. Most of the information in this document is the result of that institution's policy efforts over the years.
- Research policy documentation from the Technikon Northern Gauteng.
- Research policy documentation from the Technikon North West.
- Various policy documents emanating from the National Department of Education, such as the "National Plan for Higher Education" (February 2001), and "The Funding of Public Higher Education: A New Framework" (March 2001).

CHAPTER 2

RESEARCH AND DEVELOPMENT STRATEGY AT TSHWANE UNIVERSITY OF TECHNOLOGY

2.1. RESEARCH AND DEVELOPMENT AT TSHWANE UNIVERSITY OF TECHNOLOGY

2.1.1 Background

Traditionally, most higher education institutions have a model of knowledge production that is disciplinary based. Due to major market shifts and globalization, the bulk of new knowledge production lies outside the higher education system and is geared towards addressing needs, priorities and challenges of society and industry for the economic development of the country. This has given rise to a new mode of knowledge production, It is characterized by the fact that it:

- is governed by a discipline of specialization in application;
- is relevant, applied research, which is problem-based;
- is multi- and trans-disciplinary;
- aims to make knowledge useful;
- operates in collaboration with commerce and industry through partnerships; and that it
- relies also on useful application as a measure of success.

This new mode of knowledge production has important consequences for higher education institutions in developing countries, and more specific for Tshwane University of Technology. In the first place, it presents the contours of the intellectual landscape – the research and development environment – in which higher education institutions, in the future, are going to operate. Secondly, this environment is shared by many other types of organizations, including but not solely, business corporations, Thirdly, if higher education institutions intend to practice research and development at the forefront of science and technology, they are going to have to organize themselves so that they can operate in this new mode. One consequence of this is that they will have to become more open, porous institutions, and more aggressive in seeking partnerships and alliances than they are currently.

2.1.2 Defining Research and Development

Research and Development (R&D) is seen to be creative investigation, conducted systematically to contribute to new knowledge, and to increase scientific and technological knowledge, with the emphasis on utilizing existing and new knowledge in devising applications and solving problems.

From the preceding section and the definition of Research and Development flow the following implications for the Tshwane University of Technology:

- The recognition that the scientist's rigorous acquisition of scientific knowledge, her/his creativity, ingenuity, and curiosity, and her/his expert involvement with the subject-field, society and industry are the main stimuli to all forms of research;
- That the Tshwane University of Technology has a particular obligation to take note of and to address the priorities and needs experienced, identified and expressed by South African communities, commerce and industry, and
- That the Tshwane University of Technology will strongly focus on making the true strategic choices in terms of research focus areas, and the attainment of the correct mixture of research types and methods when developing research and application products and when investigating processes and procedures through applied research.

The typical elements for the application of technology, ranging from the acquisition and development of technology up to the diffusion and implementation of technology are listed below:

- Acquisition - obtaining and mastering scientific knowledge and its related technology;
- Development - any contribution to the innovative use of knowledge and skills, and the advancement of technology;
- Application - utilizing scientific knowledge and technology in addressing the needs and priorities of government, industry and social and scientific communities;
- Diffusion - ensuring the distribution of knowledge and technology through learning programmes and the implementation of technology in solving problems;
- Dissemination - distribution of the results of rigorous and applied scientific knowledge to a variety of target audiences, such as the community of fellow-scientists, private and public decision-makers, and the general public - also

children - through a variety of media such as scientific journals, monographs, and the whole spectrum of the mass media; and

- Management - optimising the effective and efficient utilization of technology.

As stated, the Tshwane University of Technology will focus on research, technology, demonstration and innovation, ensuring that staff and students are engaged in the different components of the innovation chain:

- As far as is possible, multi- and trans-disciplinary approaches via research focus areas, which allows for teamwork, varied perspectives and shared use of facilities, will be promoted;
- Extended networks and partnerships will continuously be established across departments and faculties, institutions, industries and countries;
- The University shall involve itself fully in R&D-related down-stream activities such as the process of patenting, licensing, and the commercialisation of intellectual property (IP) and R&D; research results in the form of products, processes and services; the promotion and development of new knowledge intensive enterprises; and supportive environments, such as technology and business incubators, business and technology parks.

In line with the second part of Goal 4 identified in the National Plan for Higher Education (February 2001), viz.

> *"To secure and advance high-level capacity which can ensure …the sustained application of research to technological improvement and social development"*,

the Tshwane University of Technology promotes and is developing a limited number of R&D Focus Areas around themes that address some of the priorities and needs of South and Southern Africa. It will remain a challenge to develop these R&D Focus Areas each to attain a critical mass of resources in respect of staff, students, facilities, equipment and financial resources.

Specific strategies for the next five years (2004 – 2009) for the Focus Areas include:

2.1.3 Development and management of Focus Areas to promote an R&D culture

Building on the existing capacity and capabilities of academic staff, we envisage the R&D Focus Areas to be developed and directly linked to the needs, priorities and opportunities of South Africa. In this process we also envisage building a critical mass within each Focus Area, in keeping with the tenets of the highest standards of critical

thinking and systematic research. A summary of the existing Focus/Niche Areas is supplied in Appendices A and B.

Research Focus Areas are managed in such a way that successful output are delivered. The way in which existing and new Focus Areas are managed determines the success (in terms of output) of the Focus Area. This includes specific attention to the following requirements, roles and responsibilities:

- The inclusion of the Research Focus Areas within the Strategic Plan and Budget of Tshwane University of Technology.
- The support and commitment of senior management and the Central Research Committee of the Tshwane University of Technology.
- Dedicated leadership within the Focus Area - i.e. it disposes over the personal research leadership that has the time and commitment for research and those administrative duties linked to the Focus Area.
- Active involvement of professors and researchers in the overall management of the Focus Areas. They also play an important role regarding the development, strengthening and restructuring of the Focus Areas. Ideally, a professor should be the leader of a Focus Area.
- Attainment of a high level of research and development activities and achievements within each Focus Area, linked to the major challenges and opportunities in economic growth, societal development and reconstruction in South Africa.
- Ownership of Focus Areas within faculties and the University. It is therefore important that a Dean, as the FRC Chairperson, and the FRC Chairperson (if not the Dean) facilitate and promote the development of a Focus Area and define the successes of the Focus Area linked to the objectives of the faculty. The Dean/FRC Chairperson supports the Focus Area Leader who accepts responsibility for the Focus Area. The Dean will however accept the overall responsibility for the Focus Areas in the faculty.
- Assessment of Research and Development projects and outputs once a year within faculties.
- Establishment and functioning of an Advisory Committee (with internal and external specialists as members) to evaluate and give advice/support to the focus area at least twice a year.
- Establishment and functioning of Focus Area Groups:

  Regular meetings of the Focus Area Groups and reporting on progress are required. An annual written report on all projects is submitted and reviewed by the

Focus Area Leader. All members of the Focus Area meet twice a year to discuss projects, and assess new ideas.

- Assuring successful R&D output:

  The team participating in the Focus Area has the responsibility to ensure successful R&D output. In this they need full support of colleagues, Heads of Department and Management within the faculties.
- The recognition of research worthiness, acceptance and recognition by peers, the community, potential investors, commerce and industry, science councils and government.
- Promotion, support and facilitation of Research and Development Focus Areas by the Directorate: Research and Development.
- Within each sustainable R&D Focus a critical mass in terms of staff, students, infrastructure, funding and outputs has to attained and maintained. This requires:
  - involvement of staff and postgraduate students;
  - academic staff development;
  - partnerships with commerce and industry, governments and science councils;
  - regional, national and international cooperation with other higher education institutions;
  - transfer of technology and knowledge and technology-intensive enterprise development, and other
  - R&D output such as students completing M- and D programmes, publications, conference papers, patents, artefacts, license agreements, and the successful commercialisation of products and processes.

The postgraduate training of students at the Masters and Doctorate level will to a large degree be linked to these R&D Focus Areas. At least six Focus Areas are envisaged, over a period of five years, to become research centres of excellence with outputs firmly situated in the domain of the application. As highest level of recognition by the National Research Foundation, a full **Research Centre** should possess:

- A clearly outlined focus in research and development, in keeping with the R&D strategy of the University.
- An approved business-plan with a five-year horizon, which includes a University-based budget, as well as an indication of additional, i.e. external, sources of income. These external sources of funding (other than that of the University and of the NRF Research and Development Programme) should

contribute at least 35% to the total research budget of the R&D Focus Area. Internal sources of income should contribute 30% of total income.

- An established researcher (as defined by the NRF) able to act as research leader and who enjoys recognition and standing as such in the institution, preferably at the level of professor or director.
- At least five other members of whom at least two should be NRF-rated researchers.
- A majority of participating members who have completed Doctorate qualifications.
- Team members who are active in R&D and able to lead individual research projects within the theme of the Centre.
- A track record of postgraduate students studying under individual members in the Centre.
- A track record of successful transfer of technology.
- A track record of recognised R&D output by individual members and by the group.
- Given that training and research for technology relies heavily on liaison and co-operation with industry and the professional sectors, each Research Centre shall dispose over a written strategy for its implementation of the principles of co-operative education in its activities. As in the case with undergraduate training, post-graduate training and research needs to attain measurable educational outcomes for both students and the staff involved.
- Well-established facilities and viable plans to improve facilities.
- Established national and international linkages.
- Established Masters and doctoral programmes.
- Good research practice requires that all the types and levels of research undertaken in the Research Centre, viz. That of masters and doctoral training, of advanced self-initiated or contract research by individuals, or of team research undertaken by groups or units within the Niche Area, regularly be subjected to Quality Assurance processes. Regular internal evaluation of the research process followed, of the levels of research performance attained in the Focus Area, of the research policies and plans in place, research management structures, research information systems and the research capacity-building activities undertaken is therefore required. Plans for research quality assurance in Research Centres will accordingly be laid in co-operation with the Directorate: Research and the Division for Quality Promotion.

- An established reputation in terms of national recognition and relevance and some international recognition.

2.1.4 Staff development

A high priority is placed on building up the necessary staff capacity for research production. This includes correcting the imbalances of the past, equity and redress for previously disadvantaged communities and groups, and academic development through postgraduate training at doctorate level.

At a strategic level, departments at all the campuses of Tshwane University of Technology will be visited by the line management and staff members encouraged to participate in research, research focus areas and to improve their qualifications. Special funding will be earmarked to stimulate participation in research activities.

The current strategy of appointing Professors for R&D, who can take the lead in the development of R&D Focus Areas and in academic staff development, is to be expanded in order to reach the envisaged targets, being that 60% of academic staff members should dispose of a master's qualification, and 20% should have a doctorate qualification. From this last group, 20% should be on full professorial level.

2.1.5 Student involvement

The strategy to involve undergraduate students during their study and experiential learning period in R&D-related activities, such as laboratory work, project work in industry or community development aspects, could create an interest and enthusiasm for postgraduate studies. Traditionally, and presently still to a large extent, almost all post-graduate students have been actively involved in the labour market, with the result that they studied part-time and extended their studies over longer periods.

Due to the type of professional and career-education offered in the University, a large component of students could in future still be in this category. However, it has also become important to attract larger numbers of full-time (postgraduate) students into the ambit of the Research Niche Areas. Full-time involvement in projects could offer students excellent opportunities to participate in technology transfer and in research processes. Special support and scholarship schemes – in partnership with

foundations and industry – have been established to ensure larger numbers of full-time postgraduate students. Full-time postgraduate and post-doctorate scholarships are currently being offered at Tshwane University of Technology. Ideally, there should be at least 10 – 15 full-time postgraduate students at Master's and Doctoral levels within each R&D Focus Area, (reflecting the demographics of the country).

Research training in the University of Technology also involves the professions and industry. As such, it makes use of principles of co-operative education - that co-operative educational linkage between these sectors and the academy (in this case, also an incidental member and partner of the research industry) - to attain measurable outcomes in research practice and quality. This will ensure that the University cultivates both researchers and research-leaders, which meet the requirements presented by both the worlds of learning and of industry.

2.1.6 Facilities and Equipment

Keeping up to date with state-of-the-art scientific and technological equipment for R&D programmes is a complex problem, one that involves the maintenance, upgrading and replacement of equipment. Current funding resources are restricted; consequently other innovative strategies have to be developed, such as the utilization of equipment on a regional basis, access to equipment in industry, as well as to equipment placed on campus by industrial and commercial agents for demonstration purposes.

The research resources-base, including the ICT infrastructure, buildings and all forms of research equipment, but also the resources traditionally associated with the library, such as bibliographical resources and, more recently, electronic and digital resources, are all subject to regular quality assurance assessments.

2.1.7 Collaboration and Partnerships

Regional collaboration between higher education institutions needs to be expanded. In the case of Tshwane University of Technology, through its constituent members, it has entered into joint R&D programmes with other higher education institutions in South Africa and with a number of universities in other countries. New strategies will be implemented to limit unnecessary duplication and to optimise the use of resources. Its unique approach to research and development makes the Tshwane University of Technology an important

partner for other higher education institutions, ensuring the necessary impact that R&D activities must have on the region and the country. Up to the year 2000, more than 58 cooperation agreements/alliances have been put into place. These partnerships should be significantly increased to 70. It is furthermore envisaged that 80% of funding for R&D should be through partnerships. Each Focus Area should have at least 2 industrial partners. The possibility of partnerships from within Focus Areas with other Higher Education Institutions (HEI's) and with science councils of South Africa should be explored and investigated on an ongoing basis. Discussions for further development of Focus Areas should include expertise from other HEI's, science councils and the industry.

The collaborative partnerships with small, medium and large enterprises, which have been developed over a number of years need to be expanded significantly using the models and business plans that have shown success in the past. As part of this, participation in the various European Union (EU) Research, Technology, Demonstration, and Innovation (RTDI) programmes is a high priority, including the opportunities offered by the International Collaboration with Developing Countries (Inco-Dev) Programme for third-world countries. These partnerships need to be productive and advantageous for all the parties involved.

2.1.8 Knowledge and Technology Intensive Enterprise Development

Experience has shown that major opportunities exist for directing R&D-related downstream activities of the University to the promotion, support and development of Knowledge and Technology Intensive Enterprises. In this way, both large and small enterprises can become part of the University's envisaged network. It also focuses the activities towards knowledge intensive and/or technology intensive environments, which, in general, offer more opportunities for reaching export markets, improving world competitiveness, ensuring wealth creation and creating new jobs.

The R&D infrastructure is intended to facilitate the development of technology incubators and of other technology transfer structures, in order to enable the transfer of the latest technology-based opportunities to the market place. This should assist in the innovation process and in the development of the Small, Medium and Micro Enterprises (SMME's), which should in turn result in new employment opportunities.

The objective of technology transfer should be to create value for the institution and to aid economic development. A strategy on Innovation and Technology Transfer is to be developed separately.

2.1.9 Funding

From the various aspects that have been highlighted, it is clear that different funding strategies and opportunities will be exploited to ensure the necessary development of R&D activities. The different funding streams, ranging from subsidy on R&D outputs and postgraduate student graduation, student fees, research funding agencies and third-stream funding possibilities, will be combined as an integral part of this new strategy, in order to ensure long-term sustainability. A more detailed R&D funding strategy is outlined in Section 2.2 of this document.

2.1.10 R&D Output

The traditional research output in the form of publications in accredited journals will form part of a wider spectrum of R&D output. However, emphasis will be placed on research output in accredited journals to ensure that the University meets national and international standards. The focus on the transfer of technology will generate and ensure other types of output, such as new products, processes and services that could lead to patents, licenses, artefacts, commercialisation opportunities and manufacturing enterprises. Nevertheless, a publications target of 0.2 units per academic staff member by 2007 is envisaged.

A second major component of R&D output is linked to the successful graduation of M- and Doctoral students. An increase of 7% to 10% is envisaged in FTE Masters and Doctoral students of whom half (50%) should be on a full-time basis.

These students will enter the labour market with innovative ideas and creative mindsets, contributing to address socio-economic problems and thereby to economic prosperity for our country.

2.2 R&D FUNDING STRATEGY FOR TSHWANE UNIVERSITY OF TECHNOLOGY

The identification and establishment of opportunities for external funding is one of the functional strategies within the overall research and development strategy for Tshwane

University of Technology. Strategies to attain external funding became evident with the recognition that funding from government alone will not be able to sustain research and development in the long term. More money needs to be invested in capacity building, infrastructure, visiting scientists, postdoctoral fellowships and full-time postgraduate scholarships. Special support and scholarship schemes particularly in partnership with foundations and industry should be established to ensure larger numbers of full-time postgraduate students.

To promote research and development excellence and performance a number of research and development niche areas have been developed at Tshwane University of Technology. Niche areas are restructured on an ongoing basis and are formed around themes that address national and international priorities and needs. The challenge in the next four to five years is to develop these niche areas so that they will attain the necessary critical mass of resources in the form of staff, students, facilities, equipment and financial resources. The overall aim is to develop the niche areas into centres of excellence identified by amongst other things a leader who is an established researcher (as defined by the NRF) and who should have recognition and standing, at least two NRF-rated researchers as team members, a majority of participating members who have completed doctorate qualifications, a track record of postgraduate students, successful transfer of technology, established national and international linkages and an established reputation in terms of national recognition and relevance and some international recognition.

To ensure the necessary development in research and development activities different funding opportunities will have to be exploited. Currently the following model and action plans are used to ensure effective promotion of research and development, communication of funding opportunities and utilization of funding opportunities.

2.2.1 Identify research and development needs of groups (e.g. niche areas) or individuals

This is done by attending meetings of the faculty research committees (FRC's), attending as much as possible research lecturers, reading research reports, attending showcases and communicating with individual researchers.

2.2.2 Identify collaborators/partnerships

The mechanisms explained above are employed, but, in addition, relevant information are collected when searching different sources, when communicating with managers of funding programs and when attending workshops and information sessions. Active partnerships and collaborations across higher education institutions, communities, industry and government are essential for a multidisciplinary research approach, quality assurance of research, networking, and competitiveness in the application for team and competitive funding.

2.2.3 Investigate different research and development funding opportunities

The full variety of relevant sources is scanned, information sessions and workshops hosted by national R&D policy makers and science departments (e.g. Department of Science and Technology), funding bodies (e.g. NRF, ESKOM, SANPAD, DAAD, MRC, ARC, WRC) are attended and liaison takes place with program managers of funding programmes. Investigating both national and international (e.g. European Union (EU) FP6 Program) opportunities are essential. Industry-funding opportunities are also extremely important especially in the applied research and development conducted at Tshwane University of Technology. The goal is seeking to diversify the funding base through a combination of national, international and industry funding opportunities.

2.2.4 Communication of funding opportunities to researchers in the University

Several mechanisms are in place to achieve this. Researchers are informed about opportunities, closing dates and procedures through the Intranet. New or unique opportunities are advertised by converting the information into an electronic newsflash. A research and development web-page has been developed and contains a special section on funding opportunities with information available on closing dates, guidelines, procedures, links to the funding bodies and other relevant web-pages. Events such as workshops and information sessions have also been listed. The researchers will have access to all the available funding opportunities summarised on one central page A research and development newsletter for Tshwane University of Technology is in development and will include a column with opportunities and closing dates as well as information on upcoming workshops and information sessions. It is envisaged that the four issues will be published in a year.

Additionally, individual researchers are identified as potential applicants and the information communicated on a personal level either by telephone or organizing individual meetings. This is important to improve networking as a basis for funding. The individual approach is especially relevant for competitive national (e.g. THRIP, innovation fund) and international funding (e.g. EU-FP6).

2.2.5 Arranging of workshops /information sessions

The programme manager of the programme will be invited to visit the campus for general or individual discussions. Workshops and information sessions are advertised in the same way as the funding opportunities. Training of the researchers or providing examples of successful applications for funding and assist in the preparation and evaluation of proposals are also important in this regard.

The envisaged outcomes of the above are:

- close liaisons with funding agencies;
- promotion of multi- and trans-disciplinary approaches to research, which allows for teamwork, varied perspectives and shared use of facilities;
- extended networks and partnerships across departments and faculties;
- involvement of industry in research projects;
- improved competitiveness of research increasing the success with applications for competitive funding and sustainability for research and development.

CHAPTER 3

RESEARCH AND DEVELOPMENT MANAGEMENT AT TSHWANE UNIVERSITY OF TECHNOLOGY

3.1. INTRODUCTION

The increase of project-based research and development (R&D) has led to a major shift in the relationship between academics and their funders, a relationship that inevitably involves the corporate support service of the University. As the number and central importance of funding bodies increase, staff will require guidance on the opportunities available and on how to apply for them to best effect. Once projects are approved, they are subject to increasingly complex contractual arrangements. Individuals need advice on their appropriateness, institutions need to be certain that staff are not incurring unreasonable legal obligations and funding bodies need to be assured that their support is being used for proper purposes.

The development of R&D Focus Areas should therefore be co-ordinated and facilitated centrally in partnership with the various stakeholders in order to promote interdisciplinary research and development projects. Support should be provided for the Focus Areas so that fundable research and development projects are submitted to external agencies. It is thus important that Research and Development management and administration should be a centralized management system (within a network approach), which allows for active involvement of faculty structures.

The purpose of this chapter is to develop strategies towards Research and Development management at Tshwane University of Technology.

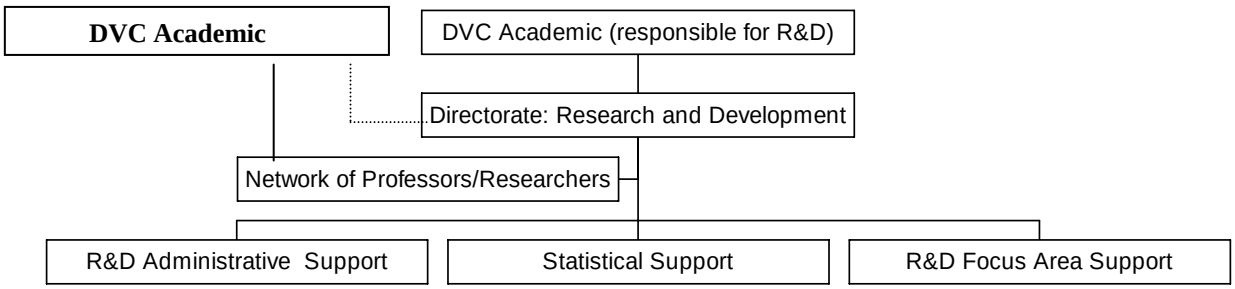
3.2 ORGANISATIONAL STRUCTURE FOR RESEARCH AND DEVELOPMENT AT TSHWANE UNIVERSITY OF TECHNOLOGY

The following proposed organizational structure at Tshwane University of Technology focuses on the formal research and development activities within the University:

Figure 1: Research and Development organisational support structure

3.3 DIRECTORATE FOR RESEARCH AND DEVELOPMENT

Research management is within the line function of each Deputy Vice-Chancellor (DVC) Academic. The DVC Academic (responsible for R&D) assumes the responsibility for the overall R&D Policy and Strategy of the institution refer to Diagram 2. The Directorate: R&D reports to the DVC Academic (responsible for R&D). Three departments namely: Research and Development Focus Area support, Statistical Support and Administrative Support form part of the Directorate. The Directorate is in many ways an empowering and facilitating structure.



The Figure 2: Structure of the Directorate: Research and Development

The Directorate: Research and Development will centrally co-ordinate research and development (R&D) in terms of:

- The publication and co-ordination of internal and external policy matters related to R&D;

- Assisting in the development of R&D strategic- and business development plans for the University
- Collecting, maintaining and publishing data on funding sources and R&D opportunities
- Collecting, maintaining and disseminating information on the research undertaken within the institution so as to assist with the management of the institution's research effort through the monitoring, planning, and improvement of the quality of the its research output.
- Providing advice on R&D bids and on R&D expenditure
- Provision of high-level statistical support and consultation where necessary
- Facilitating and supporting a progressive environment for research
- Publishing Tshwane University of Technology's R&D successes
- Recommending applications for funding to statutory councils (for example, the NRF).
- Submitting R&D output annually to the Department of Education

The Directorate pursues the following general objectives:

- To develop network relationships and partnerships for research and development across higher education institutions, communities, industry and government;
- To develop and implement research and development strategies;
- To assist researchers and research centres in the quality management of their research efforts;
- To create opportunities for the improvement of research and development capacity, and to
- Identify, promote and co-ordinate new opportunities for research and development.

The network of professors/researchers at the University plays an important co-operative and supportive role in terms of the objectives stated above. Their participation within the focus areas of the University will, for example, help with the identification and promotion of new opportunities for R&D. The strategic role of the professors/researchers is highlighted in Section 3.4.7 of this document.

The Directorate: Research and Development, in association with the staff of Tshwane University of Technology, is responsible for the administration and support of Research

and Development management including the following activities linked to each department within the directorate.

1. R&D Focus Area Support

- The promotion of R&D excellence and performance through the development and restructuring of Research and Development Focus Areas and Niche Areas:
- Increase research and development opportunities for external funding and in obtaining funding for research and development and the provision of project proposal support, and
- The improvement of R&D communication and networking through the development of newsletters, an R&D annual report and an R&D web site.

2. The provision of Statistical Support

- The provision of high-level statistical support to staff and postgraduate students internally;
- The provision of statistical support externally through the Bureau for Statistical Support (STATTECH);
- Training on aspects of research, with a strong focus on statistics and research methodology, and
- Support for projects relating to Institutional Research.

3. R&D Administrative support

- Dissemination of R&D funding information and applications for R&D support
- Evaluation of research programmes
  - Continuous evaluation of all research programmes by means of a self-evaluation system
  - Improve the success rate of application for funding
- Funding of research programmes
  - Alternative/additional funding for research programmes
  - Costing of research programmes
- Administration of external programmes
    * All NRF programmes
    * International programmes
    * Other R&D funding programmes – nationally & internationally

- Administration of internal programmes
    * Research Development Fund
    * Laurel Awards
    * R&D Questionnaires
    * Postgraduate scholarship and Post-doctoral Fellowship/Scholarship programme
    * Zethus Court residence for visiting scientists
- Research Output
    * Financial claims
    * Administrative management of output to the Department of Education
- R&D Administrative procedures and processes
- R&D Management system

The registration of postgraduate students is not part of the functions of the Directorate: Research and Development, but lies within the jurisdiction of the Academic Administration of Tshwane University of Technology.

3.4. RULES AND REGULATIONS GOVERNING R&D

The Central Research Committee (CRC), Faculty Research Committees (FRC's) and Focus Area leaders provide the necessary direction, support, and environment for R&D through the Offices of the Deputy Vice Chancellor (Academic) responsible for R&D strategy and the Directorate: Research and Development.

3.4.1 Composition of the Central Research Committee (CRC)

Chairperson: Deputy Vice-Chancellor (Academic) responsible for R&D strategy.
Members:

- Deputy Vice-Chancellors Academic (ex-officio)
- Chairpersons of the various FRC's
- The Director: Research and Development
- A representative of Corporate Relations (Co-opted)
- Professor of Technological Entrepreneurship (Co-opted)
- Deans of faculties
- Directors of the satellite campuses (Co-opted)
- Chairperson of the Ethics Committee

- A representative of the Postgraduate Office

3.4.2. Composition of a Faculty Research Committee (FRC)

Each faculty has a FRC, consisting of the following members:

- The Dean and Deputy Vice Chancellor (Academic) within the line function and the DVC (Academic) responsible for R&D Policy and Strategy are ex-officio members.
- Members' term of office shall be two years. Selected members may be re-appointed.
- Members are appointed at the Faculty Board meeting preceding the Senate meeting at which standing committees are appointed.
- The Dean shall be the FRC Chairperson. The Dean will have the option to appoint another chairperson.
- The FRC will elect the Deputy Chairperson from its members.
- A representative of each department as a member of the FRC is obligatory.
- The FRC could appoint its own executive, as required.
- The FRC may co-opt additional members on an ad hoc basis.
- The Secretariat will be appointed at faculty level.
- The Director (or a representative) of the Directorate: Research and Development must attend FRC meetings.
- The Faculty Board will determine the number of members.
- Attendance of meetings by the Professors in the faculty is determined by the FRC.
- A representative of each of the Satellite campuses, one responsible for co-ordinating research and appointed by the Satellite campus should be a member of the FRC.

3.4.3 Composition of the Ethics Committee

The Ethics Committee is a sub-committee of the CRC. The composition of the Ethics Committee is as follows:

- Each Faculty Research Committee nominates one representative to serve on the Ethics Committee.
- The Chairperson of the Ethics Committee is elected by the CRC and must be an internal member.
- The Deputy Vice Chancellor (Academic) responsible for R&D strategy is an ex-officio member.
- At least one member of the Committee should be a legal expert.
- One member external to the University with extensive research knowledge.
- One person from the community.
- The term of office of a member is two years after which that member can be re-elected.
- The Director (or a representative) of the Directorate: Research and Development shall attend the Ethics Committee meetings.

Minutes of the Ethics Committee will be submitted to, and ratified by, the CRC.

3.4.4 Functions of the Central Research Committee (CRC)

The CRC is a strategic committee, which determines the R&D strategy of the University. The Directorate: R&D is the operational organ of the CRC, i.e. the Directorate reports to the CRC on all operational issues, provides R&D information and submits recommendations. The functions of the CRC include the following:

- to advise the Senate on research and development policy matters of the University after consideration of proposals made by the Faculty Research Committees (FRC)'s;
- to negotiate for funds for the CRC from the University budget;
- to confirm the annual awarding of funds appropriated by the University for research and development in faculties, Focus Areas and other divisions involved in research and development;
- to undertake, on a regular basis, assessments of the quality of the research being undertaken by researchers and research groupings in the institution, and to assist the Section: Quality Management of the University in their assessments of research quality;
- the adjudication of the annual awards for Senior and Junior Researchers of the Year and for the Research Niche Area group of the Year;
- Annual adjudication and awards of medals for research, and
- Consideration of the recommendations of the FRC's on the acceptability of progress and final reports with the view to:
  - measurement of research and development progress
  - taking cognisance of reports accepted as satisfactory
  - deciding on steps to be taken in the case of unsatisfactory reports
  - deal with matters referred to from the Senate
  - to articulate a comprehensive Corporate relations campaign on both a national and international level

The Deputy Vice-Chancellor (Academic) responsible for R&D strategy and the Director: Research and Development shall deal with urgent matters requiring ratification by the CRC.

3.4.5. Functions of a Faculty Research Committee.

The functions of a Faculty Research Committee will *inter alia* include the following:

- the development of the faculty research and development plan;
- the planning, promotion, monitoring and review of research and development activities in the faculty;
- the implementation of the code of ethics that govern research and development activities;
- the identification and establishment of mechanisms to extend the availability of external funds through enterprise, initiative and consultation;
- the conducting of annual self-assessment of the quality of current R&D and of scholarly activities, the establishment and maintenance of an R&D skills inventory, as well as the formulation of proposals aimed at enhancing R&D strengths;
- administering the R&D budget of the Faculties;
- safeguarding the intellectual property rights of the University where patents, inventions, artefacts and other creations are generated;
  - encouraging staff to partake in research and development, staff development activities and appropriate research and development
  - working papers, refereeing and editorships activities such as:
    - conferences, seminars, workshops external postgraduate supervision and thesis examination
    - media commentary
    - writing of articles
    - acting as study leaders and promoters

- the evaluation and approval of R&D outputs and reports.

- the evaluation and approval of R&D project proposals for external funding.
- the approval of R&D project proposals (including postgraduate proposals).

3.4.6 Functions of the Ethics Committee

The purpose of the Ethics Committee is the evaluation and approval of all research on humans, animals and the environment. The most important function of the Ethics Committee is to protect the well-being and integrity of humans, the environment and animals involved in the research process, and also to ensure that the rights of humans are protected in the course of research projects. The Ethics Committee therefore approves research protocols for ethical clearance.

The Ethics Committee thus substantially contributes to the quality of research projects by its safeguarding of humans, animals and the environment, in situations where these are unable to fend for themselves. Its processes and decisions are therefore also subject to scrutiny in the process of Quality Management.

3.4.7 Network of Professors/researchers

Deans, in close collaboration with the network of all professors, will play a major role in the development of an R&D culture at the University. The strategic role of the deans, the professors and researchers is particularly important in terms of the following R&D activities:

- Participation and overall management of Focus Areas as the Focus Area leaders;
- The development, strengthening and restructuring of Focus Areas;
- The establishment of collaboration and partnerships within Focus Areas with industrial partners and other HEI's;
- Education and exposure of staff and students to R&D-related downstream activities and transfer of knowledge;

- Stimulation of knowledge- and technology-intensive enterprise development;
- Ensuring sustainable critical mass in terms of staff, students, infrastructure, funding and outputs for R&D Focus Areas;
- Academic staff development through Focus Area development;
- The development and continuous evaluation of research proposals and -themes within Focus Areas;
- The development of contract research models including appropriate costing and pricing structures and applications;
- Providing support in the development of R&D strategy documents;
- Providing support in the presentation and development of R&D training programmes such as the generic research methodology course;
- Supervising master and doctoral studies, and
- Engaging in local, national and international R&D networks.
- Training of supervisors

3.5. R&D EVALUATION PROCEDURES

All research and development project proposals tendered to external, statutory funding agencies (such as the WRC, NRF etc.) must be evaluated by the Focus Area Leader, Faculty Research Committee (through an internal peer review process) and the Directorate: Research and Development before being submitted to the funding agency in question. Evaluation is considered in terms of

- The applicant (suitability, support of team members and growth plan);
- Progress (on the previous year);
- Research proposal (suitability, scientific content, feasibility, past and envisaged outputs, composition of research team, contribution and envisaged significance);
- Research and development environment (availability of adequate infrastructure and institutional support), and
- The value of the project in terms of its contribution to the broader Focus Area.

Overall evaluation includes recommendations for funding. The Directorate: Research and Development generally ensures that prescribed guidelines have been correctly followed and that budgetary requests are reasonable. This process will provide a quality assurance mechanism with regard to research and development project proposals.

Evaluation of proposals for postgraduate studies is conducted within faculties. The structures and procedures differ from faculty to faculty and include, for example, departmental evaluation, Faculty Research Committee evaluation, Ethics Committee evaluation according to the guidelines laid down by the faculties and Ethics Committee. The Directorate also screens research proposals for postgraduate studies: assistance is rendered where deemed necessary to strengthen proposals.

Collaboration with other institutions with regard to research and development projects is to be pursued and developed. International co-operation, contacts and links are strongly encouraged. Outcomes generated through R&D have to be documented and, where possible, patented and commercialised.

The whole process of research scrutiny and evaluation is subject to continuous quality management by the CRC itself, and by the Section: Quality Management of the University.

3.6. INCENTIVES FOR RESEARCH AND DEVELOPMENT AT THE TSHWANE UNIVERSITY OF TECHNOLOGY

Developing a research and development culture and climate at Tshwane University of Technology involves both the drawing of attention to the importance of research and development and motivating staff to become actively involved in R&D and related outputs. One way of achieving this is to build a number of incentives into the research and development system. The following R&D incentives have been developed:

1. Lecturer replacement through staff mobilization:

2. Lecture exemption, or reduction of lecturing duties, for the duration of a research project;
3. Inter-departmental co-ordination on lecturing loads and the inter-changeability of staff.
4. Use of student-assistants to lighten the research workload, whereby students in turn stand to gain valuable experience;
5. Study leave and sabbaticals;
6. Sharing in Intellectual Property (IP) rights;
7. Promotion of deserving researchers to Professorial rank;
8. Bonus on completion of Masters or Doctoral degree or higher level degree (i.e. for vertical improvement in qualifications);
9. Subsidy credits earned through research output subsidies are channelled to the productive researcher;
10. Reduction in registration/tuition fees when registering at own institution
11. Special awards are annually made for the Senior Researcher, Junior Researcher and Research Team of the Year (also Researcher of the Year within Faculties).
12. Financial assistance to attend national and international conferences provided a paper will be presented.

The combination of the incentives listed above, both financial and honorary, will result in an increased awareness of the value placed on research and development in the Tshwane University of Technology.

The provision of incentives to stimulate the undertaking of research is a process, which demands intensive and regular quality management to maintain its relevance and effectiveness. The management of research quality on this aspect shall be undertaken regularly by the CRC, the Directorate: Research and Development and the Directorate: Quality Promotion of the University.

3.7. RESEARCH AND DEVELOPMENT FUNDING PROCEDURES

The University R&D Reserve Fund, through the CRC, annually allocates research and development funding for distribution amongst faculties and satellite campuses. The purpose of research and development funding is to enable the researcher to undertake R&D in a satisfactory manner. Each faculty provides an annual budget for research and development in terms of:

- Capital: Computers and Equipment
- Masters and Doctoral Operational costs
- Capacity building
- Lecturer leave/Replacement

The distribution of funds for capacity building amongst faculties are calculated using a weighted formula, which considers the following criteria for research outputs over the last three years (first year weight = 1, second year weight = 2, last year weight = 3):

- The number of papers published in accredited journals (in units);
- The number of conference proceedings (in units);
- The number of artefacts (in units);
- The number of patents (in units);

- The number of Masters and Doctoral student qualifications awarded at Tshwane University of Technology over the three-year period;
- The number of improved staff qualifications (i.e. Masters and Doctoral degrees) awarded at any institution.

The aforementioned research and development output of faculties are weighted in the following way to ensure a more representative distribution: the weight of papers published in accredited journals are doubled (x2); conference proceedings will be weighted by one third (x0.33) and artefacts will be weighted by a half (x0.5).

Funding for R&D activities taking place at satellite campuses, also by non-academic staff (not linked to a Focus Area), will be considered on merit and handled on an *ad hoc* basis, seeing that the R&D activities taking place within these groups are numerous and of substance.

Academic staff apply for funding via their respective FRC's and/or in approved Focus Areas, while non-academic staff apply at the Directorate: Research and Development. Funds may be used for expenses that directly concern the execution of a research project. These shall include travel and subsistence, books and consumables. Any capital items or book acquisitions shall be the property of the University and the researcher shall have it recorded in the asset registers of the University.

Funds allocated by the CRC may not be used for either the researcher's own profit, nor as registration fees for studying at any institution.

The researcher shall accept full responsibility for funds allocated to her/him. Funds will be spent according to the financial policy documents of Tshwane University of Technology. The way in which funds were spent shall be explained in full in his/her R&D report.

The following directives are of particular importance, and need to be adhered to closely:

- *Research projects have to be completed in the time envisaged;*
- *Project requirements laid down by the CRC have to be complied with closely, and*
- *Satisfactory progress has to be proven upon request.*

These stipulations are all closely linked to the responsible expenditure and administration of research funds. In instances where failure of compliance cannot be resolved with the Committees and research managers involved, the CRC is entitled to:

- *cancel the registration of any project;*

- *stop or suspend any further allocation of funds (pending an investigation into the matter), and*
- *recover such funds from the researcher as may have been poorly administered, or even misappropriated, or used contrary to the rules and regulations applicable.*

The funds generated by the subsidies forthcoming from R&D output by individual researchers shall be divided as follows:

- *10% to the CRC for administrative overheads*
- *20% to the FRC for stimulating research in the relevant faculty or department*
- *70% to the researcher to be used for research purposes.*

A bi-annual report on the expenditure of R&D Funds by faculties and Satellite campuses is submitted to the CRC.

Each researcher is obliged to submit research progress reports to the FRC in October of each year. A financial report must accompany the research report submitted by the project or study leader. Each faculty must submit a bi-annual research progress report. Details of all R&D projects undertaken and of any external research funding, or related funding, received by staff must be reported to the Directorate: Research and Development.

3.8. RESEARCH AND DEVELOPMENT OUTPUT

The strategic objectives of the University require that R&D outputs at the University be regularly monitored, measured and evaluated.

The CRC, through the Directorate: Research and Development, shall measure research and development performance with regard to the:

- Research output recognised for subsidy purposes by the Department of Education;
- Increase in staff qualifications on postgraduate level;

- Increase in the number of students enrolled for postgraduate studies and completion of studies;
- Number of articles published in national and international journals;
- Presentations made at local, national and international conferences;
- Projects supported by scientific, professional and other financial agencies, as well as the relative scope of the financial aid rendered to each;
- Books written linked to R&D;
- Registered patents that enjoy national or international recognition;
- Artefacts developed that enjoy national and/or international recognition;
- Research seminars presented;
- Contract research projects entered into with commerce and industry;
- R&D funding received;
- R&D-related downstream activities/successful technology transfer

Details of research and development procedures and of the distribution of tasks regarding R&D Focus Areas are given in the R&D Administrative Guidelines available from the Directorate: Research and Development and on the R&D Web site.

Compiled by the Directorate: Research and Development.

APPENDIX A

THE DEVELOPMENT OF R&D FOCUS AREAS

In partnership with the various stakeholders, various faculties identified fourteen scientific and technological Focus Areas in which they started to build their strengths. These Focus Areas must become the future centres of excellence of Tshwane University of Technology and for each area a business plan will be developed. It needs to be emphasized that the Focus Areas will continuously be evaluated and re-developed.

Within each R&D Focus Area, emphasis is placed on the attainment of a sustainable 'critical mass' with respect to staff and student numbers and composition, the adequacy of infrastructure, funding and outputs. In particular, specific attention is to be given to:

- The involvement of staff and postgraduate students;
- Academic staff development;
- Partnerships with commerce and industry, government and the science councils;
- Regional, national and international cooperation with other institutions of higher education;
- The transfer of technology and knowledge and technology-intensive enterprise development;
- R&D outputs in the form of students completing M- and D programmes and of publications, conference papers, patents, artefacts, license agreements, and in the successful commercialisation of products and processes.

In the outline below, a summary is given of the different R&D Focus Areas that have been under development since 1997.

Analytical Separations and Spectroscopy

The focus is to develop analytical, techniques for improving the level of determination of selected materials. Both elemental analysis and separations techniques are explored to

improve the sensitivity and specificity of determination of materials of economic significance. Methods to be investigated so as to improve the efficacy of industrial analysis include: atomic spectroscopy using electrothermal atomic absorption spectroscopy (ET-AAS) and inductively coupled plasma (ICP) spectroscopy including both optical emission and mass, separation spectroscopy (ICP-OES and ICP-MS); techniques using supercritical fluid extraction (SFE) and gas chromatography-mass spectroscopy (GC-MS). The possibilities associated with SF techniques will be fully investigated, comparing the elemental composition and physical properties of the product with those prepared by more convention methods. The primary goals are to:

- do international class research that would have direct benefit to South African Industry.
- Develop expertise in atomic spectroscopy and supercritical fluid extraction. The overlapping of these two techniques offers a unique opportunity *to* investigate a wide variety of materials not previously researched in this manner.
- through the optimisation of appropriate techniques improve limits detection and quantification of analyses, increase throughput, and make an economic impact on South African Industry. Industrial applications of importance to South Africa include all forms of analysis resulting in greater efficiency and effectiveness.

Industrial Control Systems

The world of engineering has considerably changed its face in the last decade. Most evident is the strong role control system techniques and computers are playing in many of the former purely mechanical/electrical working machines, plants, or devices. The main characteristic of these control systems is the ability to re-configure them to perform different tasks. This not only makes the task easier, but also more economical. These control methods are used in many different areas, for example:

a) Control of Electric Energy Systems; the main focus is how to improve control of electric energy systems in South Africa and make it more efficient under pressure of reduced resources.

b) Developing of high value adding consumer products based on modern control systems theory, which includes control of hybrid vehicles, controllers for

mechatronics products and medical products to be exported at globally competitive prices.

c) Manufacturing, e.g., incorporating modern control systems theory into the manufacturing environment through development of controllers for CNC machines and robotic machines.

The research focus is aimed at application of the modern control technology in manufacturing and energy supply environments. This will contribute to the ability of South African industries to be competitive internationally. The overall goal is to develop a well-organised applied control research centre, which will play a major role in practical energy supply and manufacturing control research and training through research in South Africa.

Telecommunications for Development

The focus is to research the radio and telecommunication network planning issues as required for telecommunication development in semi-urban, rural and underdeveloped areas in South Africa and to develop relevant implementation strategies. The primary goals of this research area is to:

- survey and research the radio and network planning issues as required for telecommunication development in semi-urban, rural and underdeveloped areas in South Africa.
- To make recommendations to government and industry about implementable cost–effective solutions about this for the development of telecommunication infrastructures in these areas.
- To establish a team of high-level expertise at Technikon Pretoria in a niche area of research that is not pursued at any other tertiary institution in South Africa.
- To develop a role model of research and technological expertise and technological models that can eventually be transferred to other centres in South Africa.
- To, through our research, support and enhance economic development of underdeveloped areas in South Africa and to enhance social and economic development in South Africa as a whole.

- To train a new generation of black technological leadership for telecoms development in South Africa.

Food Innovation, Quality and Safety

This research focus on optimising the quality and safety of foods produced in South Africa. The nature and composition of foods and food ingredients typically used in the South African food chain, is researched in order to gain a better understanding of their role in existing and new food products, with a view to enhancing their quality and safety.

The goals are:

- To develop a pool of well trained food technologists with the innovative and enquiring mindset that comes from research experience.
- To support the South African food industry in being innovative and in providing safe and quality products for competitiveness in the global village.
- To make the food industry and consumer more aware of the benefits of functional foods, ingredients and supplements for the maintenance of health and well-being and to assist the food industry in the development of such products.
- To gather information relating to the hygienic status of catering establishments and the safety of food products provided to the South African consumer.

Exercise and Immunology for Healthy Adults

The central focus is to investigate how different aspects of the immune system respond to moderate and excessive exercise. For over a decade, it has been hypothesized that moderate exercise enhances immune function. This needs to be substantiated and the exact alterations in immune function need to be clarified. Additionally, it is well documented that excessive exercise suppress immune function and puts healthy individuals at risk for developing infections, such as an upper respiratory tract infection (URIT), as well as increases the incidence of atopic disorders in generically predisposed individuals. The alterations in immune function that drive this response also need to be clarified.

The aspects of immune response that is investigated includes: the pro-inflammatory cytokine response; the lymphocyte-related cytokine response; role of cell adhesion molecules in immune activation; acute phase proteins and immune activation; alterations in systemic immunoglobulins; and mood state associated with immune activation, and the relationship of mood with circulating levels of amino acids, which act as precursors to brain neurotransmitters. Furthermore, aspects of mucosal immunity in saliva will be investigated, since this represents one of the first line of defence against external pathogens.

The targeted subject population will include elite athletes, sub-elite athletes, lay athletes, as well as healthy adults who have not engaged in physical activity on a regular basis.

The ultimate goal is to develop an Internationally recognised Research Centre in Exercise and Immunology.

Decision Support to the Wildlife Industry

The focus is to provide decision support to management undertakings in protected areas, ecosystems and game ranching undertakings in savannas and grasslands of southern Africa. The goal of the niche area is to create a centre of excellence where scientific information is made available to Governments, NGO's and the private sector, facilitating decision-making i.e. conservation and sustainable utilization of natural resources.

Polymer Processing

The research focuses on the processing of polymers. Although the research revolve around thermoplastics, thermosets and elastomers, most of the emphasise is on thermopastics. This is due to the involvement that we have with SASOL on the development of polymers based on the Fischer Tropfsch process. The major goals are:

- To provide SA with a skilled manpower pool that will be able to get the best out of the processing and end use of polymers.
- To provide the SA Polymer Converting industry with support in the processing and end use of polymers.

Cement Technology

The focus on Materials Processing and Utilisation: Inorganic Materials, more specifically Cement Chemistry Technology, is to thoroughly investigate and understand the chemical nature and behaviour of cement and cement-related materials in order to manipulate the production and applications of these materials in improved products and processes to the maximum possible benefit of all stakeholders. The aims of research work conducted in this area is to:

- provide well-trained manpower for the local manufacturers and distributors of building and construct materials.
- develop new applications of existing materials, as well as new products from cement and cement-related materials.
- improved plant and quality control procedures and analyses during cement manufacturing. It entails, among other things, the development of alternative analytical methods like free lime measurements a1 improved method for Cr (VI) measurement in cement and cement-related materials.
- help solve environmental pollution through the application of cement and cement-related materials in solidification/stabilisation technology. To achieve this a thorough understanding of the chemical and physical behaviour of various cementitious materials is necessary.
- development of more cost effective production and application methods of cement.
- improved forensic investigative abilities in cases of disputes or construction accidents involving cement and cement-related materials.
- to establish a reputable laboratory with dedicated equipment to focus on industry related problems and inquiries and that could provide advanced training to students.

Teaching, Learning and Technology (TLT)

This Research Area focuses on investigating the role and function in, and the impact of technology on the teaching and learning environment of Higher Education Institutions (HEIs) in Southern Africa to:

- empower the lecturer - as the teaching and learning manager - to design, develop, implement, manage and assess technology in a multi-mode teaching-learning environment;
- enhance the learning experiences of learners and
- ensure cost effectiveness, increased and sustained throughput and retention rates.

The primary goals are to:

- create opportunities and develop technology-enhanced teaching strategies for lecturers, through Research and Development,
- create and develop technology-enhanced learning strategies that will impact on the holistic development and performance of learners, and
- determine the extent to which the implementation of the multi-mode approach will impact on throughput and retention rates and cost effectiveness.

The overall goal is to eventually develop a Research Centre that, through projects that study the use of information and communication technology (ICT) for empowering disadvantaged communities at community centres, will gain insight and deliver outputs that will contribute to ICT benefits being more equitably spread throughout South African society.

Mathematical Technology

The research focus on mathematical modelling projects involving Game Management and Dirt road corrugations. The research could also be applied to Vibrations, mass-transfer and heat-transfer.

The research contributes to mathematically based multi-disciplinary research and development projects aimed at current TUT-industry and TUT-community partnerships, where appropriate. The goal of this area is to eventually develop a Centre for Mathematical Technology Modelling for Industry (with enough skilled personnel and equipment to sustain its activities indefinitely) which assist technologists and scientist at universities/institutes of technology with the analyses of theoretical and/or experimental

industrial research and will render a service to industry, where appropriate, by attempting to optimise industrial processes.

Food, Nutrition and Livelihoods

The overall focus of the area is on the chain of processes, activities, and technologies used to produce and prepare food for consumption by people in South Africa, with an emphasis on the poor. Of key concern are the relationships that exist or may develop between these processes and the livelihoods, nutrition, and health of poor people. The specific links in the food chain that receive attention are the food production systems of African smallholders in urban and rural areas, and the post-harvest transactions and transformations leading to income generation or to food for human consumption be it for use in the producer household of for income-generation purposes.

The research studies being done currently includes:

- Two rural settlements (Sekuruwe and Molekane near Potgietersrus) and one urban settlement (informal section of Atteridgeville), where the causes of chronic malnutrition among small children are being investigated, and where interventions aimed at reducing the problem are being tested, was the first case study in which a multi-disciplinary approach was adopted.
- The Dzindi Irrigation Scheme. This smallholder irrigation project in the Venda region of Northern Province. Research is aimed at improving the sustainability of the overall project in the context of ongoing withdrawal of the state (e.g. research into best-practices in farmer management, organizations and institutions on smallholder irrigation schemes), improving the farming systems applied by different categories of farmers (e.g. optimum application of local resources including labour, incorporation of animal production into the farming system, introduction of legumes in crop rotations), and improving income, livelihoods, and food security of local farmers (e.g. linking production planning to a marketing strategies, or to food, nutritional and cash flow needs of households).
- 'Tshwane Nutrition Project'. This project seeks to establish a chain of small production and retail units producing take-away meals based on soja beans. The project involves

researchers in agriculture, food technology and product development, mechanical engineering (development of processing and cooking equipment), and business sciences (commercialisation of the business concept).

The overall goal of the research is to improve the levels of food security, nutrition, health, and income of rural and urban households in South Africa.

ICT for Disadvantaged Communities

The research focuses on studying, developing or adapting Information and Communication Technology (ICT) initiatives, products, services and processes so that they could be used to empower disadvantaged communities in South African society. More specifically, in the projects of this area the emphasis is on finding ways to use digital ICT such as computers and the Internet in community centres (especially in rural areas) effectively in a developmental context. Projects mostly involve evaluating, creating, contributing to, or improving ICT-related products, services or processes at community centres, and also on obtaining a better understanding of the interaction between such ICTs and specific communities. The focus is therefore also on developing and testing new theories, models and insights that are relevant for the point of intersection between technology and rural societies, and also on finding ways to optimise the functioning and local impacts of ICTs according to specific local needs and circumstances of disadvantaged communities.

Society, Space and Sustainability: Reconstructing the urban landscape in South Africa

The focus is the physical and socio-economic profile of selected settlement types in Gauteng and an evaluation of their sustainability. Settlement is a built environment that constantly emerges from the need to accommodate social functions and purposes; it is a designed and re-designed landscape which both shapes, and is shaped by, environmental, cultural, socio-economic and political factors. This Area proposes to focus

on the physical and non-physical characteristics of urban built forms in South Africa in an attempt to evaluate sustainability at three elementary scales:

- Construction design - Building technology, which includes the assembly of both structural and non-structural elements that make up the physical fabric and form of a building.
- Architectural design - The overall form and shape of individual buildings for the purposes of accommodating specific social functions and meanings.
- Urban design - The overall form and shape of public urban space for the purposes of accommodating public activities, functions and meanings.
- The analytical / methodological focus - The focus above is to be investigated in terms of an elementary three-dimensional model that assumes and describes the form of artefacts in terms of space, style and technology.

The goal is to compile a database of the building fabric and form and its socio-economic content and context by investigating a set of physical and non-physical characteristics of selected settlement types in the Gauteng region of South Africa. These will include site and service schemes, unplanned informal and squatter settlement, planned townships and suburbs. This database will be structured to address issues of intellectual as well as national development concerns. The purpose is to offer a de facto overview of different settlement types in order to provide the data and theoretical underpinning for academics and planners.

Solid Waste Technology for Sustainable Resource Management and Pollution Prevention

The focus is to develop an integrated approach in waste management towards sustainable development by identifying solid waste issues (domestic, industrial and hazardous) and providing alternative solutions to these problems using innovative technologies as well as providing effective problem solving and optimal management of solid waste. The research focus mainly on resource recovery and treatment of solid waste with emphasis on the following:

- Recycle, re-use and recovery
- Biological and chemical treatment
- Disposal

This Research Area aims at achieving the following goals:

- To contribute towards the global and national quests for effective waste management for the improvement of community welfare and health through research and development.
- To develop expertise among staff members in solid waste management and technology. It is envisaged that the research is going to provide an avenue for staff members to acquire high qualifications.
- To train students especially those from historically disadvantaged communities, with the aim of equipping them with the necessary skills in environmental pollution control and prevention, particularly on solid waste technology. Students will obtain diplomas and degrees at the end of their training and will apply the knowledge and expertise acquired from their training in improving the quality of life of their communities by introducing appropriate technologies and sound waste management practices.
- To generate useful information on solid waste management that can be used in decision making in order to ensure a healthy environment for all South Africans, especially the beautiful ones that are yet to be born.
- To empower local communities in recycling and re-use of solid waste using innovative and simple methods.

The chemical and microbiological quality of domestic and industrial water sources

The research focuses mainly on the chemical and microbiological quality of domestic (rural and urban) and industrial water sectors in Gauteng, North West, and Limpopo Provinces of South Africa. The primary goals of the research are to:

- Investigate and develop technology, science, management and policies relevant to water supply, wastewater and effluent management for the domestic and industrial sectors.

- Improve productivity and economic growth while at the same time minimizing the negative effect on human and environmental health, i.e. sustainable living.

Modern Load Management, Efficient and Sustainable Usage of Electrical Energy

The research is focused on the Modern Load Management, Efficient and Sustainable usage of the energy based on Renewable Energies applications. These are part of ESKOM's Demand-Side Management (DSM) Programme aimed to save electricity and to delay building of new power station(s) by wide-spread load management activities designed to influence the time, pattern and/or amount of electricity demand in the commercial and industrial sectors. Also the load management activities can be extended at the domestic sector and to contribute to the goals of DSM Programme. In the White Paper on Energy Policy, the South African government recognises the importance and potential of energy efficiency, and commits itself to promoting the efficient use of energy in all demand sectors. It also perpetrates itself to investigating the establishment of 'appropriate institutional infrastructure and capacity for the implementation of energy efficiency strategies'. Incorporating of renewable energies solutions into the modern load management ensures sustainability and improves the efficiency of the process. In essence, the cutting age load management hardware and software, load control strategies, complimented with renewable energies applications and solutions are the technological focus. It should be noted that many of the research output would be applied for rural and remote electrification applications in demonstration of the potential of engineering technology for poverty reduction. The overall goal is to develop solutions both technological and methodological for well-implemented modern and sustainable load management based on contemporary technologies and traditional resources, while at the same time alternative solutions based on alternative / renewable energies will be researched for development and implementation.

Appendix B: Summary of Research Focus and Niche Areas at Tshwane University of Technology

1. Introduction

The purpose of this Appendix is to give an overview of the integration of research focus areas at the Pretoria, Soshanguve and Ga-Rankuwa campuses.

Title of focus area	Title of niche area
Analytical Separations and Spectroscopy ***Environmental Chemical Analysis***	Analytical Separations and Spectroscopy
Industrial Control Systems and Communication Technology	Industrial Control Systems
	Telecommunications for Development
	Modern Load Management, Efficient and Sustainable Usage of Electrical Energy
Improving Quality of Life	Food Innovation, Quality and Safety
	Exercise and Immunology for Healthy Adults
Health Promotion	♦ Biotechnology
Decision Support to the Wildlife Industry	Decision Support to the Wildlife Industry
Materials Processing and Utilization	Polymer Processing
	Cement Technology
Responsible Tourism	♦ Economic Contribution of Tourism in southern Africa
	♦ Sustainable Destination Development
	♦ Influence of Natural and Man-made Disasters, Crime and HIV on Tourism in southern Africa
	♦ Tourism Technology
Educational Design and Development ♦ ***Higher Education and Humanities***	Teaching, Learning and Technology (TLT)

Mathematical Technology	Mathematical Technology Modelling for Industry
Smallholder and Organic Agriculture	Food, Nutrition and Livelihoods
Utilizing ICT for Development	ICT for Disadvantaged Communities
	♦ Information Technology
Appropriate Architecture for Southern Africa ***A Housing Atlas of Southern Africa***	Society, Space and Sustainability: Reconstructing the urban landscape in South Africa
Pollution Control and Waste Management ***Toxicology***	Solid Waste Technology for Sustainable Resource Management and Pollution Prevention
	Water Use and Waste Management
Sustainable Livelihood and the Eradication of Poverty ***Integrated Socio-legal Studies*** ***Globalisation and Public Administration in South Africa*** ***Transport Management and Economics***	♦ Public Management
♦ Creative Arts Practice	♦ Art and Design in Community
Automotive Component and System Manufacturing	♦ Application of Laser Technology in Component Manufacturing
	♦ Mechatronics Appropriate for Automotive Industry
	♦ Development and Optimisation of Manufacturing Processes
♦ Technological Entrepreneurship	***The economic analysis of Innovation***
♦ ***History and Philosophy***	

♦ Focus/niche areas in development