The Development Of Universities Of Technology In The Higher Education Landscape In South Africa

By

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Thesis

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Promoter: Prof MAH Wallis **Date**

DECLARATION

I hereby declare that:

- This thesis is my own unaided work.
- It is submitted for the degree Doctor in Human Resources Management at the Durban University of Technology.
- It has not been submitted before for any degree or examination at any other University.

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This day ____________of___________ 2010

ABSTRACT

To face the challenges of the 21st century, institutions need to address problems experienced by the modern world. The nature of modern work is changing and continually increasing, with knowledge, information and education. As we move further into the information and knowledge age, the workforce will require sophisticated education and training to sustain competitiveness and responsible development. In response to this challenge the DOE restructured Higher Education to make it relevant to the needs of society and industry.

In terms of the National Plan Higher Education (2001) many Technikons were either converted to Universities of Technology (UOT) or merged into universities and became Comprehensive Universities. The Traditional University made up the third type of university. As a result three distinct types of institutions emerged, namely UOTs, Comprehensive Universities and Traditional Universities. In this configuration previous Technikons were reclassified as a UOTs and were able to offer degrees also. This research studied the development of UoTs and its evolution to "University" status. After being classified as Universities of Technology, it soon became clear that these universities lacked a philosophy. Its attributes were not clearly formulated by the DOE. It was left largely to the UoTs in South Africa to develop a set of attributes.

This study developed an underlying philosophy, attributes, and performance indicators to guide the strategic direction and development of UoTs in creating a unique personality for itself. Five universities were studied in UK, Germany and Switzerland to develop a set of characteristics/attributes and performance indicators that can be adopted in South Africa. Five local UoTs were also studied, together with the South African Technological Network in building a set of common attributes. A Balanced Score Card was designed as a management model. Each attribute was linked to drivers and each driver was linked to performance indicators. The model included the various perspectives and components, which illustrated the interaction and cause and effect relationships. The philosophy of a Learning Organisation was adopted and its principals underpinned the interaction and relationships. This model will ensure that South African UoTs are able to comply with both national and international benchmarks.

UoTs pride themselves by ensuring that they produce and apply knowledge to solve real world problems. These universities see themselves as part of the greater society and therefore partnerships are critical to its functioning. Technology transfer and leadership in technology is a key strategic goal in determining its unique position in the Higher Education landscape. The Balanced Score Card was used to develop a management model which is a tool in establishing a UoT with benchmarks, performance indicators and drivers.

DEDICATION

This thesis is dedicated to my late wife Shirley Perumal, whose legacy values continues to inspire and strengthen me.

To my daughters Sheena and Riweena who are my constant source of courage, determination and sense of purpose, and to Brendon for his constant support.

To Manoshni whose powerful motivation, encouragement and thoughts sustained me on this journey. To Tamara and Caleb thank you for your unwavering support and love, and being there for me.

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CONTENTS

TABLES

GRAPHS	

ABBREVIATIONS

ASGISA	Accelerated Skills Growth Initiative of South Africa
AT	Activity Theory
CHE	Council Higher Education
CoP	Community of Practice
CPUT	Cape Peninsular University of Technology
CTP	Committee of Technikon Principles
CUT	Central University of Technology
DIT	Durban Institute of Technology
DOE	Department of Education
DUT	Durban University of Technology
FET	Further Education and Training
FTE	Full Time Equivalent
HE	Higher Education
HEI	Higher Education Institution
HESA	Higher Education of South Africa
HEQC	Higher Education Quality Council
JIPSA	Joint Initiative Programme of South Africa
KBE	Knowledge Based Economy
KM	Knowledge Management
KRAs	Key Result Areas
NPHE	National Plan for Higher Education
NSC	National Senior Certificate
SC	Senior Certificate
SD	Sustainable Development
SET	Science, Engineering and Technology
TIP	Technology Innovation and Partnership
TUT	Tshwane University of Technology
UoT	University of Technology
VUT	Vaal University of Technology
WIL	Work Integrated Learning

CHAPTER 1
INTRODUCTION

1. 1 BACKGROUND

1.1.1 Global Challenges

Global changes and the evolution of knowledge have influenced the agenda for managing and governing higher education around the world. State involvement in higher education has influenced higher education policies by making them adopt business-like practices to cope with competition in the global market place. However, the growing expectations of stakeholders such as state, industry and community, drive the pressure on the Higher Education restructuring. The rapid globalization and the strong demand for the development of national economies, influence the agenda for social and economic transformation.

Many countries have had phenomenal growths over the last two decades, for example Israel, Singapore, Taiwan and Ireland. In 1970, Ireland was considered a poor country, but then it grew rapidly from 1970 to 2000. Its economy today has similar income levels to UK, France and Germany. This is attributed to several entrepreneurial interventions by the Irish Government. Education was recognised as an important tool in creating new businesses, start ups, incubators, and venture capital (Acs, et al. 2007).

1.1.2 South African Challenges

South African higher education institutions (HEIs) are subject to constant change pressures. This has resulted in several plans and reviews by the DOE since 1994. This was expected given the fact that it inherited an apartheid education, characterized and separated along racial and ethnic lines. The apartheid government created an intricate landscape in South Africa where institutions were situated close to each other but serving different race groups. This led to duplication and sometimes multiplication of departments, programmes, human resources, while targeting a small student population. This was clearly unaffordable for a developing country as South Africa, and which retarded development, competitiveness and economic growth. Moreover, apartheid was considered a gross violation of ones basic human rights and therefore the separation of people based on race was immoral and unjust.

1.1.3 Reshaping Higher Education

The White Paper of 1997 (Department of Education, 1997a: 1.1) introduced a transformation agenda in order for Higher Education to overcome social inequalities and contribute to the needs of a democratic South Africa, as underpinned by the Reconstruction and Development Programme of 1994. To address the deficiencies in higher education, namely duplication, inefficiencies and fragmentation, the Council for Higher Education (CHE) recommended changes in size and shape of Higher Education through the White Paper 3 (1997), Higher Education Act (1997), and the National Plan for Higher Education NPHE (2001).

The Council for Higher Education (CHE) formulated the National Plan for Higher Education (2001), to address the global and national challenges by identifying the inequities and inefficiencies in higher education. This meant that the academic landscape needed to be significantly altered through various measures, such as restructuring and mergers of institutions. The configurations, had to be carefully planned to align to national goals so as to give effect to increase participation rates of students and improvement of our student and research outputs.

A further development was the Higher Education Qualifications Framework or HEQF (Ministry of Education, 2004) which is an integral part of the NQF and fundamental complement to the National Plan for Higher Education (NPHE). The intention is that HEQF works within the context of a single, diverse and differentiated Higher Education system.

These documents require institutions of higher learning to restructure their institutions and reconfigure their academic programs to address the global and national challenges of academic work. It was hoped that the restructuring of academic programmes in South Africa would result in changes in participation rates of students, and improved equity and diversity.

Scholars in the field such as Jansen (2002), and Higgs (2000) have monitored the progress made by Higher Educations Institutions (HEI) in translating their programmes in meeting demands of the country. The transition is occurring during the emancipation of a global economy. Higher Education is called upon to produce the knowledge and person power that will enable this country to participate in a competitive global economy. The implications are those economies and institutions that are able to harness and effectively translate knowledge and innovation into usable commodities and services, will be able to accelerate economic growth and development.

Many forces continue to drive the restructuring of Higher Education with the aim of correcting the problems created by the apartheid planners. In particular mergers are mentioned in the context of the restructuring of the Higher Education landscape, and in response to the report by the CHE’s “Shape and Size” Task Team. The National Plan mentions a number of strategies for restructuring, including regional collaboration and mergers. It is therefore important for the landscape to be re-examined with reference to the government’s strategic plan, mission and the needs and demands of higher education and other stakeholders. Higher Education in South Africa, is one of the social sectors in which global markets have influence, where both the market and non-market influence people’s movement with cross-national and cross-regional interaction, and where work practices are heavily implicated in information and communication technologies. Higher education institutions around the world are one of the key players in the structuring of global relationships through knowledge production and exchange, in the evolution of language and communications, the formation of people's attitudes and sensibilities as required by globalisation. However, there is a need to transform education systems with a view to serving not only global interests but also local challenges and problems. The Accelerated Skills Growth Initiative in SA (ASGISA) and Joint Initiative of Priority Skills for SA (JIPSSA) have been developed by South African Government to advance economic development through skills development.

1.1.4 Higher Education: Operating in a New Landscape

Higher Education in South Africa cannot be an ivory tower amidst under-development, poverty, high unemployment etc. The study will establish the context for the development of Universities of Technology (UoTs) and how they influence demand for higher education services. The purpose of UoTs is not to replicate the Traditional University sector but to develop a distinct mission and build on its unique programs that have been historically offered in partnership/conjunction with industry. Knowledge transfer and innovation is intended to be the cornerstone of teaching and learning. However being transformed to a university brings with it new challenges, that a UoT will have to fulfil ie research and postgraduate study.

This study focuses on the new Higher Education landscape and the implementation of the goals of NPHE. The Plan envisages a unitary but differentiated system. This means that many institutions had to merge to give effect to the plan. Three types of universities emerged from this restructuring, Traditional Universities, Comprehensive Universities and Universities of Technology (UoT). Some also required mergers, others retained their previous status.

Types of Universities: Traditional Universities referred to the older established universities prior to the higher education restructuring exercise. Comprehensive Universities were mostly formations arising out of the merger between Technikons and Universities. The third type was the re-classification of Technikons to become Universities of Technology. This investigation studies the UoT as a new phenomenon in the South African Higher Education landscape.

Notwithstanding the history and challenges that faced Higher Education (HE) in South Africa, the University of Technology is expected to be on a development trajectory to position itself as a significant new role player in the higher education landscape. However, this development requires a model underpinned by clear concepts and constructs to fulfil its mandates and expectations. Critics of HE institutions in South Africa have commented on the lack of relevance of qualifications of students and poor outputs from our universities. UoTs have an opportunity to address these challenges in developing new processes and systems and focus on performance outputs.

1.2 PROBLEM

In terms of the National Plan Higher Education (2001) some Technikons were either converted to Universities of Technology (UoT) or were absorbed into other universities and became Comprehensive Universities. Prior to this, Technikons were perceived to be inferior in status to Universities. During the nineties Technikon education became very popular with employers because of its career focused programs which made them unique in the higher education spectrum. This resulted in this type of institution being strategically placed in not only increasing the participation rates of students but also ensuring that students are job ready when entering the world of work.

1.2.1 Higher Education: UoTs a new Trajectory

In the new reconfiguration of the higher education sector it became clear that, though the CHE (Council for Higher Education) proposed a unitary system, there were differences in the typologies of the institutions. In 2002, the now defunct Committee of Technikon Principals (CTP), proposed that a sub-committee investigate the concept of a UoT to determine its associated classification/categories of such a University in light of the opportunities afforded by CHE's Size and Shape Report (2000). Three distinct types of institutions emerged, namely UoTs, Comprehensive Universities and Traditional Universities. In this configuration Technikons were trapped with their history as Diploma offering institutions. They are now reclassified as a UoTs. It is now expected to perform as a university. This dilemma forced UoTs to seriously assess their mission and goals, in line with external environmental forces. These forces were characterized by a high rate of technological advancement and the need to develop partnerships with industry and community structures. To regain their competitive advantage and build on the strengths of Technikons, it was necessary to determine their key deliverables that could distinguish the UoT sector from Traditional Universities. The Department of Education (DOE) funding formula is designed to reward performance of institutions through graduation rates and research outputs. However the performance indicators for UoTs, do not fully take into account the methodology of how students are skilled. For example, the whole issue of Work Integrated Learning, so important to UoTs, does not carry a subsidy component. Similarly, the question of what constitutes research at a UoT does not include patents, innovation, technology stations, and intellectual property rights.

1.2.2 The Study Parameters of a UoT Typology

The challenge is to find the characteristics and attributes that will make UoTs unique in the Higher Education landscape, in the context of harnessing the benefits of technology to solve specific problems through partnerships with industry and society.

This study will investigate and devise a model with a set of performance indicators, criteria, attributes and underpinning theoretical constructs to operate as a single system. The model will operate in a management system that will ensure the measurement of performance against outcome criteria. This will have an influence on policy and impact on the direction of, and accountability for, the efficient and effective use of public money.

PROBLEM 1: There is no clear philosophy or theoretical construct underpinning the formation of a University of Technology. This could result in mission drift.

PROBLEM 2: There is no clear character for a University of Technology to inform its vision, mission, goals and plans..

PROBLEM 3: No clear unique performance indicators attributable to a University of Technology

PROBLEM 4: No existing model to integrate the construct and performance indicators that can be presented as a system that can be used to redefine the Government funding for Universities of Technology

1.3 RESEARCH QUESTIONS

- What are the underlying constructs and theory underpinning the formation UoTs
- What are the external forces impacting on HE institutions? .
- What are the international experiences and lessons learnt?
- What are the goals and attributes of HEIs?
- What are Performance Indicators for HE, specifically for UoTs?
- How do Performance Indicators align with the attributes of HE?
- How can Performance Indicators be systemised into a Balanced Score card model, as a means to translate strategic goals into an actual operational roadmap for transformation and implementation?

1.4 RATIONALE FOR THIS STUDY

The study attempts to sharpen understanding of what UoTs are, and are supposed to become. It is submitted that this is important, given widespread lack of clarity both within and outside these institutions.

The strategic focus of Universities of Technology (UoTs) should be through its curriculum alignment with the labour market needs and human resource development challenges, as initiatives such as ASGISA and JIPSSA. Therefore the curriculum is developed around the graduate profile redefined collaboratively with industry and the profession.

However, historical socio-political distortions in the labour market have resulted in demands for higher education beyond that which was planned by the government. Furthermore, economic development in South Africa has contributed to the skills shortage in the country thus highlighting the gap between economic planning and human resources development.

The UoTs are strategically positioned to narrow the gap by addressing these skills shortages through widening of access to higher education. Indeed it may be argued that they have been doing this since their inception as Colleges of Advanced Education. Traditional Universities only admit matriculants with endorsements. When one considers that only 15% of matriculants obtain endorsements and just over 50% receive senior certificates, it is mainly the UoT sector that can absorb the 50%, and thereby widen access through there flexible admission criteria.

The formulation of an identity map is focused on the unique functions of a UoT, such as technological capabilities and being primarily concerned with professional and career focused education. The contributions of UoTs to research, which is generally understood as the development of new knowledge, is the development of new understanding of a problem through new/existing knowledge to a problem. The management of technology as a research focus area is as important as research directed at applied problem solving. Given this position of UoT research, it can be stated that research in this sub sector of higher education straddles three issues:

- The application of knowledge to address business and industry (in the broadest sense meaning all sectors in society) and related problems.
- The training of high-level technologists.
- The inclusion of a multidisciplinary focus in research

The recognition of UoT's contribution to new knowledge and technology transfer is evident in the annual report of the Tshumisano Trust. The Report records the role of UoTs in contributing extensively to the National System of Innovation. Innovation refers to the application in practice of creative new ideas, which in many cases involves introduction of inventions into the market place.

As identified by the Technikon sector, during consultation for the development of the White Paper on Higher Education transformation and subsequently consolidated in the CTP publication, the UoTs have identified a trajectory for their development (Du Pre, 2008). However the current Higher Education environment serves to constrain and redirect the efforts of this sector thus impeding progression on the development trajectory.

Therefore this study focuses on the development of an underlying principle or construct linked to an identity map for UoTs, to enable them to develop and advance their mandate. This study would also develop a set of distinguishing attributes and features. This will impact on policy, funding and plans for this sector. Each attribute would be linked to several performance indicators. These indicators could inform the review of Government funding arrangements for UoTs which is skewed in favour of Traditional Universities.

1.5 SCOPE OF THE STUDY/ LIMITATIONS

The study is concentrated on a model for UoTs in South Africa. The study will use as a basis the work of the UoT typology project group, comprising of representatives of five South African UoTs, as mandated by SATN. Six overseas universities will be studied in developing the model. This model will then be designed and the characteristics will be tested at DUT. This could be used as a benchmark for other institutions.

1.5.1 Environmental Forces

To face the challenges of the 21st century, Higher Education institutions need to address problems experienced by the modern world; They need to be familiar with the immediate environment and the dynamic world of work. In many countries throughout the world for example in Europe, USA, Brazil, India and Australia the Higher Education sector has gone through various changes in trying to grapple with the challenge of making knowledge useful. As a result they have introduced the concept of Universities of Technology, as a means to be relevant to the world of work. Industry have also invested huge sums of money into research and knowledge production and the results of these initiatives are seen in the sophisticated systems and technology that people use on a daily basis. The human race's use of technology began with the conversion of natural resources into simple tools during the time of the Stone Age. However, the nature of modern work is changing and continually increasing, with knowledge, information and education (Eldik and Fowler 2004: 140). According to Du Pre (2009: 17), as we move further into the information and knowledge age, the workforce will require sophisticated education and training to sustain competitiveness. This poses an important challenge to HE.

This challenge for South Africa was included in the CHE (2000), Size and Shape Document, in which the Task Team highlighted the need for HE to play a critical role in contributing to the economic and social development, an equitable society and a robust democracy, through ensuring excellence in teaching, learning and research. To do this a coherent, coordinated and integrated system was recommended.

South Africa has many powerful environmental pressures that continue to impact on its economic growth. Moreover, if economic growth is not translated to benefit its people, it will result in increased poverty and under-development. In terms of Accelerated Shared Growth Initiative of South Africa (ASGISA) (2006) and JIPSSA (2006), the Government plans to grow the economy by 4.5% till 2009 and plans to grow by 6% from 2010 to 2014. There are three major hurdles that need to be addressed to realize these growth targets:

- Shortage of skilled professionals, managers and artisans, and the uneven quality of education
- Our economy is concentrated in upstream income e.g. production in primary commodities of mining, iron and steel. There is a need for more value added services and development of knowledge workers through technology and innovation
- A need for the small, medium and micro business sector to make a substantial impact in the economy

UoTs are well positioned to deliver the skills necessary to accelerate the economy in terms of the growth targets. Economic growth should not be the only benchmark for UoTs, but the quality of interaction with people and environments in solving social problems, will indeed be important performance criteria and contribute to differentiation of the HE sector. However, it became clear that a unitary system need not be a uniform system, but rather dependent on the type of mission and typology that is informed by the external environment.

1.5.2 Profiling a UoT Typology from an Identity Crisis

Because a University of Technology is a new concept in South Africa, a clear definition and criteria are needed to manage the process of redesignation of Technikons into UoTs, or merger of Technikons with Universities, making up Comprehensive Universities.

Lategan (2005: 183) criticises the Size and Shape Report (2000) and National Plan for Higher Education (NPHE 2001) because of the way they dealt with the restructuring of the HE landscape. He points out that there was lack of understanding of what a University is, as well as the diversity of University functions with respect to its social goals. Social goals represent the university's approach in channelling knowledge and technology for the improvement of society, as opposed to generation of knowledge for the sake of knowledge.

This lack of understanding was further amplified in October, 2003 when the Ministry of Education announced that the Technikons will now be called UoTs. There were no criteria to guide these organizations in fulfilling important objectives in denting the huge knowledge gap, and societal and economic inequalities. Questions were asked by Lategan (2005: 184-185) such as whether these Technikons were already Universities and only needed a name change. The reality was that while the former Technikons operated in a narrow spectrum in the HE sector, it required meeting many university criteria and standards to play catch-up with the older universities. Also, there was no clear philosophy (Imenda, 2005) ethos or construct so that a solid foundation can be made to drive the transformation to a UoT. Without such building blocks being in place, the UoT as a sector would not be able to make a significant impact in South Africa's development. Merely replicating the Traditional Universities would go against the grain of the type of education that Technikons had built since its existence i.e. the provision of cooperative education in partnership with industry. This made it possible for Technikons to provide career focused programs. On the other hand the Traditional Universities were criticized for being elitist and "ivory towers" where knowledge generated was pursued for knowledge's sake and partnerships with industry were not a requirement for their qualification.

Kraak (2005: 137) posits that UoTs were required to perform similar functions to Traditional Universities such as teaching and learning, research and community outreach. However, he describes the way they carry the functions out, that differs from Traditional Universities. The focus of these UoTS would be on the needs of business and industry and linking and accessing technology in a way that it adds value to society (Du Pre, 2005). Lategan (2005) therefore provides a basis for classification of universities based on its uniqueness of purpose to prevent mission drift. He therefore proposes a two tiered landscape with UoTs and Traditional Universities.

1.5.3 Developing Core Constructs for UoTs from its Environment

It is important to observe that while broad functions were outlined, the creation of UoTs were not immediately underpinned by a set of theoretical constructs. In developing these constructs it is necessary to examine the type of environmental pressures, and the social terrain that UoTs operate within. The 21st century represents the postmodern era, which succeeded modernism. The postmodern era is characterized by the way we live and the every day problems we face. While the previous modern era represented truth and many universal values. (Thathia, 2007: 754).The major school of thought that has emerged is that we live in a postmodern era in which people live and work in social environments with real problems that require solutions. It is within this environment that UoTs find themselves (Brown, et al. 2000:28).

This creates a tremendous opportunity for UoTs. Winsberg (2005: 197) believes that only by adopting the postmodern approach by subjecting practices to intense scholarly scrutiny can we turn the outcomes into solutions.

This ethos of shaping society is further advanced by Lungwangwa (2002) in which this HE transformation is akin to technocratic liberalism with an emphasis on the utility of knowledge, skills and qualification. Traditionally, liberal education aimed to give an individual a liberating experience so as to find his bearing in society. However in the new context the thrust of education is within this philosophy of technocratic liberalism, with emphasis on developing the individual with regard to functional knowledge, skills, careers, business-related value systems and entrepreneurship, to enable them to effectively participate in the ever changing demands of an economy.

1.5.4 Application of Technology and Knowledge: Pillars for UoTs

A prevalent interpretation of technology is to see knowledge as a tool or instrument which humans insert between themselves and nature to bring about changes in social practices in which they are used. This implies that our social realities are reconstructed through use of technologies (Skovsmose, 1994). The widening of the notion of technology to include social technology indicates that working scientifically with technology is more than applying science in the construction of tools and instruments to use in our surroundings (Cristiansen and Baijnath, 2007: 224). This brings into question the way UoTs skill their students and staff, in the light of explosion of knowledge. Edlik and Fowler (2004) points out that staff and students are to demonstrate, not only mastery of relevant modern technology, but also to contribute through the practice of technology, to the various steps of technological innovation; from the start of an idea or concept to the diffusion of technology and eventually to the successful commercialization of products and services. Learning is crucial in harnessing the knowledge of technology and applying it to enterprises or communities.

Historically, the prime purpose of business was to make a profit from a product or service. Today as products and services become increasingly knowledge intensive, the means of making profits and competing in the marketplace is to become an effective learning organization. Profit and product remain the goal, but it is continuous learning that enables growth. Owen (1991) concludes that the business of business is learning – and all else will follow. Achieving and sustaining competitive advantage requires organisations to learn better and faster from their successes and failures. In learning organizations, individuals, groups, and teams continuously engage in new processes to acquire, capture, store, disseminate, and reuse knowledge. Learning is not separate from performing, it is integral to work activities and transferred to individuals, groups and teams to improve processes and results.

Learning is beyond training at the time of entry into an organization or prescribed training sessions (Tantawy-Monsou and Gorelick, 2005). Zuboff (1988) went one step further by describing learning as the heart of productive activity and further classified it as a new form of labour. UoTs have to adopt a continuous learning approach if it has to realise its vision.

In the past it was fashionable to purchase expensive computer software as means of introducing technology. While improving productivity in certain areas it left knowledge in the hands of a few. It became clear that to improve learning there needs to be a way of integrating Knowledge Management technologies with soft Knowledge Management approaches (Sanchez, 2004) and encourage individuals to think beyond their current boundaries, facilitating organizational activity, promoting continuous knowledge creation and continuous improvement, and supporting growth through innovation (Moffett et al., 2004; Magnusson, 2004). The failure of expensive investments in new technologies related to Knowledge Management (Malhotra, 1998; Sveiby, 1997) has led managers to still question the degree of technological involvement required for a successful Knowledge Management System (Moffett et al., 2004). Dougherty (1999) proposes that knowledge transfer is about connection not collection and that connection ultimately depends on a choice made by individuals. Although connection is a key factor the assumption that it solely depends on individuals is less certain. Universities are in the position to drive this process to ensure an effective connection not only for knowledge transfer but also in order to trigger knowledge utilization and application, creation and sharing.

1.5.4.1 SMMEs and Entrepreneurship

Developing an entrepreneurial culture is key for building economic growth and innovation (Acs, et al, 2007). SMMEs are disadvantaged in this area due to reduced learning opportunities and a lack of trained staff and finance to develop and implement appropriate systems. UoTs have an opportunity to provide support to this sector as a conduit for applying knowledge. There is evidence that learning networks can successfully assist SMMEs in the transfer of new concepts such as continuous improvement and total quality management (Bessant, 1995), in the diffusion of a wide variety of technologies (for example, robotics and rapid prototyping) and to increase the knowledge base and other capabilities of their members (Harding, 2002; Fuller-Love and Thomas, 2004; Chaston and Mangles, 2000). In recent years, research has been carried out to address the utilization of the intranet and internet not only as a repository of unstructured information but also as a powerful tool to enable effective information and knowledge accessibility and communication, supporting collaborative projects and offering the opportunity to create new knowledge (Buniyamin and Barber, 2004; Clemmensen, 2005; Hardaker and Smith, 2002; Keane and Barber, 2002; Magnusson, 2004; Scott, 1998).

1.5.4.2 Experiential Learning

For UoTs to fulfil their mandate in making the desired impact in the development of skilled manpower, they need to continue to focus on the unique delivery methods. They need to ensure that they integrate education so that students are able apply knowledge in the world of work. Experiential learning is one of a number of unique characteristics of a UoT, however when it forms part of the requirements of the academic curriculum, it is termed Work Integrated Learning. In some programs students are required to volunteer their services to communities. This is common in the Health Sciences. The common thread in these interventions is the transfer of knowledge to the world of work and communities through translating of knowledge into practice.

Experiential learning is the process whereby knowledge is created through the transformation of experience (Kolb, 1984, p. 41). The underlying assumption is that for learning to take place, experiences have to occur. Based on Kolb's (1984) idea, Politis (2005) confirms that entrepreneurial learning is an example of a process in which knowledge develops through experiencing, reflecting, thinking and acting. Groenewald (2003: 49) define Work Integrating Learning (WIL) as a structured educational strategy that progressively integrates academic study with learning through productive work experiences in a field related to a student's academic or career goals, not as an add-on but an integral part of the educational process. Work integrated learning (WIL) is the component of learning that focuses on the application of theory in an authentic work based context. It addresses specific competencies identified for the acquisition of a qualification which relates to the development of skills that will make the student employable and will assist in developing his/her skills.

Having formulated a set of underlying constructs for the formation of UoTs within a social context, the next question is how can we change the way learning takes place in the face of constantly increasing rate of knowledge in the world of work. Barnett (1998) use the term “learning society” to describe the way society should respond to the challenge of increased knowledge through constant replenishment of human capital so as to maintain and, if possible, to strengthen society’s economic capital; and with learning individuals’ continued improvement of their quality of life, to the point of societal learning. This ensures that the society is self-reflexive and self learning. The focus then becomes the development of humans being capable not just of responding to an unworkable world but of contributing to it (Cristiansen and Baijnath, 2007).

The constructs act as foundation on which attributes can be drawn from. Each attribute can then be converted into performance indicators. It is envisaged that the development of a set of indicators would define the mission of UoTS in the broader HE landscape. It would develop a typology for UoTs which would inform the transformation and reconfiguration of HE. Further it would also create space to focus attention on the way UoTs are funded by DOE. For example patents, incubator, WIL are not funded in the DOE's funding formula.

CHAPTER 2
RESEARCH METHODOLOGY

2.1 INTRODUCTION

The aim of this chapter is to discuss the design type and methods used in this research project. In this study a design was employed using qualitative research techniques. As this is pioneering research into UoTs, it is necessary to recognize that UoTs are in their infancy. People who are participating in the development of UoTs, are mostly concentrated in the South African Technological Network. Therefore, interviews were conducted with and limited to this group who are also driving this process. Further, overseas specialists were also interviewed to acquire in-depth understanding of how UoTs function in those countries.

Qualitative research considers using human beings, objects and places in a natural setting in order to construct meaning from data. The study employed semi structured and in-depth interviews as one of the instruments for data collection to provide the opportunity to construct and interpret the central themes in the participant's experience. Interviews were flexible and convenient for both the interviewer and the interviewee. McMillan and Shumacher (1997) affirm that the interview may be used as the principal means of collecting data that have a direct bearing on the research. Interviews can range from being structured to being unstructured where even the expressions of the participants are observed by the interviewer for purposes of data collection.

In the context of the study, interviews enabled the researcher to explore complex issues in detail, by facilitating the personal engagement of the researcher in the collection of data; they allowed the researcher to provide clarification of issues using probing questions. Unstructured questions were avoided but probing questions were used as follow-up questions. Interviews are time-consuming and they can limit the size of the sample, especially in a purposive sample because some participants are reluctant to participate in an in-depth interview session due to reasons related to fear, their schedules and commitments. Also in pioneering research, information is normally in the hands of a few people who may be specialists.

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Although it might be difficult to analyse open-ended questions, they provide a vivid description that can raise new and unexpected insights that were not encountered in the secondary data. That is why sometimes it is important to review all the notes of the interview transcripts before reporting on them.

2.2 RESEARCH DESIGN

Field research lends itself to qualitative research study. Objects are not reduced to single variables but are studied in their complexity. Therefore the study does not take place in artificial surroundings in laboratories but in the context of practices and interactions of the subjects in their every day experiences (Flick, 1989:5). It has also a descriptive component in that it tracks the development of Universities of Technology through focus groups. Historical reports will be analysed within social and work environments and are classed as ethnographic studies (Baszanger and Dodier, 1998:18).

The focus group is represented by senior staff from the five UoTs in South Africa. The researcher will be an observer and sometimes a participant. Interviews will also be held to determine the role and views of the participants of the focus groups.

It would not be possible to sample large groups, since this is pioneering work and is being done for the first time in South Africa and is being driven by a small focus group or a project team mandated by the South African Technological Network (SATN), which is a sub-committee of HESA (Higher Education of South Africa). However, it is envisaged that the representatives of participating UoTs would provide a sense of how they see UoTs developing and how will the typology eventually affect their own institutions.

In social inquiry, the researcher looks for a way to format the study, and the question asked tends to be something that will give a title to the study. Furthermore, if the content of the study is already known, the researcher has to decide on the type of inquiry by focusing on the point of departure, the end product and the logic of research (Mouton, 2001). Therefore, research design focuses on the way the research is conceived and executed, and how findings are eventually put together. Several approaches were used in obtaining data to improve its validity.

2.2.1 Ethnographic Approach

This study is based on a qualitative paradigm, which allows the data to be collected from the natural environment. In this research, an ethnographic approach was used. An ethnographic study design is a hybrid approach in which the field worker is present in two agencies, as data gatherer and as a person involved in activities directed towards other objectives. A study becomes ethnographic when the fieldworker is careful to connect the facts that s/he observes with the specific features of the backdrop against which these facts occur, which are linked to historical and cultural contingencies. The first stage interviews were held at institutions in Germany, Switzerland and UK. This was intentionally done to capture relevance, features and connect all the facts within the organization’s own cultural and social setting, so as to understand the impact of these in the development of UoTs (Flick, 2006: 126).

2.2.2 Triangulation Study

Data was collected in order to fulfill the aim of the research using the triangulation method. Silverman (1998) affirm that triangulation is the employment of different methods in studying the same phenomena to increase reliability or confidence in research findings. The assumptions underlying the research question were driven by the existing experiences of HE institutions here at home and abroad. Literature had already been reviewed and critically analysed as part of the evidence for the inquiry.

This triangulation study included interviews, focus groups, observations and study of documents. Triangulation assumes that looking at an object from more than one standpoint provides researchers and theorists with more comprehensive knowledge about the object (Denzin, 1978).

Interviews enable the researcher to explore complex issues in detail, and they facilitate personal engagement in the collection of data. They allow the researcher to provide clarification by probing. The data was collected from specialists in various levels in the respective institutions participating in the development of UoTs (Flick, 2006).

The knowledge obtained is produced through interpersonal interaction and the use of language. However, there can be discourses that can emerge as a result of the interaction and the expressions of the interviewee and the interviewer. Kvale (1996: 148-149) suggests that for the interviewer to meet the criteria for interviewing, one must be knowledgeable, clear, gentle, sensitive, open, and critical, to be able to interpret and remember the participant's statements. The study used in-depth and semi-structured interviews where the sample was purposive (Gillham, 2000; Flick, 2006:126).

When using participant observation the observer must enter the group and find the right distance between him/her self and the group. There is a close relationship here between the observers presentation of him/herself (to enter the field throughout the study), and the place accorded to the observer by the other. The field worker has to be objective while also balancing his acceptance into the group’s interactions. He has to control his emotional reaction to what is observed and also develop a finely tuned introspection to fully understand the process of transformation which he/she undergoes by being constantly present in the field. The result of this is that the participant observer gradually makes organized sense of what he hear and sees, in this way s/he tries to verify the meaning and functions, at which point s/he recognizes their validity or rejects them (Bazanger and Dodier, 1989).

2.2.3 Focus Groups

The third methodology that was used in this study is focus groups. It was used by getting participants to give their interpretation and views and of UoT performance indicators. The groups should be as heterogeneous as possible to obtain a wide cross section of views and analyses, and as a second stage they could be homogenous in terms of their institutional levels to give more focus to the results. The groups should be informal to elicit maximum information based on the research themes (Flick, 2006).

2.2.4 Documents

Studying the documents of an organization gives insight to how it functions and what meaning it attaches to situation and how it interacts within its own members and with its society. It follows logically, from observation that a qualitative field research must pay careful attention to the collection and analysis of documents themselves. It must also incorporate a clear understanding of how documents are produced, circulated, read, stored and used for a wide variety of purposes.

2.2.5 Sample

The UoT sample was composed of specialists, academic, management members in UoTs or similarly classified institutions in South Africa, UK, Germany and Switzerland. The final report is composed of analysis of the interviews.

The main themes/questions that guided the South African interviews are as follows:

- What are the main external forces influencing the development of UoTs?
- How are the goals of the NPHE being articulated in the stipulations set by Department of Education for UoTs?
- What are the main characteristics or attributes of UoTs and how will they address the skills, human resources and economic development of the country?
- How will student access be advanced in a UoT and how different is it from a traditional university?
- How do the characteristics and performance indicators operate in the delivery of teaching and learning, research, and external engagements at a UoT?
- What are the main differences between UoTs and other higher education institutions in South Africa?
- How should DOE funding be changed to support UoTs and sustain its unique contribution to the HE sector?

These questions were informed also by government’s strategic intentions as articulated in the NPHE document which will be discussed later.

2.2.6 The Model

The research outcomes from the interviews and the principles arising from the literature reviews are integrated into a “Development of UoTs” model using aspects of the Balanced Score Card template. This maps out in detail the strategy and the interaction and processes.

2.2.6.1 Features of a Model

In a model the data collected is placed in a form to show the relationship of the various factors and variables. Models are used to demonstrate the interaction between graphical display and analytical text, where the visual display enables the researcher to summarise data, identify themes and relationships, trends patterns and clusters, discover relationships and develop explanations.

Analysis carried out through concept coding, either manually or by using computer software, lends itself to display through conceptual modeling. The strength of a particular factor, its location within a system, its co-existence with, or effect upon other variables and perspectives, are features commonly revealed through conceptual analysis of empirical data, these relationships can therefore be represented as models (Briggs, 2005).

“In capturing the nature of underlying processes, models offer the user a tool for setting up hypotheses and for considering the effect of changes to the system being modeled. Further, if one premise of using a grounded theory methodology is that the researcher should engage in an iterative process of theorizing and verification, then models offer an ideal tool for this purpose” (Briggs, 2005: 590).

Models offer a simplification of reality by showing relationships between key variables, factors or phenomena. This process of reduction may be undertaken, however, in order to amplify or enlarge understanding (Huberman and Miles, 1998).

2.2.6.2 Integrating Research into the Development of UoTs Model

This study uses the various research methods to collect data from South Africa and abroad to develop the characteristics of a UOT. The literature provides the principles of a learning organization that informs and validates the drivers of a UoT. The purpose of using data from overseas universities was to investigate their development and understand their processes to inform the development of UOTs in South Africa. The Balance Score Card (BSC) was used as a template to indicate the various factors, strategic goals, performance indicators, within the four perspectives of Customer Proposition, Internal Process, Learning and Growth, and Finance.

Having collected extensive data from several sources, it was necessary to place this in a meaningful way to indicate the relationships between variables to facilitate its use in practice. The data that was produced fell into four BSC perspectives and further into the following categories i.e. strategic goals, inputs, outputs, drivers and enablers. Some of the data were inputs into a process and were outputs of another process. The concept of a model was introduced to integrate and focus the findings of the research because the research produced many variables with complex relationships and all have them work as a whole system. Each process was further described and linked to several performance indicators to ensure the model performed in terms of desired results. The BSC model was also used to simplify this comprehensive process into a coordinated system so that it can be understood and used by practitioners.

The model ensures that the principles and strategic goals, which are characteristic of a UOT are sustained. The model is able to link the different BSC perspectives through a time line, since for example graduation rate for a particular cohort of students is available in 3 years. The model identifies the drivers that must produce outcomes on an annual or semester basis to cause an impact in 3 years. A basis is created to indicate cause and affect relationships to be identified to help institutions solve the right problems and deploy resources in a targeted manner.

The model can be adapted to cascade into a Performance Management System, with the performance indicators being described in terms of measurable target. This model shows the development of a UoT in a progressive and systemic manner it is termed Balanced Score Card Model: The Development of UoTs. The model was tested at DUT through a series of workshops to check its applicability and its usefulness in practice.

2.2.7 Research Plan

The research was planned to unfold in three stages. The first stage involved the overseas study of six institutions. The second entailed the interview of selected UoT specialists participating in the SATN project, from five different UoTs in South Africa. The third stage involved observations, focus groups and study of documents with regard to the development of UoTs.

The first stage of the plan was to study six international universities with a technological bias, to obtain detailed information of its attributes and inform the typology for UoTs. These universities have been through similar restructuring to align to the demands of a modern knowledge economy. The following universities were chosen because they responded to the researcher’s request to undertake research:

- Ravensburg Barufsakademie /University of Applied Sciences, in Ravensburg in Germany also referred to as Fachhochschule

- Lorrach Barufsakademie /University of Applied Sciences, in Lorrach in Germany also referred to as Fachhochschule
- Bern University of Applied Sciences in Switzerland
- London Metropolitan University in London, UK
- East London University in London, UK
- Queen Mary, University of London, UK

The researcher visited these Countries from 21 November 2008 to the 7 December 2008. The purpose of conducting research at these universities was to gain insight into their attributes or characteristics so as to obtain a sense of the social environment and the culture within which these universities operate, and further to what extent these influence the shaping of their UoTs. The use of ethnography allows the researcher to observe the subject in its environment. In this study it is used to obtain information about the organisation within its environment and to observe its responses.

The second stage was to interview experts and specialists in the development of UoTs in South Africa. As Silverman (1993: 91) notes, interviewers must interview the subject's constructs of the environment, society and relationships, not just narratives but social worlds. For researchers in this tradition "the primary issue is to generate data which give an authentic insight into people's experiences".

Observations were made of the workings of the task groups and all the documents emerging there from, were studied to determine the attributes and performance indicators and drivers. The fieldworker must remain open in order to discover the elements making up the markers and the tools that people mobilize in their interactions with others and, more generally with the world (Silverman, 1997:123).

2.2.8 Population and Sample

In addition to conceptualization, a decision must be made about who or what to interview or observe, where and when. However, not all the members of the population can be interviewed but only a few selected ones. The interviewer can decide in which order the questions can be answered. The interviewer can probe in further detail if required to elicit more answers to clarify responses.

Researching development of the UoT concept and its performance indicators in South Africa is new and can be categorized as pioneering research, since for the first time a typology for this type of university was developed. It was necessary to research overseas experiences at similar types of institutions that have gone through similar processes in developing institutions that are distinctly different from the traditional universities. Much progress has been made by SATN (South African

Technological Network) in developing the typology. Therefore, the interviews were concentrated on the senior experts in the field.

This study used non-probabilistic sampling. This is used when a theory is being developed and therefore, one cannot guarantee a representative sample, “but rather individuals and groups are selected according to their (expected) level of new insights for the developing theory in relation to the state of theory elaboration” (Flick, 2006: 126). Given this constraint on the small sample that is available, the researcher used various methodologies as in ethnographic observation, document study and focus groups. This research falls in the category of interpretive research, in which the investigator builds an extensive collection of descriptions of context, people, actions and perceptions of participants. Reports are grounded in narratives and accounts by participants from the field (Locke, Silverman, and Spirduso, 1998).

However, not all the members in the population had an equal chance of being included in the sample. First, the researcher considered participants who were knowledgeable with regard to UoTs. These members were part of the SATN team who were in the Typology Task Team, who participated in developing a set of performance indicators for UoTs in South Africa. Secondly, the researcher considered those who were willing to participate in the study. It was not possible to get a sample of employees at UoTs because this typology had not been fully implemented or even accepted by Government at the time of the research. Therefore, a purposive sample was selected, comprising of experts participating in the development of UoTs.

2.2.9 Collection of Data for the Study

The study has used multiple sources of data such as:

- Documentation, interviews, observation, archives, government policies, reports and legislation. The uniqueness of multiple sources is the depth in the collection of data, and the interpretation of the findings and the reflections gained as insights of the researcher.
- The study has the advantage of obtaining information from the internet and intranet which was an important data source and which can help the researcher to collect, and analyse the data concurrently. A database was created from the inception of the study.
- It maintains a chain of evidence. This case study has maintained coherence and synergy in the flow of the argument from the first chapter until the last chapter.

According to Henning (2004) the study design is the description of the way in which the study was developed and also how it was presented to its readership and other audiences. The protocol is a blueprint of this notion because it acts like a planning tool. The type of method used has to link with the genre and must be consistent. In addition, all the themes and theories used in the study are part of a bounded system of the Higher Education and Human Resources discipline- and they constitute part of the rich data collected. As already mentioned before, more than one type of data collection was used in order to comply with what Flick (2006) has referred to as triangulation. Table 2.1 summarises the methodologies used in the study for data collection.

Table 2.1: Methods of Data gathering Collection and Analysis

Method of research	**Target Group**	**Reasons for Selection**	**Sample**	**Context**
In-depth ethnographic interviews – UK, Germany, Switzerland	3 institutions in UK., 1in Switzerland, and 2 in Germany	These institutions have been restructured from non university structures to a University of Technology.	Six Institutions from abroad were studied (five who are in the category of UoTs/comprehensive and one traditional university)	Understanding the restructured overseas HE institutions in their social and economic setting
In-depth interviews with UoT specialists in South Africa	Experts participating in the UoT Typology Task Group	They were chosen because of their detailed knowledge of UoTs and the environmental forces influencing its growth	Respondents were chosen as part of a purposive sample	The evolution of a UoT in South Africa
Ethnographic Participatory Observation	UoT Typology Task Group	They are representatives from different universities participating in the Typology and the sub Committees	Two SATN meetings were observed	Discussion and development of UoTs in the Committees
Focus Groups	DUT as a focus group	The focus group was used to test the main pillars of UoT and its understanding using the balanced scorecard	Three focus groups sessions were held to ascertain the meaning of the UoT characteristics in an Strategy Alignment workshops	The cascading of the indicators to a UoT
Study of Documents		To obtain authentic documents that record the debates, development and background of the study	All SATN documents, Government legislation, DUT strategic Plans were studied.	All documents that have been drawn up in recording the development process

2.2.9.1 The First Phase – Ethnographic Study

After the approval of the proposal, the researcher sent an email to the overseas universities informing them of the study visit.

It was significant for the researcher to first spell out clearly the purpose of the research, and how the research will benefit the development of UoTs in South Africa. The researcher made contact with these institutions through the DUT DVC (Technology, Innovation and Partnership) office and the Director IEP (International Education Partnerships). The contact persons set up the interviews and visits.

Table 2.2: Universities Researched

Parts	Country	Name of University	University Type	Type of study
Part 1	Germany	• Ravensburg Barufsakademie/University of Applied Sciences, • Lorrach Barufsakademie/University of Applied Sciences	UoT	Ethnographic study in the country
	Switzerland	• Bern University	UoT	
	UK	• Queen Mary University	Traditional (chosen to study systems and characteristics that be used by UoTs)	
		• London Metropolitan University	UoT	
		• East London University	UoT	
Part 2	South Africa	• Durban University of Technology • Vaal University of technology • Tswane University of Technology • Cape Peninsular University of Technology • Central University of Technology	UoT	Ethnographic observation of the SATN Topology meeting of representative of all UoTs in South Africa

The second part of the ethnographic study was the observation of the SATN Typology Committee and the discussions and deliberations from representatives of five UoTS in South Africa.

Since this is an ethnographic study, both observation and interviews were used. In obtaining information the researcher had to bear in mind the research questions and integrate and align them into the interviews. The interviews themselves were held in an unobtrusive and informal manner, as indicated by Flick (2006).

According to Spradley (1979:58), “it is best to think of ethnographic interviews as a series of friendly conversations into which the researcher slowly introduces new elements to assist informants to respond as informants. One must guard against exclusive use of new ethnographic elements, or introducing them too quickly, which can make interviews become like formal interrogation “.

The method of documenting and capturing the ethnographic study in the First Phase was through a narrative ethnography. According to Bazanger and Dodier (1989: 15), “narrative ethnography can take the form of an approach that we might call hyperrefexive, more preoccupied in fact with questioning and reporting on the operations performed by the ethnographer”.

The encounter between ethnologist and study population is viewed as a dialogue initiated between individuals who themselves belong to different collective wholes (Bazanger and Dodier, 1989). This methodology avoids limiting the inquiry to the trajectory of a specific person, without at least suggesting why this experience is exemplary and in what way it provides information about the type of relationship which the people studied has with the world.

The researcher spent some time visiting the faculties and interacting with key people in attempting to get a sense of the social context and system within which these institutions operate. Staff and students were observed in pursuance of organizational imperatives in their surroundings. Observations were captured during the interview sessions. Information from the archival records was collected; documents from the institutions and government were also collected.

Field notes were collected and analysed ethnographically and for content validity, coding and classification of ideas was done.

Content and discourse analysis served as the basis for the analysis. Ideas were coded and classified. Comparison with theory and practice was done.

2.2.9.2 The Second Phase – Interviews

This phase was individual interviews with specialists. In preparation for these meetings, the researcher already collected a vast quantity of information of the work done in the SATN Typology Committee. Scheduling the visits for these meetings was difficult because some of the participants were in different parts of the country and were not always available.

Data Processing and Analysis

- ❖ Interviews from the recorder were transcribed and were recorded in writing.
- ❖ Transcript of interviews were coded into computer and classified in groups.

The work of the two day workshop of the Typology Committee was observed and typology documents were studied.

- **Pilot Studies**

Johnson and Briggs (1995: 64) describe a pilot study as a "small-scale investigation or trial of the materials and methods adopted in search of the study's general objective". A small group of participants, was representative of the same population as that of the research project, are selected for a pilot study. Welman and Kruger (1999) state that the purpose of a pilot interview is to find possible flaws in the procedures (like ambiguous instructions or insufficient time limits) and to recognize the non-verbal behavior of the participants which may point to discomfort about the content or wording of the questions. It is also intended to identify items which are vague or ambiguously formulated. Actual questions are posed to the participants and the researcher ascertains how the participants interpret these questions. Another purpose of the pilot study in this research will be to train an inexperienced interviewer. Two interviews were conducted as in the Table 2.3.

Table 2.3: Pilot Study

Requirements	**DUT Focus Group**	**SATN Member**
Type of interview.	Focus group	Individual
Context of interview	Test the UoT typology and Balanced Score Card Model	Characteristics of a UoT and development
Duration of interview	Approximately half a day	Approximately one hour
Medium of interview	English	English
Interviewer	Researcher	Researcher
Target group	Departmental managers and at least two staff members	SATN member and UoT specialist.

In both interviews confidentiality of information was assured and the values of the participants' inputs were emphasized. The use of a recorder to record the data was explained and placed on a small table in full view of the participants. Minutes were also being taken to capture special points in the discussion and outcomes of the working groups. The data was transcribed shortly afterwards for explication purposes. The researcher as interviewer in both pilot studies encouraged the participants to interact freely and further probing was applied to obtain supplementary information from the participants.

These interviews helped to revise certain questions so that it could be more easily understood. It also assisted in helping the interviewer to improve his interviewing skills and observing all ethical considerations in the interview process.

- **Interviews**

Since specialists in this study may be uncomfortable in interviews where people of seniority or from other institutions are present, and may not respond as freely as they wish to, hence they were interviewed individually. Participants were interviewed individually at times that were convenient for them, considering peak work or production periods. These interviews were without the threat of divulging confidential institutional information in the presence of participants from, perhaps their competitors.

The interviewer posed open-ended questions to allow the participants to reconstruct their own experiences and the roles of their institutions. The purpose is to obtain their perceptions about the assessment needs, problems and the role of industry. The use of individual interviews as well as focus groups interviews was to ensure that the data collection process occurs in a structured manner and to improve validity of the research. It would give other researchers an indication of the steps that this researcher followed to come to a conclusion.

2.2.9.3 The Third Phase – Focus Groups

Three focus group discussions were held, to test the performance typology and the Balanced Score Card instrument at the Durban University of Technology (DUT).

The typology was applied in an institutional context using a focus group to test the meanings of the characteristics and how it operates within an institution using the Balanced Score Card incorporating performance indicators. The Durban University of Technology was chosen for this phase. The focus groups were selected in terms of their functionality. There are three distinct ambits at DUT namely, Academic, Institutional Support and Technology, Innovations and Partnership. Three meetings were held in these focus group sessions. The UoT characteristics were presented and each department has to align their departmental goals with the UoT characteristics.

- **Focus Group Interviews**

Kruger (1994:6) describes a focus group interview as "…. a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment". Furthermore, it is imperative that the researcher subjects participants who may possess a limited framework of reference and limited language skills, to simple data collection methods which will set them at ease and allow comprehension of questions.

It has certain advantages. The focus group interview can be a cost-effective method. The information is gathered rapidly, since the participants are simultaneously interviewed. Focus group interviews also elicit more in-depth opinions, than if the participants were interviewed individually. The participants stimulate each other and share their opinions more readily in this way (Morgan, 1988; Jerling, 1997; Welman and Kruger, 1999). Thus, it is an effective method to obtain a great volume of information within a certain time span. Finally, interviewing is a very flexible method (Mouton and Marais, 1990; Mason, 1998) in the sense that it can be used almost anywhere and it can produce data of more depth, complexity and roundness. It is more likely to produce a fairer and fuller representation of the perspectives of the participants.

The purpose of focus group interviews in this study is to capture the perceptions of the learners and lecturers about the performance indicators (PIs) and test the acceptability of the UoT Balanced Score Card model.

- **Characteristics of focus group interviews**

Kreitner and Kinicki (1998) describe a group as two or more individuals who interact with each other to achieve specific goals and who share a mutual identity and have common norms. Focus groups are generally composed of four to six or six to twelve people, which enable them to share their insights, while still eliciting a range of responses (Krueger, 1994).

The researcher was responsible for encouraging the participants to participate in the discussion about the Performance Indicators, the model and their responses in terms of the departments they represent. The researcher acts as a facilitator in encouraging responses for integration into a plan for the department. The researcher is part of the group and can exert some control over the types of questions by means of objectives and outcomes that are required. After some introductory questions to focus the discussion, the researcher played a passive role, and only redirected the attention of the group to the relevant questions when the latter becomes side-tracked. By probing fully, the interviewers can clarify any misunderstandings or assumptions and gain a clear perspective or even explore issues that were not anticipated earlier.

Kerlinger (1986) and Krueger (1994) agree that open-ended questions permit the participants to determine the nature of the response. The participants were clustered into working groups based on the departments they are in. Open-ended questions in this study allowed the participants to reconstruct their responses in terms of their own experiences. The researcher was able to explore the understanding of UoT performance typology and their responses to the Balanced Score Card model as a way of developing and understanding the concept of a UoT.

2.2.10 Sources of data

There were various sources of documents that were studied and analysed.

2.2.10.1. Institutional Documents

Documents were collected, which included SATN minutes, institution's mission statement, strategic planning, and a three year rolling plan submitted to the Department of Education for the period 2003/4. The researcher has referred to other informal and formal institutional policies dealing with issues such as student admission, retention and staff employment practices like diversity policies, skills development, and performance management. Also, the accumulative statistics of all UoTS in South Africa were collected. They include student graduation rates, research output, enrolments in terms of race and gender. The advantage of documentation is stability. Documents can be reviewed repeatedly and are unobtrusive because they exist before the research is done. Documents always give exact names and they are legitimate, and have a broad coverage of information.

2.2.10.2. Government Documents

The researcher collected data from major policies that have shaped the new academic landscape in South Africa. Some of them are described in the review of literature. These included the NPHE, the White Paper 3: Programme for Transformation of Higher Education (1997), The Higher Education Act (1997), the Report of the National Working Group (2001), the government's National Plan for Higher Education (2001), the New Academic Policy on Programmes and Qualifications in Higher Education (2002-3), the Report on the Approved Academic Programmes for Universities and Technikons (2003- 2006) and the Annual Reviews for 2007.

2.2.10.3 Archival records

Archives are significant as a source of evidence. They are precise and give information that is scarce and unavailable from the libraries and resource centers, and also have existed for a long time. Archive documents include service records, maps, and charts, chronicles, manuscripts, lists of names, survey data and personal records like diaries.

2.2.10.4 Transcripts of Interviews

Semi-structured and in-depth interviews were conducted with selected participants. Interviews are the main source of evidence for this case study. Interviews were composed of open- ended, closed-ended and structured questions and the duration was between 1-3 hours. The use of the tape-recorder during the interview was left to the discretion of the parties involved. The writer planned the interview questions before the first visit. The study population was composed of experts and in the focus groups leaders and senior managers of departments and faculties were used. In the ethnographic research, the researcher made field notes which were later transferred to computer. The researcher recorded the interviews and made notes during the interviews and on site observation.

2.2.10.5 Review of relevant literature

Data was also collected from literature relevant to the study in order to put perspectives on the most recent research findings related to the study. Concepts and theories in Human Resources Development, Industrial Psychology and Higher Education studies have been employed and analysed including relevant legislation and policies. Cases from other countries that have restructured their Higher Education have been critically reviewed and analysed for the purpose of comparison and legitimacy. Information was obtained from journals and books from the library, intranet and internet.

2.2.10.6 Direct observation

The writer made direct observations during the visits to overseas institutions, and in the meetings of the SATN typology Committee and the Data Sharing Committee. The observations were formal and informal. They supplemented the field notes. Participant observation was also employed.

Some of the issues observed included:

- Physical artifacts and surroundings were observed as evidence of the new culture of the institution.
- The institutional structure and design
- Grounds and the environment
- Social structure of employees and students
- Documents, brochures and prospectus as were observed as evidence of the new institutional culture and image.

2.2.10.7 Quantitative data

This study used both qualitative and quantitative methods in the research. Quantitative data was collected from various institutional and government documents in the form of statistics. This included the data available on student enrollment numbers, graduation rates, three-year rolling -plans, statistics from the Department of Education, statistics from the SATN website 2004, 2005, 2006 and 2007 Annual Reviews. The other statistics were obtained from the National Higher Education database.

The central part of systems dynamics is the need to understand how all environments interact with one another. In this context, organizations / institutions have to be seen as systems. The various parts of the system interact with one another. When there is change in one of the components over-time; there are some effects that can be observed within the system when the others are affected (Senge, 1990). The systems approach and theory make one understand the system's basic strengths and weaknesses and the resulting behavior it can produce. The introduction of higher education transformation has brought about change that has introduced a new culture and behavior to institutions like UoTs. It also elaborates on the role of participants and their capacity to adapt to such changes.

2.2.11 Validity and Reliability

The issue of validity in qualitative research can be complicated. The realistic view holds that social phenomena do exist in the objective world and that lawful and reasonably stable relationships can be found among them. Henning (2004), Mouton and Babbie (1998) affirm that social phenomena, such as language, decisions, conflicts, and hierarchies, exist objectively in the world and exert strong influence on human activities because people construct them. Therefore, social phenomena can be measured using a variety of instruments suitable for the research study. The semi-structured and in-depth interviews, observation and documentation used have enabled the study to critically analyse the new academic landscape in South African Higher Education. A key strength of a case study is its use of triangulation, which involves the method of using multiple sources for collecting data. The rationale for using, multiple sources of data is based on the ideas of replication and convergence (Gillham, 2000). The researcher has systematically used multiple sources when collecting data with the aim of achieving results through in-depth description, as well as analyzing and answering the research question. In striving for internal validity, the researcher has used in-depth interviews, observations of artifacts and surroundings, documents that implied other issues uncovered in the study. This experience demonstrated the thickness of the description of the problem being studied and consistency in the interpretation of the data collected. However, there are lessons that can be learnt by other institutions and by the UoT sector, hence there are reflections from international experience. Along with literature review, views from other scholars are echoed with the intention of making a chain of evidence on the challenges and demands of Higher Education when policies for transformation and restructuring are implemented. However, there is evidence about the type of data used, which is documented and can be used again at a later stage.

2.2.12 Requirements for Interviews

In addition, the researcher avoided bias and distortion during the interview sessions. According to Gillham (2000) researchers should always bear in mind that the interviewee may be rationalizing and therefore presenting a view of an administrative set-up, which is not in accordance with rationality. The present writer took precautions by avoiding leading questions, selecting a proper sample, practicing politeness, checking conflicting statements and verifying the information given by the informants and the interviewees. There is a chain of evidence maintained from the literature review; on what the other scholars allude on restructuring of higher education in South Africa and abroad.

2.2.13 Development of Interview questions

By using open-ended interview questions, the researcher obtained answers from interviewees to the research sub-questions or objectives of the research. The questions are formulated in such a way that the interviewers were able to understand the research questions fully and provide clear and relevant responses. Questions were designed to elicit responses from specific target groups, namely the overseas institutions, South African UoT experts and specialists and Focus groups. These questions used as guides in the interviews to obtain maximum information in the field and work place.

2.2.14 The Model

The research outcomes from the interviews and the principles arising from the literature reviews are integrated into a “Development of UoTs” model using aspects of the Balanced Score Card template. This maps out in detail the strategy and the interaction and processes.

2.2.14.1 Features of a Model

In a model the data collected is placed in a form to show the relationship of the various factors and variables. Models are used to demonstrate the interaction between graphical display and analytical text, where the visual display enables the researcher to summarise data, identify themes and relationships, trends patterns and clusters, discover relationships and develop explanations.

Analysis carried out through concept coding, either manually or by using computer software, lends itself to display through conceptual modeling. The strength of a particular factor, its location within a system, its co-existence with, or effect upon other variables and perspectives, are features commonly revealed through conceptual analysis of empirical data, these relationships can therefore be represented as models (Briggs, 2005: 590).

“In capturing the nature of underlying processes, models offer the user a tool for setting up hypotheses and for considering the effect of changes to the system being modeled. Further, if one premise of using a grounded theory methodology is that the researcher should engage in an iterative process of theorizing and verification, then models offer an ideal tool for this purpose” (Briggs, 2005: 590).

Models offer a simplification of reality by showing relationships between key variables, factors or phenomena. This process of reduction may be undertaken, however, in order to amplify or enlarge understanding (Huberman and Miles, 1998).

2.2.14.2 Integrating Research into the Development of UoTs Model

This study uses the various research methods to collect data from South Africa and abroad to develop the characteristics of a UOT. The literature provides the principles of a learning organization that informs and validates the drivers of a UoT. The purpose of using data from overseas universities was to investigate their development and understand their processes to inform the development of UOTs in South Africa. The Balance Score Card (BSC) was used as a template to indicate the various factors, strategic goals, performance indicators, within the four perspectives of Customer Proposition, Internal Process, Learning and Growth, and Finance.

Having collected extensive data from several sources, it was necessary to place this in a meaningful way to indicate the relationships between variables to facilitate its use in practice. The data that was produced fell into four BSC perspectives and further into the following categories i.e. strategic goals, inputs, outputs, drivers and enablers. Some of the data were inputs into a process and were outputs of another process. The concept of a model was introduced to integrate and focus the findings of the research because the research produced many variables with complex relationships and all have them work as a whole system. Each process was further described and linked to several performance indicators to ensure the model performed in terms of desired results. The BSC model was also used to simplify this comprehensive process into a coordinated system so that it can be understood and used by practitioners.

The model ensures that the principles and strategic goals, characteristic of a UOT is sustained. The model is able to link the different BSC perspectives through a time line, since for example graduation rate for a particular cohort of students is available in 3 years. The model identifies the drivers that must produce outcomes on an annual or semester basis to cause an impact in 3 years. A basis is created to indicate cause and affect relationship to be identified to help institutions solve the right problems and deploy resources in a targeted manner.

The model can be adapted to cascade into a Performance Management System, with the performance indicators being described in terms of measurable target. This model shows the development of a UoT in a progressive and systemic manner it is termed Balanced Score Card Model: The Development of UoTs. The model was tested at DUT through a series of workshops to check its applicability and its usefulness in practice.

Table 2.4: Questions as Guides for Interviews

Experts From South Africa	Experts from Overseas institutions	Focus Groups Guidelines
1. What are the main external forces influencing the development of UoTs? 2. What are the main differences between UoTs and other higher education institutional types in South Africa? 3. How are the goals of the NPHE being articulated in the stipulations set by DOE for UoTs? 4. What are the main characteristics or attributes of UoTs and how will they address the skills, human resources and economic development of the country? 5. How are the characteristics of technology, knowledge transfer and innovation integrated in the delivery of teaching and learning, research, and external engagements at a UoT? 6. How will student access be advanced in a UoT and how different is it from a traditional university? 7. How should DOE funding be changed to support UoTs and sustain its unique contribution to the HE sector?	1. What is the profile of your students? 2. What is the profile of your staff? 3. What is the history of the institution? 4. What are the characteristics of the university? 5. Have you got a performance management system? Describe how it is implemented, 6. How does the institution respond to the external economic environment? 7. How do you form partnerships with community and industry? 8. Do you have entrepreneurship focus and how is it implemented? 9. What role does industry play in the teaching and learning programs and knowledge transfer? 10. What type of research is the institution engaged in? 11. To what extent is research commercialized and how is used to find real world solutions? 12. How is technology transfer facilitated?	1. What are the main external forces influencing the development of UoTs? 2. How are the goals of the NPHE being articulated in the stipulations set by DOE for UoTs? 3. What are the main characteristics or attributes of UoTs and how will they address the skills, human resources and economic development of the country? 4. How do the characteristics and performance indicators operate in the delivery of teaching and learning, research, and external engagements at a UoT? 5. What are the differences between UoTs and other higher education institutions in South Africa?

2.3 SUMMARY

A qualitative research design was considered as the most appropriate instrument that best serves the requirements of the research problem. The data gathering methods included an ethnographic study which included semi-structured interviews, study of documents, structured interviews, direct observation and focus groups. A protocol was outlined to ensure that the interview was as objective as possible. A research plan was drawn up to guide and coordinate the different methods and to ensure that validity and reliability considerations were adhered to. An initial pilot study was conducted to identify any problems and correct them. Interviews were conducted in South Africa amongst the representatives of UoTs participating in SATN. Interviews were conducted at overseas institutions to get a sense of how they perceived UoTs and their experiences in developing their respective higher education sector. The outcome of the interviews, focus groups, and documents were used to build a comprehensive model that showed the cause and effect interrelationships and wider impact of UoTs.

These research interventions and outcomes were then placed within a model, to understand the various variables and their relationships.

CHAPTER 3
DEVELOPMENT OF UNIVERSITIES OF TECHNOLOGY

3.1 BACKGROUND

The current landscape of globalisation has been made possible by the phenomenal technological developments of the past decade. This historical process has led to a revolution in world economies comparable to the industrial revolution, wherein the importance of ‘energy’ has been superseded by the centrality of knowledge and information, at least within the context of cyber economics. South Africa has taken a conscious decision to actively understand the emerging form and function of globalisation, and to locate itself as a competitive economy within this international context. The global competitiveness challenge is to establish a system of lifelong learning that will develop the knowledge, skills and competencies required to facilitate innovation, social development and economic growth in the 21st Century (Department of Education, 2000:1).

Universities worldwide now encounter far greater challenges, and are subjected to an unprecedented level of external scrutiny. Resources everywhere are scarce. At the same time universities have to accommodate the push from below – rising social demands for higher education opportunities – and the pull from above – growing demands for advanced skills and knowledge from increasingly sophisticated economies. Within such a policy context, universities are much more governed by market ideologies and the corporate discourse of efficiency and effectiveness. The change in governance ideology in the higher education sector has altered the way in which universities are managed, a phenomenon identified as ‘academic capitalism’ (Slaughter and Leslie 1997, Dovey et al, 2001; Yang, 2004).

To understand the challenges facing universities and to plot their journey into the future, it is necessary to observe how they evolved through various eras which shaped these institutions of learning and influenced its impact on society. The history of universities can be divided into four stages. During the twelfth to the fourteenth century, the late medieval universities at Bologna, Parma, Paris and Oxford focussed on training clergy, lawyers, and clerical administrators, which was largely vocational training. The curriculum consisted of Grammar, Logic Arithmetic, and Geometry. The fifteenth to nineteenth centuries were characterised by education for the elite. The difference between the two eras was a movement from vocation to education. Following the nineteenth and the first half of the twentieth centuries, knowledge was fragmented, whereby one may isolate a small aspect of knowledge and focus one’s energy on it. The result was that the intellectual world became isolated from the real world, as pure knowledge could not accommodate mundane technological enterprises. For example, engineering was at first avoided and was included only in the nineteenth century. Universities during 1960s were characterised by economic growth and increase in the number of subjects offered for study. This period also personified the rise in democracy and open access, which resulted in the development of social conscience of universities (Lategan, 2005: 183).

Over the last two decades there has been growing concern globally on the part of governments in respect of how government funds are being spent, and there is need for greater accountability from previously autonomous tertiary institutions (Magennis 1993, Brew 1995, Strydom 2000, Jonathan 2000). In addition to the focus on research, there is also greater emphasis now on the teaching and learning which occurs at universities, as a means of ensuring accountability, and assuring quality.

``It is ... in terms of our teaching and research that our productivity as academics, and that of our institutions, is measured by those who provide the funds. These are the terms in which we feel the pressures of accountability to assess the quality of research and teaching'' (Rowland, 2000:15).

There has been indeed a paradigm shift in academia due to advances in technology. The new breed of professionals need to be efficient to tackle problems from cross-functional, cultural and ethical perspectives and equipped with skills to benchmark for global leadership positions. Also, the IT environment is dynamic and fast changing which suggests changes in current academic environments and structures which may be more transformational than incremental. All educational institutions may have to adopt a more business-like approach to education and meet the demands of the students (Cornell, 1999). In fact, colleges and universities face major challenges that prompt a critical re-examination of IT to inform information architecture, information management and information systems (Ranjan, 2008).

The aim, today, of science and technology policy is to hitch scientific enterprise to industrial renewal and competitiveness. This has led to many formal and informal partnerships between industry, science and technology. Increasing partnerships combined with new found ease of learner articulation across institutions in many global contexts, have made the whole education and training system more flexible, with boundaries more permeable than ever before. It becomes clear that higher education must be restructured to meet the needs of an increasingly technological economy with the capacity to participate in a rapidly changing global context in order to prepare for integration into the competitive arena of international production and finance (Van Eldik and Fowler, 2004: 141).

This literature survey investigates the international experience of restructuring of Higher Education with a view of looking at South Africa's own history and current forces impacting on its development. The study investigates theoretical models and a philosophy to underpin its evolution in responding to global and national influences.

3.2 INTERNATIONAL EXPERIENCE

Globalisation is increasingly characteristic of the realm of knowledge production. Insofar as this process is altering the nature of research, it touches the heartland of the university, its modes of organization, and its core values (Gibbons 1998).

Many countries have had extensive experience in restructuring higher education in line with local and international demands.

According to Du Pre (2009: 10), the UoT as a concept and institutional type is not new. Such institutions exist in many countries, for example, the Technical Universities and the Universities of Applied Science (Fachhoschschulen) in Germany; Universities of Applied Technology in some countries in Europe; UoTs in Australia and Hungary; Universities of Applied Science and Technology in Iran; and the Institutes of Technology in the USA and Australia. While retaining a particular focus, each institute type has developed according to its own unique environment and in response to local and international demands.

According to Lowe (not dated) Plato envisioned the purposes of education being:

- Vocational and technical – committed to achieving the country's economic goals;
- Professional and managerial staff – are trained to run administrative systems and thereby exerting control over political and ideological power to run a country;
- Philosophical – primarily seeking to pursue knowledge for knowledge sake and not interested in the application and utilisation of such knowledge and development of the individuals mind.

Lowe (undated) characterizes these purposes as functional, ideological and philosophical. In line with this thinking about higher education, four models were constituted, namely Athens, Berlin, New York and Calcutta models (Botha 2004). Consistent with the Plato classification, the Athens model is to pursue knowledge for the sake of knowledge; the Berlin model is to champion the integration of research and teaching into the environment of academic freedom. The New York model represents an entrepreneurial institution, driven by market forces. The fourth category is the Calcutta model which emphasises the relevance of university education to real life societal problems, which the university must address and solve. It is evident that it is the manner in which knowledge will be used that will determine the differentiation of the type of university that needs to be developed (Imenda, 2005).

In Finland the establishment of polytechnics was linked to the general aim of raising the level of education to meet the challenges of international competition and technological change. The goal set in the 1990s was that 60-65 per cent out of each age group would be offered a place in higher education after upper secondary education; the majority should be enrolled at a polytechnic, but one third at a university (Lasonen and Stenström, 1995). In practice, the number of students who have completed higher education in each age group has remained lower while alongside the polytechnics the university sector continued to expand. The polytechnics are expected to work in close cooperation with local firms and providers of public services and to work to enhance the regional economy. In terms of Polytechnics Act 351of 2003, their mission included a higher education that will prepare students for their professional duties. The curriculum is founded on meeting the demands of working life and changes in it. Furthermore, it was expected that polytechnic education should support individual professional development. Polytechnics should also carry out research that serves their own educational needs and the development of their region and its economy. The research conducted in polytechnics was focussed in the applied sciences. The polytechnics have been enthusiastic about undertaking research and raising their status as well as attaining the objectives set for them. At the same time the funding they have received for research has been marginal compared to that given to the universities. In addition to lack of funding, establishing networks of expertise on research has been a challenge for the polytechnics (Virolainen, 2007: 291).

Virolainen (2007: 309) described the progress of workplace learning in the Finnish polytechnics, in a context driven on the one hand by the polytechnics' own ambitions and by competition with the universities for status and students. It has been feared that this will lead to academic drift and neglect of the importance of contacts with working life both by some polytechnics themselves and also by some universities, especially in questions of research funding. On the other hand public policy has underlined the duality of the Finnish higher education system and the closeness of polytechnics to working life as well as their importance in regional economic development as centres and motors of innovation (Herranen, 2003). In practice, the background of the teachers building polytechnic education has been threefold, drawing on the traditions of:

- specific vocational competence and work experience;
- professional teacher training; and
- University education (Kotila, 2004).

Each of these traditions has given their own flavour to the development of workplace learning in polytechnics.

Brazil identified the need to establish entrepreneurial universities way back in 1986, which was the early stage of their UoTs. However, the traditional universities experienced many obstacles till they began creating partnerships involving Government, Industry and University relationships, which they referred to as the Triple Helix. This led to the development of an entrepreneurial culture and new organisational structures appeared in the form of offices for technology transfer, spin-off companies, technology parks, incubators. In 2004 the Technological Innovation Law No. 10.974/2004 was an important watershed as it established innovation incentive measures and situated scientific and technological research within a productive environment. This law aimed at encouraging strategic partnerships between universities, technological institutes and companies; stimulating the participation of science and technology in the innovation process (Almeida, 2008).

Australia took a strategic decision to improve its international participation in the first world economy, and to embark on this journey, they designed their higher education to provide life long learning as a means of providing demand based education and training (Doughney, 2000). However to provide this life long learning the Victoria University of Technology needed to provided a flexible education where academic offering can be customised to suit the needs of the student and industry. The concept of a dual university was introduced to provide seamless education with multiple exit points. The programs offered ranged from entry level courses at Technical and Further Education (TAFE) level to PhDs. Various obstacles had to be addressed to make the transition from a binary divide to a dual university offering both university and TAFE (Technical And Further Education) qualifications, namely removal of systemic, government and administrative hurdles.

3.3 HISTORY OF HIGHER EDUCATION IN SOUTH AFRICA

The history of higher education has its roots in apartheid education. Institutions of learning were provided on the basis of race. Africans, Coloured and Indians could go to specifically designated schools or universities allocated for that particular racial group.

3.3.1 Racially Based Higher Education

Universities are the progeny of racial discrimination which later became institutionalized under apartheid, through the Extension of University Education Act of 1959. The act formalized and entrenched racially segregated education in the tertiary sector. It became an important part of the broader “divide and rule” strategy used to enforce racial and ethnic division. Blacks were further balkanized into different ethnic groups and each group was given “national” status and encouraged to develop a sense of venerated cultural insularity. Accordingly, the 1959 Act established ethnic universities situated in the rural hinterland (Nkomo, 1984).

Bunting (2002:74-6) summarizes the rationale for the establishment of these racially defined universities in pointing out that it was overtly political and instrumental; they were not established because of an academic need for institutions of the kind they became. They were instrumental institutions in the sense of having been set up to train black people who would be useful to the apartheid state, and political in the sense that their existence played a role in the maintenance of the overall apartheid socio-political agenda. Furthermore, the intellectual climate of the historically black universities was informed by the apartheid philosophy. In the early years, their academic staff members tended to come primarily from their historically white-Afrikaans-medium universities, which functioned with instrumentalist notions of knowledge. These academics readily accepted an academic ethos with a strong “training” focus and, in particular, a focus that placed little emphasis on the production of new knowledge or critical and analytical skills. As a consequence, few of the academics employed by these institutions believed it necessary to introduce research and postgraduate programs in these universities to pursue higher intellectual objectives. The intellectual agenda of the institutions often became no more than that of the material taught in previous years at historically white Afrikaans-medium universities.

The pattern was that the greater the prestige, status and influence, particular positions had, the greater the extent to which white men dominated. For example, in 1990, 92 percent of the executive/administrative management members in higher education institutions were white (National Commission on Higher Education, 1996). The Historically Black Institutions were also poorly funded, resulting in profoundly impoverished intellectual cultures that still, to varying degrees, remain deeply steeped in their current incarnation. The funding formula which government used to finance universities was also biased towards historically white universities and against black universities. This was particularly the case where the formula rewarded course offerings in the natural sciences which included life, physical and mathematical sciences, health care and health sciences, engineering, architecture and the agricultural sciences on the one hand, and the humanities group which includes all other disciplines, on the other. More funding was allocated to the former subject groups than to the latter, which perpetuated the practice of in-built inequalities between these two sets of institutions, since many of the Historically Black Institutions had fewer natural science students. These practices led to South Africa's higher education system being one of the most fragmented and highly unequal systems in the world (Nkomo and Sehoole, 2007: 2).

3.3.2 Emergence of the Early Universities and Technikons

Most of South Africa's universities and technikons have a common ancestor in the technical college. The South African College in Cape Town, and the technical colleges of Natal, Pretoria and the Witwatersrand gave rise to both the universities and the technikons which bear (or bore) these names. The universities broke away from the technical colleges during the 1920s - 1930s, leaving behind an aggregate of programmes, which were deemed inappropriate for university status at the time: such as the trades, crafts, nursing, teaching, some of the health sciences, business, and engineering (Winberg, 2005: 161).

By the 1960s there was wide distribution of technology across industrial and commercial workplaces in South Africa, and a resultant shortage of technically skilled personnel. The technical colleges were identified as having the potential to address this need. The Advanced Technical Education Act of 1967 changed the status of the technical colleges of the Cape, Natal, Pretoria and Witswatersrand to Colleges of Advanced Technical Education (CATEs). To these were later added new colleges at Vanderbijlpark and Port Elizabeth, so that by 1969 there were six CATEs enrolling over 23 000 students. Others were soon to follow, such as the M. L. Sultan College for Advanced Technical Education in 1969. As these colleges evolved, their CATE designation was changed to `technikon' as a result of the Advanced Technical Education Amendment Act of 1979. The existing CATEs were henceforth known as technikons. In addition, a number of new technikons were established such as Technikon Mangosuthu (1979), Technikon Northern Transvaal (1981), Peninsula Technikon (1982), Border Technikon (1987) and Transkei (later Eastern Cape) Technikon (1991) (Committee of Technikon Principals 2004; Winberg, 2005).

Winberg (2005: p 192) highlighted the most significant effect of the role of industry in curricular decision making as being `cooperative education' which, in the technikon context, means taking up in-service training, usually in a company, for a period of up to one year. During this time, students are supervised by a designated person at the workplace, their performance is monitored and assessed, and this assessment contributes to the student's final mark for the course.

Technikon programs were characterised by shortage of pedagogical expertise in the development of technikon curricula. The content is dense, packed with many subjects, with virtually no time allocated to individual study, research or project work. Technikon libraries, up until the 1990s, were virtually non-existent. There was long bureaucracy in developing new programmes, in the meantime, industry had undergone dramatic changes in technology. Workplaces were becoming globalised; production methods had reduced the need for narrowly competent technicians. Flattened decision making structures, creative, problem solving teams, and the complex social changes wrought by the new technologies meant that technikon education was (with notable exceptions) locked in a time warp, and was no longer meeting the needs of industry. By the 1990s there was a need to make some fairly wide ranging changes. The convener system was used to cope with the integration of new knowledge into the syllabus. Technikons were appointed as conveners in certain programs in which they were considered as specialists, this information was shared by all other Technikons who intended offering that particular program.

By changing the staff profile to include more `university trained' people, and raising the level of the programmes it was assumed that the technikons would once again be in a position to satisfy `the requirements of commerce and industry' (Committee of Technikon Principals 1995) (Winberg, 2005).

The Committee of Technikon Principals spearheaded the move by technikons into post-diploma studies and higher qualifications. The Technikon Act of 1993 made it possible for technikons to become degree-awarding institutions. However, their core offering is still the Diploma. The first Bachelors degrees were offered in January 1995, and shortly thereafter technikons offered Masters and Doctoral degrees in particular fields of study. While this seems like a natural progression, considering the expansion and distribution of technology in South African society, and the concomitant need for more advanced technical personnel, Weinberg (2005: 192) called this period one of `imitation' because, although there were superficial changes, there was a lack of systemic change to the technikon system during this period, as they were merely reproducing what was already being done by other institutions.

By 2000, most technikons, across all departments, had staff with different types of expertise (university, technikon and/or industry-based), varying degrees of disciplinary or professional affiliation, different levels of tertiary education, and different institutional histories. While, to a greater or lesser extent, this is a normal situation in all higher education institutions where there are likely to be experts and novices, in the technikon this was (and still is) an unhappy mixture. Firstly, the leadership (predominantly at the head of department level) consisted of the people originally recruited from industry, who did not have the experience, the qualifications, or the inclination to provide academic leadership; secondly, the persistence of the strong mindsets and practices associated with an older version of `educating for the needs of industry' was a constraint on the achievement of university equivalence (Winberg, 2005).

These difficulties were recognized and several measures, with varying degrees of success were put in place to address these shortcomings. Firstly, staff with only industry experience were no longer recruited. Technikons began recruiting those with higher degrees and with research and publication records. There was increased investment in research by National Research Foundation (NRF) and international funding agencies, however without proper research infrastructure, the research and publication output remained low (Winberg, 2005).

3.3.3 Democracy and Transformation in Higher Education

After the advent of democracy in South Africa in 1994, the new Government made various attempts to rationalise and focus Higher Education in addressing duplication based on race, fragmentation, inequalities and inequities of the education system.

Council for Higher Education (2000:1) outlined the pervasive dysfunctionality that characterizes parts of the higher education system which reduces its great potential. These include:

- The very serious decline in the rate of enrolment of new entrants into higher education as a whole. The enrolments predicted by the NPHE (National Plan for Higher Education) have not materialised. Indeed, there has been a dramatic decline in enrolments at many institutions. This is likely to have a crippling effect on the ability of several institutions to continue to fund their activities because of the relationship between enrolments and funding. And the serious decline in the retention rates of students from the first to succeeding years of study has compounded the problem of overall enrolment patterns.
- The extremely poor graduation and yearly pass rates relative to overall student numbers at most institutions
- The problems of funding are exacerbated by the inability of many institutions to effectively collect student fees with the resultant increases in student debt.
- The largely unregulated growth of the provision of private higher education has had profound effects on the public higher education system.
- The skewed racial and gender distribution of students in the various fields of study and the skewed patterns of distribution of students in the various fields of study (Science, Engineering and Technology, Business and Commerce, Education and the Humanities and Arts).
- The extremely poor race and gender distribution (in aggregate numbers and in many disciplines and at different levels) of academic and administrative staff
- The extremely low research outputs of most institutions and the uneven levels of outputs even in those institutions which demonstrate a higher ratio of research outputs relative to other institutions
- The fragile management and administration capacity in many institutions and the persistence of crises in some of these.

Arising from these systemic weaknesses the CHE Task Team proposed a differentiated national system. A coherent, co-ordinated and integrated national system is not a uniform system. Differentiation in higher education is characteristic of most national systems of higher education. In the South African context, differentiation has been either along socially unacceptable lines or has been essentially of a horizontal nature.

Differentiation, however, is necessary for a number of reasons. These include the need:

- To enable institutions to find their niches in a way as to enhance their ability to meet national needs and to compete in the higher education environment.
- To provide much greater levels of access to the diverse population of South Africa to address the historical barriers which characterized the system under apartheid
- To increase overall participation levels in higher education in South Africa
- To provide a diversity of programme offerings to learners across the system
- To ensure that different methods of teaching, learning and assessment are encouraged in the higher education system
- To provide for and to encourage diversity in the levels and contents of learning programmes
- To provide for diversity in the modes of learning available to learners
- To allow for different criteria for admission to the diverse institutions in such a system
- To provide for flexibility and innovation throughout the system of higher education so that it can be continuously renewed and reinvigorated
- To produce an educational system whose outcomes are qualitatively higher than the present system in South Africa (CHE, 2000).

To develop a differentiated Higher Education System, the whole Higher Education system needed restructuring. However, without fully consolidating the position of Technikons as degree awarding institutions, the Higher Education Act of 1997 was repealed in its entirety. The Technikon Act of 1993, and later amendments (1999/2000/2002) established the principles by which technikons could become fully fledged higher education institutions and entitled to adopt the new nomenclature of university/institute of technology. In one sense, this felt premature, as if technikons are being rushed into an advanced level of operation when the processes of becoming a university (begun in the 1990s) are not yet fully established, and when there was not enough time to consolidate emergent practices, or to learn from the mistakes which are inevitable when innovation is pursued. On the positive side, the propulsion of technikons (ready or not) into a new era, has forced the institutions to rethink their educational and research missions. And for most, this has meant rediscovering `technological education' (Cape Peninsula University of Technology 2004; Durban Institute of Technology 2004).

3.4 POSITIONING HIGHER EDUCATION FOR RELEVANCE

A country's progress and ability to create wealth in an international market is closely allied to both its level of science and technology development as well as the quality of its people. This fact is demonstrated in the World Competitiveness Report of 1998 by countries such as Singapore, Switzerland, Japan and the USA where a high correlation exists between the level of science and technology development as well as the quality of its human resource. With poorer countries, the opposite is visible where the level of science and technology development is low; their human resource capability is also low. It may thus be concluded that those countries that improve their educational productivity and their involvement with science and technology will improve their wealth creating abilities and therefore the possibility of prosperity for all (Almeida, 2008).

Clark (1998) has produced work on the direction universities are heading. He maintains that universities have been pushed towards internal change because there is a deepening asymmetry between environmental demand and institutional capacity to respond. Higher education is in a period of crisis. Increased competition, decreased enrolments, greater numbers of non-traditional students, ageing facilities and decreased government funding are only the most glaring of many problems that most universities encounter (Surrey, 2000).This ‘imbalance’ leads to ‘institutional insufficiency’. Traditional ways become inadequate. In the new context universities need to develop capacity to make selective and flexible responses (Clark, 1998).

This challenge for South Africa was included in the CHE (2000), Size and Shape Document, in which the Task Team highlighted the need for Higher Education to play a critical role in contributing to the economic and social development, an equitable society and a robust democracy, through ensuring excellence in teaching, learning and research. To do this, a coherent, coordinated and integrated system was recommended.

South Africa has many powerful environmental pressures that continue to impact on its economic growth. Moreover, if economic growth is not translated to benefit its people, it would result in increased poverty and under-development. In terms of Accelerated Shared Growth Initiative of South Africa (ASGISA) (2006) and JIPSSA (2006), the South African Government plans to grow the economy by 4.5% till 2009 and plans to grow by 6% from 2010 to 2014. There are four major hurdles that need to be addressed to realize these growth targets:

- Shortage of skilled professionals, managers and artisans, and the uneven quality of education
- Our economy is concentrated in upstream income e.g. production in primary commodities of mining, iron and steel etc. There is a need for more value

added services and development of knowledge workers through technology and innovation

- A need for small, medium and micro business sector to make a substantial impact in the economy
- The cyclical recession in the economy

UoTs are well positioned to deliver the skills necessary to accelerate the economy in terms of the growth targets. Economic growth should not be the only benchmark for UoTs, but the quality of interaction with people and environments in solving social problems, will indeed be important performance criteria and contribute to differentiation of the HE sector. However, it became clear that a unitary system need not be a uniform system, but rather dependent on the type of mission and typology that is informed by the external environment.

3.4.1 Transforming Technikons to UoTs

The Size and Shape document contained the Higher Education Restructuring plan that addresses the problems of this sector. Lategan (2005: 184) criticises the Size and Shape Report (2000) and National Plan for Higher Education (NPHE, 2001) in the way they dealt with the restructuring of the HE landscape. He points out that there was lack of understanding of what a University is, as well as the diversity of University functions with respect to its social goals. Social goals represent the way university's approach in channelling knowledge and technology for the improvement of society as opposed to generation of knowledge for the sake of knowledge.

This lack of understanding was further amplified in October, 2003 when the Ministry of Education announced that the Technikons will now be called UoTs. There were no criteria to guide these organizations in fulfilling important objectives in denting the huge knowledge gap, and societal and economic inequalities. Questions were raised by Lategan (2005) whether these Technikons were already Universities and it only needed a name change. The reality was that while the former Technikons operated in a narrow spectrum in the HE sector, it required meeting many university criteria and standards to play catch-up to the older universities. Also, there was no clear philosophy (Imenda, 2005) ethos or construct to drive the transformation to a UoT. Without such building blocks being in place, the UoT as a sector would not be able to make a significant impact in South Africa's development. Merely replicating the traditional universities would go against the grain of the type of education that Technikons had built since its existence e.g. the provision of cooperative education in partnership with industry. This made it possible for Technikons to provide career focused programs. On the other hand the Traditional Universities were criticized for being elitist and "ivory towers" where knowledge generated was pursued for knowledge sake and partnerships with industry was not a requirement for their qualification.

Kraak (2005) posits that UoTs were required to perform similar functions to Traditional Universities such as teaching and learning, research and community outreach. However, he describes the way they carry the functions out, that differs from Traditional Universities. “The focus of these UoTs would be on the needs of business and industry and linking and accessing technology in a way that it adds value to society” (Du Pre, 2005: 25). Lategan (2005: 185) therefore provides a basis for classification of universities based on its uniqueness of purpose to prevent mission drift.

3.4.2 Developing Core Constructs for UoTs from its Environment

Therefore it is important to observe that while broad functions were outlined, the creation of UoTs were not immediately underpinned by a set of theoretical constructs. In developing these constructs, it is necessary to examine the type of environmental pressures, and the social terrain that UoTs operate within. The 21st century represents the postmodern era, which succeeded modernism. The postmodern era is characterized by the way we live and the every day problems we face. The previous modern era represented truth and many universal values. (Thathia, 2007).The major school of thought that has emerged is that we live in a postmodern era in which people live and work in social environments with real problems that require solutions. It is within this environment that UoTs find themselves (Brown, et al. 2000).

This creates tremendous opportunity for UoTs. By adopting the postmodern approach through subjecting practices to intense scholarly scrutiny can we turn the outcomes into solutions that can be applied in solving real world issues (Winsberg, 2005).

This ethos of shaping society is further advanced by Lungwangwa (2002) in which HE transformation is akin to technocratic liberalism with emphasis on the utility of knowledge, skills and qualifications. Traditionally, liberal education aimed to give an individual a liberating experience so as to find his bearing in society, however in the new context the thrust of education is within this philosophy of technocratic liberalism, with emphasis on developing the individual with regard to functional knowledge, skills, careers, business-related value systems and entrepreneurship, to enable them to effectively participate in the ever changing demands of a knowledge economy.

3.4.3 Integrating UoTs into the Social Landscape

Cunningham and Harney’s (2006) investigation of Higher Education Institutions (HEIs) focussed on two streams, namely teaching and research, while third stream activities are formed by technology transfer, incubators, innovation, and entrepreneurship. Efforts to develop and promote third stream activities typically focus on attempting to replicate the success of the USA, where the Bayh-Dole Act served as a catalyst to encourage commercialisation activities among universities. In the UK the Lambert report (2003) noted the necessity of universities of universities to cast off their “ivory tower” image.

Cunningham and Harney (2006) believe that successful Higher Education Institutions in the 21st century will be those that continue to excel in teaching and learning, while at the same time developing complementary third stream activities to exploit research for public good. Engaging in third stream activities brings into focus issues of coordination, adherence to university regulations and recognition in terms of access to institutional resources, or of a financial return to the institution. If these are not resolved it could leave institutions at risk due to high cost of investment carried by HEIs. These tensions can be managed by putting in place solid governance structures and transparent policies to underpin third stream activities.

The European Union emphasizes the value of collaboration, Brint (2005), suggests that the role of university needs to be reconceptualised. The outdated model of the individual researcher, single discipline, national rankings and mere cumulative progress in the fields of formal knowledge will not serve us as well in an innovative-based era. Instead, Brint proposes new university models encompassing interdisciplinary groups and large-scale economic and political support networks, where the underlying dynamics are constant innovation in the economy and society (Cunningham and Harney, 2006).

It has become clear that the scene is set for a new type of intellectual academic landscape. For institutions of higher education to be able to operate in a technologically challenging 21 century, diversification and differentiation may, also, entail paradigm shifts away from:

- A liberal to a professional education
- Inner to outer directed foci
- Knowledge for the sake of knowledge to applicable knowledge
- Institutional autonomy to partnerships and networks
- Self-reliance to business with/amongst others
- Face-to-face tuition to technology enhanced flexible learning
- A hierarchical organisational to flatter, diverse structures
- Homogeneity of skills to greater heterogeneity and diversity
- Move from competition to collaboration and cooperation (Van Eldik and Fowler, 2004: 152)

According to Du Pre (2004:17), the focus of universities of technology should be `to deliver on-site education and research enriched by industrial and business experience. A university of technology must deliver appropriately qualified graduates to the labour market '. He subsequently even goes further to assert that relevance in higher education should be assessed in terms of the fit between what society and the modern world of work expect of institutions and what they actually do (Du Pre 2004:17).

One of the stated South African governmental priorities (National Plan 2001) is recognition for an education with a sophisticated, technological bias, and the plan contains an instruction to institutions to produce "...graduates with the skills and competencies required to participate in the modern world in the 21 century". More specifically the subsequent White Paper (1.1 and 1.12) indicates, the role of higher education in a knowledge driven world is three-fold:

- Human resource development: the mobilisation of human talent and potential through lifelong learning to contribute to the social, economic, cultural and intellectual life of a rapidly changing society.
- High-level skills training: training and provision of person power to strengthen the county's enterprises, professionals and knowledge workers with globally equivalent skills, but who are also socially responsible and conscious of their role in contributing to the national development effort and social transformation.
- Production, acquisition and application of new knowledge: national growth and competitiveness is dependent on continuous technological improvement and innovation, driven by a well-organised, vibrant research and development system which integrates the research and training capacity of higher education with the needs of industry and of social reconstruction (Van Eldik and Fowler, 2004: 149).

3.5 IMPLICATIONS OF BECOMING A UNIVERSITY OF TECHNOLOGY IN SOUTH AFRICA

In developing a University of Technology, several critical requirements need to be met and implications arise. The concept of a University of Technology was accepted into the South African Higher Education landscape in 2003. However, a mere alteration in name as such might not necessarily change an institution's activities additional attributes and criteria defining technology-based teaching and other aspects associated with a technological institution need to be coined. Some institutions have already embarked on this course and therefore, in order for its full potential to be realised, the applicable higher education legislation should be revised in such a manner as to accommodate such changes (Lategan, 1999).

Institutions within the diverse higher education band will have specific criteria which include the following:

- a mission statement related to specific outcomes;
- admission requirements;
- qualifications offered;

- the nature of the curriculum;
- the characteristics and level of its research;
- minimum student numbers and distribution across the fields of learning;
- the qualifications and expertise of staff (Lategan, 1999);
- Community engagements, external liaison.

Looking at the concept of an institution of technology from a holistic viewpoint, there is room for such an arrangement within the higher education framework. However, it is important that a balance should be retained amongst institutions of higher education in niche markets targeted. Not all former Technikons should, become universities of technology, but depending on how "technology" is defined and typified a few, strategically placed institutions, might be adequate. Care, however, should be taken that the higher educational scene in South Africa be developed as a single coordinated system that will yield the best returns for the people of this country. A technological institution should have the same status as other institutions of higher education as well as representation on the various higher education governing committees. Foci and processes should be amended to accommodate the uniqueness of a technological institution. The introduction of a university of technology to the South African higher education framework will enable integration to the international higher education landscape by embracing the characteristics and the systems of a UoT in terms of partnerships and cooperative engagements. Technological institutions should position themselves within the national system of innovation. Further, a national system of innovation indicates to all science and technology players that the challenges belong to all institutions (Lategan, 1999).

A technological university will provide ample opportunity for knowledge growth, curricula redesign, international cooperation and the revitalisation of theoretically applied higher education in South Africa. Learners educated in technological natural and human sciences will have more job prospects and will be in a position to articulate between various job markets on the basis of their technological know how. Technologically founded teaching/learning and research will provide new job opportunities and will enhance the process of the internationalisation of South Africa's higher education. Information technology has the potential to make distance an irrelevant factor. This would contribute to globalization and internationalisation of higher institutions in particular, and society in general. Partnerships will prosper, since a technological institution would be able to provide much needed technological backgrounds not readily available elsewhere. The nature of technological institutions should be expanded to become that of an entrepreneurial institution. This means new forms of contact with industry, national and regional government and the active transfer of science and technology directly into enterprises. This approach will account for an explicit orientation towards the community. Technological institutions should have a clear view on the kind of philosophical paradigms underlying this institution. Institutions of technology should guard against evolving into ideologies of power which should never become a means in itself. Technology should never be characterised as the only way in which value could be added to life and society. Rather it should be subservient to the purposes of an institution and to education, training and development (Lategan 1999; Hoekstra, 1999).

3.5.1 Analysing the Argument for a Need of UoTs in South Africa

Traditionally, liberal education aimed to give an individual a liberating experience so that students would find their bearing in society, and be able to contribute towards the shaping of that society' (Lungwangwa, 2002). In line with this, the thrust of education within the philosophy of technocratic liberalism is on developing the individual with regard to functional knowledge, skills, careers, business-related value systems and entrepreneurship - to enable one to effectively participate in, and adjust to, the ever-changing demands of an economy which is in a state of transition. In this regard, the central purpose of South African higher education appears to revolve around the notion of liberating the individual from unemployment by being imbued with specific job and real-world related skills by the time of graduation and consequently contributing to the economy (Imenda, 2005).

According to Imenda (2005: 1414), the autonomy of universities has been steadily eroded as the Government uses funding mechanism to achieve its transformational agenda. Institutions have to account for their use of Public money or State subsidies. As a result there is a fear of pursuing goals that may conflict with the State's plan. This could explain why in the South African context the three types of universities pursue similar programs even though they are categorised differently.

Imenda (2005: 1417) states "the distinctions amongst the three university types have been eroded by government `interference', by using the same funding framework and giving the same directives for transformation to all the university types in the country".

The impact of this is that all the universities tend to do the same thing to survive, resulting in further duplication, which was what the reconfiguration of the Higher Education was meant to address in the first instance. But even more serious is the lack of a philosophical or ideological foundation for the transformation process.

Lategan (2005) investigated, various policy documents such as National Plan for Higher Education (2001), National Council for Higher Education (1996a, 1996b), Size and Shape report (CHE, 2000) and the Higher Education Act (Act 101 of 1997 and all its amended versions), and concluded that these were unclear as to what a university is. His observation was based on two issues. Firstly he notes, a lack of direction as to what needs to change or transform, whether it is the concept of a university, unique features or the practices of a university. The example referred to is whether the newly formed comprehensive universities and universities of technology are mere results of mergers or re-labelling. The second basis of his criticism relates to its structure and function, and fitness of purpose. Whether the institution is doing things right and this can only be measured if there is clarity on what the institution is expected to do.

Lategan (2005), argues that there does not appear to be a clear definition of what a modern university is, and given the changing environments, the definition and the nature of universities has also undergone tremendous changes. However, Lategan (2005: 196) believes that “arriving at a definition of a university is difficult because it is relative to the position it stands in terms of the society it serves. Buchanan (2001, 1) believes the best way of describing South Africa's idea of a university of technology is an institution which: `would explore new problems of technology through the sciences, the arts, and the humanities, as well as through the new sciences of the artificial (otherwise known as design) and the new disciplines of computer science, cognitive psychology, and information and decision sciences . . .' Therefore it is a changing concept and will be redefined as society changes to adapt to new challenges, just as it changed from the fourteenth century”. However, according to Lategan (2005: 195) there is broad agreement that a university is “an academic institution at which research is conducted and teaching and learning are offered within the organised cadre of the contract between the lecturer and student, and supported by networking, cooperation and collaboration with external academic partners to create, develop and transmit knowledge”. This means that knowledge creation, development and transmission are the core business of a university. New knowledge can be produced (research), transmitted to other people (teaching or/and learning) and applied (community services).

In the South African situation, the Size and Shape Report (CHE 2000: 25) states, “Higher education itself has a vital role in producing the knowledge, generating the socially committed graduates, and providing various services for enabling this country to pursue social equity, justice and higher standards of living for all and contributing to the revitalisation of the African continent”. This statement indicates a social role of higher education.

The NPHE (2001) describes the provision of universities in terms of cost effective programmes and market related programmes within the context of reconstruction of South Africa. Nowhere is it questioned whether social responsibility is the primary role of universities or whether social responsibility is on equal footing with teaching and learning or an appendage. Instead of addressing these issues, attention was paid to using external funding mechanism, accreditation, mergers, and governance and internal mechanisms such as three year rolling plans, academic development grants and equity targets (Lategan, 2005).

The current theme that dominates the reconfiguration process which is captured in the NPHE is one of empowerment of the previously disadvantaged students. The focus falls on the social role of HE institutions, which further breaks down the “ivory tower” mentality, which characterised universities prior to the ushering in of democracy in South Africa (Lategan, 2005)

The targets were informed by the functions of the universities rather than by the nature of a university. Universities were assigned different qualifications by the Department of Education e.g. UoTs were given undergraduate qualifications (BTech, National Diplomas) with experiential learning; also they were required to produce research and postgraduate students. Very little support was forthcoming with these changes. While the NPHE provides detail motivation for the mergers were the issues of duplication, broadening of access, redressing staff and student racial imbalances were addressed, little was said about how the different types of institutions were going to reach these goals without merely duplicating each other when the market place require a variety of skills in various levels of human resource expertise.

The blurring of the boundaries between the universities and former Technikons continued with Technikons also offering Bachelor of Technology degree qualifications. There were few immediate criteria to guide the process of distinguishing between the university and Technikons qualifications, or even determining any articulation between the two types of institutions. The previous Diploma associated with Technikons is now at a lower NQF than a university Bachelor degree. The Diploma is now at a NQF 6 level and to move to a Masters will require an additional year, unlike the previous arrangement when students completed a one year BTech program to be admitted to the Masters program. To correct this will require recurriculation of the Diplomas (Du Pre, 2009: 75).

To design Diplomas as degrees will result in change in admission requirements, which may negatively impact on student numbers. Presently only 15% of students receive endorsements, over 50% receive senior certificate. It is from this latter group that UoTs obtain their students. If the HEQC insist on a higher point score for those students aspiring to study higher degrees then it would disadvantage a majority of students seeking access to Higher Education. Du Pre (2009: 76) highlights the implications of the unresolved issue of the Diploma “it appears that whilst the policy imperative is to make higher education accessible to more South Africans, especially from previously-disadvantaged backgrounds, the HEQF is putting a ceiling on how far these students may aspire. The current provisions – where the Diploma is at level 6 – would hamper progression from certificates to higher degrees for many of these students.

Kraak (2006: 145) points out, the ‘process which gave rise to the category “University of Technology” was once again not informed by a rational process of policy development, but rather, it arose from political lobbying with minimal policy documentation evolved to explain the new category and its institutional functions' Indeed, the 2004 publication of the Committee of Technikon Principals (CTP), lists the benefits of becoming a university of technology purely in terms of status, recognition, credibility, recruitment, funding and, by virtue of this change, universities of technology would 'be in a better position to respond to the increasing quantum of knowledge needed for progress' (Du Pré 2004, 22). The CTP document, however, does not outline how this would be achieved and neither does it begin to interrogate the concepts of knowledge and progress (Thathiah, 2007).

In the South African HE context, the mergers and incorporations were based on a mechanistic process where similar institutions were grouped together and a disaggregation of those from different pockets of the new institution. Usually, the criteria for doing so was based on expediency to get the pain of merger out of the way rather than being based on a conceptual model or a theoretical foundation (Imenda, 2005). While Imenda's view appears to be too generalised, there is some truth in his assertion in the way the mergers were held. Most of the Historically White institutions were not subject to any of the mergers. The mainly Historically Black institutions were often subject to mergers and many were swallowed by the larger institutions.

Overall, it appears as if the best way of describing South Africa's idea of a university of technology is an institution which: `would explore new problems of technology through the sciences, arts, and humanities, as well as through new sciences of the artificial (otherwise known as design) and the new disciplines of computer science, cognitive psychology, and information and decision sciences . . .' (Buchanan 2001, 1).

3.5.2 Challenges facing the formation of UoTs in South Africa

The South African Technology Network is an association of the five major UoTs in South Africa. Presently, Mangosuthu University of Technology is not part of SATN. The SATN has been advocating for recognition of UoTs as a distinctive sector within a unitary but differentiated Higher Education landscape with special focus on the development of a set of characteristics for the sector and the effects of the funding formula and targets. The funding arrangement for UoTs and its size and shape is informed by three categories:

- Funded student places (input grants)
- Institutional outputs, including student and research output
- Development grants as per agreement with DOE

After the transition from the previous Technikons to UoTs, several arguments and proposals that were made by the UoT sector was not carried forward. These have far reaching funding consequences for the financial sustainability and recognition of

UoTs as a part of the differentiated Higher Education sector, the issues are summarised as follows:

- The research output of 0.5 units per full-time academic employee did not define what constitutes research for a UoT. The research referred to in this funding regime refers to traditional research that was typically generated by the traditional universities. Should employability of graduates and improving economic competitiveness of business through innovation be considered part of research, is a question that needs to be debated and discussed with the DOE and other stakeholders in education.
- Research must aspire to be directed as problem solving and commercialising output as opposed to traditional research where these criteria are not prioritised.
- The proportion of postgraduate enrolments must not exceed 7%. The SATN Report (2008) argues that these proportions constrain UoTs to be essentially diploma awarding institutions, and since postgraduate study attracts a larger percentage of state subsidies, it means that they will be financially disadvantaged. A much more constructive strategy as argued by the SATN and as stated in the NPHE (National Plan for Higher Education), postgraduate students must be increased and developmental funding must be made available to this end.
- Given the history of UoTs as former Technikons, it is difficult to reach the benchmarks for postgraduate student enrolment, since the present staff do not have the requisite postgraduate qualifications to produce research outputs. The former Technikon staff were recruited for their technological skills and industrial experience instead of their ability to produce research outputs. UoTs may not have the critical mass presently, but they need the flexibility, to proceed progressively and strategically to a realistic target to produce postgraduate students in the future.
- The DOE has set about 50% target for UoTs to ensure that students to be enrolled in the SET (Science, Engineering and Technology) disciplines. Since many of these institutions have arisen from expensive mergers and now have to comply with the requirements set by DOE, SATN has requested developmental funding to build infrastructure that is critical for the provision of SET courses and facilities (SATN, 2008)
- The perception that UoTs are second rate institutions. This perception exists also in the UK and Europe with regard to the recently formed universities of Technology. Most of these perceptions seem to emerge from the more traditional universities.

These challenges have to be addressed to ensure that the UoT sector is sustainable and has the support and ability to develop a niche for itself in producing the required combination of skills required by a growing economy, and expanding knowledge base.

3.6 CONCEPTUAL FRAMEWORK AND PHILOSOPHY UNDERPINNING UoTS

3.6.1 Locating UoTs in a Postmodern UoT Philosophy

Thathiah (2007: 754) argues that UoTs operate within the postmodern society of the 21st century and are defined by a society's lifestyle, styles of dress, consumption habits; way we watch television, respond to advertising. It is the element we inhabit, the sea we swim; basically it is everything we do. There is recognition of symbiotic relationship and one cannot pursue knowledge and apply technology to develop society, without being critical of the long term negative consequences that may damage or destroy society. This introduces a new dimension that redefines the mandate of UoTs. This is in stark contrast to modernism of the 20^{th} century, which was characterised by universal values of perpetual peace, justice, truth and so forth. Hence postmodern problems cannot be adequately defined by modern means.

Postmodernism locates institutions within society and this environment. The context and experiences of the social setting help in learning and finding solutions, to world problems through reflection and critical thought. 'It is only by subjecting practices to intense and scholarly scrutiny that universities of technology will be able to achieve excellence in their teaching and research missions' (Winberg 2005, 199). Moreover, Winberg states that universities of technology 'have a responsibility to analyse, debate and deconstruct technology. Their mission should not only be to make a contribution to technological innovation, but to make a contribution to the ability of society to control and manage the development of technology' (Winberg 2005, 198). One of the obstacles in this process is the lack of a theoretical construct when UoTs were declared. It was motivated by political considerations and therefore lacked a theoretical construct to nourish its development.

Therefore if UoTs are required to apply their knowledge to solving societal problems it will have to identify the type of society it exists within. Technikons were products of modernism, its subsequent transformation to a university of technology ushers in a new context of postmodernism. A UoT in a postmodern era will have to be dynamic and responsive to the needs of society. This requires critical and cutting edge research and an interdisciplinary approach to society's dynamic needs and problems. The walls of the university and wider society must be broken down to fully fulfil its mandate. Further, this requires collapsing of the barriers between Arts, Engineering, Commerce, Education, Medicine, and so forth. Presently, universities of technology seem to be maintaining the traditional compartments and departments and faculties are encouraged to work across their borders without really interrogating and deconstructing why these insular compartments need to be maintained in the first place (Thathiah, 2007: p757).

Universities of technology are first and foremost, academic institutions. It is in such academic institutions that a critical theory of technology is being debated to facilitate its application in the world of work and the community. Technology in the postmodern context is not neutral. It is very much part of society and a catalyst in debating civilisation alternatives and its influences (Feenberg nd,). Thathiah (2007: p762) concluded “The presence of such a theoretical perspective, would promote the conceptualisation of universities of technology that can deal with complexity and diversity, challenge conventional wisdom, deconstruct its own conceptualisation, question its own methodology and will certainly evolve with the changing ethos. It will also prevent the automatic acceptance of new meta narratives that position themselves beyond analysis and criticism”.

3.6.2 Using Metaphors to Study the Evolution of Organisations

In the early 1960s and 1970s, organisations showed high growth rates, low inflation. They could afford long turnaround times of technological innovation and plentiful natural resources. Organisations were viewed as machines that would require constant upgrade and repair. Later Bennis (1969) used organic metaphors that signified growth and adaptation of organisations to fast changing environmental forces as compared to the mechanistic structures which were characterised by highly structured power relations (Yeo, 2005: 368). Mechanistic organisations were unable to respond to changes in society as it fails to account for the human dynamics, inherent in all organizations that are so crucial for growth and development (Schein, 1988).

This type of management evolved from a classical viewpoint, to a humanistic perspective, and then subsequently to a management science perspective, systems theory, contingency views, total quality management and eventually culminated with the learning organisation paradigm. With the phenomenal growth in knowledge the traditional management styles no longer apply. Successful organisations of the twenty-first century must be able to learn and respond quickly. The learning organisations will be led by managers who can effectively challenge conventional wisdom, expand the organisation's knowledge base, and make needed changes. Obviously, the new management paradigm focuses on continuous improvement and innovation in the way work is done. In order to remain competitive and survive, the challenge is not only to help organisations learn or increase their knowledge base but help them to learn more effectively (Kumar, and Idris, 2006).

However Peter Senge (1990), popularized the notion of the learning organization. The features of this are five disciplines which are personal mastery, mental maps (constructs), shared vision, team work, and systems thinking. These are catalysts for the development of tools to establish a learning organisation. These five dimensions or disciplines fit well with the five pillars of the UoT that has emerged form the literature survey.

3.6.2.1 Learning Organisation as a Construct

To understand the evolution of a UoT within a postmodern society, the concept and approach of a Learning Organisation will be used in this study.

The characteristics of a UoT correspond closely to a Learning Organisation. The Dearing Report on higher education in the UK places itself in the context of ‘the learning society’. It notes a world of change and unpredictability and looks to higher education to assist in the development of the nation’s people so as to sustain a competitive economy. The Report offers a view of higher education in a learning society, and allowing it to respond to changes in society (Barnett, 1998).

A learning organisation is studied from two positions, namely realist and nominalist. The realist position proposes that any given theory actually mirrors existing features of the real world. However, if one assumes organizational learning to be an organic and dynamic process, theories and models are not necessarily as straightforward or simple as realist models.

The nominalist position is arguably a more appropriate ontological perspective for an organizational learning theory because it holds greater capacity to capture more of the subtleties of the process. As opposed to the realist position, nominalism assumes that observations are theory-dependent and that we cannot have real direct access to knowing the real world due to innate human sensory limitations. In other words, the nominalist position is concerned with the process of making sense of the perceived real world. This negotiation with the reality is a meta-cognition that is commonly found in organizational learning practices influencing members to acquire knowledge strategically and be involved in process evaluation (Barnett, 1998; Stacy, 2003).

This theme reinforces the earlier view that as members learn collectively, they (as an organization) will react more strategically to external challenges and perform better than their competitors.

Organisation learning deals with the process of change and adaptability. This means that the way we approach change must change and this involves expansion of our values and beliefs about what is possible and how it works.

Yeo, (2005), asserts that while the whole of Senge's five disciplines should operate together, systems thinking is clearly the bridge between these elements both as a skill and an approach in implanting a learning organization. Reflection is a key component in learning which results in changes in the organization. Buckler (1996) distinguishes between two types of learning, adaptive learning in which the organization remains the same with modifications, and generative learning is a development of a new organization to cope external and internal changes and challenges to improve organizational output.

3.6.2.2 Drivers of a Learning Organisation

The main drivers of a learning organisational model are culture, reflection and transformational leadership.

(a) Culture

Culture is a main component of the organisational model, because of its power in the alignment of the educational partners' values and efforts. Any organisational change is based above all on the human factor and the human relationships between the people involved. Not taking this into account partly explains the failure of many reforms undertaken in the educational field. Organisations goals must be supported by values and a belief system (Konidari and Abernot, 2006: 12). Culture refers to the way things are done and is underpinned by shared values (Schein, 1985). This provides a mental map that determines our approach to learning and problem solving.

The culture needed for a learning community is a "people-centred", "shared-vision", "systems-thinking" professional culture that engages teachers, support staff, parents, students and the wider community in defining the organisations goals. For Senge (1990, p. 9) shared vision is "a shared picture of the future we seek to create" but not "unearthing shared pictures of the future". He further elaborates the concept of a shared vision as a "force in people's heart". This talks to leadership and team work as a means of coping with changes in a learning system.

(b) Reflection

The purpose of reflection is to develop critical thinking to a point where it can enhance organisational learning. Day (1999) argues that reflection is an important requirement in developing critical thinking to bring about sustained change at the level of the organisation. However, he believes critical reflection cannot be practiced in isolation. He describes teachers' groups as "communities of reflective practice" in which traditional teaching and management practices are changed, core values and beliefs are revisited. This allows academics and managers to assess the institution's intellectual and emotional assets by giving them the time to reflect on their practice and to align internal systems to external forces and contribute to change (Konidari, and Abernot. 2006). The aim is to create a process of critical investigation of the teaching experience so that teachers can create new knowledge and even seek ways of applying it. Reflection is a step toward professional research (Schon, 1983). “This reflection has not to be limited to the activity analysis as it is based on two axis: on the one hand elaborate the elements for the comprehension of the situation in the institutional and organisational level and on the other hand deepen the work with the subjects so that larger elements of people's reality emerge” (Konidari and Abernot, 2006: 13).

(c) Transformational leadership

To bring about learning in organisations, it is vitally important for people to work in teams and for teams to be effective, they need good leadership

Furthermore, continuous training should consist not only on pedagogical issues but also on issues linked to a systemic approach, organisational development, and work psychology as well as on the work analysis as the quality gurus perceived it. Developing learning oriented organisations require a different leadership style and philosophy and vision based on organisational development and people performance enhancement through fostering and leveraging individual, team and organisational learning processes. Such a leadership style is inspired by the assumption that people are a resource like no other and is the key strategic source of wealth creation in knowledge economy (Belet, 2007)

3.6.2.3 Teams and Multi-disciplinary Approach in a Learning Organisation

Olsson and Jonson’s (2008) research into the effects of experiential learning in organisational effectiveness indicated the importance of multidisciplinary cooperation and sharing individual knowledge of the organizational processes across the functional boundaries. The organization needs to create multidisciplinary, process-oriented cross-functional teams, where individual learning can take place among members and across functions. In order to facilitate this kind of knowledge in an organization, an awareness of the importance of multidisciplinary teamwork needs to be instilled. They found that in their study in a Volvo manufacturing plant that when it employed learning organizational strategies there was marked improvement in production, quality and efficient incorporation of knowledge to correct problems and deviation from standards (Olsen and Jonsen, 2008).

Following their study Olsson and Jonson (2008) suggested future strategies for capturing learning in daily activities can be summarized in the following points:

- structure a procedure in order to initiate and develop learning as it takes place in operational daily problem-solving;
- identify the individuals in an organization who initiate change and let them act as ambassadors for the change process and learning outcome;
- identify the different competencies related to a certain problem and integrate these competencies in the early stages of projects, with the aim of transferring knowledge among individuals;
- enhance future learning through multidisciplinary cooperation and sharing individual knowledge of the organizational processes across the functional boundaries within and between firms; and
- Integrate an awareness of the importance of multidisciplinary teamwork in finding solutions and in this study in engineering education at university.

3.6.2.4 Applying the Learning Organisation Principles to a UoT

Traditional discipline based academic knowledge is increasingly perceived as unable to address issues of importance to South African society. Disciplinary based curricula tend to be isolated from ‘real world’ problems. Even in long established professional learning programmes, such as the different branches of engineering, learning tends to happen in separate subjects, with no explicit links made between them or the contexts which they serve (Jansen 2002). To address South Africa’s twin challenges of increasing the number of skilled graduates and global competitiveness, and the urgency to address the inequalities of higher education, there is a need to move away from disciplinary communities to contexts of application. In other words knowledge must be more socially accountable and reflexive; it must include a wider, heterogeneous set of practitioners, who collaborate on a problem defined in a specific and localised context so that knowledge can be applied in the world of work (Winberg, 2006).

In the South African context, however, there is pressure for teaching and learning in the higher education sector to be seen to be knowledge producing and contextual, rather than knowledge ‘reproducing’ and discipline-bound; and ‘transdisciplinary’ (Nowotny et al, 2001). In the South African context, new undergraduate programmes are emerging, which are the result of the integrated work of academics, housed in different disciplines, and representatives of institutions outside of the academic context – workplaces, state and private research laboratories, local and national governments, and communities.

In such undergraduate programmes discipline based knowledge remains important, but other ‘knowledges’ have entered into academic programmes – and it is this recontextualisation of other knowledge systems within the undergraduate curriculum that is the focus of this study. There are thus few examples of major research projects in work-integrated teaching and learning. The major initiative has probably been the Workers in Higher Education Project (WHEP) which was initiated by the Joint Education Trust (JET) in 1995, with funding grants from the Ford Foundation and the W. K. Kellogg Foundation in partnership with the Chicago-based Council for Adult and Experiential Learning – which has extensive experience in the recognition of prior learning (RPL) and workforce development in the US. Most of this work has focused on RPL related projects in the fields of management and leadership training, teacher education, primary health care nursing, agriculture and rural community development. (Winberg, 2006: 163).

3.6.2.5 Community of Practice

In today's world, organizations have to learn constantly, in order to respond flexibly to changes in the environment and to stay competitive. For becoming or sustaining a learning organization, management has the task to make the best possible use of the knowledge of the workers in the organization, as it is the human capital that holds the most valuable potential for organizational learning (Mittendorff et al, 2006).

To develop a community, universities, and the individuals within them, need to commit themselves to increasing collaboration and decreasing competition, at the individual, group, and organizational levels. This involves minimizing status differences, dissolving intra-disciplinary boundaries and cliques that are created from fear and arrogance, and eliminating the competitive organizational structures and incentives that traditionally create and maintain turf battles. At the level of the individual, these goals involve changing one's sense of oneself to be part of a larger collective unit. At the group and organizational levels, an understanding of the systemic results of competition and individualism versus collaboration and interdependence, is required (White and Weathersby, 2005).

Kumar and Idris (2006) observed that all colleges and universities can and must grow smarter. They have a duty to apply themselves in instilling intellectual curiosity among students, must encourage and reward learning at the organisational level. Educational institutions have been criticised for while they have been effective at creating or acquiring new knowledge but notably less successful in applying that knowledge. UoTs consider the application of knowledge in practice and to the world of work, as an important aspect of teaching, learning and research. These institutions use partnerships and collaborations as means of advancing of applying knowledge in practice.

This study of Learning Organisations strongly suggests that UoTs can be classified as such because they possess significant characteristics of a Learning Organisation. The UoT model constructed as part of this research integrates the principles of a Learning Organisation.

Table 3.1: Aligning the Characteristics to a Learning Organisation Arising From The Literature Review

Characteristics of an Evolving UOT	Characteristics of a Learning Organization
• Postmodernism: universities are part of society and therefore must be relevant to its community in solving and contributing to real world problems • Learning by adopting sustainable development as a principle	**Systems thinking** where everything is connected and cause and effect exists. E.g. universities must train to find solution and invent new technologies in an environmentally safe and sustainable manner to protect natural resources.
The new values and belief must be shared to create a new organizational culture to deliver teaching, learning and research within a social system with emphasis on application of knowledge, technology and innovation to solve problems.	**Shared vision**: means developing a shared purpose and meaning within an organization and its leadership and stakeholders. Creating processes so that shared vision is cascaded down and understood in the organization to obtain unity of purpose
To introduce change an organization needs to assess their shared beliefs and assumptions to ensure that there are no barrier to learning, innovation and transfer of learning	**Mental models**: enhances the ability to critically evaluate ones own belief and acquire knowledge and information to facilitate learning and acceptance of new knowledge
Staff and students must be developed and embrace the new form of learning so that it can be applied to resolve real world problems. Continuous learning and development	**Personal mastery**: this assumes that for mastery to occur, a person must be motivated to learn, to produce results and seek to continuously improve one's competencies to enhance application of knowledge
New knowledge must be acquired and transferred into learning and application through communities of practice and reflection – to be integrated into world of work and profession	**Teamwork** refers to reflection and inquiry to acquire skills that is necessary to obtain information and knowledge so that it can be shared and contributes to the greater benefit of the team

3.6.3 Sustainable Development

One of the problems facing society is the damage on the environment caused by humans through their technology and growth. The way people view education, work, and productivity has to change to preserve the fragile systems that we operate within. Inventions and development has to be seen in the broader context of an environmental system that needs to be preserved and protected to continue to sustain quality of life. One of the reasons for this has been unbridled exploitation of the earth's resources. Pollution, deforestation, the thinning of the ozone layer and global warming are issues related to human development. It has to be realised that the environment and human habitation are part of a single system and any imbalances caused by humans can have long term consequences that can irreversibly harm the environment and very human existence. Universities need to educate students to be sensitive to the environment, society and consideration of other disciplines that may not be related at face value, but have long term impact and consequences. They need to understand the cause and effect relationship in designing systems and new technology in the various disciplines, taking into consideration the society, stakeholders and the environment they operate in.

In South Africa many socially responsible projects have emerged in conjunction with universities. The National Research Foundation for example, funds research in particular 'focus areas', such as poverty reduction, food security, and environmental sustainability. International funding agencies similarly support programmes, which are likely to contribute to community development. The Ford Foundation currently funds the Community Higher Education Service Partnerships (CHESP) Project, which aims at fostering community development through the establishment of partnerships between community organisations, higher education institutions and community based service providers. The South African Netherlands Programme for Alternatives in Development (SANPAD) funds research into economic development and the management of natural resources, as well as in areas of culture and identity, democracy, government and civil society.

Peet et al (2004) categorised the obstacles for the integration of sustainable development into curricula into three groups, viz organisational culture, academic culture, engineering culture.

- **Organisational Culture**

In the university organization with its sharp divide between departments and units, the various courses are "owned" by the separate units. Changes in curricula are directly translated into budget claims. Discussions on curriculum reform therefore end up in struggles on the division of assets, i.e. power between the basic units of a department. Integrating Sustainable Development into a course is tricky if the lecturer is insecure regarding his power position or his competence in the department: it might trigger discussions regarding the credit points of his course that are potentially a threat to his academic credibility, i.e. his position. At the departmental level, one is generally very reluctant to change curricula, mainly because of the risk of internal conflict and the costs of change.

- **Academic culture**

University lecturers are expected to be specialists in their disciplines. The scientist makes his own choices and only needs to take into account the remarks of (more senior) colleagues. Careers are built on this. This implies that disciplinary divides are perceived as essential as they determine who is allowed to be involved in discourses on specific subjects. Interdisciplinary work is perceived as important only for applied projects, not for scientific progress as it does not contribute to the conceptual core of the discipline. This creates a barrier for the introduction of sustainable development in the academy, since sustainable development is generally multidisciplinary.

- **Engineering**

Engineers tend to consider only those aspects of their design work as worthwhile that can be included in the “program of demands” for a design. Aspects that are not quantifiable are often removed from the “program of demands” of a design: “beauty”, “socially acceptable”, or “no depletion of non-renewable resources” are demands that cannot be measured directly. Sustainability of an engineering design deals with all features of the program of demands of a design. However, very often, attempts are made to make sustainability only one of the demands next to, for example, costs, durability or safety. For sustainability to make a significant impact on design or priority, it should be included at the beginning of a project, to guide the development and determine whether one needs to invent robots to play soccer or to remove mines. Engineering has to provide solutions to benefit society in a manner that will maintain the ecological balance.

The University of Technology Sydney (UTS) embarked on major policy changes to address the future of engineering curricula. This policy stipulated that UTS curricula, teaching, research and consulting, community service and institutional practices must emphasise and promote the “. . . achievement of sustainable futures embracing ecological, economic and social aspects of human existence” (UTS, 1999).

3.6.3.1 The Higher Education System in South Africa: Sustainable Resource for Development

One of the first initiatives undertaken by the post-apartheid government was to develop legislative and policy tools aimed at transforming the higher education system in line with the vision of government. Amongst some of the policy tools developed were:

- the White Paper 3 on Higher Education (1997) which outlines the program for the transformation of the system; the human resource development strategy document, developed in conjunction with the Ministry of Labour to meet the socio-economic needs of the country;
- the National Plan for Higher Education (NPHE) which addressed the policy goals which higher education needs to address and how it will address them;
- the development of new institutional landscape documents which culminated in the adoption of the merger plan aimed at transforming the higher education system but also put in place the new institutional types in line with the government's vision for transforming the system.

What emerged out of these documents was a new conceptualization of the role higher education is to play in the local, regional and national development of the country that cuts across racial, ethnic, urban and rural divides. The role of higher educational institutions is conceptualized and defined along regional and national development goals. It is no longer according to race and ethnicity as in the past. In particular, the White Paper 3 on higher education proposed the creation of a single co-ordinated system of higher education that is planned, governed and funded as a single system.

It also argued that the goal of a single coordinated system requires an assessment of an optimal number and type of institutions needed to ensure a higher educational system which is, on one hand, affordable and sustainable and, on the other, able to contribute effectively to social and economic development. To this end, the NPHE, which was released in March 2001, provides the implementation framework for achieving the White Paper's vision of a single national co-ordinated higher education system that is affordable, sustainable and which is responsive and contributes to the human resource and research needs of the country. (National Plan for Higher Education, 2001a, p. 14).

One intriguing contradiction of the legacy of apartheid planning and rationale is that flowing from the restructuring of higher education institutions and program rationalization, what was regarded as wastage and duplication under apartheid, has the possibility of becoming a resource for sustainable development in a new South Africa. In making recommendations for institutional reconfiguration, the National Working Group (NWG) identified the strengths and weaknesses of each institution and suggested what it deemed as an appropriate role each institution is to play in the new context. However, the focus and mission of higher education should be reconfigured to harness the unique benefits in addressing the human resources needs of South Africa. Thus, sustainability implies effective community participation to assure that the projects and activities undertaken respond to articulated priorities at the local level (Nkomo and Sehoole, 2007).

A critical factor is the transformation of the mindset: that is, to encourage the development of attitudes, values and ethics that will serve as the fundamental core undergirding sustainable development. In this sense, these institutions can help to promote the fulfilment of the Rio Declaration to "equitably meet developmental and environmental needs of present and future generations" Report of the United Nations Conference on Environment and Development, 1992, page 2 (United Nations General Assembly, 1992,).

3.7 SUMMARY

This chapter analysed the criticism of Higher Education such as its lack of relevance and the call for a more inclusive of role universities in providing skills for the real world. It delved into the history of universities and its changing roles as society evolved. It emphasises the new role of universities within a postmodern world. It assesses and defines knowledge in relation to the society. Producing knowledge without the ability to apply it in resolving real problems in industry and in a social setting is seen as an "ivory tower" approach. Universities should be seen as part of social system and be able to facilitate the application of knowledge through technology and innovation. Similarly, research should inquire and find solutions through innovations and technology and these institutions must be able to communicate its research.

The characteristics of a learning organisation correspond well to the aspirations and goals of a UoT. Both focus on the acquisition and learning of new knowledge and eventually systemising it through applications. However, the learning organisation has a set of theories that have been applied over time that UoTs can adopt and use. In attempting to understand all the variables influencing universities, especially the newer institutions classed as UoTs, it was necessary to align it to a learning model so that it could be studied and understood as part of a larger system. It formed the basis for understanding how UoTs can generate new knowledge and apply it in contributing to the growth and development of society. Having to operate in a changing external landscape, places an added responsibility on UoTs to continually assess its relevance in a dynamic context through learning strategies and to cope with the impact of many variables and forces.

CHAPTER 4

EMERGING CHARACTERISTICS OF A UoT

4.1 INTRODUCTION

Having provided the development trajectory of UoTs, this chapter investigates the role of UoTs. This analysis is conducted in the context of fast accelerating knowledge base economy and focus on the UoT's role in improving the human resources talent of the country. Further, this chapter studies the drivers of knowledge transfer and application, technology transfer, entrepreneurship, innovation and collaborative links and other features of UoTs, and its ability to contribute to growth and development of a knowledge society.

4.2 FEATURES OF UNIVERSITIES OF TECHNOLOGY

The previous chapter discussed the learning organisation as a model for the modern UoT. Continuous learning, personal mastery and systems thinking are features of a learning organisation that also characterised the formation of UoTs, as they seek to generate and apply knowledge through technology and innovation.

The 21st century requires a special type of university that is dynamic and responsive to its environment. The following features characterise a UoT to deliver on its core mandate of teaching and learning and research:

- Knowledge transfer and application
- Technology Transfer
- Entrepreneurship
- Partnerships with industry and international organisations
- Innovation

4.2.1 Influences and Impact of UoTs

In developing a learning university, institutions now increasingly recognise that they exist in an interdependent world; their networks of influence extend out to professional colleagues and others outside our institutions, and even outward to include the concept of global learning (Patterson, 1999). As a result some universities, particularly in Australia, New Zealand and the UK, are examples of educational institutions that both learn and foster learning.

Educators have the opportunity of choosing to become members of multiple communities of practice within their organization and larger profession. For institutions of higher education, to be learning organizations, they need to implement management's traditional competencies including leadership, team development, cultural proficiency, knowledge management, strategic thinking and planning, and ethical decision-making, among others. Additionally, they need to utilize two other competencies – learning how to learn, and community development – in order for there to be organizational change through transformational leadership at many levels (White and Weathersby, 2005).

4.2.2 Knowledge Transfer and Application

Knowledge is defined as the capacity (potential or actual) to take effective action in varied and uncertain situations (Bennet and Bennet, 2004). Knowledge can only reside in the mind and is therefore bound to individual context, values, mental models of the world, and visions of the future. Taking a knowledge perspective, innovation can be defined as the outcome of a set of activities that use knowledge to create new value to those benefitting from its use. What is inherent to innovation is not so much the novelty of a given product or process, albeit that is often the case, but the creation of new value to those using the innovation. This draws a clear distinction between innovation and invention or creativity, which by definition are novel or new but do not necessarily create new value.

The classical definition of knowledge is "justified true belief" (Audi, 1998). In a sense, knowledge is a meaning made by the mind (Bhatt 2001:68). It is a product of human reflection and experience (Roth, 2003: 33). Therefore, only a human can be knowledgeable (Blair, 2002; van Beveren, 2002).The concepts of data, information and knowledge are generally confused. A commonly held view, stated roughly, is that data are raw numbers and facts, information is processed and organized data, and knowledge is meaningful and authenticated information (Davenport and Prusak, 1998; Alavi and Leidner, 2001).

Drucker (1985) developed a definition which refers to the co-ordination and exploitation of organizations' knowledge resources, in order to create benefit and competitive advantage. According to Call (2005: 20), a more concise definition to help in understanding knowledge is the fact or condition of knowing something with familiarity gained through experience or association. While this definition is good for knowledge, knowledge management gives access to the information you need to do one's job, better than in the past. Knowledge management does not provide you with the answer to your problem rather it facilitates the learning of the answer. People search for knowledge because they expect it to help them excel in their work. Knowledge is the most sought after remedy to uncertainty (Davenport and Prusak, 2000).

Knowledge is an organizational resource that can be created and applied. This gives an organisation tremendous strategic advantage. The more an organisation knows, the more it can learn and sustain competitive advantage (Kalkan, 2008: 390).

According to Argyris (2003) learning occurs when understanding, insight and explanations are connected with action, which indicates that reflection over imposed actions is a prerequisite for conscious learning. In this type of learning, the individual changes his/her thinking and/or action in relation to the task to be performed (Döös, 2007). Experiential learning can therefore be said to take place when an individual experiences new ways of doing things while undertaking certain actions (Argyris, 2003; Olsson, Bjöörn, Jonson, 2008).

4.2.2.1 Knowledge as Driver to Economic Development

Notably, in the Knowledge Based Economy era, technology, innovation and productivity effectiveness were greatly affected by the level of labour and education. In detail, this investment process of education and training implied the improvement of human capital. Similarly, Schultz (1960) indicated that natural resources and physical capital did not completely explain the productivity unless the human resources aspects were considered also. Moreover, Harbison (1973) suggested that the human resource component is the core foundation of national wealth, and highlighted that the education investment was important to economic productivity.

In many countries without many natural resources, knowledge has become a key commodity for commercialisation. For example Japan is noted for its innovation and technology which it markets successfully throughout the world. Some countries have developed knowledge-based-economies and developmental plans to improve national competitiveness. There higher education system forms part of the whole knowledge based system.

Chen (2008: 502) found that the KBE competition emphasizes the innovation, circulation, and application of knowledge and information. Not only the knowledge proliferation and innovation integration, but also the transformation from knowledge into economic competitiveness depends on the vehicle of excellent human resources, the tool of effective information technology, the incentive of powerful economic environment, and notably an open innovation system.

The technological progress appears with new knowledge formation. Knowledge through the vehicle of human capital can be served as an important production tool. Thus, the national income of the advanced country improves as the excellent human resources increases. In contrast, the developing country with abundant manpower and capital still did not reach a sustainable economic development. This view reflects the characteristic of fast technology change in the KBE era at the latter stage of the twentieth century (Chen, 2008).

The “Global Competitiveness Report” of the World Economic Forum or the “World Competitiveness Yearbook” considered that the focus of economy development had shifted from emphasizing on resource-based economy to centering on knowledge-based economy, that is, the discrimination of cross-country competitiveness depends on the difference of the KBE development (Chen, 2008: 504).

Moreover, Harbison (1973) suggested that the human resource is the core foundation of national wealth, and highlighted that the education investment was important to economic productivity. More recently, some information showed, in KBE competitiveness, the disparity of wealth and the digital gap enlarged by the disparity of information; as a result, the decreasing social cohesion and the distortion of social opportunity were unfavourable to the sustainable economic development. To date, some research (OECD, 1999) proposed the measured performance indicators as a driver of economic development in a country, are as follows:

- the average quality of labour such as the secondary enrolment and college enrolment, etc.;
- the supply of professional manpower such as the professional technical and knowledge worker rate percent of total labour force;
- The extent of well-educated people emigrating abroad etc (Chen, 2008).

The characteristics of post-industrial information society are as follows: the development model of economy has shifted from production economy to service economy; the intellectual technology is greatly improved by the application of computers and other smart machines. Similarly, OECD's (1999) research suggested that effective information technology helps improve the transmission and proliferation of the accumulated explicit knowledge contributing to the KBE development, decrease the transmission cost, and improve the transmission effectiveness (Chen, 2008: 504). In South Africa there has been a growth in call centres. These centres provide a variety of services and solutions to customers. Tourism, IT and the financial services are notable industries that provide valuable services.

4.2.2.2 Knowledge transfer – Work Place Learning

Smith et al (2007) recognises that society has become very sophisticated and hence the approach towards knowledge transfer has to be reassessed. Knowledge transfer is not simply building a data base in the hope that it will be useful and used. Society is learning to distinguish between types of knowledge to link it more tightly with the characteristics of the knowledge to be transferred and the value to the organisation. Researchers attempted to classify knowledge into tacit and explicit knowledge. Explicit knowledge refers to more traditional knowledge in that it can be captured and transmitted, whereas tacit knowledge is more costly and difficult to access. It cannot be separated from the people who possess it. However, organisations don’t care about these classifications (Alavi and Liedner, 2001); they are interested in how knowledge transfer can improve their performance. This depends on how knowledge management is aligned to business strategy. One of the reasons for this difficulty in defining knowledge transfer is society’s persistence in viewing knowledge transfer as mechanistic activity. There is a bias towards scientific and analytic thinking which makes it difficult to deal with the most significant characteristics of all forms of knowledge, that is its people attributes. People are an important component of knowledge. It is embedded in a social and cultural context. To grasp this concept more thoroughly Smith et al (2007) identifies four categories of knowledge exchange takes place, i.e. best practice, expertise, experience and innovation. The bottom line is that knowledge transfer take place within a social context which will define that category and strategy of knowledge transfer. Whether knowledge transfer will be implemented via best practice, expertise, experience or innovation strategy will be required.

For knowledge to be shared, organisations require a culture that can act as a vehicle for change. A knowledge oriented culture challenges people to share knowledge by building confidence and trust. Developing such a culture should be a key function for management to advance knowledge and innovation (Perumal, 1999).

For universities to advance the learning organisation concept they need to become partners with students in creating learning communities in classrooms. We can experiment with changing our own mindset and seeing students as teachers, teaching themselves, each other, and ourselves. For example students develop leadership skills in our classrooms, even if they are not studying leadership, by having students lead part of a discussion, design a group exercise, or facilitate a role play for a case (White and Weathersby, 2005).

Human resources departments in industry play a crucial role in ensuring that the appropriately skilled employees are recruited, retained and developed, to strategically position the organisation in its ability to create, share and utilise knowledge (Soliman and Spooner, 2000). Work-related learning, to an increasing extent does, not only take place at the workplace alone, but also, for example, at courses, in networks and exchange schemes, in contacts with customers, users and suppliers, under trade unions, in industrial organisations and in more private work-related contexts. However, it is clear that the workplace learning is still of central importance, and the construction process therefore takes its point of departure in the model for learning at the workplace, developed by Jørgensen and Warring (2001) (Illeris, 2004). This model basically operates with the concepts of learning environment and learning processes. Learning in the workplace takes place in the encounter between the learning environments of the workplace and the employees' learning processes. By the concept of learning environment, Jørgensen and Warring understand the opportunities for learning contained in the material and social surroundings. By the concept of learning processes, continuous learning builds on the complex experiences of the previous life course and which is given direction by the forward-looking life plan and future perspectives. The learning process is decisive for the readiness for learning with which the individual and groups meet and exploit the opportunities for learning in the learning environments. Learning takes place in a dynamic relation between the employees' learning processes, the communities at the workplace and the enterprise as a technical-organisational system (Illeris, 2004).

Human resources management has the tools to invoke a range of organisational development interventions to encourage a culture enabling the flow and sharing of employee’s knowledge, through co-ordination of the workings of teams. The sharing of knowledge operates efficiently within a flat structure. This avoids the hierarchical structure that alienates people and has an over reliance on rules instead of recognition of the skills of employees to do the job to free up the creative energy.

On-going research at the UK's Chartered Institute of Personnel and Development (CIPD) has indicated that a shift is taking place from training, which a top-down intervention initiated by the organisation, to learning, is an ongoing process that lies in the domain of the individual. Only learners can learn, and the way in which they learn is changing. Partly because of the nature of today's organisations and partly because of individual preferences, informal learning has become more increasingly important (Sloman, 2005).

Knowledge-intensive firms are characterised by a shift to learning from training and much more emphasis on individual responsibility for learning. In these organisations, a focus on the learner is happening in practice. Formal instructor-led training, delivered internally, is not seen as important. Taught training courses were therefore of little value – it was only the sharing of experience in different communities within the organisation and with the client that laid a solid foundation for knowledge creation (Swart et al., 2003). Therefore, the context as defined by the social setting and described as sharing of experience is an important knowledge determinant of learning and knowledge creation.

Tikkanen’s (2002) studies in technological intensive work environments distinguished learning as a process and job competence was seen as the result of learning. Further, learning and competence building at work was approached as holistically formed by the learner, learning activities and situations as means for building competence, and job competence as an object of learning at work. Thus, the study of learning at work took working as such as a starting point and context. Further, consideration of working as such cannot be limited to an organisation but must also address the total action environment of the organisation, including its relationships with borderline and external actors. The latter refers, for example, to the business community, the branch and the regulative environment (rules, laws, etc.). The results of this study showed that current job competence was largely addressed to work experience, but also strongly to various personal characteristics, but less to formal training. His research, further showed the best ways to maintain and develop competence were self-initiated and directed learning, collegial communication and reflection (sharing knowledge with colleagues), and being personally open and courageous towards showing one's limits and interest in new knowledge, while no-one preferred learning through formal training. This indicates that work integrated experience as an aspect of learning and evidence that can accelerate job competence in the highly technological and knowledge environment in which organisations find themselves in.

4.2.2.3 Experiential Learning

Learning is a somewhat less clear concept but most definitions concur that learning involves some behavioural change and experience (Merriam and Caffarella, 1999: 249). Taking again a knowledge perspective, learning can be seen as the creation and acquisition of potential and actual capacity for people to take effective action, or in other words, the creation of knowledge (Bennet, 2006a).

For UoTs to fulfil their mandate in making the desired impact in the development of skilled manpower, it needs to continue to focus on the unique delivery methods. They need to ensure that they integrate education so that students are able to apply knowledge in the world of work. Experiential learning is one of a number of unique characteristics of a UoT.

Experiential learning is the process whereby knowledge is created through the transformation of experience (Kolb, 1984). The underlying assumption is that for learning to take place, experiences have to occur. Based on Kolb's (1984) idea, Politis (2005) confirms that experiential learning is an example of a process in which knowledge develops through experiencing, reflecting, thinking and acting. Groenewald (2003) defines Work Integrating Learning (WIL) as a structured educational strategy that progressively integrates academic study with learning through productive work experiences in a field related to a student's academic or career goals, not as an add-on but an integral part of the educational process. Work integrated learning (WIL) is the component of learning that focuses on the application of theory in an authentic work based context. It addresses specific competencies identified for the acquisition of a qualification which relates to the development of skills that will make the student employable and will assist in developing his/her skills.

Universities of Technology in South Africa need to drive knowledge applications, innovation and entrepreneurship to solve real problems in society to systematically grow the wider economy. To achieve this UoTs need to reassess the learning process. Having formulated a set of underlying constructs for the formation of UoTs within a social context, the next question is how we can change the way learning takes place in the face of constantly increasing rate of knowledge in the world of work. Barnett (1998) use the term “learning society” to describe the way society should respond to the challenge of increased knowledge through constant replenishment of human capital so as to maintain and, if possible, to strengthen society's economic capital; and with learning individuals' continued improvement of their quality of life, to the point of societal learning. This ensures that the society is self-reflexive and self learning. The focus then becomes the development of human beings capable not just of responding to an unworkable world but of contributing to it (Christiansen and Baijnath, 2007: 226).

The constructs act as foundation from which attributes can be drawn from. Each attribute would then be converted into performance indicators. It is envisaged that the development of a set of indicators would define the mission of UoTs in the broader Higher Education landscape. It would develop a typology for UoTs which would inform the transformation and reconfiguration of HE. Further it would also create space to focus attention on the way UoTs are funded by DOE. For example patents, incubators, WIL are presently not funded in the DOE's funding formula for UoTs. This will be discussed later.

4.2.2.4 Knowledge through Technology

Constructing a knowledge-based society based on knowledge learning and information technology is the best strategy for solving this digital gap. There are two approaches to knowledge management. One focuses on use of technology to utilise knowledge while the other focuses on the capture and transformation of knowledge into an institutional asset (Mason and Pauleen, 2003; Guah and Currie, 2004). The first approach requires the use of IT, while the second involves people and processes. This second approach is often referred to as a social process.

Explicit and systematic management of knowledge has emerged as a result of several developments. Rapid development of advanced information technologies, progress in management science and strategic planning, enhanced understanding of human cognitive functions, globalization of business and international competition, and sophisticated market actors led to our present perspectives on knowledge management (Davenport and Prusak, 1998; Civi, 2000).

Overall, the increasing connections between personal computer, web sites, and internet hosts worldwide shape the effective global information network. According to Metcalfe's law, the effectiveness of internet was positively related to the square of internet connection, showing that the importance of excellent information communication infrastructure. In any case, the empirical study on information technology has increased noticeably in recent years, but the measured indicators for evaluating information technology endowment should be further developed. To date, some performance indicators for IT usage are as follows: first, the information hardware such as the telephones, computers, and internet hosts per thousand people, etc. (Piazolo, 2001); second, the information communication applications such as the supply of professional manpower, mobile phones per thousand people, e-commerce development, and internet population, etc. (OECD, 1999).

Most academic institutions realize that they will improve performance if their staff work together. However, building collaboration amongst people is not an easy task. IT practitioners apply many different approaches to develop the type of interface that builds the desire for teamwork and a collaborative working as described by Senge (1990). Techniques such as meetings, forums, e-learning and discussions are used extensively through the processes of social interaction and collaboration. Tools such as e-mail, video conferencing, use of interactive white boards, blogs and wikis, discussion forums, chat services and intranets are used to encourage active collaboration among people in academic institutions. The changes in the traditional teaching techniques due to the introduction of IT as envisaged by many writers may be a harsh indication of the transformation education may undergo. Perhaps, the familiar, traditional, intimate classroom may be revolutionized into a distant communication, which takes place online that could ultimately be ineffective. (Jones-Delcorde, 1999) however, argues that for the near future, IT is not threatening to replace the instructor. Nevertheless, despite this, Jones-Delcorde (1999) also believes that while IT stimulates creativity, it also stifles it by eliminating creative motivations.

Colleges and universities must recognize that, increasingly, the influence and demands of their respective IT ventures extend beyond physical locations that include remote or distance learners, part-time students, collaborations with industry and consortia of other institutions. The construction of a unified information technology infrastructure should be responsive to the needs of all its users in academia. IT development and implementation must demonstrate definable benefits to academia. There has been indeed a paradigm shift in academia due to advances in information technology (IT). The new breed of professionals need to be efficient to tackle problems from cross-functional, cultural and ethical perspectives and equipped with skills to benchmark for global leadership positions. There has been a crying need to usher in a quality movement and to benchmark the same with world standards. Generally, it is observed that IT is used as an umbrella term to represent communication and computing tools, while educational technology is used to denote the application of IT tools in teaching and learning. Accordingly, educational technology could further be differentiated into instructional technology (tools based in the delivery of educational material), and learning technology, which is student centric. Collectively considered, IT has the ability to provide access to worldwide resources; facilitate the accumulation and presentation of data; and enable communication, interaction, and collaboration among students and instructors to improve the practice of teaching and the experience of learning (Ranjan, 2008).

IT is used extensively for development in academia. Any IT-based tool should enable students to simulate, visualize, model, and experiment with complex, real-world scientific problems, thus promoting exploratory and inquiry-based modes of learning. IT within its broader designation enables collaboration and interactive learning. The rapid pace of change in IT is increasingly influencing the creation, publication, dissemination of educational materials and sharing of information. IT facilitates connections across disciplinary, institutional, geographical, and cultural boundaries (Ranjan, 2008; Applegate et al., 1994)

4.2.2.5 Knowledge Management (KM)

One of the characteristics of a Learning Organisation as popularised by Peter Senge is the ability of an organisation to adopt a knowledge management approach in coping with pressures of change. The world has made tremendous strides in managing the growth of knowledge. The June 2000 issue of CIO Magazine estimates that worldwide spending for KM services-including consulting, implementation, operations, support and training will grow from $776 million in 1998 to $10 billion by 2004" (CIO Magazine, 2000).

Promoting the effective sharing and transfer of these intellectual assets is the centrepiece of knowledge management. An Information Week survey indicated that 94 percent of companies considered knowledge management to be strategically important to their business (Kleindl, 2003) yet it is reported that at least half of all KM initiatives fail; some peg the failure rate as high as 70 percent (Rossett, 2002). This is due to the poor management of knowledge; due to the lack of understanding of what knowledge is and how to go about managing its use.

The starting point is to define knowledge, Bill Gates points out knowledge management has become infused with almost any meaning somebody wants to associate with it. If reporters talk to a database company, they find that knowledge management is the newest thing in databases. If reporters talk to a groupware company, they find that knowledge management means the next generation of groupware (Gates, 1999). IBM and Lotus used the definition of knowledge management as a discipline that systematically leverages content and expertise to provide innovation, responsiveness, competency, and efficiency (Pohs, 2001). While Microsoft prefers to state that knowledge management is nothing more than managing information flow; getting the right information to the people who need it so they can act on it quickly (Gates, 1999).

i. Tools of Knowledge management

Usually people begin a KM project by focusing on the technology needs, whether they want a database or a portal. But the key is people and process (Kaplan, 2002). "Technology is only a small part of what's overwhelmingly, a cultural endeavour" (Berkman, 2001, p.2). Companies that are successfully doing knowledge management understand that "knowledge management is not intended to ever stand out there on its own. Knowledge management helps us do what we do better. It is there to connect information and people, and people and people (Chatzkel, 2002):Knowledge cannot, by definition, be converted into an object and "given" from one person to another … Information technology, while critical for enabling the spread of information, cannot capture and store knowledge. Only people can do that (Senge et al., 1999).

Often knowledge management is seen to be focussing on technological needs, whether they want a portal or database. While knowledge management can succeed and thrive without technology, it is technology that expands its horizons beyond the small office into large worldwide corporations. But knowledge management is not meant to be a stand alone but connects people and information, and people and people" (Chatzkel, 2002). Call (2005), highlights many attempts to use technology as a tool to manage knowledge but which were unsuccessful, due to the assumption that people must change to suit the technology. His view was that technology must change to suit the way business operates. This means that the way people learn knowledge, is critical in the knowledge management process. Prior learning explains why two individuals who have undertaken the same task can accomplish it in radically different ways. Therefore, it is important in getting users to learn, or take note on how the users that were willing actually went about learning.

By applying knowledge management processes to the problems facing their organization, leaders can see and learn more about them than ever before. Knowledge management can provide new insights into a problem as well; allowing it to be solved in a way never before thought of (Call, 2005).

Kiri Nesbitt defines six steps for creating a knowledge management system. These six steps are (Nesbitt, 2002)

- Define the business goals the KM system will address.
- Perform a knowledge audit to identify any duplication, gaps, and overlaps in an organization's knowledge base.
- Create a visual map which describes units of knowledge and the relationships between them.
- Develop a KM strategy based on the content management, integration, search mechanisms, information delivery, and collaboration.
- Purchase or build appropriate tools for capturing, analyzing, categorizing and distributing knowledge.
- Periodically re-asses the value of the KM system and make necessary adjustments.

Instilling a culture of trust and recognition of the value of an individual's knowledge is important in building an environment to advance knowledge management. Employees must know that well intentioned failure and experimentation are acceptable if it leads to future successes and the ability of the organisation to learn (Call, 2005).

4.2.3 Technology Transfer

The concept "technology", according to Lategan (1999:3) is derived from the Greek word, which means "skill" or "proficiency" and is also related to the words meaning "understanding and skill", and which denotes "working, creating, and skill". Technology is how knowledge is used to do something (techne = making and logos = knowledge) (Lategan, 2005). Technology, therefore, refers to the skill of creating or fabricating things. Institutions of learning that operate on the terrain of technology will pride themselves in providing an education aimed at empowering students with the required technological skills to maximize opportunities in the work situation, to assist in wealth creation for the country and thereby in prosperity for all. In its broader sense the concept may be defined as ".... the systematic utilisation of available knowledge and skills residing in people for the development and implementation of useful products, processes and the rendering of services, contributing towards economic prosperity and an improved quality of life" (Strategic Information and Planning 2001: 3).

Christiansen and Baijnath (2007: p 224) proposed that "technologies change the social practices in which they are used which implies that our social realities are reconstructed through the use of technologies. Thus, technologies are inserted between human beings as well, and have to be recognised as socio-physical systems organised with the purpose of producing certain effect". At the same time technologies are invented, reinvented and altered through their use in practice. The widening use of technology has evolved from the mere use of applying science in the construction of tools and instruments to use in our relationships with our environment and society.

4.2.3.1 Application of Technology to Facilitate Learning and Knowledge Acquisition

With increasing numbers of students, the decreasing cost of technology and the widespread invasion of the internet into society, the teaching practices in Higher Education are changing. Many university administrators now view technology as a cost-effective and innovative solution to many of higher education's problems. Higher education has, as a result, been given greater access to innovative technologies. These technologies include both 'product technologies' such as computer hardware, software and internet connectivity and 'idea technologies' that represent pedagogical alternatives, new theoretical assumptions and learning environments (Hooper and Rieber, 1998). It has long been assumed that technology refers to hardware or products; however it is now accepted that technology is also an idea. This concept of technology represent ways of conceptualizing the teaching-learning-technology partnership. They focus less on 'what is' and more on 'what can be' given emerging views on learning. With idea technologies, the potential of emerging technologies is considered in concert with unique learning opportunities and processes that can result (Surrey, 2000).

A prevalent interpretation of technology is to see knowledge as a tool or instrument which humans insert between themselves and nature to bring about changes in social practices in which they are used. This implies that our social realities are reconstructed through the use of technologies (Skovsmose, 1994). The widening of the notion of technology to include social technology indicates that working scientifically with technology is more than applying science in the construction of tools and instruments to use in our surroundings (Cristiansen and Baijnath, 2007). This brings into question the way UoTs skill their students and staff, in the light of this explosion of knowledge. Edlik and Fowler (2004) points out that staff and students are to demonstrate, not only mastery of relevant modern technology, but also to contribute through the practice of technology, to the various steps of technological innovation from the start of an idea or concept to the diffusion of technology and eventually to successful commercialization of products and services. Learning is crucial in harnessing the knowledge of technology and applying them to enterprises or communities.

In the past it was fashionable to purchase expensive computer software as a means of introducing technology. While improving productivity in certain areas it left knowledge in the hands of a few. It became clear that to improve learning there needs to be a way of integrating Knowledge Management technologies with soft Knowledge Management approaches (Sanchez, 2004). This encourages individuals to think beyond their current boundaries, facilitating organizational activity, promoting continuous knowledge creation and continuous improvement, and supporting growth through innovation (Moffett et al., 2004; Magnusson, 2004). The failure of expensive investments in new technologies related to Knowledge Management (Malhotra, 1998; Sveiby, 1997) has led managers to still question the degree of technological involvement required for a successful Knowledge Management System (Moffett et al., 2004). Dougherty (1999) proposes that knowledge transfer is about connection not collection and that connection ultimately depends on a choice made by individuals. Although connection is a key factor (Dougherty, 1999; Magnusson, 2004), the assumption that it solely depends on individuals is less certain. Universities are in a position to drive this process to ensure an effective connection not only for knowledge transfer but also in order to trigger knowledge utilization and application, creation and sharing.

Distance learning is viewed as a part of educational ecosystems, which include homework, classrooms, lecture halls, and libraries. It is not treated here as an independent system, since our main point is the integration of various forms of learning activities within pedagogical scenarios. This is a far cry from the early attempts at using Technology Enhanced Learning systems housed in separate laboratories without integration with pedagogy. Learning technologies have lost their high status in recent years. They appear more rarely among the priorities within university strategic plans, probably because the expected gains in efficiency or reduction of costs failed to emerge in any important way. (Dillenbourg, 2008). As Salomon (1998) pointed out, technologies engender no intrinsic effects; rather, they have specific affordances. Designers, teachers, and students are those who turn affordances into learning outcomes. For instance, when promoting online video lectures, which is more innovative from the logistic viewpoint than from the pedagogical viewpoint. Technology Enhanced Learning (TEL) has the potential for innovation but is not intrinsically innovative. To use the metaphor of augmented reality, computers would then be viewed as tools for augmenting social interactions in learning contexts (Dillenbourg, 2005).

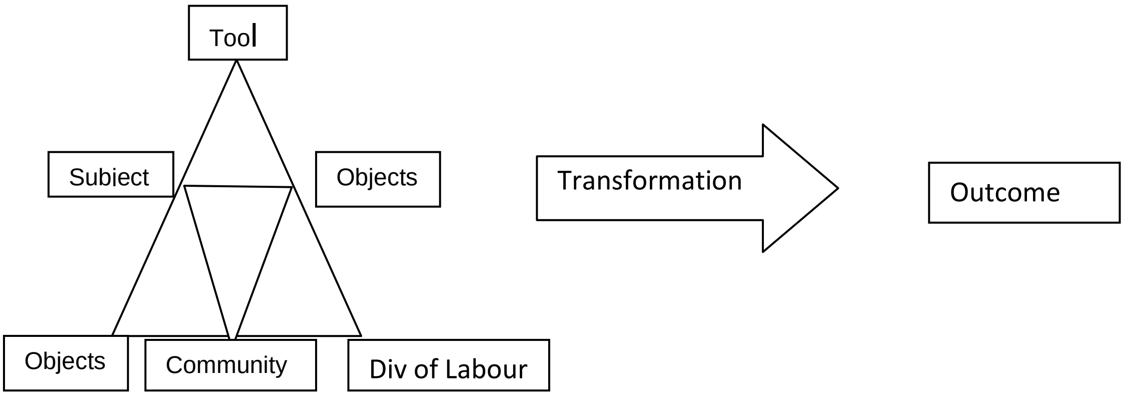
4.2.3.2 Technology as Part of a System to Facilitate Transfer

Technology transfer is a term used to describe a formal transferring of new discoveries, innovations and technology, resulting from research and development activities at higher education institutions, to the commercial and industrial sectors. Implicit in the term, technology transfer is the understanding that a tangible 'intellectual asset' has been identified for transfer. A second, yet no less important, requirement is the implicit understanding that a suitable partner has been identified as the recipient of this intellectual asset. Innovation and technology transfer requires that an institution identifies its intellectual assets, packages these assets into attractive and marketable products or services, and builds the required relationships and infrastructure to promote and exploit these opportunities (Van Eldik and Fowler).

Also, higher education institutions are expected to transfer technology to improve the quality of life in society. However, this use of technology and its application needs to be used with sensitivity and appropriately, taking into consideration of its environment and stakeholders. Activity theory is a model that integrates various components of the use of technology. Activity Theory (AT) builds on the work of Vygotsky (1978, 1986), and conceptualises learning as involving a subject (the learner), an object (the task or activity) and mediating artefacts (for example, a computer, laws). AT is now increasingly being used to study a variety of contexts which involve technology. AT emphasises naturalistic study, culture and history. Nardi (1996), who was instrumental in the introduction of AT into Human–Computer Interaction (HCI) contrasts AT with traditional research as a means of coping with problems like context, situation and practice. Kuutti (1996) describes AT as 'a philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time.' (p. 25)

In AT, the basic unit of analysis is enlarged from human action to include a minimal meaningful context which is called an activity. This is under continuous change and development and contains artefacts (machines, laws, signs) which have mediating roles. Activities are distinguished from one another by their objects. An activity is motivated by the need to transform the object into an outcome (an outcome can be a material thing or totally intangible, such as an idea). The object and the motive can change during an activity. The relationship between the subject and the object of activity is mediated by a tool. This tool has the history of developing relationships and can be either a material object or a tool for thinking. However, it was observed that this tool did not take into account the relationship between the individual his or her community and also the environment. Engestrom (1987) introduced a third component which indicated the relationship between subject-community and community-object as represented below. There are three mutual relationships between the subject, the object and the community. The relationship between subject and object is mediated by tools, while the relationship between subject and community is mediated by rules. The relationship between object and community is mediated by the division of labour. The tool is anything used in the transformation process while the rules are explicit and implicit norms, conventions and social relations within a community. The division of labour is the explicit and implicit organisation of a community as related to the transformation process of the object into the outcome. Activities are not isolated units, but nodes in crossing hierarchies and networks which are influenced by other activities. Activity Theory incorporates many relevant features of interactions such as actors, mediation, historicity, constructivity. As it is dynamic and developmental, it is able to cope with changes and developments (Kuutti, 1996: 25).

Figure 4.1: Using Technology in a Social Setting



Issroff, K. and Scanlon, E. 2002. **Using technology in Higher Education: an Activity Theory perspective.** Journal of Computer Assisted Learning, 18, 78.

While networked technology has a materiality and is a social agent in its own right, the potentialities of the network form are not defined from the outset by a set trajectory but are socially embedded and highly variable. Therefore, in the study each university employed various strategies in embracing technology to impact in knowledge transfer and its influence on its environment and stakeholders (Lewis, Marginson, Snyder, 2005).

Botha, et al (2000) proposed a set of identifiable actions that need to be taken to advance technology transfer and innovation process in the rapidly changing world, they are, amongst others:

- Continuous scanning of changing external and internal milieus in which the institution is embedded in order to assess their impact upon it and its staff and students, and to take timeous steps to adapt to or protect it against any developing forces of mismatch
- Changing the palette of academic offerings in order to respond quickly, to changing environments and societal problems
- Changing the teaching model to accommodate the many new possibilities and opportunities opened by modern education, information, communication, electronic storage and computing technologies
- Adapting the administrative and financial model in time to incorporate changes occurring in the business and academic milieu to retain a competitive edge

- Changing both faculty and subject growth patterns inside the institution to adjust to internal and external forces, such as international trends and national priorities
- Planning the development of its own and students' technological infrastructure, buildings and campus(es) to give expression to the ideals voiced

4.2.3.3 Application of Technology

Technology as such does not solve social problems. However, the availability and use of ICT is increasingly a pre-requisite for economic and social development. The question for countries on the scarce side of the 'digital divide' is how to strategically place and utilise ICT to enhance local social and economic aims. Our experience demonstrates the complexity of this challenge. Most importantly, we have found it critical to continually reflect on the question, who is driving whom? The level of education in general and of technical education in particular, is essential for the design and productive use of new technologies. It has proven important, over and over again in our experience, to ensure that content, application, and human ability drive technological decisions – not the other way round. Thus, a computer becomes less important than the ways in which a computer can support our objective to develop an application for a local priority, such as the development of the small and medium micro-enterprise sector. Technological centres, developed in the absence of creative or practical applications, or divorced from building the human capacity to utilise technology to improve the local quality of life, at best becomes a wasted investment and, at worst, can serve to undermine other development processes (Department of Education, 2000)

4.2.3.4 E learning

There are about 2400 learning institutions world wide that can be categorised as corporate universities. Since many of these organizations have a global, or at least multi-national, footprint, these institutions are likely to have a significant impact on the nature and direction of the education of the current and future workforce. Within this context of the growth of corporate universities, there is also increasing use of e-learning (Homan, Macpherson, 2005).

It is difficult to define E-learning, due to its dynamic and the speed of which its technology is changing. However, Beamish et al. (2002: 105) define e-learning as: … a wide set of applications and processes allied to training and learning that includes computer-based learning, online learning, virtual classrooms and digital collaboration. These services can be delivered by a variety of electronic media, including the intranet, internet, interactive TV and Satellite". Alternatively, a broad, all-encompassing definition may be used such as "any learning activity supported by information and communication technologies" (Sambrook, 2003). Sims (2008) explores the possibility that technology is part of the human evolutionary process and it is slowly and irrevocably becoming part of the individual and the broader human psyche. It defines the learning environment and the type of learners that now occupy this space. It is up to educators to respond to this to ensure that technology can be embraced to enhance learning through creative partnerships and innovation.

The benefits of e-learning focus on two areas namely return on investment (ROI) and the flexibility of learning. ROI is achieved through reduced training expenses, costs saved in travel, and the ability to serve large numbers. Hammond (2001) notes that 80 per cent of Fortune 500 companies are using, or intending to use, e-learning, and expect a significant ROI. Flexibility of learning refers to using e-learning outside the organisations with wide communication and distribution reach.

Despite their benefits Dringus (2000) warns us that e-learners may be unable to sustain their momentum unless they have the skills for self-directed learning and management, and are self-motivated. It is important that learners have the support, technology and incentive. This theme of socialization is also addressed by Newmann and Smith (1999), who use Lave and Wenger's (1991) concept, "communities of practice", to note the significance of a supportive and interactive context of learning, highlighting the danger of the learners' needs being ignored in the enthusiasm for technology. Indeed, Govindasamy (2001) argues that pedagogy is the most neglected aspect of attempts to implement e-learning to enhance socialisation of the learner.

Universities use e-learning to communicate to a broad constituency to effect culture change and to align with strategy, however one of the main challenges arising from Homan, Macpherson's (2005) research is that e-learning has to create a stimulating learner experience to enhance transfer of learning via technology. It needs more research into pedagogy and learner response to improve e-learning so that the effective learning transfer can take place.

There have been many firms and organizations that have explored IT advancements and implemented various tools. However, academic institutions have taken more interest recently in introducing several information sharing tools. From the academic learning point of view, IT by its very nature especially is suitable in sharing of information. Institutions use IT-based tools for admissions, registrations, and timetable processing and performance evaluations of their faculty, students, staff and administration. Many have turned to a new paradigm that merges academia with computer and telecommunication technologies. The possible problem with institutions is that information is held tacitly by individuals and it becomes very much difficult to share it institution-wide. In South Africa the use of SABINET is a library database that networks universities throughout South Africa, making it easier to access journals and articles on-line without having to physically enter the library. The Scopius publication systems is an online database that tracks articles and journal usage on-line. It also analyses trends and indicates resources for topics for future research. It provides profiles of authors and indicates to authors the number of times their publications were used by other authors.

Australia's history of high quality open and distance education (Barcan, 1981) has created a culture where academic and industrial entrepreneurs now offer a range of educational software that is well aligned with the demands of flexible education. In response to such demand many Australian universities have now reengineered themselves to offer flexible education (Evaline, 2004). These universities are chasing an industrial model of flexibility in which education is customised to meet demands of industry faster and more perfectly than their global competition, or they go out of business"

(Gee and Lankshear, 1995). Transnational education and training is also a substantial driver for this trend as it is now Australia's third largest services export at over ten billion Australian dollars per annum (DEET, 2004). Accordingly, all Australian universities have now provided transnational courses (Shuville and O'Grady, 2008).

Goodyear and Ellis (2008), cautions about the adoption of new education technologies without proper assessment with regard to its benefits on learning outcomes. He posits that each technological intervention should not be questioned about whether it is better than what exists, but rather than whether it can be integrated to what exits. For example, earlier attempts at using technology, centred on how technology can be used as a standalone. Many computer aided instruction packages were introduced but were found to be ineffective, since it was not sufficiently integrated into the learning system. Flowing from these experiences, a student centred approach was adopted, in that the intervention must fit into the complexity of the environment. Rather than blindly introducing a technology because it looks high technology and without being assessed on its value and the ability to enhance learning. They refer to the technological environment as the ecology, a space in which interventions must blend into the natural scheme of things. There is no evidence to prove the hypothesis that technology enhanced learning would act as a prime determinant of knowledge acquisition, however when viewing e-learning as a partner with pedagogy, the importance of harnessing education technology to achieve positive, engaging and interactive learning experience becomes critical (Sims, 2008). Oblinger and Hawkin's (2006), experience indicates that technology has impacted on how we approach learning and learning design, however using technology exclusively in teaching as in a virtual university has not produced significant results. E- Learning has tremendous value when it is used in collaboration with the teacher and learner, for example students studying global warming can vary the amount of green house gasses and observe results through different scenarios. Students can share ideas on the internet and engage in team work (Woo, Herrington, Agostinho and Reeves, 2007).

4.2.4 Innovation

In the nineteenth century, Schumpeter (1934) emphasized that knowledge innovation is the key to economic development. The opportunity for wealth creation which has become available is not a recent phenomenon. Early examples of value creation through structural innovation became evident in the early 1900s as vertically-integrated, industrial corporations began to feature strong supply-chain hierarchies. This led to businesses making process and structural innovations which resulted in new ways of production, for example, through collaborative networks leading to outsourcing and the formation of virtual corporations (Tapscott*, et al.*, 2000:14-15). Economic development and new value creation through the process of technological change and innovation first observed by Schumpeter, who identified several sources of innovation, or value creation, including the introduction of new goods or new production methods, the creation of new markets, the discovery of new supply sources and the reorganisation of industries. Schumpeter's notion of creative destruction (Becker and Knudsen, 2002:394) was developed after noting that certain economic rents, or income streams, become available to entrepreneurs following disruptive technological change. These diminished once the innovation became an established practice. Schumpeter (1934) highlighted the contribution of individual entrepreneurs and placed an emphasis on the innovations and services rendered by the new combination of resources. Firms may differ in terms of the resources and capabilities they control until some exogenous change, or Schumpeterian shock, occurs. Value creation in virtual markets comes from exploiting relational capabilities between a firm's resources and its capabilities, for example, between online and offline capabilities.

Within the framework of a University of Technology should be a process of transforming an idea into a new or improved product, process or approach. It relates to the actual needs of societies and involves application in scientific, technological, organizational or commercial fields. The gist is "to do something different rather than do better what is already been done." An innovative culture hence describes a mindset that is creative in identifying and transforming good ideas in a pro-active manner. The importance of innovation as the underlying engine for modern economic development is emphasised in the National System of Innovation (White Paper on Science and technology, 1996), and it is necessary that institutions of technology should play an active role in promoting this.

Romer (1990) proposed the new-growth theory, namely, the endogenous growth theory, focusing on the knowledge and technological progress, emphasizing that knowledge and technological progress should not be served as an exogenous variable. The technological progress appears with new knowledge formation, the knowledge by the vehicle of humane capital can be served as an important production tools that likes other capitals. Thus, the national income of the advanced country improves as the excellent human resources skills improve. In contrast, the developing country with abundant manpower and capital still did not reach a sustainable economic development. This view reflects the characteristic of fast technology change in the Knowledge Based Economy (KBE) era at the latter stage of the twentieth century. Information technology and human resources improves and enhances innovation in a country. His work suggests that every country should recognise the important role of information technology in building a knowledge based economy to be used for creative problem solving, in terms of its uniqueness through patents, copyright, intellectual property etc (Chen, 2008). Innovation has been a dominant factor in maintaining worldwide competitiveness. It fuels organizational growth, drives future success, and is the engine that allows businesses to sustain their viability in a global economy (Gaynor, 2002). Porter and Stern (2001) argued that companies must be able to create and commercialize a stream of new products and processes that extend the technology frontier, while at the same time keeping a step or two ahead of their rivals. The Ministry of Economic Affairs of Taiwan (2004) reports that in 2003, Taiwan ranked fourth globally in the number of US patent grants received, up from 11th place a decade earlier and was surpassed only by the USA, Japan and Germany. Exploring innovation practices of SMEs in Taiwan may have academic as well as practical value (Lin and Chen, 2007).

4.2.4.1 Drivers of Innovation

Recent studies in this field reported positive associations between organizational characteristics stimulating learning and innovation, and performance of the firm. Ekvall and Ryhammer (1999) found that perceptions of employees (climate) and resources exerted the strongest influence on learning and innovative outcomes for university teachers, and West and Wallace (1991) showed that team climate for learning and innovation significantly predicted team learning and the innovativeness of health care teams.

Conceptual knowledge impacts on the level of organisational innovation. Further the depth and diversity of knowledge affects the likelihood of innovation occurring. It is therefore necessary for depth and diversity of knowledge to be present to stimulate innovation and creative thought. The notion of impact is crucial when discussing idea generation and learning capability, because impact means a new idea has affected customers, financial performance, and/or employee performance.

Tierney et al. (1999) showed that the quality of leader-member exchange was a significant predictor of employee development and innovation, and Axtell et al. (2000) found that employees with more supportive managers were more likely to have their ideas implemented. Recently, Baer and Frese (2003) found that climates for initiative and psychological safety were positively related with process innovations and firm performance. Symbiotic leadership, culture, multifunctional workforces, all show positive correlation with learning and innovation (Van der Sluis, 2004). In South Africa universities hoping to inculcate an innovative spirit need to develop systems to support creative talent. This might mean providing rewards and recognition incentives. Also allowing creativity comes with risks like projects failing to come up to expectations or projects exceeding budget, but whatever the circumstances innovators need to be supported by their universities and to realise that failure is an opportunity for learning and not a time for sanction. This requires a paradigm shift, because most universities have structures and bureaucracies that act as gatekeepers for their disciplines and systems and organisational cultures take long to accommodate change or even tolerate a measure of lateral thinking.

To date research has revealed human resources indicators to drive KBE. They are measured as secondary enrolment and college enrolment, etc.; second, the supply of professional manpower such as the professional technical and knowledge worker rate percent of total labour force, and the extent of well-educated people emigrating abroad etc (OECD, 1999).

Overall, most scholars agreed that the capability of knowledge of a country depend on the researcher and expenditure in R and D and the proliferation network of knowledge. In any case, the empirical study on innovation system has increased noticeably in recent years, but the measured indicators for evaluating innovation system endowment should be further developed (Drucker, 1986, Amidon, 1997)). To date some works (OECD, 1999) proposed the measured pillars as follows: first, the R and D input such as the expenditure and research in RandD, etc.; second, the innovation capability such as the granted patent applications, and science and technical journal articles per thousand people, etc.; third, the knowledge proliferation such as the research cooperation between business and university etc.

4.2.4.2 Shift to a Knowledge Based Economy

Anderson (2001) suggested that the characteristics of post-industrial information society are as follows: the development model of economy has shifted from production economy to service economy; the intellectual technology is greatly improved by the application of computers and other smart machines. Similarly, OECD's (1999) research suggested that the effective information technology helps improve the transmission and proliferation of the accumulated explicit knowledge contributing to the KBE development, decrease the transmission cost, and improve the transmission effectiveness. In the process innovation is being enhanced and harnessed for the benefit of the economy. This innovative spirit will have to be merged into the universities curriculum and research.

4.2.4.3 Collaborations Drive Innovation

In a learning process, individuals intuitively make associations between different contexts, insights and information that lead to creative ideas, which can then be used to stimulate innovation (Quinn, 1993). These associations can be created through both individual learning and organisational learning. As a social and cognitive activity, organisational learning can greatly enhance the probability of the emergence of creative ideas as the number of possible association increases through knowledge sharing and group interaction. In a group setting, the exposure to different thinking styles and people promotes what is called creative abrasion, which, if properly managed, can greatly enhance the innovation potential of an organisation (Leonard and Swap, 1996). In this context, a greater diversity of knowledge will induce a greater variety of associations, often from different contexts, creating a bed-rock for higher levels of creativity (“out of the box thinking”). One can therefore define knowledge diversity as the spread of different knowledge areas existing in an organisation. Greater knowledge diversity can be stimulated within the organisation's workforce, but can also be achieved through external people and knowledge (De Sousa, 2006).

Innovation is also developed through effective partnerships. These collaborative initiatives need to be formed and organisations need to adopt appropriate technologies to accelerate the sharing and communication of knowledge. Today's academic world is very demanding and very competitive and South African universities, being part of the global village are no exception. Universities need to sustain the continuous knowledge flow. Issues and challenges in academia not only affect people within the institutions, but also other segments like environment, industry standards and demands, educational norms and growing academic institutional competition. One has to tighten their strategies to sustain competition in the education market. IT is used to examine the overlapping and ongoing relationships among faculty, students, course, and programs in any academic environment (Ranjan, 2008). UoTs in South Africa have made a conscientious attempt in adopting “leadership in technology” as one of their central themes in their vision and mission. This theme determines the important role of technology in teaching and learning, and research and how technology is applied in practice.

When the knowledge base of an industry is both complex and expanding with widely dispersed sources of expertise, the locus of innovation will be found in networks of learning rather than in individual large firms (Powell et al., 1996). Networked innovation (Tuomi, 2002), openness to innovation (Berthon et al., 1999), or open innovation (Sawhney, 2001, 2002; Chesbrough, 2003) implies that companies have more permeable boundaries. Ideas can be spun-out from one organisation and spun-in to another organisation where they can better complement innovation strategy and have greater likelihood to reach exploitation (Teresko, 2004). The greater ability to identify and bring in external ideas and technologies enhances a company's flexibility to respond to changing customer needs (Harryson and Kliknaite, 2008). This principal of partnership and networking are one of the pillars of a UoT. Experiential training is carried in conjunction with industry. Applied research is conducted in such a manner so that knowledge generated can be of use to society, as opposed to doing research for the sake of finding knowledge only. In applying knowledge to find solutions to societal problems or industrial issues, it is essential for researchers to partner with stakeholders to develop lasting solutions involving transdisciplinary expertise.

This well-known context of open innovation, coupled with accelerating technological complexity and shrinking product lives, creates an intractable dilemma for companies that rely entirely on internal technological development, which may cause internal "competence traps". To aim for a radical new solution, one needs to look outside internal boundaries of knowledge, which may reside in traditional organizational structures. The new knowledge generated by internal specialists is not well-disseminated across the organization and, therefore, causing further specialisation in isolation instead of transfer to design and manufacturing for transformation into innovation. Many multinational companies have reached an inner limit in terms of flexibility and innovation ability due to excessive internal technological development (Harryson, and Kliknaite, 2008).

The growth of tacit knowledge and challenges of translating to organizational knowledge has resulted in many firms turning to external sourcing strategies and learning partnerships to acquire new knowledge and reduce uncertainty in R and D. Key factors contributing to this include:

- the growth in cross-technology and interdisciplinary fields;
- the globalisation of technology and proliferation of sources; and
- the necessity for rapid commercialisation at reduced risk and cost (Harryson, and Kliknaite, 2008).

4.2.4.4 Industry-university collaboration to support learning both in exploration and Exploitation

If innovation is viewed as the ability of organisations to adopt new ideas, processes or products, learning alliances between industry and academia can enhance both flexibility and speed of innovation. Indeed, industry-university (I-U) collaboration is recognised as a critical form of learning alliance, and an essential instrument to gain speed and flexibility in technology innovation, while reducing cost in R and D. As stated by Etzkowitz and Leydesdorff (2000, pp. 117-18): "Students are also potential inventors. They represent a dynamic flow-through of "human capital" in academic research groups, as opposed to more static industrial laboratories and research institutes. Although they are sometimes considered a necessary distraction, the turnover of students ensures the primacy of the university as a source of innovation.

While the degree of Industry-University collaboration is increasing, it is still widely recognised that such collaborations are exposed to significant learning barriers – summarised in Table 4.1 below.

Table 4.1: Barriers to Industry-University Collaboration

Main barriers	**Accounts by authors**
Lack of adequate resources on industry and university side	Schartinger et al. (2001)
Cultural differences between industry and university counterparts	Kruecken (2003)
Inflexible academic research timetables	Liyanage and Mitchell (1994)
Long-term orientation of academic research, tending to remain in exploration – vs. focus on short- and medium-term exploitation-oriented research by companies	Mansfield and Lee (1996), Howells and Nedeva (2003), Gonnard (1999), Liyanage and Mitchell (1994), Beise and Stahl (1999), Meyer-Kramer and Schmoch (1998) and Chiesa and Piccaluga (2000
Incompatible reward systems with focus on publishing vs. protecting results	Santoro and Chakrabarti (1999) and Howells et al. (1998)
Risk related to obtaining control over university inventions through intellectual property (IP) rights	Graf et al. (2002) and Rappert et al. (1999)
Inadequate policies and systems to articulate university and industry relationship	
Industrial-University collaborations struggling with exploitation of too premature technologies	Thursby and Thursby (2003)

Adapted from Harryson. and Kliknaite. 2008: 15. **How technology-based university research drives innovation in Europe and China Leveraging the power of proximity**.

Many of these barriers relate to a fundamental difference between corporate and academic research: scientific knowledge produced by companies is usually claimed to be short- and medium-term oriented, aiming at exploitation, whereas the strength of academic research is claimed to prevail in exploration, but seldom coming up with results ready for commercialisation. As a consequence, I-U collaborations are often struggling with exploitation of too premature technologies.

The highly bureaucratised structure, with its entrenched policies and procedures, appears unbreakable to most working within it, while those in leadership positions often seem unable to address the strategic contradiction that Michael Dell, CEO of Dell Computers, regards as a fundamental task in change management is to understand the economics of a business before you have a strategy, and you have to understand your strategy before you have a structure. If you get these in the wrong order, you will probably fail. And if you limit a company by its structure or people, you will limit the full potential of that business. Structure should come last, not first (Dell, 1999). In consequence, the values-in-practice (power hierarchies, control and customer irrelevance) take precedence over the new espoused values of entrepreneurship (market focus, speed of decision-making, results and customer orientation) (Argyris and Schon, 1996). Thus, in spite of the rhetoric, the reality of everyday practice within universities often remains unchanged and potentially innovatory endeavours fail to attract support (Dovey et al, 2001).

Harryson and Kliknate (2008: 14) propose three Industry-University collaboration models.

- The spin-off model: Creating a separate spin-off company entirely dedicated to university collaboration in one core technology area
- The outsourced model: Outsourcing the whole management of university collaboration to a specialised organisation located in a strong university environment to access specialised academic expertise when required by the customer organisation
- The insourced model: Insourcing all university collaboration by turning the whole internal R and D and engineering division into a university-collaboration centre focused on exploitation – as practised, among others, by a European sports car manufacturer: Porsche (Harryson and Lorange, 2005, 2006).

4.2.5 Entrepreneurship

Gibbs (1999:3) criticises institutions of higher education as they “see themselves as spending organizations and not as profit generators; for the most part they function as non-profit businesses and not as entrepreneurial enterprises”. Where they do have 'business' orientated divisions they tend to be inexpert. As an institution of technology, where there is an emphasis on innovation and entrepreneurship, this needs to change. In fact, an institution of technology needs to 'put its money where its mouth is' this means to lead by example in terms of innovative thinking and entrepreneurial actions. Economic constraints prohibit the conducting of research purely for the sake of research. Social accountability and responsibility requires that research and development activities be relevant. Increased interactions on the research and development level with small and medium businesses should lead to great improvement of the relationship between the higher education sector and SME's to the benefit of both. Institutions could take a lead in commercialising patented products and processes, thus paving the way for future entrepreneurs, further research and development, job creating and progress for the community and country and with a resultant spin-off of new information, ideas, applications as well as funds flowing back into the institution thus maintaining and perpetuating the (renewal) process (Van Eldik and Fowler, 2004)

Historically, the prime purpose of business was to make a profit from a product or service. Today as products and services become increasingly knowledge intensive, the means of making profits and competing in the marketplace is to become an effective learning organization. Profit and product remain the goal, but it is continuous learning that enables growth. If business accepts that learning must be integrated into its core functions then all else will follow (Owen, 1991). Achieving and sustaining competitive advantage requires organisations to learn better and faster from their successes and failures (Tantawy-Monsou and Gorelick, 2005). Learning is the heart of productive activity and a new form of labour (Zuboff, 1988). UoTs have to adopt a continuous learning approach if they are to realise their vision.

4.2.5.1 Drivers of Entrepreneurship

Developing an entrepreneurial culture is key for accelerating economic growth and innovation (Acs, et al, 2007). SMMEs are disadvantaged in this area due to reduced learning opportunities and a lack of trained staff and finance to develop and implement appropriate systems. UoTs have an opportunity to provide support to this sector as a conduit for applying knowledge. There is evidence that learning networks can successfully assist SMMEs in the transfer of new concepts such as continuous improvement and total quality management (Bessant, 1995), in the diffusion of a wide variety of technologies (for example, robotics and rapid prototyping) and to increase the knowledge base and other capabilities of their members (Harding, 2002; Fuller-Love and Thomas, 2004; Chaston and Mangles, 2000). Almeida (2008) posits that the basis of developing an entrepreneurial culture is the partnership between university, industry and government. This is referred to as the triple helix. To create an entrepreneurial culture the university, requires the cultural transformation of academia, so that it plays an active role in society at several levels and to contribute to economic and social development and as well as promoting entrepreneurial attitudes amongst its faculty and students.

In recent years, research has been carried out to address the utilization of the intranet and internet not only as a repository of unstructured information but also as a powerful tool to enable effective information and knowledge accessibility and communication, supporting collaborative projects and offering the opportunity to create new knowledge to enhance entrepreneurship (Buniyamin and Barber, 2004; Clemmensen, 2005; Hardaker and Smith, 2002; Keane and Barber, 2002; Magnusson, 2004; Scott, 1998).

For universities to successfully adopt entrepreneurship they need to adopt flat matrix structures and an organisational culture that embraces change, innovation, and taking risks (Elsmore 2001; Hofstede 1997; Kezar and Eckel 2002). They need networks to establish and maintain links with agents, competitors and partners in the external environment (Castells 2000). These networks keep the firm apprised of changes in markets – threats, opportunities and assist them to penetrate existing markets and develop new markets. Management and decision-making authority in entrepreneurial firms is usually devolved to the site of the operationalisation of actions rather than located at a distant central point. The essence of entrepreneurialism is innovation, differentiation and change (Ricketts 2002).

If universities continue to use their traditional structures, culture and mode of decision-making it is unlikely that they will continue to be successful in dynamically changing markets.

4.2.5.2 Entrepreneurial Opportunities and Challenges for the Education System

Urban (2006) singled out problems in the education system in South Africa that is responsible for low entrepreneurial activity. Research indicates that people with postsecondary education or graduate education are twice as likely to be involved in entrepreneurial activity as those with less education (Acs, Arenius, Hay, Minniti, 2004) . A key issue towards raising the rate of South African entrepreneurs appears to lie in increasing the supply of skilled people who have the necessary knowledge to start and run a business. Such educational endeavours need to be supported by a helpful regulatory framework and facilitative environment. No doubt a set of complex interrelated factors, many of which are embedded in specific cultural and social norms of societies, are responsible for entrepreneurial activity. The natural strengths of entrepreneurship education - via its multidisciplinary focus and bridging of functional areas - render entrepreneurship as a field of noteworthy study. Some insights gained from studying entrepreneurship embodied in different paradigms are learning to distrust neat categorizations, which ultimately fail to explain and predict, due to the eclectic nature of the subject matter (Lewis, 1999) .

Throughout the mid-late 1990s Australian public universities received less public funding than they had in previous decades. In order to compensate for reduced public funding they turned to entrepreneurialism as a means of competing in research, staff and student markets. However, they did not become conventional entrepreneurial firms (De Zilwa, 2005)

Three types of entrepreneurial entities can be identified within Australian universities:

- Pure entrepreneurial entities – spin off companies and joint venture partnerships and research centres attempting to make a profit usually by developing patents and products from research, although some are engaged in teaching (Productivity Commission 2002; Australian Research Council et al. 2000).
- Semi-entrepreneurial entities – research centres and academic units (departments, faculties and schools) using entrepreneurial techniques like innovation, risk taking and industry partnerships to generate more revenue, not necessarily to make a profit.
- Public funded entities – academic units and administrative units that rely on public funding. Here it is observed that although there are some academic units and administrative units such as International Student Units, and Commercialisation Units that are engaged in entrepreneurial activities.

There are three reasons why Australian universities did not become full entrepreneurial institutions, despite their increase in third stream income from enrolling foreign students.

- there are strong tendencies within these institutions to resist change because they feel uncomfortable about any new process, also because they feel that their power base will be eroded (Harding,2002);
- some academics and administrators view entrepreneurialism as a anathema to the traditions of scholarship, and discovery (Coady 2000; Cooper et al. 2002);
- Australian universities are governed by government regulations that place responsibility on enrolling local students and the capping of student fees (DETYA 2001; DEST 2002). Australian Universities of Technology gained 49% of their independent revenue from overseas student fees and New Universities gained 40% of their income, which is a significant proportion of their budget which they would not want to lose, but will have to balance their intake by reducing overseas student enrolment in favour of local students to qualify for State subsidy (Turpin, et al, 2002).

The older traditional universities have a diverse range of sources of independent income and earn substantially more revenue from Consultancy, Contract Research and Investments than Universities of Technology and New Universities. Older universities enjoy the positional advantages of academic capital, global research networks, established infrastructure support, and capital reserves that make it comparatively easier for them to raise income from Consultancy, Contract Research and Investments. It is clear that these are the areas that Universities of Technology and New Universities need to develop and enhance (Clark, 1998).

In South Africa, as in other countries, the economic landscape is changing, with a move from foreign direct investment to self-employment and entrepreneurship. Universities and training organisations require their curriculum and programs to accommodate entrepreneurial studies and innovation thinking to make our students entrepreneurs and innovators (Richardson and Hynes, 2008). Ireland, is one of the leading countries in Europe in terms of entrepreneurship (Global Entrepreneurship Monitor, 2005). According to the Small Business Forum (2006), there are approximately 250,000 small firms in Ireland (inclusive of both manufacturing and service firms). These firms account for more than 99 per cent of all enterprises in the State and contribute to 68.4 per cent of private sector employment. In achieving this milestone it was important to highlight the link between the small firm and the University sector to improve the quality and relevance of entrepreneurship education. Doing so gives benefits to a variety of stakeholders – to students, faculty, educational institutions and small firm owner/managers (Richardson and Hynes, 2008).

Courses should have entrepreneurship skills as part of the curriculum, irrespective of the discipline that one is studying. Industry is increasingly looking to recruit graduates with practical work experience and commercial understanding. As a result, students with strong technical abilities but little practical experience are losing out on potential jobs. Education courses need to develop entrepreneurship ethos, which fosters adaptability, flexibility, and innovation skills which must become integral to the education system at all levels, if the needs of a changing workforce are to be met. For example, the introduction and expansion of project-based learning will help to provide these skills. By moving in this direction, there is significant scope to improve both the quality of learning and the development of soft skills relevant to the workplace without compromising the intellectual content of courses. Ireland has developed a strategy to develop management skills for the 21st Century which includes skills in decision making, risk taking, managing change and people management have become increasingly important to national economic development. Therefore, there is a need to ensure that students are well equipped in these necessary management skills. In particular, when we focus on innovation and entrepreneurship, the need to ensure technology transfer from the research laboratory into the commercial arena requires specialised management expertise such as the management of technology transfer and intellectual property (Richardson and Hynes, 2008).

For example research by De Faoite et al (2003), on entrepreneurship education in Ireland, found that entrepreneurship education provided for the integration of a variety of business subjects, the promotion of improved decision-making skills and an increase in technology transfer between universities and the market place. The need to broaden enterprise education outwards from business schools have also been endorsed by the European Commission (Europa, 2003) and Galloway and Brown (2002), who suggested that a “cross disciplinary approach” to enterprise education could influence a range of industry sectors including the arts, science and technology disciplines. Furthermore, Hytti and O'Gorman (2004) found that the more successful courses were those which integrated learning across the general educational experience and which introduced enterprise education into other courses. The innate abilities of an individual, coupled with the overall socio-economic environment (ease of establishing a new business, access to finance and advice as well as the prevailing cultural attitudes to entrepreneurship) are extremely important factors in determining whether they pursue an entrepreneurial path. These innate abilities can be greatly enhanced by education and training.

4.2.6 Partnership

The European Union emphasizes the value of collaboration, Brint (2005), suggests that the role of university needs to be reconceptualised. The outdated model of the individual, a researcher, single discipline, national rankings and mere cumulative progress in the fields of formal knowledge will not serve us as well in an innovative-based era. Instead, Brint proposes new university models encompassing interdisciplinary groups and large-scale economic and political support networks, where the underlying dynamics is constant innovation in the economy and society (Cunningham and Harney, 2006).

Persons operating at the cutting edge in industry, both nationally and internationally may already have outsmarted classroom bound teachers by far. This lends credence to the fostering of partnerships, both nationally and internationally, for the enrichment that comes from synergy, cross-fertilization and perspectives from other disciplines, shared use of expertise and facilities and teamwork approaches. For the purpose of survival, institutions of higher education will have to learn to co-operate rather than compete with each other (Van Eldik and Fowler, 2004).

According to Chen (2008), innovation can be enhanced, no matter what kind of innovation activities take place. The performance of inter-organization cooperation or partnerships was always better than that of individual business themselves. Moreover, the business strategies were affected by various institutions and norms such as laws, culture, rules, and technology standards; similarly, the performance of national innovation systems can be improved too. In any case, according to the evolution of innovation development, the innovation unit has shifted from individual business to the network and national innovation system.

Konidari and Abernot, (2006) affirm the need for human beings to help and support to organise, construct and understand the world. This requires internal and external partnerships to promote the emergence of collective competence. In this way, a new partnership is structured within the establishment based on equality of esteem so that the institutions open and establish partnerships with all actors of learning.

Partnership is a key feature of a learning organization which is driven by a process of gaining, sharing and utilizing the knowledge accumulated by individuals, and transferring it through the organization in order to meet its strategic goals (Braham, 1996; Murray, 2002). The belief in the organic model of organizational learning presupposes that learning is experienced by and channelled through each individual within an organization. This perspective resembles the nominalist position on knowledge creation with its emphasis placed on the importance of individuals and social relationships in organizational learning. Here, learning is normally viewed as taking place via close and interactive relationships with the people who possess the relevant knowledge (Yeo, 2005).

As technology dictates the social and economic development activities of people, the role of information and communication technologies as part of this development framework is becoming increasingly important (Onojaef and Leaning, 2006)). The use of the internet is such an example of technology at work to foster partnerships. Networking through partnerships gives access to information that enhances partnership through information sharing. These partnerships could be local or international in nature and jointly benefit organizations (Selwyn and Gorard, 2002).

A holistic approach to economic development of communities is important, as it combines the many factors affecting social, economic and political relations in human interaction and partnership (Onojaefe, Leaning, 2006). Partnership is especially important because we must be concerned with the development, deployment and management of community information systems that are formulated with, and by, communities – to solve their social, economic and political problems (Clement et al, 2004). This is only possible through a partnership with those agencies that are critical to solving those problems, such as public service departments, community based organisations and banks. Through active engagement with the community or institution, the university can contribute significantly to the building of social capital that can sustain development over time to benefit future generations. It can raise literacy through its core activities as a learning centre, resulting in high social capital; high literacy, increase prospects of employability (including self employment); leading to high productivity and a higher GDP; leading to higher standards of living and an improved quality of life and social well being.

The restructured higher education spectrum is designed to convey the idea that sustainable development is multidimensional. It lends itself to the view that education is one amongst many levers capable of unleashing the full potential of each individual and, by extension, of the society as a whole. Universities acting in isolation cannot activate the full range of potentials embedded in their immediate community or society at large unless they act in concert or in dynamic partnership with other institutions thus, generating synergies that are capable of arousing the collective potential within a broad-based and mutually-supportive social infrastructure(Nkomo and Sehoole, 2007) .

4.3 SUMMARY

This chapter studied the emerging characteristics arising from local and overseas experiences and its relevance to UoTs. This is with particular emphasis on changing knowledge perspectives, the ability to transfer knowledge through various vehicles eg technology, innovation. The role of UoTs was investigated since the application of knowledge to solve particular problems, is a key function of UoTs. If knowledge is to be useful, it needs to be applied.

This chapter explored the knowledge and technology relationship. Knowledge is applied through the use of technology in bringing tangible benefits to communities and industry. The uses of new knowledge in innovative ways have created knowledge-based economies. UoTs have adopted innovation as an important goal in advancing teaching, learning and research and are stakeholders in the knowledge-based economy system.

Knowledge transfer in collaboration with industry forms an important strength of UoTs. This is provided through experiential and community learning. Applied research is particularly important in using knowledge to develop technology stations or technology parks, the registration of patents, entrepreneurship and commercialisation of products.

This chapter focussed on the influences impacting on UoTs and their responses in generating and managing the knowledge transfer and application process in contributing to the greater development of society. Several approaches were highlighted which drive economic development. Innovation, partnerships and creation of a knowledge based system, are the main drivers of UoTs. Initiating an entrepreneurship culture to advance creativity and also to generate income, are also seen as important roles of this sector.

CHAPTER 5

INTEGRATING PHILOSOPHY WITH A UoT

5.1 INTRODUCTION

In the university setting, the notion of ‘interpretive flexibility’, to borrow a term from the field of Science and Technology Studies, suggests that technological systems are not simply forced on organisations in a preordained, top down fashion. Instead, this process is characterised by an ongoing struggle between various groups over the uses and meanings of technology, a struggle that is manifested most clearly in the university setting between forces of centralisation and standardisation, and disciplinary and departmental narratives of specificity and autonomy (Lewis, Marginson, Snyder, 2005). Van Eldik and Fowler (2004:140) observed “traditional approaches to business have changed virtually overnight”. The emerging Information era has brought fundamental changes to the way work is done, work is organized, technology is used and the way in which new skills and knowledge disciplines are created. Sources of wealth and economic development in the Information Era have shifted to knowledge, learning and innovative ideas which reside in people and have brought new pressures and challenges to educational systems to cope with the changes.

5.2 NEW TYPE OF UNIVERSITY

As Peters and Roberts (2000: 127) note, while drawing upon ‘neoliberal theories of human capital, public choice and new public management’, government policy has tended to push universities towards an increasingly massified and vocationally oriented model of education characterised by the management of predetermined outcomes. This shift towards a mass university system and away from traditional models has seen new organisational forms emerging in higher education.

Australian universities have adopted managerial techniques to control the destinies of universities through a series of devolved mechanisms, such as accountability-based and performance-oriented funding strategies and standardised data collections, a process that has been described as ‘steering at a distance’ (Vidovich and Currie, 1998: 194).

McNay (1995: 110) argues that there are four models of university organisation: the collegium, characterised by its lack of central control and high level of autonomy; the bureaucracy with its fairly loosely defined policy but tightly controlled rules and regulations for organisational practices; the corporation, with its characteristically strong central control over both policy and implementation; and the enterprise, an organisational model marked by clear central goals but a considerable degree of autonomy in relation to how those goals are carried out. Universities tend to be a complex mix of all four organisational cultures. McNay argues over the past few decades universities have been progressing from a primarily collegial organisational structure through bureaucratic and corporate modes to a predominantly enterprise-oriented model.

As a number of critics have noted, while the introduction of networked ICTs into the organisational setting is meant to empower workers, it also increases the ability for organisations to exercise centralised control and surveillance. According to Hardy (1996), the movement towards management strategies in making universities more accountable have caused many to fear that they will lose the collegial and collaborative culture that existed within these institutions. But Thompson (2003) notes that, the network model underpinned by internet and communicative technologies have the opposite effect in that there is more space for collaboration on line and access to information sharing. On a macro front many universities are collaborating through consortia, not only for commercial reasons but to enable greater power when lobbying government and when dealing with benchmarking and accreditation issues (Gallagher 2000).

This partnership is also extended to community and social needs, exhibiting the character of a borderless university. Through these partnerships universities are able to reach out to communities and strengthen areas of justice, equity and community mindedness. This opens many possibilities for democratisation of education. (Lankshear, 1996)

The organisational cultures and identities of Australian universities, like their British counterparts, have for some time been undergoing a period of rapid transformation that has seen notions of academic collaboration, knowledge sharing and community engagement jostling for ideological airspace with discourses of managerialism, entrepreneurialism and marketisation. Added to this complex and often volatile mix is the more recent push towards reconceptualising universities as informational or network organisations. Managers in particular have held up the devolved network model as an emancipatory alternative to what they define as the previous culture of universities: bureaucratic, inflexible, and unresponsive. Yet while terms like the network university and the virtual campus are figuring increasingly in management, media, policy and academic debates over the future of higher education, these labels are subject to little critical scrutiny and have tended to take on a primarily normative quality.

Over the past decade, Australian universities have moved towards corporate models of management and accountability. As Marginson and Considine (2000) argue while universities may differ somewhat in the way they have taken up such models, in general they have adopted new forms of governance marked by an increased emphasis on the role of the university executive and a tendency to marginalise collegial structures. Much of the rhetoric found in university mission statements attributes this organisational change to global and market pressures. The new corporate forms embraced by many universities are seen to embody a shift from an administered public service model to self-managed market practices.

Noble (1998: 39) argued an opposite view in the 'wired' university. The role of academics is being restructured, via technology, in order to reduce their autonomy, independence and control over their work and to place workplace knowledge and control as much as possible into the hands of the administration (Noble, 1998). Notwithstanding, this there appears that the networked organisation offers wide opportunities for collaboration

5.2.1 Research

Academic, scholarly and applied social research is in crisis in South Africa. As the Department of Science and Technology's (DST's) National Research and Development Strategy (R and D Strategy) indicates, spending on research and development declined from 1.1 percent of Gross Domestic Product (GDP) in 1990 to 0.7 percent in 1994, though South Africa's scientific system now had to support the political and socio-economic aspirations of 40 rather than 5-6 million people (Government of the Republic of South Africa, 2002). This percentage is particularly low considering that the OECD countries spend on average 2.15 percent of GDP across the public and private sectors, with countries like Finland and Korea approaching the 3.5 percent level. As DST's R and D strategy document concludes, this is disastrous, since 'South Africa's current expenditure is significantly lower than it should be to ensure national competitiveness in years to come' (Government of the Republic of South Africa, 2002:17).

But the problem is more profound than aggregate research spending. South Africa's share of global research output has been declining for over a decade, from 0.8 percent in 1990 to 0.5 percent by 2001(Government of the Republic of South Africa 2002).

R and D strategy indicates that whereas researchers over fifty years of age produced only 18 percent of publications in 1990, their contribution to total output had increased to 45 percent by 1998. Moreover, black scientists accounted for only 8 percent of total scientific publications at this stage (Government of the Republic of South Africa 2002). In short, South Africa's scientific personnel are mainly white, male and ageing. If this is not addressed urgently, it will result in the decline of the country's scientific profile and infrastructure in coming decades.

The plan adopted by Human Resources for Knowledge Production in South Africa Conference in June 2005 is summarised below:

- Recruitment and retention of high-level scientific and technological personnel, and the promotion of partnerships between universities, research councils and industry in support of this agenda.
- Careful attention to the support of advanced study, to its form and content and appropriate incentives.
- Linking the research agenda to national priorities, and allocating funding accordingly.
- Increasing national investment in research in ways that also leverage quality overseas and domestic involvement.
- Promoting South Africa's role in Africa as a leader in scientific research for continental development.
- Engaging with scientific globalisation so that South Africa becomes a hub in appropriate research areas, and attracts talented researchers (Department of Science and Technology, 2005b).

One of the constant criticisms made by society and industry was the poor translation of university research into practice, or to turn it into commercial value through technology transfer initiatives. Since the early 1980s, first in the USA and more recently in many other industrialized countries, governments and research-intensive universities have put considerable efforts into enhancing research commercialization capacity. These developments have been driven partly by the need of universities to generate additional income, but many universities engage in commercialization activities primarily to enhance relationships with business firms and generate ongoing political support for continuing public investment in university research. Governments, on the other hand, seek to capture the benefits of university research outputs to facilitate economic and social development, and generate national wealth. The terms 'technology transfer' and 'research commercialization' are often used synonymously, although strictly speaking there are important differences in their precise meanings.

Steiner and Laws (2006: 324) categorise different degrees of problem solving to understand learning strategies find solutions in the real world. This is distinctly different from traditional modes of education where universities focused on theory and was far removed from practicing within a social context. Complex problems are characterized by the sheer number of interacting elements and subsystems and the dynamic character of the system that together produce changing patterns and structures, as well as changing intensities over time. Accordingly, the particulars of a given system are often unknown or inaccessible

5.2.1.1 Research and Technology Transfer

Knowledge is embodied in two carriers of knowledge, namely human capital and technology. The use of human capital is exclusively transferred by humans and its application cannot be exactly replicated at the same time. Technology on the other hand can be transferred and used in several countries simultaneously. For example the computer was invented in the USA but it is now used every part of the world. (Cichy, 2008: 16)

In the scholarly literature, the term 'technology transfer' refers to 'the movement of know-how, technical knowledge, or technology from one organisation to another' (Bozeman, 2000, 629) but the most common use is in relation to the transfer of inventions and associated 'know-how' from research organizations (especially universities and public research institutes) to research users.

In many respects, Australia has followed a similar pattern of development to leading overseas countries, particularly the USA and the UK. While a small number of American universities established technology licensing offices before the Second World War (for example, the University of Wisconsin in 1925, Iowa State University in 1935 and MIT in 1940), most did not create such offices until the 1980s, following the passage of the Bayh-Dole Patent and Trademark Amendments Act 1980. This landmark legislation shifted responsibility for commercializing federally funded research from the Federal government to universities (Rogers et al., 2000). Today, virtually every major American research university has a well-staffed technology licensing office, with such offices handling 60% of all invention disclosures arising from federally funded research (Sandelin, 1994). The major expansion of technology licensing offices was pushed ahead in the 1990s with big wins by particular universities, such as two cancer drug patents at Michigan State University and the recombinant DNA gene-splicing patent at Stanford University. In the UK leading universities, especially members of the 'Russell Group', have strong research commercialization capacity, often located in combined research and commercialization offices (such at the University of Glasgow) or in commercialization companies (such as at Oxford, Imperial College London and Edinburgh). One lesson that can be drawn from overseas practice is, as Tornatzky et al. (1999, p. 24) emphasize: "There is no single or simple approaches to university-industry technology transfer. Each approach is context-specific, and will be more or less a fit with the perspectives and aspirations that stakeholders bring to the process… It is incumbent upon universities and their industrial partners to choose those linkages and approaches that are most suitable for their environment".
Typical functions of a Technology Transfer Office are the following:

- Educating and creating awareness of Intellectual Property (IP) processes and requirements among researchers;

- Assisting researchers with their IP and patent protection;
- Assessing market potential;
- Identifying potential industry partners and collaborators;
- Negotiating license agreements;
- Forming start-up companies; and
- Finding investors and industrial partners (Knowledge Commercialization of Australasia, 2003).

The housing of the Technology Transfer office depends on the university's strategic thrust. In smaller institutions Technology Transfer is located in the Research Office. In large institutions, with high income generated from commercialised research and Intellectual Property rights, these institutions have dedicated Technology Transfer Offices or companies. Universities with low levels of research expenditure tend to focus their commercial activities on marketing courses and training programs and training programs, and commercial consultancies, sometimes managed through a corporate framework, but with IP issues being handled by a university legal office (Harmon and Stone, 2006: 215).

5.2.1.2 Commercialising Research

'Research commercialization' refers to the process of turning scientific discoveries and inventions into marketable products and services. Generally, research outputs are commercialized by licensing patents to established companies or spinoffs that usually depend on assignment of university intellectual property (IP) for their initiation. Research commercialization is based on IP rights of which patents, industrial designs, copyright and trademarks are the most important. IP rights reward investment in R and D by granting ownership to inventors, their employers or those who funded the research or some combination of these (Harmon and Stone, 2006: 229). Allen Consulting Group (2004) identified perquisites for university success in commercialization, including production of high-quality research, a strong institutional commitment to university ownership of IP, significant university financial investment in research commercialization functions, and a well-resourced central facility with access to capital for 'proof of concept' activity. This report also emphasized the importance of developing specialist skills for research commercialization activities, commenting that international experience shows it is the ability of commercialisation entities to draw upon appropriate skills and scale of activity, rather than their organizational structure, which is the single most important driver of performance.

Harmon and Stone's (2006: 228) study identified several barriers to research commercialization in his review of international experiences. By far the most important barriers perceived by technology transfer managers were the lack of government funds to support commercialization and the lack of internal university funds for ‘proof of concept’ work. The cultural gap between universities and industry, lack of an entrepreneurial culture among scientists, slow moving university approval processes and a shortage of relevant skills in research commercialization offices were also seen by many to be significant barriers. In concordance with the reasonable ratings of universities’ IP activities given by technology transfer managers, university IP policy was only seen to be a barrier by a relatively small group. Other studies in Australia have revealed strong agreement that universities should collaborate more in research commercialization, that Australian industry often does not see the value of working with universities. Technology Transfer managers contend that further barriers disadvantage them through taxation concessions that favour industry more than they do researchers and universities. On the other hand, relatively low support was given to the propositions that Australian universities rely too much on licensing rather than spinoffs, that universities price their IP too high. Another key finding of the research was the lack of support of Government funding to build infrastructure to convert research to commercial projects. Some of the funding issues are no capital outlay and start up funding, lack of the appreciation for the cost involved in bringing inventions into the market. Clarity was needed on whether commercialization was required for additional income or for genuine attempts to turn research/technology transfer into viable ventures.

However Cunningham and Harney’s (2006) cautioned, academic freedom should not be compromised on the alter of commercialization of research and that research that may not fall in the priority areas for funding should also be supported.

The next generations of faculty and students have an important role in the technology exploration. They should be treated as developers, educators, testers and disseminators. For developing strategic internal alliances, the academic institutions have to more effectively use their resources and infrastructure to reap more benefit from their investments in both people and technology. The IT-based approach will enable academic institutions to quickly respond to its goals and objectives and in some cases pre-empt staff and faculty demands and needs. To build and develop a robust and thriving IT environment in academic institutions, these institutions need to look beyond technology and develop the overall culture of accessing, sharing and managing information (Ranjan, 2008). In South Africa, the growth in IT was limited by bandwidth, which increased cost of transmission and also placed a limitation on the speed and volume of information that can be transmitted. However the good news is that by the end of 2009, the new undersea cable by SEACOM will be fully operational. This cable connects South Africa to Europe and Asia. This opens up whole new possibilities in terms of creating access to technology to Africa. Many more South Africans will be plugged into the global village through high speed technology. For universities it would enhance their technological capability. Already students in certain universities in South Africa can download notes and other academic material through the cell phone, however due to bandwidth problems it has not fully taken off, but it is anticipated by 2010 this technology will be available for use by all universities in South Africa,

5.2.1.3 Research Collaboration

The Human Resources for Knowledge Production in South Africa Conference emphasised, that in modern conditions in many crucial research spheres, collaboration in substantial focussed groups is essential. It is unlikely that such groups can always be constituted from within a single institution. In many cases, they will have to transcend institutional boundaries. This leads to the many forms collaboration can take. It can consist of networks that evolve purely from the logic of a particular research enterprise, without necessarily being predicated on the formal alignment of institutions. In other cases, however, institutional collaboration is important in facilitating research and making best use of the expertise and facilities available nationally, regionally and even internationally.

In South Africa, some barriers to institutional collaboration have been partially eliminated in recent years. The mergers and realignments in higher education of the past few years have begun to clear away some obstacles to such collaboration, in research as in other areas. Though undoubtedly the fundamental motivating factor in the mergers was an attempt to reduce costs, and cut through the racial categorisations that had previously divided the sector, and began to clear away this pernicious legacy of educational apartheid (Habib and Parekh 2000).

Notwithstanding the rationalisation and mergers, universities still battle to engage in meaningful collaboration. One of the main difficulties is the researchers' time is rigidly costed, it makes it virtually impossible to create space for a mentoring relationship with the postgraduate students who are at the heart of university research, and who represent an important next generation of cadres of skilled researchers (Habib, Morrow, 2007: 125).

In South Africa itself, the declining rate of state support, particularly in the science councils but also in the universities, tends to move research in directions favoured by the remaining funders such as domestic or international donors, or industry and commerce. Research funding has never been a neutral or a simple process, and the argument here is not that there is always and in every case an automatic correspondence between the public interest and the state. However, it can be argued that the state's partial retreat from direct funding of research, particularly in the science councils whose remit is applied science, has tended to limit the available options and has opened the way for research agendas not always or primarily aligned to the interests of the South African public. Collaboration between research bodies is to be encouraged; it enables large projects to be undertaken, makes good use of skilled researchers and saves in personnel and other costs. However, it is more questionable if it masks the decline in state support and provides a channel for the elaboration of research agendas over which South Africans have little control. The SATN advocates for the increased role of applied research, and therefore continuously lobbies Government and other state agencies for increased subsidy and financial assistance for applied research, which can impact on solving real world problems.

In facing the ‘globalised’ world, South Africa in research terms, tends not to hold the trump cards because of its low research output. However, in some research areas this may not be the case. South Africa thus needs a clear research focus, and a keen appreciation of what it can and cannot do, and where its comparative advantages lie. South African researchers are in a better position to enter collaborative international agreements on a basis of approximate equality than are other African research communities, and they need rapidly, though prudently, to develop collaborative international networks of this kind. To do this, however, the level of support in South Africa itself will need to be maintained and increased (Habib, Morrow, 2007: 120).

5.2.1.4 Developing Research Capacity

Retention of good researchers is a tremendous challenge. This is because of competitive salaries being offered by other sectors and also by good researchers being absorbed into high paying management positions. There are attempts by certain institutions to pay staff according to research productivity (Habib, Morrow, 2007: 117).

One of the critical problems facing research universities according to Habib and Morrow (2007: 120) is that staffing vacancies are often not filled and are left vacant because no suitable black candidate can be found. Talented and highly qualified black researchers find themselves courted from all sides, and, as noted above, often have well-rewarded options, which many exercise, outside research. In short, as Jansen argues, ‘The university ceases to exist when it represents nothing other than an empty shell of racial representivity at the cost of academic substance and intellectual imagination’ (Jansen 2004:11).

Working conditions must also be structured appropriately if a vibrant research culture is to emerge. Studies have indicated that South Africa’s academic workplace has become more onerous and stressful in the last decade. In one such study, Webster and Mosoetsa (2002) demonstrated that academics have to teach and mark more, and that a more commercial managerial logic in the universities has produced demoralisation, stress and decline in productivity. This leads to the inevitable conclusion that working conditions in the academy have to be radically reformed if research output is to increase. This must not be interpreted to mean that teaching and marking, and in general educating a new generation of high-level workers, are not important. These functions are crucial to the nation's development, stability and future prosperity. But if the demand to educate a new generation is to be coupled with generating more research, then the institutional environment has to empower researchers and research activities more. Again, lessons can be learnt from other experiences including those of the American academy. The net effect of these reforms would be greater expenditure on the university system from the public purse and a more entrepreneurial approach from higher education managers to provide better incentives to attract, develop and retain skilled researchers.

Fowler (1999) articulates a growing concern about the problem of the 'gap' between practitioner and researcher endeavors in the private sector. He claims that a situation exists where researchers regard practitioner analyses as 'not rigorous enough', while academic analyses are viewed by practitioners as 'ungrounded'. This results in weak theory and poor practice.

To address the above problems Kemmis (1983, p. 133) describes the action research process as creating "A forum for group self-reflection (and action) which transforms communities of self-interests into learning communities". This is sustained on two levels of action-research: one at the programme level where key stakeholders continuously re-create the programme, and another at the sector level where organisations represented by students, continuously re-address key sector-specific strategic issues. In this way both practitioners and researchers can collaborate to produce practices that can be implemented.

The aim, today, of science and technology policy is to hitch scientific enterprise to industrial renewal and competitiveness. This has led to many formal and informal partnerships between industry, science and technology. Increasing partnerships combined with newfound ease of learner articulation across institutions in many global contexts, have made the whole education and training system more flexible, with boundaries more permeable than ever before. It becomes clear that higher education must be restructured to meet the needs of an increasingly technological economy with the capacity to participate in a rapidly changing global context in order to prepare for integration into the competitive arena of international production and finance Van Eldik and Fowler (2004: 148).

The model of government-funded research at many American and Australian universities has shifted from long-term programmes of 'pure' research under academic control to university-industry partnerships in which the direction of research is directly shaped by potential commercial applications. Universities are now more incorporated in industry, and their ethos shifts from the client welfare of their students to the amount of income that can be realised. This is trend has resulted in universities sacrificing programs because it does not bring in sufficient income. Academic considerations are given less weight when considering what programs to cut. (Marginson and Considine, 2000).

The narrowness of government definitions of research has placed increasing pressure on the faculty to focus on engineering science rather than engineering practice in order to raise its research profile. This has encouraged recruitment of new staff with a relatively narrow research focus and limited experience of engineering practice. The SATN has lobbied on behalf of UoTs, the Department of Education to recognize innovations in WIL, intellectual property, entrepreneurial projects, product development, and technology stations to be considered as valid research outputs for UoTs. This will attract funding and subsidies and also will enhance the research profile of the university and of the academic staff.

While single discipline research efforts by staff in recent years have had some notable successes, they have not often led to financial spin-offs to the teaching efforts of the faculty and cannot thus generate management support for a change in pedagogical policy. Moreover, multidisciplinary and transdisciplinary research and development at some overseas university faculties have also demonstrated distinctive successes, and have been presented as a future growth path for staff interests that support and nurture the unified teaching components. The direct community relevance of these latter activities may not have provided any greater financial spin-offs, but have provided useful marketing benefits for management (Bryce, Johnston, and Yasukawa, 2004).

5.2.1.5 Research Drivers

The National Plan for Higher Education (NPHE) (Ministry of Education 2001) is very specific when it comes to the role that higher education institutions should play in research. It provides the following two outcomes for research: firstly that research concentration and funding should be linked to outputs, and secondly that graduate enrolments and outputs should increase at the master's and doctoral level (Ministry of Education 2001). The purpose of this policy is, amongst other things, to encourage research productivity by rewarding quality research output at public higher education institutions (Department of Education 2003, 4).

For the Central University of Technology, Free State (CUT) to be a UoT it needed to comply with the national goals as contained in the NPHE. The institution identified two goals pertaining to the development of research that are in line with the research objectives contained in the NPHE, namely to increase the enrolment of postgraduate students and to increase research outputs across the spectrum of disciplinary inquiry. This institution was a former Technikon and like all such institutions, it lacked research capacity amongst its academic staff and had poor research infrastructure (Lues and Lategan, 2006: 108).

CUT identified setting up of research culture as a first step in achieving postgraduate and research goals. This was advanced by creating three structures that provided funding, capacity and quality to develop a research culture and infra structure. To develop a critical mass of skilled researchers and academic staff to increase the number of postgraduates, several key interventions were introduced. The research capacity-building workshops and seminars aimed to provide all researchers (staff and students) with the opportunity to develop their research skills and knowledge. Secondly, an additional off-spin of the seminars was that delegates were urged to convert their papers into article format for submission to in-house and other journals. This publication offers much needed writing skills which empowered them to contribute to external journals. After a four year period, the strategic decision to develop a research culture was paying off. The number of accredited research outputs increased by 300%. This is clear evidence that focused attention and management of research infrastructure and selected capacity building interventions are important drivers in building a research culture (Lues and Lategan, 2006: 109).

5.2.2 Teaching and Learning

During the second and third decade of the twentieth century, there were influential calls for a renewal of education. Most criticism was aimed at the monotony, one-sidedness, lack of independence, lack of application and experience, lack of personal responsibility and flexibility, and inappropriate learning environments that characterized traditional education (Freinet, 1993).

Illeris (2004:433) observed that the definition of learning has traditionally been the “process through which an individual acquires knowledge, skills and possibly also attitudes and opinions”, and on a professional level, it has been considered as belonging to the field of cognitive psychology, together with areas like the senses, reasoning and memory. However, in recent decades, several commentators have called this view into question. First and foremost it has been maintained that learning is fundamentally to be viewed as a social process that takes place in the interaction between people, for instance in various communities of practice (Lave and Wenger, 1991), or more generally and exclusively in terms of the so-called social-constructionist view (Gergen, 1994; Burr, 1995). In extension of this, a discussion is conducted on the question of whether the ability to learn is the exclusive ability of individuals, or whether it might be said that also groups, corporations, organisations and perhaps even nations have this ability.

In summary, the basis for our understanding of learning is that it involves specifically human processes (which only on certain points, resemble features found in more highly developed animal species), which include both social interplay and individual psychological processing and acquisition. The social element gives learning the context in which learning takes place and gives the learner more meaning to the information being interpreted. There may well be joint or social learning processes, but only in special cases will the outcomes be the same for all involved, to an extent that permits the use of the term collective learning (Illeris, 2004).

5.2.2.1 Conceptual Framework of Teaching and Learning: Solving Real World Problems

Given the criticisms of education Dewey (1963) provided the starting point to rethink education by giving attention to experience and reflection, democracy and community, and to environments for learning. Within the new European education movement Freinet (1993) gave specific attention to the pedagogy of work, co-operative learning, and enquiry-based learning, the so-called natural method, and centres of interest.

- **Problem Solving through a Collaborative Approach**

A recent international transdisciplinarity conference framed the significance of complexity as a demand on practice. In order to effectively manage complexity, you need a joint problem-solving among science, technology, and society (Häberli *et al.*, 2001). This highlights the importance of stakeholders. Once a complex problem with social implications becomes the subject of a case study, it is no longer possible to neglect the stakeholders of the considered system without leading to inappropriate solutions to the given problem.

The identification, investigation, and participation of stakeholders become essential facets of all problem-solving approaches applicable to complex problems. This is also valid for every type of case study methodology dealing with complex problems. No matter who is trying to solve a complex problem – academics, students, consultants, other external persons, or the stakeholders themselves – the problem-solving process needs the involvement of the stakeholders. This process of interacting with stakeholders around a problem is also understood as transdisciplinary problem solving. In the context of higher education, transdisciplinarity involves intense interaction between university – with academics guiding and coaching students – and society in order to promote a mutual learning process between these groups. It can be seen as a move from science on or about society towards science for and with society (Scholz and Marks, 2001). In other words, learning includes the context and social setting that enhances meaning and results in acquisition of skills that can be applied in similar situations. Most complex real-world problems are not only characterised by stakeholders but need to bring different disciplines to bear in order to adequately understand the problem and design meaningful solutions (Scholz and Tietje, 2002). The significance for UoTs in

South Africa is that this sector needs to function in collaboration with various stakeholders in arriving at problem identification and problem solving.

- **Knowledge Application Approaches**

For a long time industry's demands on the university emphasized the need for specialists in single disciplines who could solve specific problems based on know-how and routines developed in their studies. For complex problems (e.g. strategic questions), firms relied on experienced employees who had already gained general knowledge of the overall company system by working in relevant fields inside the company. Employees began this step-by-step development of competences by applying routines and proven solutions to solve simple and complicated problems. Employees who were willing and capable, or were forced by their company to enhance their competences, would gradually become involved with more complicated problems, finally progressing to complex problems (Steiner and Law, 2006).

The demands on university graduates have changed drastically, especially in fields with high social impact. For example, in the Health Sciences, students are required to do community service to prepare them for the world of work. Increasingly, other programs are also adopting this approach of interacting with communities as part of their experiential training. Graduates are expected to bring the competences needed to solve complex problems with them instead of acquiring them over a long period of practice. This changes the demands on the university which has to react to these changed demands in order to provide graduates with the needed competences for dealing with complex real-world problems (Steiner and Law, 2006).

University systems have grown more dependent on their environments (i.e. companies and other institutions). Whereas in the past universities had a more or less independent academic status, they now face demands for practically oriented students who are not only theorists but also capable of solving practically relevant real-world problems which have become central in industry and other real-world systems. The differentiation of a theoretical university world and a practical industrial world has lost its meaning. Moreover, real-world problems – especially those with strong social impacts – and their implications for various involved or influenced actors are themselves changing over time. This consequently also requires adaptable styles of problem solving in society (Steiner and Law, 2006).

To summarize, complex problems cannot be solved by simply applying the standard solutions that may be appropriate for simple or complicated problems. Recent university graduates now need to possess a broad set of sophisticated competences that include:

- field-related knowledge;
- the capability to design and understand a complex system;
- the social competence needed to actively participate in group work together with the stakeholders including the ability to:
    - analyze potential stakeholders and their specific competences (i.e. design a "stakeholder map"); and
    - set up of a "participation road map" for the various actions needed in the cooperation between science and the different stakeholder groups at the various stages of the problem-solving process.
- the capability to responsibly choose and apply the appropriate problem-solving methods including:
    - the construction of variants for a consistent future development together with their evaluation; and
    - the design of an "implementation action plan" for further steps toward the realization of promising variants together with the responsible stakeholder (Steiner and Law, 2006: 323).

South African higher education institutions are increasingly under scrutiny to produce knowledge that is more relevant to South Africa's social and economic needs, more representative of the diversity of its knowledge producers, and more inclusive of the variety of the sites where knowledge is produced. Only a small percentage of South Africans are graduates of universities or technology institutes, and these graduates are not sufficiently representative of the diversity of the South African population. As a result there is a shortage of skills to address the country's reconstruction and developmental needs (Winberg, 2006).

- **Multidisciplinary Approach**

Traditional, discipline based academic knowledge is increasingly perceived as unable to address issues of importance to South African society. This is of concern, as an important role of higher education in a developing country, in which only one percent of the population hold degrees is to prepare graduates to contribute significantly to social and economic reconstruction. Disciplinary based curricula tend to be isolated from 'real world' problems. Even in long established professional learning programmes, such as the different branches of engineering, learning tends to happen in separate subjects, with no explicit links made between them or the contexts which they serve (Jansen 2002). To address South Africa's twin challenges in developing and increasing the number of skilled graduates and global competitiveness, and the urgency to address the inequalities of higher education, there is a need to move away from disciplinary communities to contexts of application. In other words knowledge must be more socially accountable and reflexive; it includes a wider, heterogeneous set of practitioners, who collaborate on a problem defined in a specific and localised context so that knowledge can be applied in the world of work (Winberg, 2006: 167).

5.2.2.2 New Type of Students in a Technological Era: Alignment of Learning Strategies

In teaching and transferring new skills to learners, it is important to analyse the type of students that emerge from society in the 21^{st} century. This will give universities the opportunity to devise learning pedagogies that is targeted and suited to their particular learning style.

Coming of age in the internet bubble of the 1990s and web boom of the 2000s, it often seems that every facet of the newest generation's life involves on-line technologies and the internet serves to define the generation (Tapscott, 1998). Generation N (as in Network) relies on technologies from computer or cell phone-based instant messaging (IM) to Google and Wikipedia and has grown accustomed to instant communication, instant gratification and ongoing multitasking. Do the generation's defining characteristics warrant changes in the way we educate its members? This issue, the proverbial elephant in the room for many educators, sparks intense emotions for both the tenured staff as well as the customer service-seeking students.

Educators and professionals alike share a common concern that today's graduates do not possess the skills needed for the business world. What is the best approach for teaching a generation that is ready to turn to other sources if an individual educator's delivery methods are less than ideal for the student? The answer rests not in using technology. Instead, the answer rests in adult learning theory. “Basic andragogy principles offer more to Generation N than the common pedagogical approach” (Feiertag 2008: P 458). Before we can examine how to approach this generation within the realms of business training or higher education, we must understand it by examining some defining characteristics.

I. Student Learning Typology

Whereas the previous generations grew up with push media – radio and television – this generation has come of age in a digital universe with the internet at the forefront. Even without its technology, this generation has held the focus of both parents and politicians. This generation perceives life through the very technology appearing in the background; the individuals have what some researchers call a “hypertext mindset” and bounce from activity to activity, person to person (Oblinger and Oblinger, 2005, p. 2.4). Despite a techno-centric focus, Generation N is a set of individuals who recognize they need each other and thrive in group activities. Part of the need to work within a group comes in the form of a desire for constant feedback.

Previous generations were characterized by their independent nature at one level or another, while this generation needs to know that support is present (Carlson, 2005). It should come as no surprise that university administrators, faculty and students do not necessarily see eye to eye on the how Generation N learns. School officials approach the issue as a business decision, seeking to meet customer service expectations. This generation, for better or for worse, does not respond well to the lecture and has become accustomed to interactivity. To the members of Gen N, regurgitation of facts is just data and not learning (Oblinger and Oblinger, 2005). These learners are also referred to Generation Y.

Generation N (or Y} students and employees possess certain key traits that translate into learning in school and the business world. Generation N employees are often not as independent learners as their predecessor generations; these learners require more structure, guidance and regular feedback. They prefer working collaboratively, do not respond well to the lecture, often do not communicate effectively by traditional standards, require information individually tailored to them, and require technology that is available to use. When asking what changes can be made in facilitating the learning of Gen Ns, these characteristics need to be taken into account (Marstons, 2007; Feiertag, 2008).

Generation N (or Y) are described as confident, independent and individualistic, self reliant and entrepreneurial (Martin, 2005) and at the same time socially active, collaborative, team oriented and used to having structure in their lives as a result of the type of parenting they have received (Glass, 2007; Shih and Allen, 2007). This manifests itself in a desire for clear directions and managerial support in what to do but at the same time “a demand for freedom and flexibility to get the task done in their own way, at their own pace” (Martin, 2005, p. 40). Moreover, despite being independent they are seen as being emotionally needy and consequently, constantly seeking approval and praise (Crumpacker and Crumpacker, 2007). In terms of work they are capable of multi-tasking quickly (Freifield, 2007), are results oriented and have an appetite for work and pressure (Shih and Allen, 2007) and above all expect to be empowered (Morton, 2002). At the same time they exhibit a high external locus of control, being significantly more likely to attribute their fate to forces beyond their control than the equivalent Baby Boomer (Twenge et al., 2004). What is more, they seek work life balance and if forced will select family and friends over work (Crumpacker and Crumpacker, 2007). Finally, their expectation that they will change jobs frequently means they actively seek out jobs that provide training (Morton, 2002). The different characteristics and attitude to career development attributed to Generation N suggest that the millennial learner's requirements and expectations of the learning environment are going to be different from their predecessors (Howe and Strauss, 2000; Partridge and Hallam, 2006; Jonas-Dwyer and Pospisil, 2004). Much of the research into this generation's learning style focuses on their experiences as university undergraduates (Raines, 2002). Above all technology has shaped how this Generation learns and processes information (Martin, 2005). Research into their experiences as students in higher education, suggests they enter university with “very different learning backgrounds, experiences, preferences, attitudes and skills sets” which call for different pedagogies and learning style strategies together with new forms of learning environment (Shih and Allen, 2007).

These authors argue that Generation N, given that they exhibit many of the characteristics and traits discussed above, require structure both within the classroom and in relation to learning administration and infrastructure. They go on to argue that experiential learning is the dominant pedagogy with “hands –on and interactive assignments and in class activities”, “team-work” and “collaborative presentations” resonating well with the millennials' predisposition to stay connected and engaged (Shih and Allen, 2007, p. 98).

UoTs in particular are well positioned to incorporate the learning experiences that match the characteristics of the new type of learners. Especially, the application of knowledge to solve real world problems through collaborative learning or team learning, and experiential learning.

II. Pedagogical Approaches to Accelerate Knowledge Transfer

Alongside structure, teamwork and experiential activities Jonas-Dwyer and Pospisil (2004) add technology, entertainment and excitement to the new Generation N's learning and communication preferences, whilst Partridge and Hallam (2006) argue that curriculum should include real world activities and perspectives as well as being customisable and flexible. Once in the labour market, Generation N is perceived to be high maintenance (Hira, 2007) typically motivated by a desire to enhance professional skills in order to remain marketable (Holden and Harte, 2004; King, 2003; Sayers, 2007). Arguably, the reduction in lifetime employment has made Generation N graduates more aware of the need for constant skill development and updating and as a consequence more likely to play a proactive role in their own career planning and execution (Westerman and Yamamura, 2007).

This generation perceives challenging and meaningful assignments to be far more important for their self development than lifelong employment (Baruch, 2004). They are characterised not only by a desire to have a portable career but even greater degrees of personal flexibility, professional satisfaction and immediacy, wanting to and needing to learn and seeing continuous learning, like change, as a way of life (Sayers, 2007). This type of student has a major impact on pedagogy and curriculum development and the world of work (Shaw, 2007: 367).

Shaw (2007) concludes the new Generation graduates require early feedback on performance. The use of technology in teaching and assignments will enhance their involvement in learning. The use of group work and workshops will increase knowledge transfer. As we have seen this generation also has a preference for doing rather than listening – for them experience is what counts. Consequently, what is important is a development programme that is flexible enough to enable them to move laterally as well as vertically – allowing them to gain knowledge, skills, and experience as they go – all within a wider multi-directional career system.

Learning is the process by which knowledge is created. It is through learning that an organisation will be able to increase its level of knowledge depth and diversity. Knowledge depth can be increased by learning more within specific existing areas, while knowledge diversity can be increased by learning in different areas (Correia de Sousa, 2006).

With the diversification and massification of the student body, universities have increasingly shifted their educational rhetoric from a notion of 'one size fits all' to a concept of tailored, flexible learning, one which seems to complement the notion of the university as a borderless, network organisation. The studies reveal a progression to a student centred learning or self managed learning. Networking in this context creates a seamless boundary between work, study and leisure, often referred to as lifelong learning or capability oriented education (Lewis, Marginson, Snyder, 2005).

Van Eldik and Fowler (2004: p141) believe "access to Higher education in South Africa is no longer a privilege, but rather a general expectation open to the majority of people". The widening of access to previously disadvantaged communities and the demands for new skills arising from the information economy world-wide also accentuated and stimulated growth in recurrent and continuing education and life-long learning.

Knowledge empathy needs to be stimulated through the structuring of knowledge flows and the nurturing of an environment that rewards knowledge sharing. Bennet (2006b) points out the importance of this ability to understand different contexts and perspectives in a learning process: People must always be prepared to let learning transform our own perspectives and belief system – perceiving from a new point of view, transforming the way they see the world and themselves in relationship to the world. The learning ability of an organisation is greatly increased through emergent networks of relationships (the organisation's social capital (Cohen and Prusak, 2001)). These networks of relationships can emerge only if people know what other people know and how much other people's knowledge can be of value to them (Cross et al., 2001). Context needs to be provided so that people know the goals, functions, constraints, language and standards of the firm.

The critical factors mentioned above require an institution to carefully think of its structure, culture, leadership style, and knowledge management (KM) practices. An appropriate structure will have the information technology systems and layouts that stimulate communication and collaboration creating learning environments. An action culture needs to emerge supported by collaborative leaders that learn and stimulate others to learn (Bennet and Bennet, 2004). KM practices need to exist to enable and nurture relationship networks; and create knowledge transferring mechanisms (De Sousa. 2006).

III. Institutionalising Innovation and new Knowledge into Learning Applications

The concept of connectivity referred to and presented in Guile and Griffiths (2001) and Griffiths and Guile (2003, 2004), stresses the socio-cultural approach to learning. In their connective model (Virolainen, 2007: 297) emphasize five ideas about learning when planning learning at work.

- The first is the learning context. Contexts like workplace and schools have their specific histories and cultures of knowledge and expertise. These cultures have ways of meaning-making typical to them. At workplaces, especially, some knowledge is implicit only and embedded in orders of artefacts, for example where the important tools are placed, or how signs and symbols structure the objects of work and actions related to them (Billett, 2002, p. 31). The context that each workplace provides for learning has to be reflected upon in order to realize what kinds of access to learning it allows.
- The second aspect underlines learning as the active mediation of different kinds of knowledge and experience as well as mediation of their relations as a central feature of learning through work. Accordingly, learning is seen as a purposeful process where learners transform meanings, identities, artefacts and contexts.
- The third idea is the importance of participation in social practices, i.e. membership of communities of practice that allow the expansion of knowledge by asking questions and resolving problems.
- The fourth idea is linked to the purpose of work experience and its usefulness as a pedagogic approach. Ideally, work experience supports learners to become progressive experts able to use their experience to create new knowledge and better practices. Experience is the basis for experts' reflective action.
- The last idea sets demanding tacit criteria for the dialogue between supervisors, students and experts in the workplace. It presupposes a shared will towards expanding knowledge and developing sustainable practices, as well as accepting work for this purpose as a valuable goal in

> itself. It emphasised the importance of inclusiveness in communities of practice, opportunities for the co-construction of practices in the workplace, sensitivity to individual developmental problems in achieving expertise, and the importance of having collegial support, exchange and challenges that enable reflection upon and development of one's own expertise

A new type of approach, such as a UoT will lead to amongst others, the following:

- A technological institution will provide ample scope for growth in knowledge, curriculum design, international cooperation and the revitalisation of theoretically applied higher education in South Africa
- Opening of job markets for students, both nationally and internationally and be in a position to articulate between job markets
- Allow for practical application of theoretical knowledge
- It will create a niche market for a university or institution of technology catering for a specific target market
- Information technology has the potential to make distance irrelevant as it will transcend international boundaries in the light of globalisation and access to knowledge
- By developing a culture of entrepreneurship and focussed application to solutions will drive innovation(Van Eldik and Fowler, 2004: 149-150)

Traditionally, universities were assumed to be the only sites where knowledge was produced. The idea of the workplace as a site for the production of knowledge is particularly appealing to South African policy makers in the context of job creation and poverty reduction. There has been no shortage of policy directives or legislation to encourage transdisciplinary linkages between work and education, such as the collaboration between the Departments of Education and Labour, which resulted in the South African Qualifications Authority (SAQA) Act (1995) and which introduced the National Qualifications Framework. (Winberg, 2006). However, translating policy into practice is a serious problem in the South African context.

The 'situated learning' approach refers to a broad collection of work, which shares an emphasis on the importance of context in acquiring knowledge and skills and acknowledges that different social practices lead to different ways of appropriating and structuring knowledge. For Lave and Wenger (1991) and Billett (1996), knowledge production in workplaces involves participation in 'communities of practice', individuals with different skills and abilities engaged in a common set of tasks, with its associated contexts, traditions, and ways of working.

In making the transition to a UoT, technikons have to realise that their new mandate is to make students critical thinkers with inquiring minds and not merely transmit blocks of information. There are many reasons why UoTs in particular need to promote critical thinking. Universities of technology are beginning to realise that they cannot offer `quick fix' solutions to national industry's lack of competitiveness; and they cannot transform a `low skills' society into a `high skills' one, given their own limitations. Universities of technology are beginning to see themselves as offering a broad and critical education: one that enables students to engage with the consequences of science and its applications, and to question scientific ways of knowing, especially in the context of environmental sustainability and human health (Winberg, 2005).

Another strategy to ensure students are adequately trained within a work environment requires students to integrate experiences both within and outside the academic knowledge systems. Many higher education programmes consider work-related projects and learning contracts to be valid pedagogical tools in a variety of learning contexts. Most professional training programmes include a workshop or training program, which can vary from a few weeks to a few years of practical experience at a site of professional practice. The workplace becomes both as a learning resource and as a site of knowledge production, in many higher education learning programmes. Other universities also present short courses as a way of accelerating key learning outcomes (Winberg, 2006). There is a growing tendency for 'outreach' programmes to become formalised and accredited within mainstream programmes – such as the University of Cape Town's Trade Union Educator's Diploma (DITSELA) – which offers the option for students to progress into a formal teaching qualification (Waghid, 2002). DUT offers a wide variety of short courses in IT, CAD, business and entrepreneurial courses. Other UoTs also run courses and some dedicated departments that coordinate these courses.

Dovet et al's (2001, p386), study in transforming curriculum to a work based course of study at University of Technology Sydney (UTS) revealed several constraints.

- "The politics of implementation of strategic plans, oriented around organizational transformation, are extremely complex and difficult to manage". These include staff power struggles, resistance to change, and inappropriate 'mental models' (assumptions about oneself, others and 'the way the world works').
- The failure of institutions of formal education to develop knowledge bases beyond those of factual and conceptual knowledge. The high status that formal qualifications carry within most organisations, leads to a 'paper chase' that is oriented more towards the acquisition of status within organisations than to the acquisition of knowledge that can transform workplace practices and, thus, organisational performance".

Dovey et al (2001, p389) indicate "work-based projects thus carry important advantages over conventional methods of education:

- third sector (industry) organisations can invest precious resources in education that develops staff members' capacity to solve difficult workplace problems and implement challenging strategic plans.
- universities are able to provide education that is relevant to the needs of third sector organisations.
- students take responsibility for learning that improves their work-related skills and human capabilities, and that is grounded in issues that have intrinsic motivational value for them".

To develop a holistic education that encourages lifelong learning the Australian institutions have recognised the necessity for graduates to have generic skills such as communication skills, interpersonal skills, an appreciation of and capacity to work in culturally diverse environments, problem-solving skills, literacy, numeracy, and the capacity for critical reflection. They need these skills regardless of whether they graduate from Technical and Further Education (TAFE) or higher education. Moreover, ACNielson Research Services (1998, p25) have found that 'there is unlikely to be any difference in the skills sought by employers of Technical And Further Education (TAFE) graduates compared to those of higher education graduates'.

The aim of intensifying and activating the process of instruction these days does not so much call for increasing the amount of the information that is to be transmitted but rather the creation of the didactic and psychological conditions that are necessary for understanding what is taught (Dmitrenko, 2005).

The characteristics of the new context universities are—universalisation, lifelong learning, spreading of the vocational destinations of graduates, the skills and attributes demanded of graduates, employer perceptions, declining resources, and the transformed character of learning and teaching requires the reconceptualisation of tertiary education. It necessitates rethinking the boundaries between higher education and TAFE (Technical and Further Education), and the way in which students progress through education. It has implications for curriculum, and the way in which courses of study are constructed (Doughney, 2000)

While the new century affirms the importance of education, there are worrisome tendencies woven within its fabric. How can we unite to affirm basic education as a human right, transcendent of the economic purposes it serves? How can we manage, or regulate the opportunities and dangers posed by the growing private industry of further and higher education? How do we uphold the integrity and purpose of public further and higher education in this context? What solutions can we put in place to retain skilled professionals in developing nations? How can we ensure that socially useful knowledge is not inaccessible, due to the marketisation of ideas through intellectual property rights? One of the most daunting challenges as we join the 21st Century is the complicated area of values in education (Coady, 2000; Department of Education, 2000).

According to Rhodes and Shiel (2007), critical reflection will promote the awareness of the workplace as a learning environment and thereby enhance learning abilities. Argyris (1993, 1995) further asserts that knowledge creation and learning are initiated by confronting the status quo by means of critical inquiry and reflection. Individual learning is therefore a process of critical reflection on the daily work tasks followed by a change in the established way of knowing or doing things, resulting in new knowledge. Cunliffe (2002) suggests that by questioning the self, others, theory, knowledge, reality and ideology on different levels we might become more critical and responsive practitioners.

5.3 TOWARDS A NEW HIGHER EDUCATION LANDSCAPE

The new Higher Education landscape in the developed world has changed considerably over the last decade. The environment has placed enormous pressure on institutions to change or risk becoming irrelevant. The study revealed many universities in Europe and Australia have realigned their institutions to integrate entrepreneurship, technological leadership, innovation in their research, teaching and learning, to accelerate knowledge transfer in society and the world of work,

5.3.1 Reconfiguring the Higher Education Landscape in South Africa

At the Higher Education level, the need for change emphasised the move towards to a unified system with equitable distribution of access – overshadowed demands for curriculum reform or need (Breier. 2001: ix).

According to Imenda (2005: 1408) education reforms in South Africa rest on three sociological foundations:

- Promoting diversity of access routes sensitive to different educational backgrounds of individuals
- Getting involved with communities outside the physical boundaries of HE institutions
- Defining and meeting key social relations by education taking place at various sites and in formal and non-formal and even informal settings; in and out of school environments. The sociological consequences of these educational reforms are that the environment at large represents the “classroom”, thus a very active inter-relationship between the learning and real-world environments.

Imenda (2005: 1412) described the three different types of universities in the South African higher education landscape. He outlined the distinct characteristics of each university type in the table below namely the Traditional University, Comprehensive University and the Universities of Technology.

Table 5.1: Models of South African universities, purpose and knowledge production focus

Institutional type	**Primary focus**	**Purpose**	**Knowledge production focus**
University	Philosophical	Ideational and Liberal	The pursuance of knowledge for knowledge's sake Cultivating an educated citizen Cultivating wisdom Research in basic disciplines Social Responsibility: promoting access, redress and equity Cross-disciplinary research Addressing and solving the problems of the community Traditional University
Comprehensive University	Professional and Managerial	Ideological and Functional	All-round humanistic education, encompassing professional qualifications Unity of research and teaching Cross-disciplinary research Social Responsibility: promoting access, redress and equity Research in applied and basic disciplines. Addressing and solving the problems of the community Combination of Traditional and UoT type courses
University of Technology	Vocational and Technical	Functional	Professional and career education - driven by market forces and entrepreneurialism Cross-disciplinary research with a research and development focus Social Responsibility: promoting access, redress and equity Addressing and solving the problems of the community Emphasis on applied research Emerged mostly from the former Technikon sector

Adapted from Imenda, (2005: 1405).

Imenda (2005: 1415 – 1416) describes the salient features in Table 5.1.

- Academic freedom (i.e. freedom of teaching; academic self-governance) has disappeared
- Addressing and solving the problems of the community is a common attribute of all the three university types in South Africa
- Social responsibility is also a common aspect of education in all the three university types

- Research in basic disciplines transcends both the universities and the comprehensive universities, but is absent in the universities of technology.
- Cross-disciplinary research is a feature of all the three educational types, as a result of government expectations which require that South African universities to be relevant to their communities, and help solve societal problems. Even at lower levels, the school curriculum talks about cross-field educational outcomes.

5.3.2 Overcoming Structural Issues in Higher Education

If we accept the features of the higher education landscape, then it is clear that universities will have to respond to changes by adapting to them. This response could explain the evolution of differentiated types of universities which address different social, political, economic and technological needs of the country and community

Universities are organisations which often represent paradoxes, dilemmas, and conflicts between our ideals of creating learning-oriented organisations and the obstacles inherent in the ethos and traditions in a university. On the other hand, academics work in institutions that rarely practise the simplest tenets found in the theories of learning organizations (White and Weathersby, 2005). They identify (p 292) the problems as “the culture of institutions of higher education is full of examples of competitive ratings and rankings, acceptances and rejections, and authoritarian and hierarchical structures – departmental, school, and university-wide, that shape our lives”. Universities, like the church and the military have historically been rigidly hierarchical, resistant to change, and structurally stable. For example DUT, has been managed through highly centralised and hierarchical structures. These have over time become resistant to change. They have also usually been led by conventionalists who prefer to wield influence through positional power. When the external environment started to change, for example when the DUT was classified as a UoT, the institution completely ignored this important event even though it had enormous legal and academic implications and requirements to become a fully fledged university. This avoidance attitude can be attributed to poor leadership and a large bureaucracy that had difficulty in accepting change. This ultimately led to instability in management and the early exiting of the CEO.

It is difficult for higher education institutions to cope with adaptation and innovation. First, educational organizations are notoriously slow to change. Dynamic leadership is required in employing governance structures more characteristic of learning organizations, e.g. faculty task forces and other consensus building initiatives, to support curriculum innovation and enhance the institution's financial viability and responses to changing external environments (Drugovich et al., 2004).

Academic life often fosters autonomy, competition, critical judgment, intellectual scepticism, power distance and self-interest. In practice, a surprising number of values of academic life are antithetical to the values and ethos of a learning organization community. Embedded within the ideal of community is a spirit of cooperation, compassion, acceptance, egalitarianism, common vision, mutual respect, and concern for the group. Values of a learning organization, which would in its ideal have many of the same characteristics as a community, include growth and development, openness, risk-taking, innovation, change, flexibility, collaboration, and interdependence (White and Weathersby, 2005). Universities have been traditionally built on the basis of differentiation based on disciplines and specialist areas. Cooperation and interaction across disciplines are more exceptions than common practices. There are strong forces that encourage specialisation and thereby perpetuating the discipline divide. This goes against the grain of community learning, openness, and transdisciplinary learning which are characteristic of a learning organisation. UoTs have flagged this handicap and have adopted transdisciplinary learning to break the silo approach of teaching and learning.

5.3.3 Model for a UoT

The Van Eldik and Fowler's (2004) model was designed as a framework for application in the Southern African context and developed around four key principles, namely, specialization in application, leadership in and through technology, the promotion of innovative and entrepreneurial culture and the formation of active partnerships.

5.3.3.1 Specialization in Application

Specialization in application is a fundamental approach that exploits useful knowledge to become applicable and be to the benefit of communities, government, industry, and to the socioeconomic development of the country.

It is also a trans-disciplinary and problem-solving approach that cuts across a wide variety of disciplines in search for the best application and solution possible, thereby increasing international competitiveness and thus contributing to prosperity and improved quality of life. This approach permeates education, research and development, as well as community programmes.

A discipline in application of knowledge, challenges an institution to become a learning organisation. As such educational programme, research and development, as well as community activities need to ensure that participating students will, indeed, master extensive knowledge and skills they can apply, as well as an internalised ethos to make knowledge more useful. As knowledge workers they need to become the next generation of knowledge producers who will be able to challenge the problems and opportunities within the developing environment in an innovative and entrepreneurial manner.

Research and development are both academic functions. A well structured research and development initiative, geared to meet the growing needs and priorities of South Africa, supports repositioning of a few institutions in the technological niche market. To ensure application and problem-solving close links with trade and industry are fostered and trans-disciplinary research and development focus areas allowing for teamwork, both nationally and internationally have resulted at a number of institutions.

5.3.3.2 Leadership In And Through Technology

Current trends in knowledge and information technology indicate a major shift towards creative utilization thereof. The challenge is to be a key player in the practice of technology within its education, transfer methods, research and development as well as community upliftment activities. It entails leadership in the application of technology, leadership through the utilisation of technology

- **Leadership In The Application Of Technology**

Staff and students are to demonstrate, not only mastery of relevant and modern technology, but are also to contribute, through the practice of technology, to the various steps of technological innovation - from the start of an idea or concept to the diffusion of technology and successful commercialisation of the product or service. Initiatives are to cut across the spectrum of the sciences and at various appropriate levels, linked to current and future needs. Staff and students should not only be able to demonstrate their mastery of technology, but also contribute to the various steps within technological innovation, right from the start of an idea to the implementation phase or successful commercialisation of a product, process or service .

- **Leadership through the utilization of technology**

It is crucial that the utilisation of technology forms part of the institution’s strategy and is cascaded into the organisation’s key performance areas. It should form the core of the delivery of academic programs and support structures and processes.

In practical terms it means the integration of information computer technology (ICT) in for example, data warehousing, linking of local and regional internet and intranet networks, technology enhanced learning as part of multi-mode program delivery and ICT in research and development (Van Eldik And Fowler, 2004: 150-151).

5.3.3.3 Promotion of Innovation and Entrepreneurship Concepts

Concepts of Innovation and Technology Transfer include, inter alia, the following:

- Human potential development through appropriate entrepreneurship curricula in educational programmes
- Enhancing research and development related activities and 'spin-off's' such as patenting, licensing, commercialisation and marketing of intellectual property, as well as R and D results in the form of products, processes and services.
- Promoting, and marketing a corporate culture for innovation, entrepreneurship and technology transfer.
- Developing appropriate policies, strategies and models for innovation and technology transfer.
- Promoting and developing knowledge and technology intensive enterprises.
- Participating in the establishment of technology and business incubators and related support structures (Du Pre, 2009; Van Eldik and Fowler, 2004; Strategic Information and Planning 2000).

The formation of an innovative and entrepreneurship culture is a prerequisite for innovation and entrepreneurship to take firm root. It will have to feature prominently in the institution’s strategic plan and clearly articulated as a key performance indicator with targets. The key performance indicator would drive the marketing and branding exercises.

5.3.3.4 Partnership

To advance the all the goals of a university of technology will involve many stakeholders that will enhance knowledge and its application in innovative ways. These partnerships take the form of closer regional collaboration and cooperation amongst institutions to promote mutual endeavours and benefit. On the international front, partnerships foster learning from international experiences and applications that can be adopted and adapted for local needs and environment. Also the recognition of local qualifications by international institutions will improve the reputation of local institutions.

5.3.4 Parameters for Attributes, Criteria and Functions

To create a UoT model, it is necessary to define the four mentioned pillars and to analyze them in terms of markers and benchmarks typifying the type and nature of the institution. This provides information in terms of targets and standards that will help institutions to assess their progress towards becoming an institution of technology.

Van Eldik and Fowler (2004: 159) proposed a model in which “pillar” is elaborated as Properties. Each of these Properties are further analysed to determine inherent attributes, resulting in “Attribute” category. Lastly each “Attribute” is broken down into criteria. These criteria serve as practical and functional purposes in concretely describing the requirements for a UoT. Flowing from this review which forms the theoretical foundation representing the constructs, the attributes and goals will be built on, forming the pillars of the UoT.

5.4 SUMMARY OF ENVIRONMENTAL DEMANDS ON HIGHER EDUCATION AND RESPONSES FROM THE LITERATURE CONTRIBUTING TO HIGHER EDUCATION DEVELOPMENT IN SOUTH AFRICA

5.4.1 The View of the SATN

5.4.1.1 Background

The background to publication “The Place and Role of Universities of Technology in South Africa” arose from the designation of Technikons as UoTs by the DOE in October 2003. In 2004 the Committee of Technikon Principals (CTP), at its last meeting of its existence, proposed the formation of a network of UOTs. This was accepted in 2005 and was named South African Technological Network (SATN). It was envisaged that the discussion and proposals were to be fed into HESA (Higher Education South Africa).

In February 2004 it became apparent that there was little information on what constituted a UOT in the South African context. CTP requested the Committee for Tutorial Matters (CTM) to form a task team led by Professor Roy Du Pre to investigate the position, role and functions of UOTs in South Africa. This formed the basis for the book. “The Place and Role of Universities of Technology in South Africa”. In 2008 the South African UOTs partnered with Finland’s UOTs to develop Performance indicators for UOTs in South Africa, which was also included in the 2009 version of this book. Both versions were authored by Du Pre.

In section 1 of the book the author sketches a detailed argument for the establishment of UOTs. The main themes through which he addresses teaching, learning and research, are the growth in knowledge, leadership in technology, application of knowledge, and partnerships with wider society.

He highlighted certain weaknesses in Higher Education systems, the main one being that many people with degree qualification find that these qualifications are not relevant to the needs of the market. In developing a new landscape for Higher Education, this needs to be seriously addressed through the formation of a new type of university. He advances an argument for the establishment of UOTs in a unitary but diversified Higher Education structure with particular emphasis on making knowledge useful, work integrated learning, community engagements, and “just in time education”.

Du Pre (2009:15) explores the history and definition of a university and eventually offers his definition of a UOT.

"At a technological university the focus is therefore on the study of technology from the viewpoint of various fields of study rather than a particular field of study"

5.4.1.2 Four Pillars of a UoT

The author describes 4 pillars on which the UOT concept rests. They are identified and discussed below.

- **Teaching and Learning**

  Qualified graduates must be able to function optimally in the world of work. This means strengthening the work integration learning initiatives. The introduction of flexible leaning models is proposed as a means of broadening access e.g. the introduction of a four year undergraduate program.

  Entrepreneurship should be encouraged to build capacity in students to be innovative and to seek ways of commercialising their products. Partnerships are formed with industry and with various agencies to enhance academic programmes.

- **Research and Development**

  Du Pre (2009:30) questions the need for many high quality research centres and its affordability, especially when one considers that many students cannot afford the "Mercedes" facilities and therefore offers an alternative to more practical types of institutions i.e. UoTs, which are able to concentrate on applied research.

- **Leadership in Technology**

  UOTs should participate in patenting, commercialization and marketing of intellectual property. Development of technology and innovation is an important role in Research and Development for UOTs.

- **Technology Transfer and Innovation**

  UOTs should not only be generating new knowledge but seek to apply and utilize knowledge and technology for new products, processes and services. To promote a culture of technology in innovation and technology transfer among staff and students, technology needs to be integrated into learning programs. Research and Development needs to be described in terms of number of patents, licenses, spinout companies and financial benefits. These initiatives need to be supported with incentives, resources, support services and systems to drive technological innovation.

5.4.1.3 Challenges

In section 4 of the book the author outlines the key challenges facing UOTs. He focuses on strategies that need to be employed at a macro level and program level to mirror the characteristics of a UOT.

The non subsidy for WIL seriously disadvantages the UOT sector in terms of its financial sustainability. The restriction by the DOE on UOTs to limit postgraduate degrees will deprive UOTs of much needed subsidy. The Minister expects SET enrolment of UOT to shift to 50%. This requires a large amount of resources for this to happen.

The issue of the type of research that emanates from UOTs need to be addressed since certain categories of research are not considered for funding purposes. There is acknowledgement that there are other modalities of outputs, especially technology oriented outputs. A broadening of the traditional understanding of research output is needed.

On a program level UoTs will require a transdisciplinary program design (e.g. between graphic design and information technology) and interdisciplinary programs (between various subjects). All programmes should have an entrepreneurial, technological and WIL focus. Programmes should integrate basic research components to build a foundation for problem solving and applying knowledge to find solutions.

The book reports on the Performance Indicators Project that was jointly carried out with the Finnish UoTs. This gives more details on the performance indicators of a UOT. This is discussed extensively later in this research.

Many of these challenges have been taken up by the SATN to lobby Government and other partners in Higher Education sector.

5.4.1.4 Assessment

This book provides a comprehensive view of the SATN. It provides a very good basis for transforming the UoT sector and negotiating with DOE and other stakeholders in adopting the many proposals that were outlined. However, it is not meant to be a plan, it also does not exhaustively address the underlying philosophy and constructs at work and that is why it is difficult to see the full system and its interacting drivers at work.

This research seeks to complement this book by providing a set of principles to provide a holistic model.

Table 5.2 summarises the findings from the literature review in addressing the powerful forces and needs that have arisen from the global and national environment.

Table 5.2: Summary of Findings from the Literature Review in Response to Environmental Demands

NEEDS AND DEMANDS OF THE ENVIRONMENT ON HIGHER EDUCATION ESPECIALLY UoTS	RESPONSES ARISING FROM THE REVIEW
1. Need for fundamental change to Higher Education given the forces for change in the global environment e.g. growth in knowledge, fragility of the natural environment, competition, need for economic growth etc	• The National Commission for Higher Education report (2001) recognised the High-level skills training: training and provision of person power to strengthen the county's enterprises, professionals and knowledge workers with globally equivalent skills, but who are also socially responsible and conscious of their role in contributing to the national development effort and social transformation. • Production, acquisition and application of new Knowledge drives national growth and competitiveness and is dependent on continuous technological improvement and innovation, driven by a well-organised, vibrant research and development system which integrates the research and training capacity of higher education with the needs of industry and of social reconstruction (Van Eldik and Fowler, 2004.
2. Generation and transfer of new knowledge to solve real world problems	• A liberal to a professional education • Inner to outer directed foci • Move away from finding knowledge for the sake of knowledge to applicable knowledge • Institutional autonomy to partnerships and networks • Self-reliance to business with/amongst others • Face-to-face tuition to technology enhanced flexible learning • A hierarchical organisational to flatter, diverse structures • Homogeneity of skills to greater heterogeneity and diversity • Move from competition to collaboration and cooperation (Lategan, 2005; Van Eldik and Fowler, 2004)
3. Innovative solutions to society	• Conceptual knowledge impacts on the level of organisational innovation. Further the depth and diversity of knowledge affects the likelihood of innovation occurring to stimulate innovation and creative thought. • The notion of impact is crucial when discussing idea generation and learning capability, because impact means a new idea has affected customers, financial performance, and/or employee performance. • The quality of leader-member exchange was a significant predictor of employee development and innovation, and Axtell et al. (2000) found that employees with more supportive managers were more likely to have their ideas implemented. • Baer and Frese (2003) found that climates for initiative and psychological safety were positively related with process innovations and firm performance. • Symbiotic leadership, culture, multifunctional workforces, all show positive correlation with learning and innovation (Van der Sluis, 2004).

NEEDS AND DEMANDS OF THE ENVIRONMENT ON HIGHER EDUCATION ESPECIALLY UoTS	RESPONSES ARISING FROM THE REVIEW
4. Technology transfer	• Technology, therefore, has to do with the skill of creating or fabricating things. Institutions of learning that operate on the terrain of technology will pride themselves in providing an education aimed at empowering students with the required technological skills to maximize opportunities in the work situation, to assist in wealth creation for the country and thereby in prosperity for all. • Described as systematic utilisation of available knowledge and skills residing in people for the development and implementation of useful products, processes and the rendering of services, contributing towards economic prosperity and an improved quality of life.

5. Demand driven curriculum, teaching and learning
 	
6. Curriculum Design reflect demands of industry and incorporation of ‘just in time education”
	• Partnerships and collaboration with industry and community to accelerate knowledge transfer
	• International partnerships to share knowledge and expertise
	
	• **Competencies of students would include**:
	  o field-related knowledge;
	  o the capability to design and understand a complex system;
	  o the social competence needed to actively participate in group work together with the stakeholders including the ability to:
	  o analyse potential stakeholders and their specific competences (i.e. design a “stakeholder map”); and
	  o set up of a “participation road map” for the various actions needed in the cooperation between science and the different stakeholder groups at the various stages of the problem-solving process.
	• the capability to responsibly choose and apply the appropriate problem-solving methods including:
	  o the construction of variants for a consistent future development together with their evaluation; and
	  o the design of an “implementation action plan” for further steps toward the realization of promising variants together with the responsible stakeholder (Steiner and Law, 2006).
	• **Learning when planning, learning at work**.
	  • The first is the learning context. Contexts like workplace and schools have their specific histories and cultures of knowledge and expertise. These cultures have ways of meaning-making typical to them. At workplaces, especially, some knowledge is implicit only and embedded in orders of artefacts.
	  • The second aspect that Guile and Griffiths (2001) underline about learning is the active mediation of different kinds of knowledge and experience as well as mediation of their relations as a central feature of learning through work. Accordingly, learning is seen as a purposeful process where learners transform meanings, identities, artefacts and contexts.
	  • The third idea is the importance of participation in social practices, i.e. membership of communities of practice that allow the expansion of knowledge by asking questions and resolving problems.
	  • The fourth idea is linked to the purpose of work experience

NEEDS AND DEMANDS OF THE ENVIRONMENT ON HIGHER EDUCATION ESPECIALLY UoTS	RESPONSES ARISING FROM THE REVIEW
	and its usefulness as a pedagogic approach. Ideally, work experience supports learners to become progressive experts able to use their experience to create new knowledge and better practices. Experience is the basis for experts' reflective action (Griffiths and Guile, 2003). • The last idea sets demanding tacit criteria for the dialogue between supervisors, students and experts in the workplace. It presupposes a shared will towards expanding knowledge and developing sustainable practices, as well as accepting work for this purpose as a valuable goal in itself.
7. Entrepreneurship	Three types of entrepreneurial entities can be identified within Australian universities: • Pure entrepreneurial entities – spin off companies and joint venture partnerships and research centres attempting to make a profit usually by developing patents and products from research, although some are engaged in teaching (Productivity Commission 2002; Australian Research Council et al. 2000). • Semi-entrepreneurial entities – research centres and academic units (departments, faculties and schools) using entrepreneurial techniques like innovation, risk taking and industry partnerships to generate more revenue, not necessarily to make a profit. • Public funded entities – academic units and administrative units that rely on public funding. Here it is observed that although there are some academic units and administrative units such as International Student Units, and Commercialisation Units that are engaged in entrepreneurial activities. • I**ntegration of entrepreneurship in curriculum**: Curriculum is designed to integrate entrepreneurship as a program to build a entrepreneurial culture so that students are able to start their businesses
8. Increase research and ability to discover new knowledge and innovation	The Department of Science and Technology commissioned a conference Human Resources for Knowledge Production in South Africa Conference in June 2005 to address the issue of knowledge production. The plan adopted is summarised below: • Recruitment and retention of high-level scientific and technological personnel, and the promotion of partnerships between universities, research councils and industry in support of this agenda. • Careful attention to the support of advanced study, to its form and content and appropriate incentives. • Linking the research agenda to national priorities, and allocating funding accordingly. • Increasing national investment in research in ways that also leverage quality overseas and domestic involvement. • Promoting South Africa's role in Africa as a leader in scientific research for continental development. • Engaging with scientific globalisation so that South Africa becomes a hub in appropriate research areas, and attracts talented researchers

NEEDS AND DEMANDS OF THE ENVIRONMENT ON HIGHER EDUCATION ESPECIALLY UoTS	RESPONSES ARISING FROM THE REVIEW
	(Department of Science and Technology, 2005b). • Create a research culture • Increase the enrolment of masters and doctorates students • Capacity building of potential researchers

5.5 SUMMARY

This chapter investigated the features of a UoT and its value in a knowledge environment and economy and how the characteristics of entrepreneurship, innovation, technology are integrated in practice. It delved into the pedagogies and analysed the type of learners that the modern university have to cater for. This analysis calls for dramatic shift from the traditional methodologies to one of integrating approaches that will engage the new generation of learners that seek to be active participants who require the use of technology in applying knowledge and expecting immediate feedback. UoTs are important links in providing solutions in redesigning its education systems to meet these new demands. Its ability to build a culture of innovation enhances the country's economic development and competitiveness in the global landscape.

To progress to a point of determining the performance targets and indicators, the characteristics or attributes of a UoT are described in terms of criteria and each criterion are further described by requirements of a UoT. These criteria are then defined by performance indicators which represent standards or targets for an institution to assess their progress. This issue will be studied in the next sections.

CHAPTER 6
PRESENTATION AND DISCUSSION OF ETHNOGRAPHIC RESEARCH FINDINGS

6.1 INTRODUCTION

This chapter contains the research findings and data. The presentation is presented as follows. First, UoT data are presented to show various trends over time. Data category 1 contains the data findings from the ethnographic studies (interviews, observations and documents) carried out overseas. Data category 2 contains the findings from the interview conducted with South African experts from the SATN task group (South African Technological Network). The third data category constitutes data from the focus groups.

This chapter contains the results and discussion of the research conducted in Germany, Switzerland and the UK. The purpose of categorization of the research is because the guideline questions for Data Category One are different from the set of questions used for Data Category Two. This assisted in the presentation and understanding of the research.

6.2 PROFILE OF UoTS IN SOUTH AFRICA

In the new reconfiguration of the higher education sector in South Africa, it became clear that though the CHE (Council for Higher Education) proposed a unitary system, there were differences in the typologies of universities and Technikons. In 2002, the now defunct CTP proposed that a sub-committee investigate the concept of a UOT to determine its associated classification/categories of such a University in light of the opportunities afforded by CHE's Size and Shape Report (2000). Three supposedly distinct types of institutions emerged, namely UoTs, Comprehensive Universities and Traditional Universities. Comprehensive universities mostly arose from mergers of a university and a technikon. However not all such institutions were created through such mergers e.g. University of Zululand is a comprehensive which was not subject to a merger. Comprehensive Universities should offer both UoT and traditional university programs. The UoT type courses include cooperative education as a component of the program. Traditional universities refer to Rhodes University, University of Cape Town, University of Witwatersrand, University of Stellenbosch, University of North West, University of Kwa-Zulu Natal, University of Free-State, and University of Pretoria. UoTs referred to in this study are affiliated to the SATN. They comprise of Durban University of Technology (DUT), Mangosuthu University of Technology (MUT), Vaal University of Technology (VUT), Tswane University of Technology (TUT), Cape Peninsular University of Technology (CPUT) and Central University of Technology (CUT). In this configuration Technikons were trapped with its history as a Diploma offering institution and now reclassified as a UoT. It is now expected to perform as a university. This dilemma forced UoTs to seriously assess their mission and goals, in line with external environmental forces. These forces were characterized by a high rate of technological advancement and the need to develop partnerships with industry and community structures. To regain their competitive advantage and build on the strengths of Technikons, it was necessary to determine their key deliverables that could distinguish the UoT sector from Traditional Universities. The DoE funding formula is designed to reward performance of institutions through graduation rates and research outputs. However the performance indicators for UoTs do not take into account the complete methodology of how students are skilled, for example the whole issue of Work Integrated Learning which does not carry a subsidy component. Similarly, the question of what constitutes research at a UoT does not include patents, innovation, technology stations, and intellectual property rights.

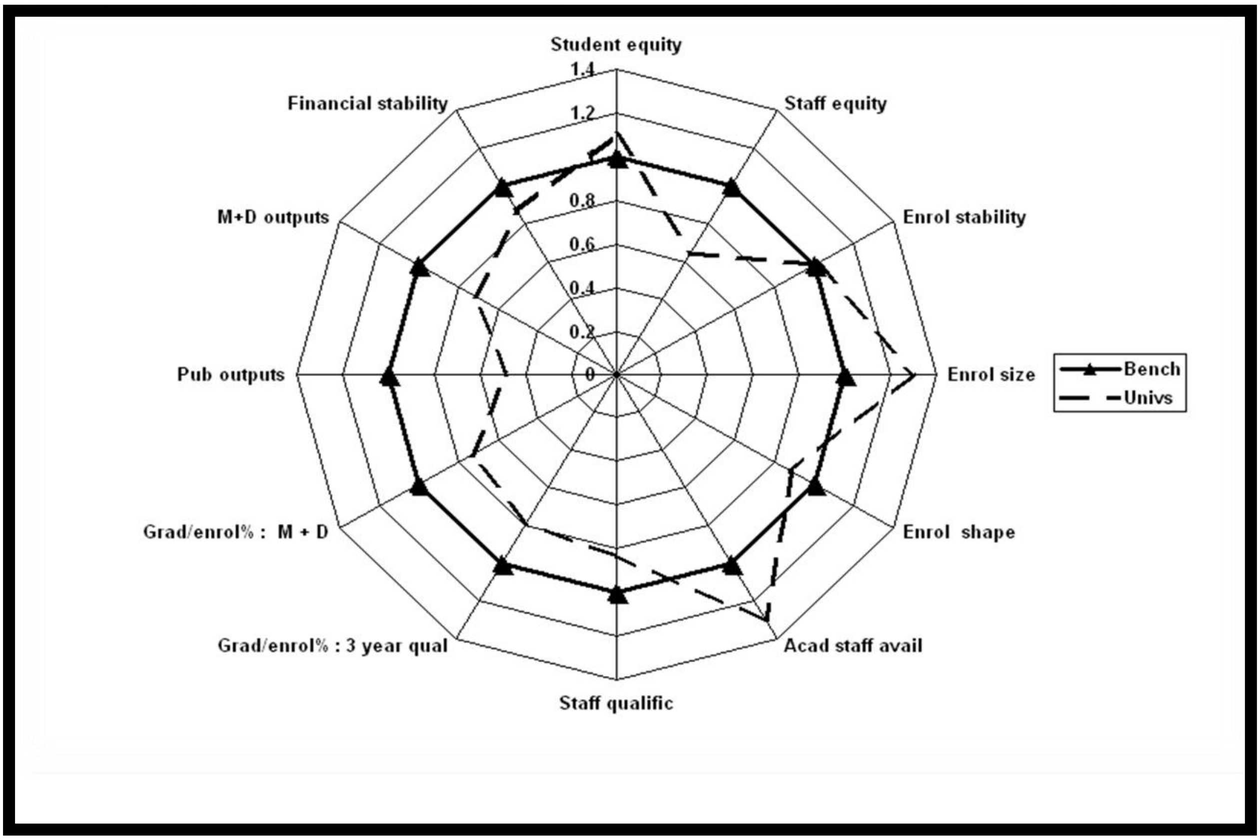
This study will utilise the outlined research methods to investigate and determine the characteristics and attributes of UoTs and their unique contribution to the Higher Education landscape, in the context of a social system, while harnessing the benefits of knowledge application, technology and innovation to solve specific problems through partnerships with industry and society.

Our starting point is to establish where UoTs are positioned presently, in terms of its students, graduates, research, partnerships etc.

6.2.1 Norms and Averages for Universities

The radar graph below captures the macro position in terms of averages from universities in South Africa.

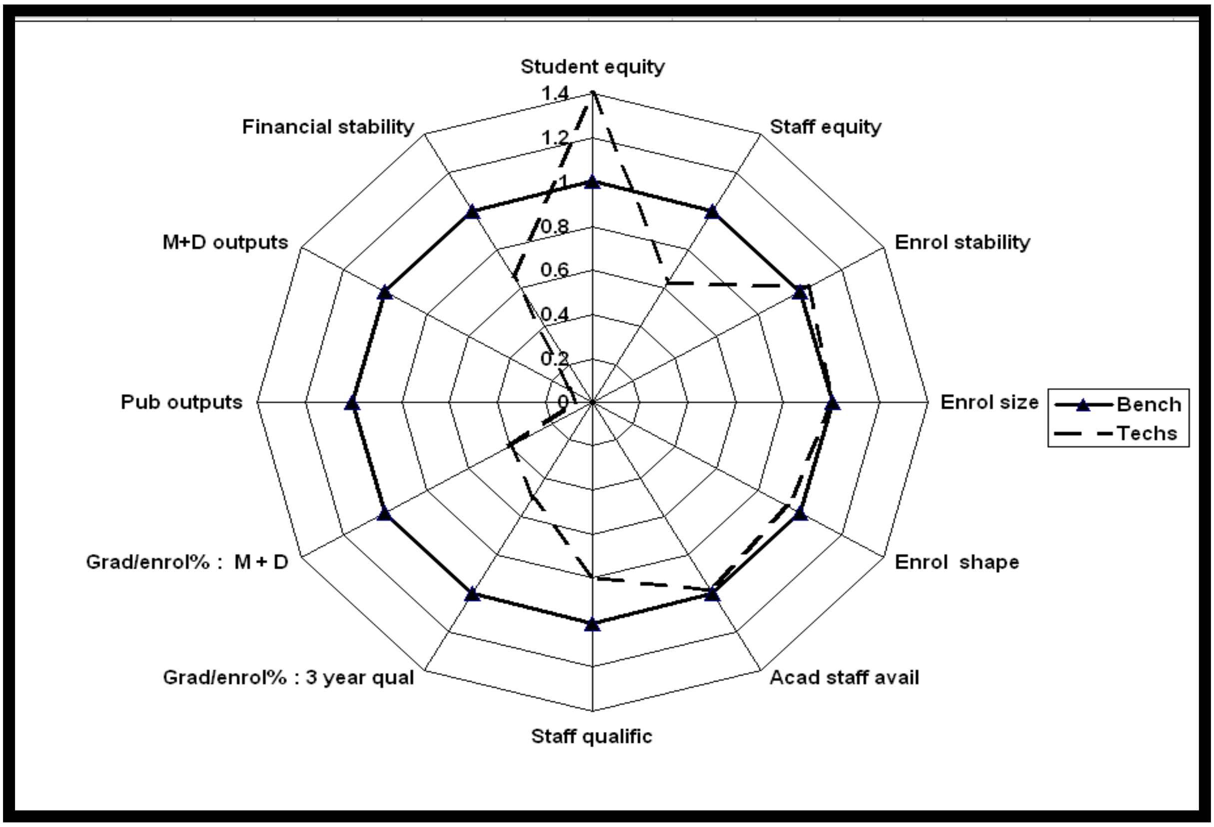
Graph 6.1: Norms and Averages for Universities



Radar graph norms and averages for universities (www.satn.ac.za) - 2001

The Graph 6.1 has the DOE benchmarks for universities in South Africa. This is indicated with a solid line. The broken line refers to the average actual outcomes of the universities. Of significance to this research is the gap between the DOE benchmarks and actual results in key areas of financial stability, Masters and Doctorate outputs, Publication output, Graduation to enrolment percentages in Masters and Doctorates, Graduation to enrolment percentages for 3 year qualification and staff qualification. These areas are core to the main strategic objectives of what a university should be doing.

Graph 6.2: Norms and averages of Technikons



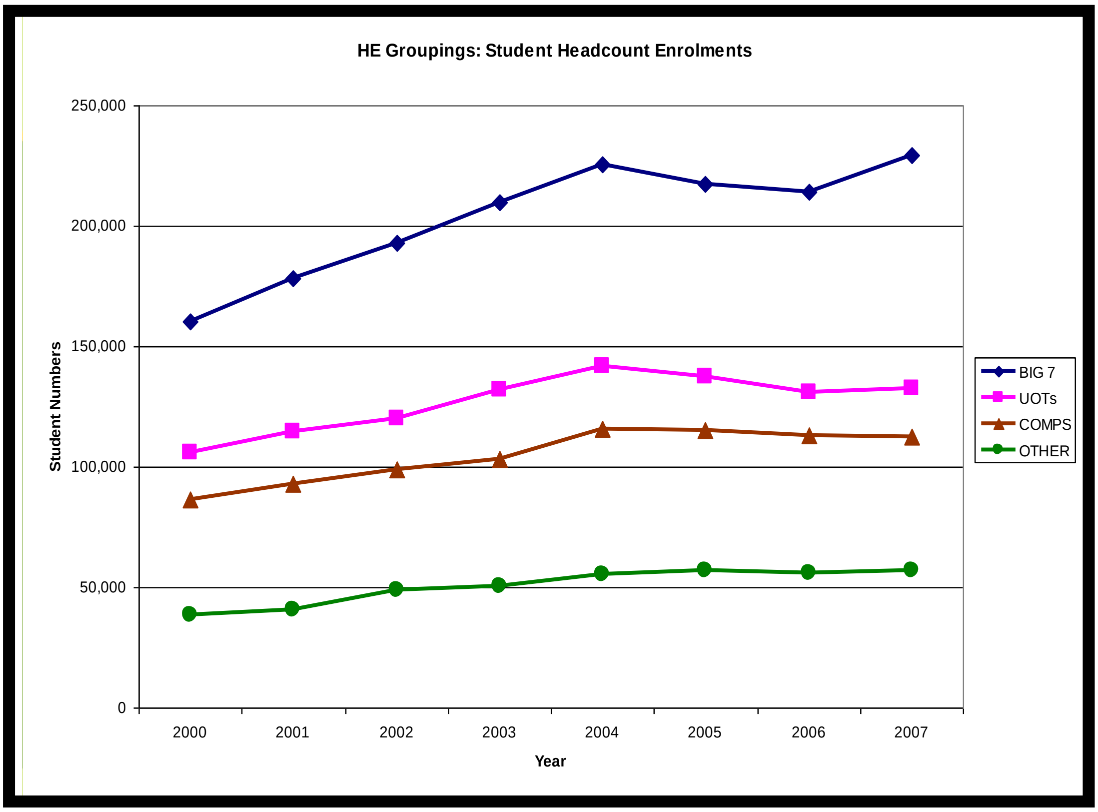
Radar Graph: Norms and averages of Technikons (www.satn.ac.za)-2001

Graph 6.2 indicates the DOE benchmarks for the Technikon sector. Of significance is the gap between the benchmarks and the actuals outcomes in the categories of financial stability, Masters and Doctorate outputs, Publication output, Graduation to enrolments percentages in Masters and Doctorates, Graduation to enrolments percentages for 3 year qualification and staff qualification. This mirrors the norms of the university outcomes in Graph 6.1. Technikons fall short in terms of these benchmarks.

Clearly, this indicates a severe problem for most Higher Education institutions in that they appear to be unable to meet the minimum benchmarks.

According to the above diagram Technikons had however achieved the benchmark of enrolment size and enrolment shape and student equity. This is an average position and therefore, there may be individual institutions that may have not reached these benchmarks.

Graph 6.3: HE Groupings Student Headcount Enrolments

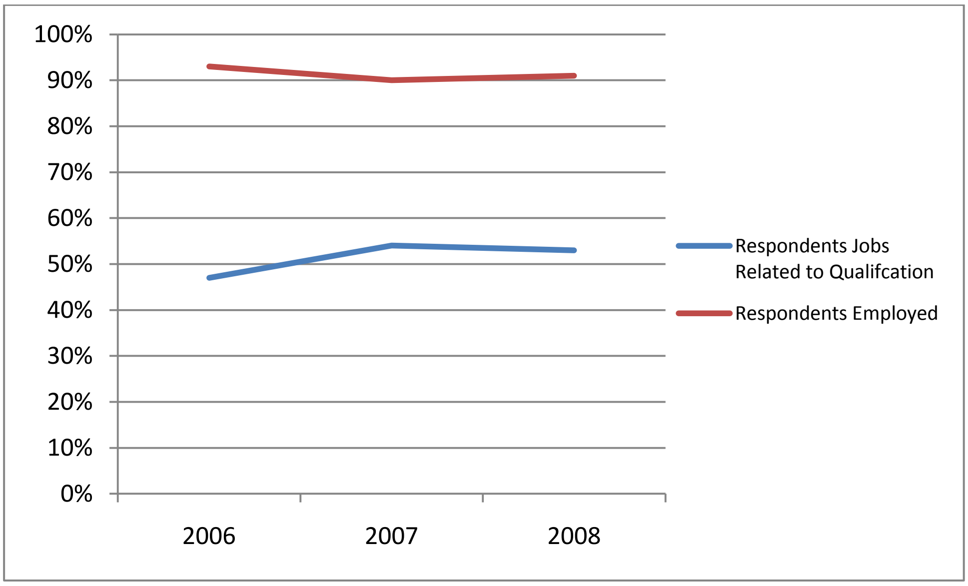


www.satn.ac.za

The Traditional Universities are referred to as the Big 7 and they also constitute some of the oldest universities in South Africa. The UoT sector is the latest addition to the university sector, having being converted from Technikons to Universities of Technology. Comprehensive Universities are a new type of university that should offer both Traditional University and UoT courses. They tend to display characteristics of both types of institutions.

The UoT sector has the second largest enrolment in the Higher Education sector, after the Traditional Universities. It is therefore, an important component of Higher Education, with a combined total of 125 000 students, growing from just over 100 000 students in 2000 to about 125 000 in 2007.

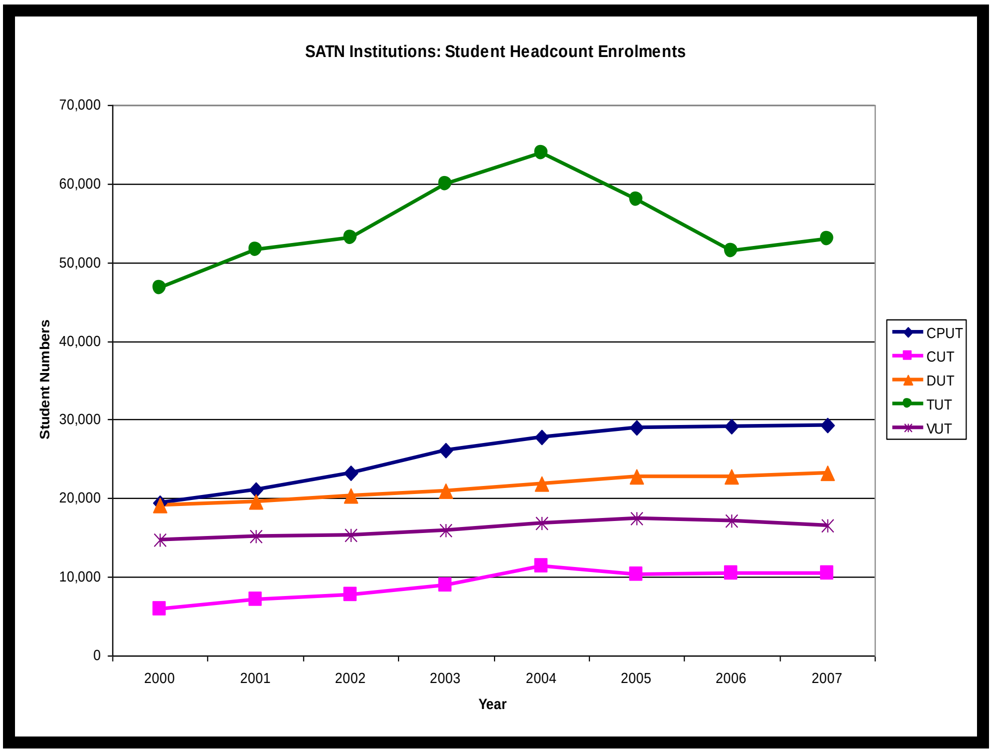
Graph 6.4: Graduate Survey – Estimated Employment Figures



(www.satn.ac.za)

Graph 6.4 indicates there appears to be a significant gap in those who have the appropriate relevant qualification and those who are employed. This gap can be attributed to the lack of experiential training in the qualifications of students, and difficulties experienced in entering the world of work. Many traditional universities have very little, or no work integrated learning and this does place them at a disadvantage in certain disciplines.

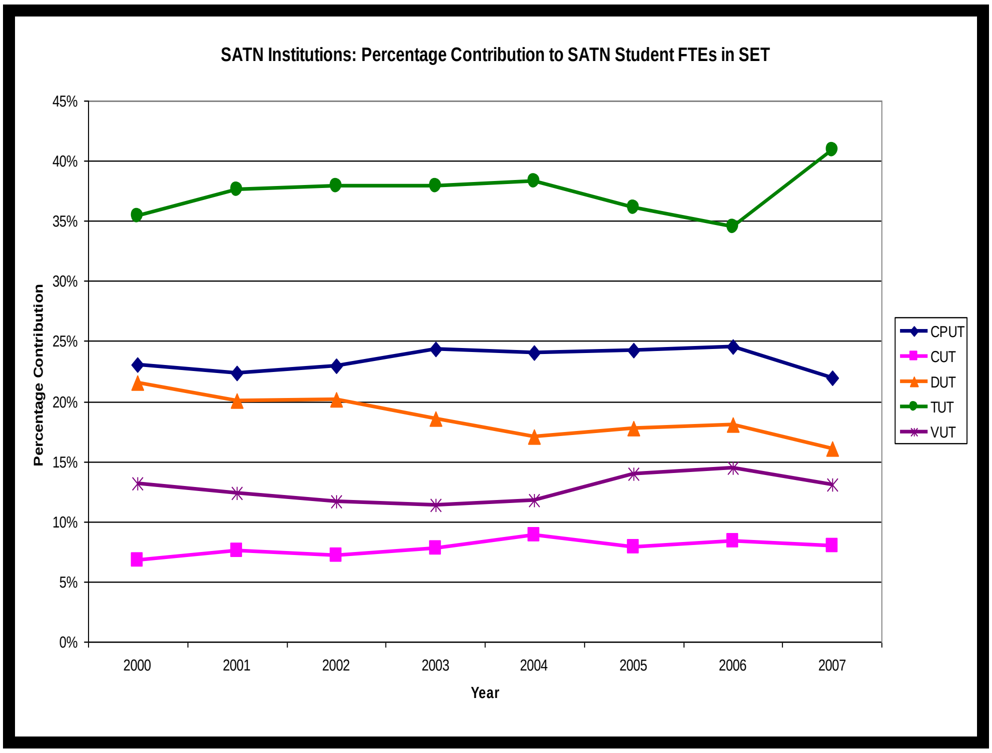
Graph 6.5: SATN Institutions – Student Headcount Enrolments



www.satn.ac.za

This graph indicates the enrolment trends in the five UoTs. Enrolments have been capped by the DOE, hence the plateau in the enrolments from 2005 to 2007. The observation here is that due to the poor graduation rates, lack of capacity, instability caused by the restructuring, this capping was introduced to allow universities to improve the pass rate of the present cohort and stabilise the respective institutions.

Graph 6.6: SATN Institutions – Percentage Contributions to SATN Students FTEs in SET

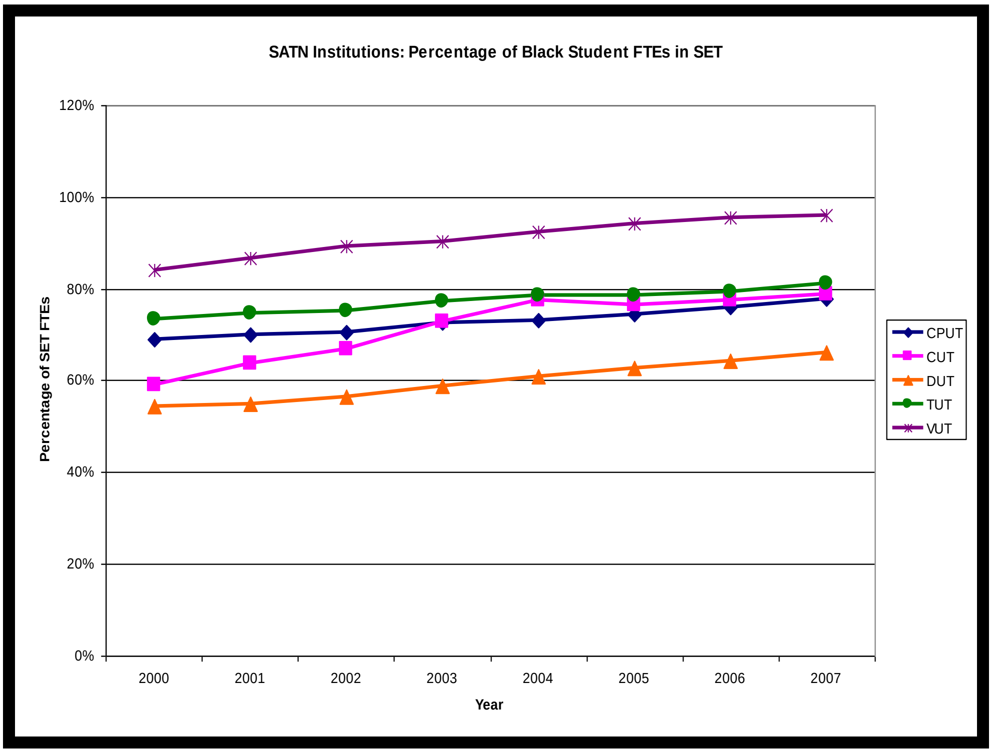


www.satn.ac.za

The DOE has set a target of 50% of FTEs to be in the Science, Engineering and Technology disciplines. Presently, the actual figures indicated here show the comparative contribution of each of the SATN UoTs to SET. CPUT shows the highest proportion of FTEs in SET, followed by DUT, then VUT and lastly CUT. However, DUT tends to show downward trend. The graph does not show the percentage of students within each institution that are enrolled in SET, e.g. DUT has approximately 50% of its students enrolled in SET.

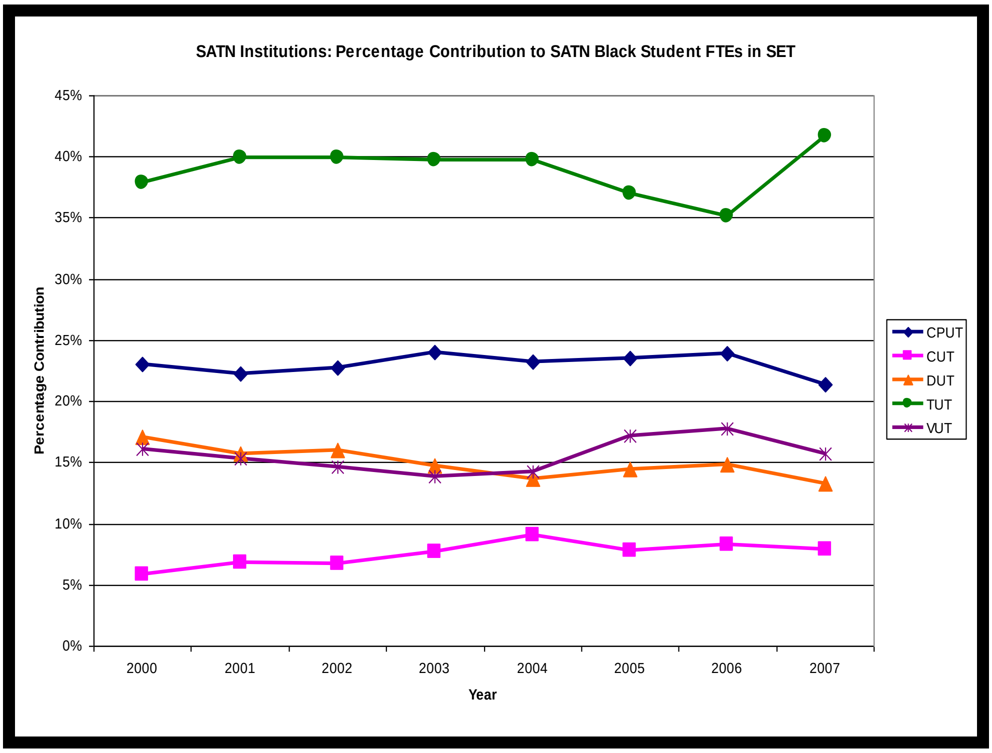
FTE refers to the Full Time Equivalent of students. The DOE defines it as the product of student enrolment per instructional subject multiplied by the credit for that instructional offering eg   a three year qualification has a weighting of 3. In year 1 the weighting is given as 1, and if a student is doing 4 subjects then the credit value would be the weighting of 1 divided by 4 (number of subjects) giving a credit of 0,25 per subject. To work out the number of FTEs in that subject, will then be the credit rating 0.25 multiplied by the number of students enrolled (eg 100), this will give the number of FTEs as 25 for that subject. The FTEs of all the subjects can then be added to obtain a total of FTEs at the institution.

Graph 6.7: SATN Institutions – Percentage of Black Students FTEs in SET



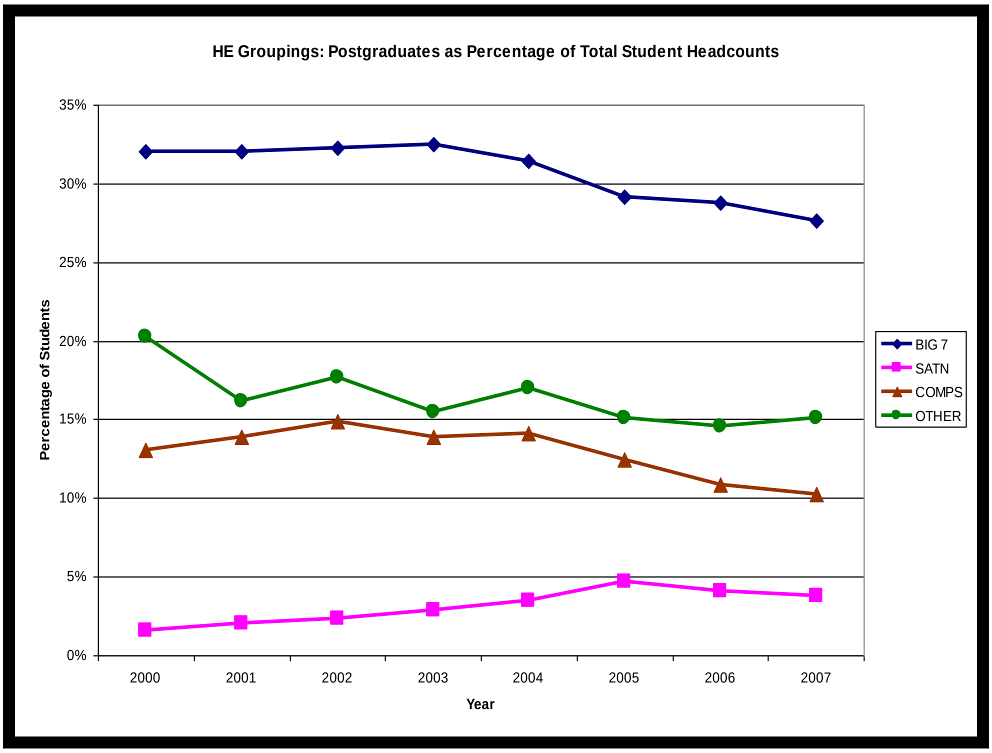
The percentage of Black UoT student FTEs in SET (Science, Engineering and Technology) is steadily increasing over the last five years. This is a national priority in improving the number of Blacks in SET.

Graph 6.8: SATN Institutions – Percentage Contributions to SATN Black Students FTEs in SET



This graph shows the percentage contribution by SATN/UoT institutions to Black student FTEs, in the Higher Education sector, which are enrolled in SET. The percentages vary from a low of 8% to high of 43%. This illustrates the important role played by UoTs in contributing to the education and training of Black students in Science, Engineering and Technology.

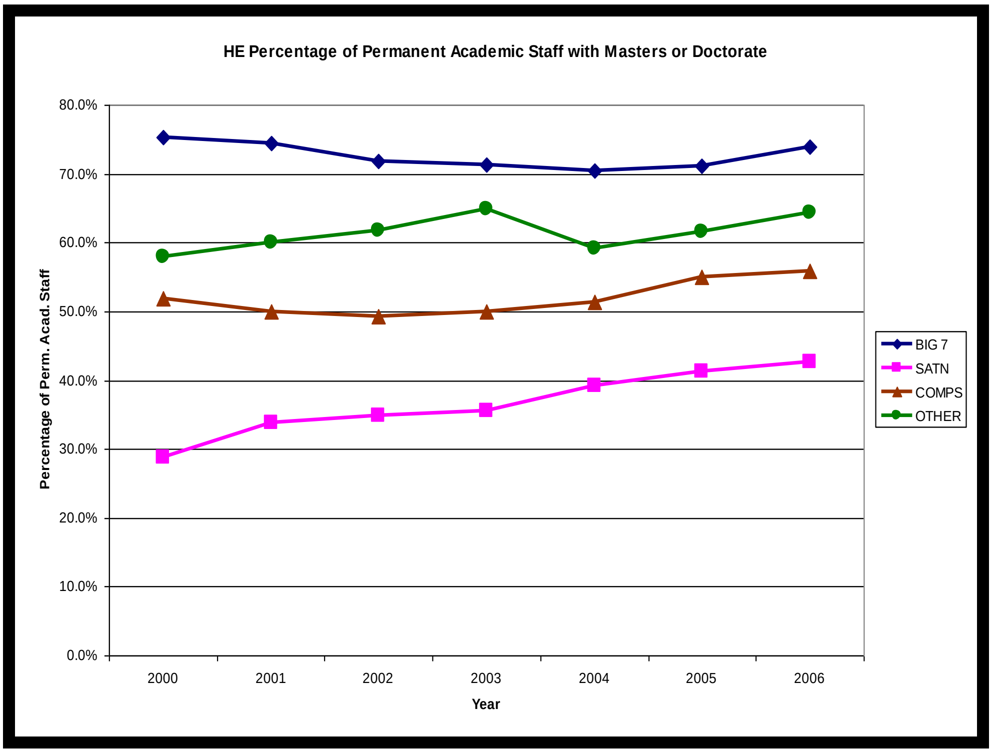
Graph 6.9: HE Groupings: Postgraduate as a Percentage of Total Student Headcount



www.satn.ac.za

The graph indicates the percentage of postgraduate enrolment of the different sectors in Higher Education. Predictably the Big 7 also referred to as traditional universities produce the bulk of postgraduate enrolment. The UoTs/SATN institutions are at the bottom of the graph. This is so, because these institutions are former Technikons and have not had a long history of postgraduate study. They were largely diploma producing institutions. The academic staff had no need to seek master and doctorate qualifications since they taught undergraduate diplomas and degrees.

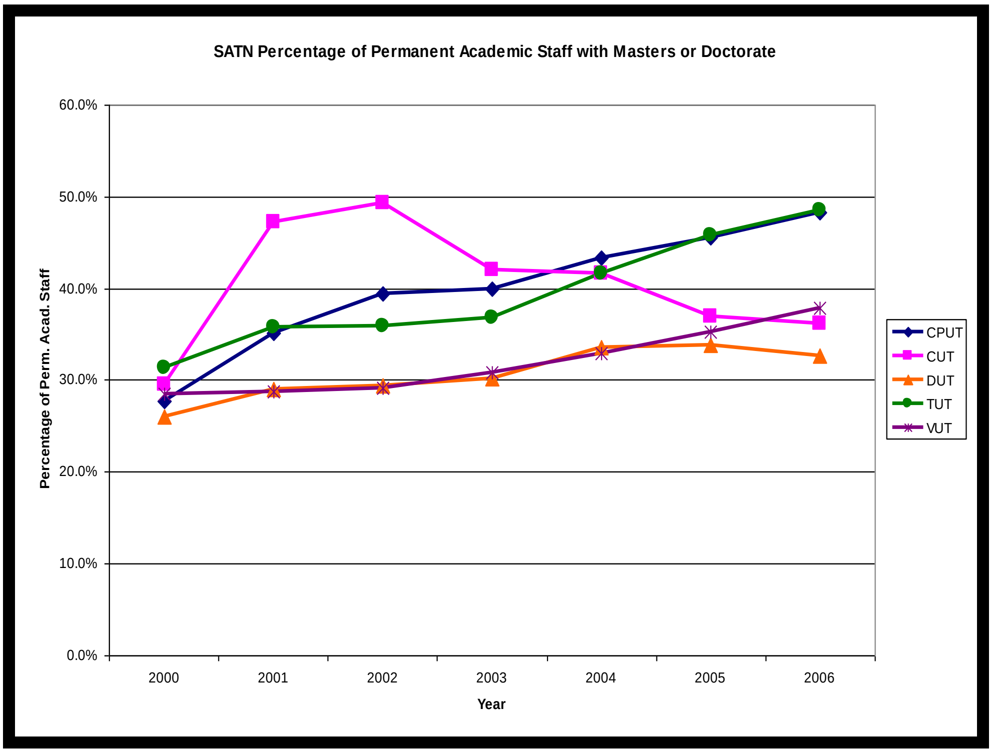
Graph 6.10: HE Percentage of Permanent Academic Staff with Masters and Doctorates:



www.satn.ac.za

The traditional universities (Big 7) are at the top of the graph when it comes to the percentage of staff with masters and doctorates. At the bottom of the graph is the UoT/SATN institutions with the lowest number of postgraduate qualifications. Their history as Technikons have resulted in their low number of masters and doctorates as illustrated earlier which constrains them in terms of publications, research and postgraduate enrolments.

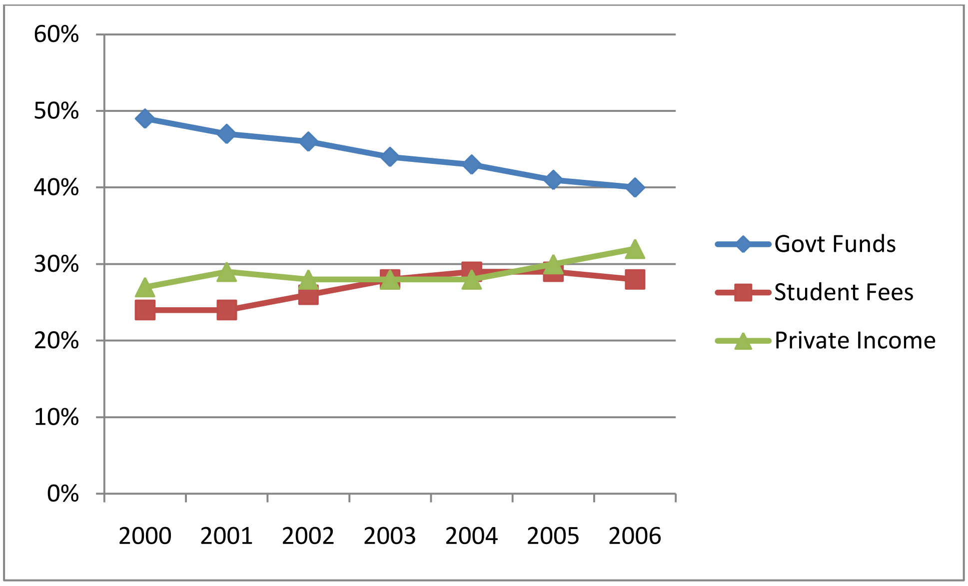
Graph 6.11: SATN Percentage of Permanent Academic Staff with Masters and Doctorates



www.satn.ac.za

This graph indicates the relative positions of the different UoT/SATN institutions. Most of the institutions exhibit an increasing trend in masters and doctorates. Dips in the graphs can be attributed to the mergers and the resulting exit of qualified staff when staff at these institutions were offered voluntary severance packages. Many staff with Masters and Doctorate qualifications opted to take these packages and exit the system

Graph 6.12: Sources of Income – averages for higher education system



www.satn.ac.za

The graph illustrates the dilemma faced by all institutions where there is a gradual drop in Government subsidy. Student fees seem to have levelled off. This indicates that student fees as a source of income is not increasing at the same rate that government subsidy is decreasing. Third stream income (green) has not increased substantially. The effect of this is a steady decline in income, which if not arrested will impact on its core business.

6.2.2 The DUT Case

Table 6.1: DOE BENCHMARKS FOR UoTs

INDICATORS	DOE BENCHMARKS BY 2012	DUT as at December 2008
% doctorates among academic staff	40% (203)	8.7% (50)
% Academic Staff with M degree	60%(317)	26% (136)
Research Outputs	0,5 pl (260)	0.1pl (61)
Success Rates	80%	75%
Graduation Rates	22,5%	21%
% of Student FTEs in SET	50% for UoTs	40%
Student Enrolment	Capped Growth 22226	21763

Table 6.1 sets the DOE benchmarks for all UoTs. The third column describes the situation at DUT. The numbers in brackets in the third column show the actual targets that DUT must reach. Significant changes are required from this sector in terms of qualifications. All academic staff are required to have a minimum of Masters Degree. The actual situation at DUT is that only 26% of staff have masters while the benchmark is 60%. For doctorates the figures are even worse in that 40% should have a doctorate by 2012. The present situation is that only 8.7% have doctorates.

The other important target is 0.5 research output per staff member is required; DUT produces 0.1 research output per staff member. This is very low compared to the requirement set by the DoE. However, these targets are required to be reached by 2012.

Fifty percent of students are expected to be enrolled in SET courses which are on track in terms of UoT requirements.

While these are quantitative targets, the qualitative targets in the type of learning and research must also be adhered to meet the requirements of a UoT. This will be discussed later on.

6.3 PRESENTATION OF INTERVIEWS HELD AT OVERSEAS INSTITUTIONS

Five institutions were studied in UK, Germany and Switzerland and they are indicated as follows:

Table 6.2: Overseas Universities chosen for Research

Country	Name of University	University Type
Germany	Ravensburg Barufsakademie	UoT
Switzerland	Bern University	UoT
UK	Queen Mary University	Traditional
	London Metropolitan University	UoT
	East London University	UoT

For the UK and Europe part of the study, a coordinator was identified at each of the institutions to liaise with the researcher. In this study, interviews were organised, and the researcher was taken to relevant areas to observe, interview and talk to key university staff. Extensive field notes were made and these were later transferred to computer. However, it was not always possible to engage with certain key people for any length of time due to their time constraints.

6.3.1 Ravensburg Barufakademie/University of Applied Sciences, Germany visited on the 25 November 2008

The following persons were interviewed for this study, the Vice Chancellor, one Head of department, Head of International Relations, students in the Film Production Department. The researcher observed the facilities in the Hospitality Department and students in action.

Ravensburg-Weingarten University of Applied Science (German: Hochschule) is a Public University in the city of Weingarten, in south of German state of Baden-Württemberg. The university was founded in 1962 and offered qualifications in Electrical Engineering and Computer Science, Automotive and Mechatronics Engineering, Mechanical Engineering and Business and Technology Management. It has relatively small campus with a population of 4,500 students; however, it is an important institution in Technology, in Baden-Württemberg.

6.3.1.1 Background

The Ravensburg Barufsakademie/University of Applied Sciences is one of eight such institutions in the state of Baden-Württemberg in the southern part of Germany. It was reconfigured in 1978 and referred to as Fachhochshule or University of Applied

Sciences. Their main strengths lie in close cooperation with industry in the teaching and learning programs.

Universities in Germany are part of the free state education system, which means that there are very few private universities and colleges. While the organizational structure claims to go back to the university reforms by Wilhelm von Humboldt in the early 19th century, it has also been criticized by some for having an unbalanced focus, more on education and less on research, and the lack of independence from state intervention. Many of today's German public universities, in fact, bear less resemblance than for example, a typical US institution or traditional South African university.

The Fachhochschulen (Universities of Applied Science), offer similar degrees as traditional or classic universities, but often concentrate on applied science (as the English name suggests). While in traditional universities it is an important part to study "why" a method is scientifically right, that point is not so important to students at Universities of Applied Science. There it is stressed to study what systems and methods exist, where they come from, their pros and cons, how to use them in practice, and last but not least when they can be applied. To get on-the-job experience, internship semesters are a mandatory part of studying at a Fachhochschule. Therefore the students at Universities of Applied Sciences are better trained in transferring learned knowledge and skills into practice while students of traditional Universities are better trained in method development. But as professors at Universities of Applied Sciences have done their doctorate at traditional universities and classic universities have regarded the importance of practice of both types as coming closer and closer. It is nowadays more a differentiation between practice orientation and theoretical orientation of science. Further the Bologna process was set up by the European Union to standardise universities and allow for articulation between universities from the different countries. This has now resulted in the both types of universities moving closer together in terms of recognition of their different but equal mandates.

The important feature of this university is that class size averages about 30. Germany is one of the leading industrial nations in the world. It does not have large natural resources but possesses a rich reservoir of skilled human capital that drives the economy to be a world leader in technology. It is easy to observe how they have made this journey. The Germans have invested heavily in education and training, and there is a close cooperation with industry to facilitate transfer of learning and technology

6.3.1.2 Characteristics of the University

The University has a very close partnership with industry. In fact industry recruits, and selects students. They are then subject to further screening by the University, Those who are successful are then admitted into the program. A contract is signed between the student and the industry partner. A Fachhochschule student has a complete education and can go right into working life. Fachhochschule graduates received traditionally a title that starts with "Dipl." (Diploma) and ends with "(FH)", e.g. "Dipl. Ing. (FH)" for a graduate engineer from a Fachhochschule. The FH Diploma is roughly equivalent to a Bachelor degree. An FH Diploma does not usually qualify the holder for a Ph.D. program directly -- many universities require an additional entrance exam or participation in theoretical classes from FH candidates. The last point is based on the history. When Universities of Applied Sciences were set up, the professors were mainly teachers from high schools who did not hold a doctorate. This has completely changed since the end of the eighties, but professors of classic universities still regard themselves as "the real professors", which is no longer true. Due to the Bologna process the bachelor and master degrees operate in classic universities and universities of applied sciences in the same way.

- **Partnership**

The student spends 18 months at university and the other 18 months in industry. At the end of the period, if the student is successful a degree is awarded. They have a throughput rate (students who graduate within the allotted time at the institution) of over 90%, it was explained that this high throughput rate is because of the stringent recruitment process and constant liaison between the university and the industry partner. If certain key benchmarks are not met in terms of the contractual obligation of the student, then the student may be requested to leave.

Industry is integrally involved in the development of the curriculum. For example Mercedes Benz, a major employer in Germany, require that 90% of the courses offered be relevant to their work in the plant. Therefore they make input into the curriculum so that it is relevant to the world of work. All heads of Department spend one day a week with industry partners in ensuring that students are placed. Heads make contact with new industry partners to widen their collaboration efforts. Fifty percent of their teaching staff are part time and it was explained that this is deliberate, so as to invite specialist from industry to keep the university in touch with the latest developments from industry. UoTs in South Africa employ mainly full time permanent staff. UoT Heads do not spend one day a week in industry. At DUT, WIL is coordinated centrally by the Cooperative Education department, while supervision of WIL is normally carried out by the lecturer in that program.

The University and industry embark on joint projects which allow students and staff to have access to find solutions to real world issues. Staff are encouraged to get involved in consultancies and technology transfer stations, as vehicles to enhance partnerships and also open up the institution for innovation and knowledge transfer. An example of a joint collaboration is in film production with DUT. This is being planned for later in the year. Also two South African students are doing their final year studies at Ravensburg as part of international partnership.

- **University Status**

Presently the Facoschule offers degrees that some states in Germany don't necessarily recognise, mainly due to the fact that they don't recruit their own students, and it has always seen as a lesser university. Many attempts were made to the education authorities to ensure an equal place for Facoshule. However, this was met by stiff opposition by the traditional universities. After many years of advocating recognition for the Facoshule the political authorities have relented. Therefore from 2009, the Facoshule will be a dual university. This means that they will accept students who may come direct to the university instead of being recruited by industry. It will now be called be called Dualhogschule. It will offer degrees that will be recognised by the traditional universities and therefore open up the system so that students can embark on post-graduate study, which was a problem in the past. In this new designation, it will be fully recognised as a university by the other traditional universities, but they will have to comply with many requirements that they have been exempted from previously. For example, staff will have to participate in research. The type of research they will be engaged in will be in cooperative education, technology transfer and knowledge transfer. These will be recognised as acceptable research outputs which is different from the more traditional research outputs. This will require a major mind shift.

6.3.1.3 Human resources

Staff are allowed to accumulate leave to go into industry for up to six months after seven years of employment. This helps staff to stay in touch with latest technology and learn new skills. It also strengthens University-industry partnerships.

Heads of department are expected to have doctorates, and preferably have exposure to the world of work.

The Facoschule has a performance management system that is linked to remuneration. Staff are appraised on their performance in key result areas. Positive performance is rewarded through the remuneration system.

6.3.1.4 Support Systems

They have a highly centralised planning and administration system, where the State of Wetensburg is responsible for budgets and key administrative functions for education. These reduce their efficiencies as decisions take a long time to be made.

It must be pointed out that the traditional universities have a highly autonomous structure. The higher education landscape has three types of universities; namely the Facoschule, Traditional and Universities of technology. These three types of institutions would have equal status as from 2009. While the Facoschule/University of Applied Sciences are not Universities of Technology they nevertheless share many characteristics of a German UoT and their differences lay in how they offer their programs. Facoschule are required to offer programs in conjunction with industry which does not constrain UoTs.

The Facoschule has an excellent track record in terms of its pass rate of 90% and the high calibre of the students trained in this type of institution.

6.3.2 Lorrach Berufsakademie/University of Applied Sciences Visited On 27 November 2008

Interviews and discussions were held with Vice Chancellor, Head of Human Resources Dept (Academic), Head of IT Department. Observed their intelligent robot project in the IT lab. The library was also visited.

6.3.2.1 Background

The Lorrach University of Applied Sciences is similar in all respects to the Ravensburg University of Applied Sciences. The University is situated on the southern border between Germany and Switzerland.

The Fachhochschule or University of Applied Sciences and Arts is a type of German institution of higher education that emerged in the early 1970s and differs from the traditional university (Universität) mainly through its more application or practical orientation. This includes research and vocational aspects. Subjects taught at a Fachhochschule include Engineering, Computer Science, Business and Management, Art and Design, Communication Studies, Social Service and other professional fields.

6.3.2.2 Characteristics

These are similar to Ravensburg University of Applied Sciences, as they form part of a cluster of similar type institutions. The Vice Chancellor explained that staff are encouraged to participate in joint projects with industry. These are carried out through technology transfer initiatives. These projects not only advance their own development but also build university-industry partnerships. This acts as a conduit for innovation, technology and research.

- **Knowledge and Technology Transfer**

There are many joint projects that apply knowledge and transfer technology to modern applications. One of the laboratories visited had a team of robots being controlled remotely connected in a game configuration. This has implications for the replacement of human beings with robots in hazardous work environments that are too dangerous for humans. This type of research will eventually result in commercialisation and manufacture of this product. This type of commercialisation of research was traditionally low. However University of Applied Sciences has increased its activity in innovation and knowledge and technology transfer.

- **Partnership**

Because of its close proximity with Switzerland, many students who qualify from this institution eventually find work there, since it is a short train journey. The institution is serious about international partnerships. The Vice Chancellor was very familiar with South Africa, having been a consultant to South Africa in helping the Department of Labour form the SETA system. Two South African lecturers from DUT in the Faculty of Management Sciences were spending a sabbatical at this institution, where they were holding entrepreneurship seminars for their students.

The Fachhochschule represents a close relationship between higher education and the employment system. The students' up-to-date knowledge of the field enhances their preparation for their profession. Their practical orientation makes them very attractive for employers.

Research is increasingly being carried at Fachhochschulen. The research projects are usually sponsored by industry. The German Universities of Applied Sciences enjoy a high importance for German industry and they have several partnerships with the local firms. Nevertheless, in Germany the right to confer doctoral degrees is still reserved to Universitäten. So some Fachhochschulen run doctoral programs where the degree itself is awarded by a partner university.

6.3.3 Bern University of Applied Sciences, Switzerland visited on the 2 December 2008

The researcher met The Head Of the Electrical Engineering Department, The Head of Human Resources Administration, Professor and specialist in Solar Energy also a writer of a book on solar energy. Interviews were carried out with two students in the Electrical Engineering Department were interviewed. Many documents were also studied, namely the strategic plan, historical documents, web sites.

6.3.3.1 Background

This University is categorised as Fachhochschule or University of Applied Sciences. It was previously equivalent to a technikon. The actual foundations of the University of Bern were laid as early as the 16th century when it became necessary to assure the training of protestant ministers after the Reformation. During the 18th century education in the humanities and divinity stayed in the foreground. With the onset of the Age of Enlightenment Chairs of Law and of Mathematics were added.

After several attempts at passing legislation to make the University autonomous, it eventually became its own legal entity in 1997. The Institution has about 13000 students enrolled.

The federal government (central) and the cantons (provinces) co-operate in steering the system of the universities of applied sciences. Both are committed to maintaining the high quality of teaching and research at the universities of applied sciences and to providing the best conditions for further development of the system. The universities of applied sciences are currently faced with a number of challenges; these include continuing the reform process caused by the Bologna Declaration, positioning of the universities of applied sciences in Switzerland's higher education landscape and in an international context, increasing applied research and development and closer networking with the traditional universities and the Federal Institutes of Technology. Courses in the fields of Technology, Economics, Design, Health, Social Work and the Arts will also be reorganised to better meet today's needs.

The University of Bern firmly believes that Switzerland requires a third university centre alongside the traditional institutions of the Universities and Swiss Federal Institutes of Technology in Zürich and Lausanne/Geneva. The University of Bern aims to actively promote the development of such a centre, and will continue to strengthen its own leadership role within the centre. The University of Bern is bound by the Bologna Declaration. This declaration seeks to ensure uniform standards and articulation between the EU universities.

The Universities of Applied Sciences (FH) provide more practice-oriented courses in the areas of engineering and information technologies, architecture, construction and planning nature, chemicals and life science, agriculture and forestry, economics and services, design, healthcare, social work, arts, music theatre, as well as applied psychology and applied linguistics

6.3.3.2 Characteristics

The University's Strategic Plan (2006:1) expresses its main thrust as "The University of Bern is undergoing a major change. For one thing, the region requires an institution of higher education that is on a par with the universities and Swiss Federal Institutes of Technology in Zürich and Lausanne/Geneva. It also requires a university that can compete at a high international level. Therefore, the University of Bern must focus on its strengths and refine its profile; it must implement the necessary structural adaptations, and enter into strategic alliances and useful cooperation agreements with other universities. In view of this situation, the Senate of the University of Bern requested the University Board of Directors to draw up a long-term Strategy”.

- **Partnerships and Cooperation**

The Bern University of Applied Sciences is very much involved in cooperative education. Students begin their studies by first spending 4 years in industry, thereafter students then enrol at the University to complete the academic component of their degree.

Significant contributions, in particular available educational programs and cooperation schemes, advance the University of Bern's international standing (e.g. international specialized Master's and PhD programs; provision of continuing education programs with participation of international students and lecturers; international exchange programs; international cooperation; etc.);

- **Applied Research and Postgraduate**

Important features of this University are:

i. It provides predominantly national Master's programs without neglecting the regionally important Bachelor programs. There is a strong emphasis on research and project work. Moreover, the University aims to provide various Master's and PhD programs that will enable it to continue to play an important international role,
ii. Its research remains geared to high international standards, some research areas achieving top international results.
iii. The University of Bern is to remain a multi-discipline university, which implies a complete rejection of it being reduced to the status of specialized university
iv. Excellent quality of (student) life at the University itself and regionally;
v. Its research and innovation are characterised by commercialisation, and entrepreneurship through patents, intellectual property, copyright etc

The University draws heavily on its post-graduate offering. This is deliberate as it is from their masters and doctorates that their research strength lies. Their research and innovation are characterised by commercialisation and development of entrepreneurship. The University plays an important role in society by forming a highly qualified next generation. The fundamental research carried out at universities produces new scientific knowledge and guarantees a continuous innovation process which is of high importance to the Swiss economy. Often new knowledge is created in collaboration with other public research institutions or the private sector.

Some excellent achievements in research are for example publications of international relevance, and participation in international/national research projects.

- **Technology Transfer and Knowledge Application**

Universities are responsible for making new scientific knowledge available to society and are therefore interested in a partnership with the private sector. With this in mind the Universities of Berne and Zurich have jointly set up the technology transfer organization called Unitectra its functions are the following:

i. commercialization of research results (protection and management of intellectual property, patents, etc.),
ii. commercialization strategy, search for suitable commercial partners, negotiation of licensing agreements
iii. negotiation of research agreements
iv. support for the creation of new spin-off companies
v. contact point for commercial partners with regard to technology transfer issues
vi. training and education for scientists in the field of technology transfer

The Unitectra offers the following support:

i. Acquiring information about the state of the art in the relevant field (patent searches)
ii. Acquiring information about the ownership situation (other universities, firms)
iii. Evaluation (economic, under patent law) together with the inventors
iv. Negotiations with potential licensees
v. Elaboration, filing and supervision of patent applications (in collaboration with external patent attorneys)

This institution has made significant progress in building local relations, i.e. its embeddedness in the political, social and economic context (e.g. promotion of incubators and establishment, cooperation with public institutions/private enterprises/trade associations, cooperation in "state" committees, provision of services not prescribed by the state). This has resulted in the institution raising significant third stream income.

6.3.4 University Of East London visited on the 4 December 2008

The representative of Human Resources was interviewed. Many documents were also studied, namely the strategic plan, historical documents, and web sites.

6.3.4.1 Background

The University of East London (UEL) is a relatively new university, situated on two campuses in East London. Founded in 1970 as North East London Polytechnic, UEL was formed from a merger of higher education colleges, including West Ham Technical Institute, in Stratford, and South East Essex Technical College in Barking. The Polytechnic changed its name in 1989, becoming the Polytechnic of East London, and was granted university status in 1992. The university attracts a large component of student from minority groups (67%), and is largely multiracial and multi national.

6.3.4.2 The UK Higher Education landscape

The number of universities in Britain almost doubled in 1992, as 38 former polytechnic schools or colleges changed status and names - ending a distinction between the two types of institutions. For years, the polytechnics have been turning out some of Britain's best scientists and technologists, without neglecting the humanities and social sciences. There was however, perceptions by the public that Polytechnics were second best to the traditional universities.

In March1992 the government's Further and Higher Education Act gave the polytechnics exactly the same status as the universities, giving them the same access to government funding as the universities. The bill allowed the polytechnics to call themselves universities - all but one have done so - and to award their own degrees instead of relying on a national council.

6.3.4.3 Characteristics

- **Partnership and Cooperation**

Over the past 20 years, the polytechnics have pioneered part-time and "sandwich" courses, where students alternate jobs and academic work. They have introduced American-style modular degrees. They educate more than 80 percent of the "mature students" - those over the age of 21 - in higher education in Britain.

Providing alternative access to a wider group of students is a tradition that began during the time of its status as a Polytechnic. As an example of fostering access to higher education, on 21 November 2006, the new UEL/Birkbeck, University of London Partnership at Stratford was launched when a memorandum of understanding between the two institutions was signed. The partnership aims to improve participation in higher education in east London by attracting new students who would not otherwise participate through the provision of new opportunities and progression pathways.

Birkbeck was awarded nearly £5m in April 2006 by the Higher Education Funding Council for England (HEFCE) to take its flexible, evening teaching provision to east London, which has the lowest higher education participation levels in the London region. Birkbeck courses were offered at the Stratford campus of UEL from September 2007 as part of the Birkbeck strand of the new partnership, now called Birkbeck Stratford.

Some educators warn that there is a danger that, now that they have also become universities, the polytechnics may be tempted to abandon some of their strong cooperative training approaches with industry. Among the advantages enjoyed by the polytechnics has been not only their closeness to the community but also the strong links they have forged with industry, enabling students to get hands-on experience.

To illustrate its strong links with the community and industry, in the run up to the Olympic Games that will be held in London in 2012 UEL is a key partner in the Sports Development Framework produced by the five Olympic Boroughs of Greenwich, Hackney, Newham, Tower Hamlets and Waltham Forest. UEL sports science leaders are working with local authority partners to encourage disability sports in local schools, and in 2004 helped set up the Newham Disability Sports Club.

- **Technology transfer and Knowledge Application**

Researchers and policy development staff at UEL have been consulted by London 2012 on topics including urban planning, transport and sports development and community engagement. The Director of the Centre for Institutional Studies at UEL and a founder member of the Institute for Volunteering Research is on the London 2012 Volunteer Strategy Group, which is developing strategies for co-ordinating volunteering activity, and engaging and empowering local communities through voluntary action.

The London East Research Institute at UEL managed public debates and discussion around the Olmpic bid, delivered community consultation and developed projects investigating the impact of regeneration on local communities. The Cascade Arts Mentoring project, run by Space with UEL's School of Architecture and the Visual Arts, has worked with schools and colleges in Newham to give young people a voice in the project.

Working in partnership with National Health System trusts and workforce development consortium, UEL's School of Health and Bioscience is expanding its programmes in professional health sciences, particularly Physiotherapy and Podiatry, Health Services Management, Biomedical Science, and Applied Sports

Science, and delivering professional development programmes for health workers across the region.

UEL's Centre for Physiotherapy and Podiatry, incorporating the London Foot Hospital, is now under construction at the Stratford campus, building on the university's reputation as a leading provider of physiotherapy training. In 2004, the Human Motion Research Laboratories were equipped with state-of-the art technology for movement analysis.

Areas for future development include sports coaching and development, working with local authority partners to deliver sports programmes for young people, coaching, disability sport in partnership with the National Paralympics Association, and support for elite performers at our new sports science laboratories.

UEL's Business School is building on links with regional partners to develop facilities and event management training, and staff from Social Sciences, Media and Cultural Studies are building on links with national and local volunteering programmes to train students for volunteering opportunities including coaching young people, welcoming visitors, officiating at sporting events, engaging and empowering local communities through voluntary action.

- **Research**

This institution is primarily a teaching institution, and it is still developing its research capacity. All lecturing staff will have to have a PhD qualification when they are recruited in future. This is being phased in as it matures into a fully functioning university. It has staff complement of 1700 and 400 part time staff. Part time staff are mostly from industry, to allow the institution to link knowledge to applications.

- **Access**

Some of the challenges being faced by the institution is the twenty five percent drop out rate. A variety of developmental courses are offered to support students at university eg English second language communication courses. Planned tutorship and mentorship are key interventions that are integrated into the program of the university.

- **Human Resources**

The institution has a Performance management system that articulates with the institutions strategic plan. Two assessments are held every year. Budgets are linked to plans which are cascaded form the strategic plan to an ambit plan and finally to a departmental plan. The university has five priority areas that must be integrated into every departmental plan. Training and development are linked to plans and priorities of UEL. A staff development handbook details the courses that are available for staff. All newly appointed Deans are assigned a coach to support them in their initial period of their tenure. A 360 degree feedback tool is used to assess Management performance.

6.3.5 Queen Mary University visited on the 3 December 2008

Interviews were held, with the Chief Administrative Officer; Head of Management and Leadership; Director Education and Staff development.

6.3.5.1 Background

This University was included in this study to highlight differences between UoTs and a Traditional University. It is a very old university that is going through changes and it provides valuable data in informing how this sector is grappling with environmental challenges. The study also highlights the quest of the University to adapt to many of the characteristics that are typical of UoTs.

Queen Mary is a Traditional University whose origins lie in the mergers, over the years, of four older colleges: Queen Mary College, Westfield College, St Bartholomew's Hospital Medical College and the London Hospital Medical College. In 1989 Queen Mary merged with Westfield College to form Queen Mary and Westfield College. Although teaching began at the London Hospital Medical College in 1785, it did not become part of Queen Mary until 1995. In that same year the two medical schools merged together to form the School of Medicine and Dentistry at Queen Mary and Westfield College, but Barts and The London has, to some extent, retained its own identity. In 2000, the college adopted its present title of Queen Mary, University of London.

Amongst the largest of the colleges of the University of London, Queen Mary’s 3,000 staff deliver degree programmes and research across 21 academic departments and institutes, within three sectors: Science and Engineering; Humanities, Social Sciences and Laws; and Barts and The London School of Medicine and Dentistry.

6.3.5.2 Characteristics

Although the size and diversity of Queen Mary gives it all the characteristics and facilities of a university in its own right, it is also part of the federal University of London, a wide-ranging body comprising some 40 academic institutions and 120,000 students. Together, these make it the largest and most diverse university in the country. It also means that, although Queen Mary is a self-governing institution, its students are able to take advantage of the wide and varied educational and social facilities of the University of London. These include the Senate House library, which contains more than 1.4 million volumes, and the University of London Union (ULU), which is amongst the most active and lively in the country (Strategic Plan, 2006-2010).

- **Partnerships and Cooperation**

Queen Mary possesses a culturally diverse student population with over 7,000 students studying on up to 200 degree courses. Many of these students value highly the opportunity to undertake some form of work experience and can assist with specific business or technical assignments, or general office management activities. The types of work experience being sought are varied but typically include project-based work, out of term-time placements lasting from four-twelve weeks, or full-time twelve month work placements.

The University has a long and successful track record of working in partnership with businesses, including Small and Medium Size Enterprises (SMEs), industry, local and central government, NHS trusts, the legal and financial sectors, and cultural organisations providing cutting edge research, consultancy and technology transfer services.

Queen Mary is increasingly seen as traditional university breaking away from its traditional character. Strategic Plan (2006-2010: P6) articulates in its mission

> "to transfer the knowledge it generates to business and the community, regionally, nationally and internationally"
>
> In its vision "encourages innovation and enterprise in particular through partnerships with industry, business and community"

This is a deviation from its traditional role as a university as a generator of knowledge and its image as elitist and an "ivory tower". Of significance in the mission is its focus on integrating with communities, industry, and business. It makes a strong statement of driving the transfer of knowledge to these sectors. In many ways, its mission and vision seem to reflect the functions of the former polytechnic universities

As a means of widening international partnership, Queen Mary offers a joint degree programme with Beijing University of Posts and Telecommunications, one of China's top engineering universities. This was the first of its kind to be approved by the Peoples Republic of China's Ministry of Education: it is taught 50% by each institution in English in Beijing by staff who fly out from Queen Mary to teach its part of the programme; and the students receive two degrees, one from each university.

To build the university's research capacity, it has given special focus to increasing its post graduate students. It believes that the solution to broaden research lies with the new and up-coming post graduate researchers

- **Technology Transfer**

To advance innovation and entrepreneurship, the university has a technology transfer and business office. This office is responsible for identifying and managing all intellectual property (IP) generated from research at the College, as well as commercialising new technologies. Queen Mary Innovation and Enterprise is a central point of contact for new business enquiries.

Business Development Managers help to provide solutions to business problems by providing access to a range of services including:

- Research and consultancy
- Technology transfer
- Training and development
- Business development facilities

One of the institution's primary thrusts is to take innovation and business ideas, from bench to the market, where it can be commercially reproduced into viable products.

Queen Mary Innovation and Enterprise is active in pursuing a wide-ranging portfolio of patent applications globally and holds a number of granted patents. Staff within Innovation and Enterprise are highly experienced in transferring technology from academia direct to industry.

Specific successes rising out of commercialisation are the following:

- 13 active IP assignments
- Licensing agreements covering 19 different technology families in ICT materials, biomedical sciences and chemistry
- Six active spin-out companies

The university is mindful of the highly competitive environment in which commercialisation of technology is being produced. The constantly changing nature of technology, places tremendous pressure on institutions to be on the cutting edge of new technology and this can only be possible through effective partnerships with other academics, specialists' networks, to achieve superior results.

Their business model has not only secured research income for the College, but has enabled the research team to take a pivotal role in the commercialisation of their technology by carrying out research and development themselves, as well as working towards creating income from their licences.

- **Research and consultancy**

The Queen Mary Innovation and Enterprise Centre provide advice and support to staff that are seeking collaborative and contract research. It links academic research to a network of specialists and experts to create viable commercial projects.

Queen Mary is a major research-led institution renowned for its breadth and quality of research and development. Fifty percent of the institution is in the medical field. The London School of Medicine and Dentistry, is a major centre for clinical education, research and innovation in the UK.

Some of the specialised service centers that support leading edge technology are:

- The Centre for Commercial Law Studies
- The Interdisciplinary Research Centre in Biomedical Materials
- The Wolfson Institute of Preventive Medicine
- The William Harvey Research Institute

Queen Mary's commercial success in exploiting academic research is evident in the number of licensing agreements and sustainable spin-off companies generated by the College. Its strong science base, is highly productive in creating research outputs, enabling it to transfer this knowledge directly to industry through the creation of intellectual property (IP).

As evidence of income from research related projects, in 2002-2003 Queen Mary staff earned over £36 million in external research grants, contracts.

- **Knowledge Transfer**

Queen Mary Innovation and Enterprise works to promote knowledge and skills transfer between the College and business and the wider community for mutual economic and social benefits.

One way in which Queen Mary seeks to engage in knowledge transfer activities is through Knowledge Transfer Partnerships, KTPs. KTPs promote and support research projects carried out by businesses in partnerships with higher education institutions.

Businesses engaging in knowledge transfer with the College can benefit from building strong alliances with researchers and lecturers. In return, the College benefits from the opportunity to work closely with business and industry to help provide real solutions to real problems.

Knowledge Transfer opportunities include:

- Research staff placements
- Student work placements
- Professional training and development

Queen Mary is active in pursuing knowledge transfer with businesses and the wider community through research staff placements programmes in industry.

By accessing Queen Mary's pool of talented undergraduates, businesses and other community organisations alike can benefit from a wide range of academic know-how. The provision of student work experience opportunities is designed to encourage the efficient transfer of knowledge and skills from academia directly to the workplace, and to help forge stronger relationships between Queen Mary and the wider business community.

- **Entrepreneurial training and development**

Developing a sense of entrepreneurship is an important objective that runs through its strategic plan. To this end various initiatives and mechanisms have been created, namely.

- Simfonec
- LCACE

Simfonec: Queen Mary provides access to entrepreneurship training and development courses in partnership with Simfonec. Simfonec is a world-class evidence based science entrepreneurship centre orchestrating the delivery of science ideas to the commercial market place. A range of training courses to help meet individual and business needs; from flexible modules and custom made short courses to an MSC in Science Entrepreneurship. These professional courses are designed to give an understanding of the technology transfer process and to help encourage enterprise awareness.

London Centre for Arts and Cultural Enterprise (LCACE): Queen Mary is a partner in the newly established London Centre for Arts and Cultural Enterprise (LCACE).

The centre provides continuing professional development, business advice and mentoring to arts and culture professionals and practitioners, as well as creating networking opportunities to facilitate greater collaboration between the university sector, industry and wider community.

It provides access to a number of College resources including in-house facilities and state of the art equipment to assist with business growth and business development. It helps individuals and organisations with the necessary capabilities that will help enable business ideas to get off, and stay off the ground.

- New arts quarter development**:** Includes the 40-seater cinema and screening room, a film production studio, a newly developed performance space including the Pinter Studio and a state of the art Linguistic Laboratory.
- Other facilities which the institution makes available are Laboratory space, State of the art equipment , Conference rooms and facilities

6.3.5.3 The London Technological Network (LTN)

The Queen Mary University is part of the London Technological Network which is affiliated to the Enterprise Europe Network. This Network normally constitutes all universities of technology and former polytechnics. It is however very significant for a Queen Mary University, a traditional university to identify with the LTN and EEN (Europe Enterprise Network). LTN has access to more than 6,000 scientists working in world-class research across London. Through the Enterprise Europe Network, they have access to over 70 different technology centres, with contacts at thousands of businesses based across Europe.

The LTN helps universities identify and define customer's needs, and then translate them into manageable projects to find a corresponding solution. This is done through accessing a world-class academic research base, which is linked to a wider European technology market and connecting to a skilled Technology Team.

For businesses the LTN provide solutions to R and D needs by providing a single point of targeted access to the vast pool of expertise in the academic research base across London.

Direct access is offered to expertise and technologies of 6,000 academics, while managing the inter-culture boundaries that exist between industry and academia, thus increasing probability of success. Its process helps to facilitate the flow of knowledge from the academic sector into the commercial world. It has Technology Consultants who act as your Account Managers expertly liaising with all parties involved in the collaboration while technology analysts identify and filter technical resources of relevance to the member organisation.

For academics LTN offers a forum to promote UK research through more effective interaction between the industry and the academic research base. It helps universities develop their research portfolio of technologies and support their active engagement with industry. The LTN has trained a specially-selected group of academics to map their departmental technologies and work with their university's Technology Transfer departments to identify solutions for industrial R and D needs, and help stimulate commercial incentives, enhance research activity, and motivate students and skill gain.

6.3.5.4 Human Resources

The Strategic Plan is cascaded into the Performance Management System. It is implemented in two ways, formal and informal. Performance is attached to a reward system. Research is considered very highly and not enough weight is attached to teaching in assessing performance. Promotions are based on research output only and this has been criticised by some staff, since they believe that there is too much of emphasis on research output and not enough recognition given to good teaching. Each employee has a development plan which is aligned to their performance reviews.

The Human Resources Department is highly decentralised with a central pool of highly specialised services being shared by all faculties. Leadership development is an important development point, so much so that there is a separate directorate that specialises in leadership development. A 360 degrees assessment is also being used as an instrument to develop staff. All courses are certified with the Institute of Management. Investors in People are a benchmark that is used to evaluate the quality of human resources.

6.3.6 THE LONDON METROPOLITAN UNIVERSITY

Interviews were held with the Head of The Centre for Academic Professional Development; Senior Lecturer of Pharmaceutical Science; Associate Head of School of Human Sciences; Lecturer of Education Technology. A variety of documents, situations and websites were studied to get a feel of the university. Many facilities were visited, mainly the Science laboratories.

6.3.6.1 Background

London Metropolitan University was formed on 1 August 2002 by the merger of London Guildhall University with the University of North London. The new institution ensured continuity by assuming the company registration of the former London Guildhall University, and as a result there was no hiatus in the corporate existence of the University or its degree awarding powers.

The London Guildhall University was initially established in 1848 by the clergy to improve the spiritual well being of young men. Subjects on the original curriculum included Greek, Latin, Hebrew, English, History, Mathematics, Drawing and Natural Philosophy. In 1861 the classes were reconstituted and named the City of London College. Over the next twenty years, the College was one of the pioneers in the introduction of commercial and technical subjects. In 1970 the college merged with Sir John Cass College to form the City of London Polytechnic. From 1992 to July 2002, the institution changed its name to London Guildhall University. The other historical component of the university was the University of North London. It was founded in 1896 as a Polytechnic, to become officially known as the Polytechnic of North London in 1929. Under the Further and Higher Education Act 1992, the institution, a pioneer of widening participation and access to higher education, was granted University status and the right to award its own degrees. Following the merger with London Guildhall University, London Metropolitan University became the largest unitary university in Greater London.

In October 2006, the University opened a new Science Centre, part of a £30m investment in its science department. Close to its Holloway Road site, the facility includes a "Super Lab" claimed to be one of Europe's most advanced science teaching facilities with 280 workstations equipped with digital audio visual interactive equipment.

6.3.6.2 Characteristics

London Metropolitan University is the largest "single university" in London, serving more than 34,000 students and with buildings spread throughout the centre of London. The University offers 485 degree courses and has the largest choice of courses in London. The University has nearly 8,000 overseas students from more than 155 different countries. In 2005/06, London Metropolitan University was ranked third most popular university in United Kingdom for international students.

- **Partnership and Cooperation**

The LMU is increasingly making its mark in the post-graduate and research areas. It has history in the Polytechnic sector and therefore has had to work extra hard in developing critical areas of research and post-graduate study. The institution is increasingly developing partnerships to increase its research capacity and the ability to transfer this knowledge to the private sector to enable this knowledge to be commercialised. Knowledge transfer, technology transfer, partnerships, and entrepreneurship are relatively new objectives that the university has recognised as ways of making itself more relevant in the modern world of work. Their plan is to build on the type of instruction that were considered strengths of the polytechnics, in which courses were offered in conjunction with industry. With the consolidation into a university, it has continued with the ethos of partnerships by cementing its relationship with industry. The underlying philosophy is to inculcate in students the ability to find solutions by transferring knowledge and applying innovative solutions through technology in solving real world problems. This is in contrast to the traditional universities which see themselves as knowledge generators as opposed to application of knowledge. Several interventions are in place to take this mandate forward, specifically the The London Enterprise Office (TLEO).

London Metropolitan University is one of the largest universities in the UK with a comprehensive range of disciplines. Consequently, it has diverse expertise to offer businesses, public sector bodies and civil society organisations. The main concentration of expertise is in:

i. Financial, business and professional services
ii. Creative industries (fine art, media, digital design and advanced manufacturing technologies)
iii. Computing
iv. Hospitality, leisure and tourism
v. Public sector management and service delivery
vi. Regeneration

This expertise is offered either by fully formed enterprise clusters such as the London Financial Academy, London Environment Centre, Accelerator Incubation Services, Events Management Knowledge, and Management Development Unit or by individual experts. The type of expertise includes applied research and evaluation, business creation and incubation, consultancy, continuing professional development, knowledge transfer partnerships, market intelligence, traditional and digital design and technical skills, workforce development.

London Metropolitan University undertakes a very large number of commissioned projects that contribute to economic and social development. Some are large, such as capital projects like the new building to house the Digital Manufacturing Centre, or research projects like regeneration master-planning. Others are pan-European, such as projects funded to stimulate the development of SMEs or tackle discrimination in the labour market. Some are more localised, such as community development projects in disadvantaged localities in London's inner city.

The diverse projects profiled here have two things in common: they are real-world and problem-solving in focus and they are high quality. Some of the projects are:

i. London Financial Academy-The LFA offers a wide range of open short courses in banking, finance and regulation,
ii. Metropolitan Works, part of London Metropolitan University, is a unique centre that supports London's creative industries and related manufacturing.
iii. Security Industry Observatory

iv. GameLab Case Study -Hearing Impaired TV and Gaming

The university advances partnerships through The London Enteprise Office (TLEO) and assists by:

i. Helping partners and customers obtain and develop innovation and business development projects
ii. Finding the appropriate academic expertise for business needs
iii. Introduction to specialist equipment and facilities
iv. Project management through collaboration from development, through implementation to completion
v. Helping to find government subsidies, to support knowledge transfer from London Metropolitan University to partner organisation, such as those available through the Knowledge Transfer Partnerships (KTP) scheme

- **Knowledge Transfer Partnerships**

The Innovation and Enterprise Unit specialises in helping firms, especially SMEs (small to medium enterprises with less than 250 employees) to release latent creativity and become successful innovators, sometimes dealing with major initiatives such as the development of a new software product.

The Innovation and Enterprise Unit focus is on providing support to the local business community. They work with agencies such as the Business Link network on providing regional innovation and with SMEs on improving manufacturing agility.

London Metropolitan University is increasingly involved in the KTP (Knowledge Transfer Partnerships) programme with many Academics from schools across the University participating in KTP schemes.

KTP is a Government scheme which helps companies access the knowledge and skills within the UK's 'Knowledge Base' (universities, independent research and technology organisations, and Government-funded Research Institutions).

KTP programmes bring a host of benefits for participating companies in the short, medium and longer-term. From the outset, the institution will have expert knowledge applied directly to key areas of your business, leading to product, process or management improvements.

KTP schemes last anywhere between one and three years - involving collaboration between an academic, a graduate and an industrial or service sector company.

The scheme is about technology, knowledge transfer and strategic business projects and entails substantial external income.

The benefits of KTP for business partnership

i. New product lines and markets are created
ii. Highly skilled employees are developed
iii. Reductions in costs and lead times

KTP is first and foremost business orientated, delivering results which meet the needs of businesses who take part.

The company comes up with a specific strategic project that it wishes to develop. Projects can include developing a new product, improving quality and productivity or developing a web-based customer interface. The company contributes 40% of the total cost; the DTI (Department of Trade and Industry) contributes the rest.

Finding out whether KTP is suitable for a company requires a partner to identify a development, which is strategically important to an organisation’s future but needs additional knowledge and skilled personnel. After an assessment with a KTP Consultant, the customer will be advised on the best route for the company. Together a plan is drawn up, which forms the basis of a proposal for a KTP Programme.

Once an offer of grant has been made, a talented graduate - a KTP Associate - is recruited jointly by the company and the University to work within your company on a one to three year contract. Their project work is designed to realise the organisation’s commercial aims, and is supervised jointly by the partners own staff and academics from the University.

Businesses who participate in KTP often go on to have long term partnership with the university. Many of the companies benefit from the other services which the university offers business, including:

i. Consultancy
ii. Training/short courses
iii. Student placements
iv. Graduate recruitment

Benefits for KTP Graduates

The graduate, known as the KTP Associate is supervised jointly by the university and the company; works directly with the company and can register for a research degree simultaneously.

KTP programmes last anytime between one and three years and offer an opportunity to develop a portfolio of personal, business and management skills and can be a head start on a fast-track to senior management.

The KTP Associate benefits from:

i. combined practical and formal training - 10% of your time will be devoted to enhancing non-technical skills
ii. receiving academic supervision throughout the programme
iii. gaining a higher degree
iv. follow a tailored programme of business related development

6.3.6.3 Entrepreneurship

The London Enterprise Office (TLEO) is also the vehicle in LMU for the development and delivery of third stream activity. It seeks commercial opportunities for the University's academic and professional expertise and provides technical assistance and capacity building support for academic staff.

This is the entrepreneurial arm of London Metropolitan University. It connects London Metropolitan University's academic and professional expertise and facilities with business and public sector agencies.

It does this through:

i. Developing relationships with influential private and public sector organisations and securing introductions and contacts for enterprise active academic staff
ii. Providing strategic and market intelligence
iii. Developing enterprise skills in academic staff
iv. Transforming new ideas for products, processes and services into viable commercial propositions
v. Supporting the efficiency and productivity of organisations through expanding the University's capacity to deliver work-force and professional development
vi. Supporting new business creation through physical and virtual incubation services
vii. Growing a new generation of entrepreneurs and enterprising employees through a well-connected student enterprise programme
viii. Promoting access to the University's advanced facilities in digital design, industrial prototyping facilities, bio-science and sports science laboratories

Innovation and Enterprise drives and enables collaborations between external organisations and London Metropolitan University's academic experts. The university's professional knowledge transfer managers help businesses and public sector organisations to identify and exploit their intellectual assets and state of the art facilities, so that they can develop new products and processes, and become more competitive.

At the same time, TLEO supports London Metropolitan University's academic staff in their work with external organisations by providing efficient project and account management, and straightforward processes to facilitate effective knowledge transfer.

- **Accelerator - London's Business Incubator**

Accelerator is a specialist business incubator, at the heart of London's ICT and digital media industry. It specialises in sector-specific business development programmes for innovative and growing businesses.

By engaging with London Metropolitan University's academic capabilities and industry specialists, Accelerator continues to deliver pioneering resources for business development, high growth potential and long term sustainability, by offering clients:

i. Incubator space of several sizes
ii. Shared premises
iii. Business consults and mentoring
iv. Business support services
v. Access to investor, market and international networks
vi. Full-time, hands-on management team
vii. Access to workshops and seminars,
viii. Networking and social events
ix. Meeting room hire

This initiative drives potential and encourages innovation and enterprise through business development programmes and support. As London's Business Incubator, Accelerator is key in moving business to the next level.

Incubation is claimed as the fastest route to growing a business. It is more than just office space - in fact, incubation defines the process of supporting business growth. In the case of Accelerator, it has a clearly defined sectoral focus on information and communication technology, interactive media, e-learning and design. Companies wishing to enter the building must meet tightly defined criteria relating to their level of innovation, their growth potential, the experience of the management team and their willingness to stick with the process and to take the advice offered.

Businesses normally expect to spend 2-3 years in Accelerator to fulfil their plans and achieve the growth that enables them to move onto the next level. Within the service level agreement, tenants receive:

i. ongoing advice and support from Accelerator staff
ii. high tech serviced office space with fast broadband connections and a technical and network architecture designed to facilitate a development environment
iii. R and D support and advice on funding from the full range of technical, business and media expertise within London Metropolitan University
iv. 24/7 secure access to the building
v. short course training
vi. reception facilities and use of bookable meeting and seminar rooms
vii. regular networking forums, access to other business and financial networks and free attendance at a number of industry events and forums.

The Accelerator short course programme is specifically designed to meet the needs of established businesses, normally between one and five years old, that are looking to grow further and faster than the competition. Some of the supporting courses on offer are the Accelerator’s four course units that together constitute a holistic approach to business development. The courses are:

i. Business diagnostic clinic
ii. Customer value proposition
iii. Turning relationships into business
iv. Structure and manage your finances

Each course may be taken separately, but maximum benefit is derived from following the series through. As well as the above courses, Accelerator runs small business workshops.

- **Business Intelligence**

Business Intelligence aims to provide briefings to inform decision making for both internal and external clients as well as identifying income generating opportunities and potential providers of services from across the university.

Additionally, this unit supports academics and other university departments to write responses to tender requests, develop appropriate partnerships and to set up new projects if successful.

Business Intelligence can assist by providing flexible tailor-made services including:

i. Succinct, jargon-free briefings, interpretation, and business advice around new Government policy
ii. Analysing and forecasting new trends in education and business
iii. Market and competitor analysis for new products and services, including an overview of the marketplace and identifying gaps for innovation
iv. Assembling a business case or feasibility study for new project developments
v. Providing a portal to local, national and European tendering opportunities as well as support in preparing successful bids

6.4 SUMMARY

The results of the research conducted abroad was presented and discussed. However firstly a comparative analysis of the profiles of the UoT sector was studied to understand its early development and its present profile of headcount, pass rates, research outputs, staff qualifications, enrolment in SET. When compared to other sectors within the HE landscape, a picture starts to emerge of the UoT playing a significant role producing graduates. However, notwithstanding its new role as a university, it was still stuck with the “Technikon” culture. To break out it needed to address the weaknesses in staff qualifications and low research output. Further, it can continue to do more of the same when the external environment as changed significantly or remodel itself on established UoTs as in other parts of the world. However in learning from other successes it needs to apply its resources and expertise to suit local needs and demands.

To obtain a picture of what the international experiences are, this study investigated six universities in UK, Germany and Switzerland. The results indicated that knowledge generation and knowledge transfer are key components of their teaching, learning and research. Several mechanisms are used to advance these concepts. Technology transfer is achieved through transfer stations, IP, patents, partnerships, and community and industry collaborations. Entrepreneurship is encouraged in the teaching programmes, and applied in through incubators, SMME development, training and development etc. Applied research is a cornerstone of the knowledge transfer goal. It is based on solving real world problems through partnerships and collaborations to ensure that it contains other disciplines and stakeholders in finding solutions. All the institutions have international collaboration as a strategic goal and have evidence in showcasing projects completed on an international level with international agencies and other overseas institutions. These roles and functions have shaped the development of the UoT concept and informed this study in the evolution of this sector in the HE landscape.

CHAPTER 7

PRESENTATION AND DISCUSSION OF THE OUTCOME OF OBSERVATION, FOCUS GROUPS AND INTERVIEWS

7.1 INTRODUCTION

This chapter reports on how the SATN has tried to take the UoT concept forward in practice through a project supported by Finnish aid. This study observed the discussions of the SATN Board as they discussed the report of the Typology Committee. The results of the Typology Committee were tested at DUT in four focus groups, in which the attributes, criteria, KRAs and performance indicators were tested for its applicability in an operational environment. The results were further tested against interviews conducted with UoT experts in South Africa. These were discussed and integrated into a Balanced Score Card to develop an implementation plan to create a model for UoTs. The interviews of experts in this chapter represent the second set of data in the research. The third set of data is the results of the focus groups.

7.2 OBSERVATION OF DISCUSSION

The SATN committee presented their report on the characteristics, criteria and performance indicators to the Board. The researcher was an observer to this very significant final report back meeting since it included the Finish delegation. The Finns were also the funders of the Typology Project and they provided tremendous support in the development UoTs in South Africa. The report back was the culmination and summary of extensive work done to develop the performance indicators for the UoT sector. The researcher captured the discussions and the outcomes.

This is the summary of observations of the final report back of the Typology Committee of the Finland-South Africa Cooperation Project to develop Evidence-Based Performance Indicators for UoTs and UoT-Related Parts of Comprehensive Universities at Sea Point, Cape Town on the 20 and 21 August 2008.

7.2.1 Present

The representatives from the following institutions were present:

- Durban University of Technology
- Vaal University of technology
- Tswane University of Technology
- Cape Peninsula University of Technology
- Central University of Technology
- Nelson Mandela University
- University of Johannesburg

7.2.2 Background

The chair made a detailed presentation which set the background for the discussions. The DOE subscribes to a unitary system; however the diversity within South Africa's higher education system should form the basis of its strength. This diversity exists not only in the three main categories of higher education institutions in South Africa (viz, UoTs, Comprehensive Universities and Traditional Universities), but also within each of these three categories, institutions such as 'UoTs', which specialize in making knowledge useful, will, alongside the traditional and comprehensive universities, constitute a dynamic and appropriate higher education system for South Africa. The differences between these institutions lie in their focus and ethos between UoTs and traditional universities. It was emphasized that the three main categories should be seen as the strengths of the HE system by complementing one another. They will not only bring much wider variety and diversity into the higher education scene but also contribute meaningfully to greater innovation, technology transfer and international competitiveness.

Providing access to HE is a critical goal in the NPHE, and UoTs have the ability to drive diversity. Unless HE draws upon a greater diversity of people as scholars and students, South Africa cannot hope to generate the intellectual capital needed to respond to a changing society. The burgeoning complexity and rapidly increasing rate of change will force UoTs to draw upon a broader breadth and depth of human knowledge and understanding. The inclusion of underrepresented groups will allow UoTs to tap reservoirs of human talent and experiences from which they have not yet fully drawn. Although UoTs are required to provide access to higher education in terms of the entry requirements for the Further Education and Training Certificate (FETC), they need to explore other creative ways to identify latent talent, for example Recognition of Prior Learning (RPL).

7.2.3 Mood and Temperament

The mood of the committee was of determination. It was pioneering in that no other attempt was made in the South African HE sector to develop performance indicators of the whole sector. The DOE had already set benchmarks for UoTs, and there was a feeling that these were unrealistic given the history of UoTs. For example the benchmark for research is 0.5 output per academic staff. To reach this benchmark it takes time and resources and even established institutions struggle with this. It was felt that some intervention needs to take place to support UoTs in its achievement of this target. A further restriction is a cap of 2% - 7% on post graduate students that can be enrolled at UoTs. The fear of this capping might relegate UoT as undergraduate institutions and the restriction on post graduates will undermine its funding base since post graduate enrolment attracts a substantial subsidy. The balance of students must be in the undergraduate category. The feeling was that in arriving at these benchmarks in 2001, the UoT sector was not fully prepared in responding to the DOE proposals and as a result these benchmarks appeared to be flawed. For example, what constitutes the benchmark of 0.5 output per staff member? The SATN is of the view that research for UoTs should include innovations in WIL, technology transfer projects, intellectual property and entrepreneurship ventures. At the moment these are not recognized for research purposes. However, the SATN has engaged DOE in addressing their concerns.

7.2.4 Objectives of the Project

The project was intended to produce a plan and implementation strategy to develop a set of performance indicators for UoTs and UoT-related aspects of CUs. This will provide performance indicators for amongst other things teaching and learning, research and innovation and engagement with society. It would also identify the unique contributions of UoTs to Academia in terms of research and innovation. As such, a set of performance indicators acceptable to the sector, and a development trajectory for UoTs and CUs, were developed. The DoE and other relevant players, such as the CHE/HEQC, will be engaged on these documents. Further cooperation between institutions in Finland and SA would also be discussed.

A project plan was developed, broken down in different phases:

- Phase 1: Development of a Detailed Project Plan
- Phase 2: Design of an Identity Map and a Sector Development Trajectory
- Phase 3: Identification of an appropriate set of Institutional Performance Indicators (PIs)
- Phase 4: Discuss PIs (Performance Indicators) with Finnish experts, the DoE and HEQC to finalise the assessment framework
- Phase 5: Testing of PIs
- Presentation of PIs to SATN Board and CUs
- Presentation to DoE, CHE, CPED
- Final project report
- The project will incorporate:
    - Performance indicators acceptable to the broader sector
    - A document to identify the unique contributions of UoTs within the overall, differentiated sector
    - A development trajectory for UoTs and CUs
    - Engaging the DoE, CHE and other stakeholders on the document
    - Further cooperation between SA and Finland

The process was linked to the characteristics of UoTs, as identified. The characteristics were defined and validated against other models. UoT staff members were requested to comment on the PIs, and to refine them using the characteristics. The implementation and piloting of each PI will be assessed in terms of practical applicability.

7.2.5 Characteristics

The framework adopted by the Typology Committee included the identification and mapping of the characteristics, attributes, criteria, and performance indicators. For this purpose the performance indicators were defined as quantitative or qualitative data that measure the effectiveness in attaining objectives or the system. Every PI agreed to must meet several criteria. The characteristics cannot be determined in isolation. The following characteristics were agreed to by the Committee:

7.2.5.1 Technology focused programmes

All Undergraduate career programmes to contain a technology driven PQM. The aim of the program should include technological competence by using leading edge technology in teaching and research.

Technology is a loaded concept, which led to some lively debate – technology is not easily measured. Confusion around 'technology' had to be clarified. Technology was defined as the effective and efficient application of the accumulated know-how, knowledge, skills and expertise that, when applied, will result in the output of value added products, processes and services. In terms of teaching technology, the understanding of the application of the subject in the real world is essential. Technology has to be seen in relation to staff and students, physical ICT infrastructure, expenditure on technology training, etc.

Comments by the various UoTs were analysed and used to further refine the PIs. While generically applicable to all UoTs, some PIs are unique to certain UoTs, and could therefore be used to distinguish them from traditional universities. Some aspects would be easier to measure than others, and would have to be supported by policies, systems and mechanisms within institutions.

UoT distinctiveness is indicated by

- Fully operational Advisory boards
- WIL
- Delivery and innovative teaching practices
- Staff with industry experience
- Focus on technological competence

7.2.5.2 Research and Innovation in and through technology in strategic areas

Applied research and innovation expertise is necessary to advance technology transfer. Postgraduate research is considered a natural characteristic of UoTs – not a unique characteristic. Research should focus on niche/specific area. This type of research undertaken will differentiate institutions among themselves. Research projects will be linked to industry problems – the nature of the projects will indicate uniqueness. Prototypes, patents, procedures, artifacts, artistic outputs should be recognised as output. Technology stations and incubators might set UoTs apart, although it is not yet unique to UoTs

It should be recognised that research and innovation is in a developmental phase; targets must therefore be realistic. Partnerships and collaborations will assist in increasing research activities. Research should focus on specific areas. Implementation of research and increase in inter-disciplinary and trans-disciplinary research projects focused on real problems. Their application to society and industry is unique to UoTs.

Innovation is seen as the application of the 'know-how', knowledge, skills and expertise towards a value-added product process. All outputs linked to the innovation process should be acknowledged and funded. Staff development in research capacity should be a priority. UoTs serve as a learning lab, with new approaches and practices for the design and delivery of learning and research initiatives

7.2.5.3 Entrepreneurial and innovative ethos

To advance entrepreneurship spirit and activities an enabling environment needs to be created through appropriate support and control mechanisms which must be embedded in the management structures of the UoT.

Commercial ventures must be pursued as a priority. Student entrepreneurship projects must be encouraged through projects. There should be greater emphasis on UoTs' ability to create an environment where ideas can be converted to products and commercial purposes.

Social and community based organisations should be included in processes, which will require joint projects in finding solutions.

7.2.5.4 National and international impact and recognition

National impact must be achieved through providing skilled graduates and applying research and knowledge to finding solutions. Throughput should refer to the contribution to the nation's skills development

Access to HE would be increased, through alternative routes of access. This aspect should be seen as a differentiating factor for UoTs, and it would be essential to actively market diplomas as worthwhile qualifications – therefore, the percentage of enrolments in diploma programmes should be tracked as a PI. UoTs should participate in nationally prioritised skills and development. They should be creating jobs and providing the skills by including in the learning program innovation, entrepreneurship, problem solving and technology transfer project assignments. This would build capacity in students in seeking to recognize opportunities and translate them into commercial ventures, thereby being a job creator.

7.2.5.5 Sustainability in engagement and practice

UoTs should work closely with the Community in participating in socially responsible projects. Teaching, research and knowledge creation and transfer should take place in close collaboration with Government, business and industry.

7.2.6 The Implications of the characteristics, attributes and PIs

It is important to look at the characteristics, attributes and PIs critically and ask whether they assist in differentiating UoTs from other institutional types. The results of the discussion with the participating institutions suggest that PIs do not successfully differentiate UoTs from institutional types. Only 4.16% and 10.4% of the PIs are unique for UoTs and CUs respectively. The reason for this is that UoTs are universities and therefore will share many of the same outcomes and therefore are subject to the same standards. It would appear that the difference is on the how UoTs carry out their mandates rather than in the “what”. Seventy five percent of the PIs were found to be generic across the HE system; this is attributed to the unitary nature of the system and an indication of academic drift that is taking place. UoTs are characterised by technology focused programs (PQMs), fulfilling the needs of industry, community and society. Application of knowledge and knowledge transfer are important features of their programs. However, describing their learning programs as making students “job ready” undermines their basic ethos to teach students to solve problems whether in industry or in society in general. Faced with a changing environment and dynamic community needs, it is incumbent on institutions to equip students with the skills to devise innovative strategies through technology and knowledge to find new solutions.

There appeared to be less enthusiasm from the traditional universities for this project. Arising from the discussions, universities do not have PIs, most of these institutions have rules rather than indicators to track performance. However, most of the PIs are applicable to all HE institutions.

7.2.6.1 Performance Indicators

Since the PIs are applicable to all universities including the UoT sector, it emphasizes that the status of UoTs are on par with the other university types. The outcome of the work on PIs has revealed several findings:

- PIs do not successfully differentiate UoTs from other institutional types

- Although PIs are effective in distinguishing UoTs from traditional institutions to some extent, they fail to address this distinction adequately
- Uniqueness was calculated by 4.16% (UoT) and 10.4% (CU)

The following reasons could account for the low differentiation of UoTs vis-à-vis other institutions:

- The general perception is that since UoTs now have university status, there is little to differentiate them from traditional universities in terms of the core functions of teaching and learning, research and community engagement
- Although differentiation was based on the 'how' rather than the 'what', the general feeling seems to be that neither the attributes, criteria or PIs for the stated characteristics succeed in making UoTs explicitly unique from traditional universities, because the benchmarks for universities are the same for UoTs. However, these benchmarks do not consider the manner in which experiential teaching, and learning and applied research takes place in a UoT.

7.2.6.2 Validation of Performance Indicators

Internal validation is about checking each PI against a set of internal criteria. External validation is based on the following:

- The differentiation model
- Against other models (balance and coverage) – balanced scorecard, input-process-output model, etc.
- UoT staff collectively – this validation check has been completed
- UoT staff at institutional level – this validation check has been completed
- DoE and Finnish government – this validation check was completed
- External validation by the CHE still has to be negotiated

7.2.7 Department of Education

The representative of the DOE was supportive of the project and expressed a wish that these proposals be circulated to all stakeholders for discussion and debate.

The PIs on its own has no value unless it is linked to plans, resources, processes and systems. For example it needs to articulate with South Africa's development, and at a micro level it needs to link with institution's plans and PQM.

7.2.8 Finnish Response to the Identified Performance Indicators

Overall the Finnish delegation was very supportive and complimented the Committee for a thorough work done in producing the document. However, they cautioned the Committee, while an indicator system is necessary, it is very seldom sufficient in a broader sense, unless all the necessary qualitative viewpoints are considered as well. PI-based funding models, for example, carries major risks. Areas where PIs can be applied with lower risk include HEI internal development and management support, benchmarking, marketing support, stakeholder information, and as the basis for negotiations with the DoE. The PIs should be simple and easy to implement and cost effective also, otherwise the process becomes too unwieldy.

The Finnish model is focused on processes. The proposed PI system should and must be developed for the SA context and suit local needs. The input-process-output model was used to define the indicators. The Finnish HE system is also evolving, in which the Government intends privatizing universities and reducing the number of institutions. There will be severe financial cut backs from government.

One of the significant recommendations was that In terms of the balanced scorecard model, a strategy map is essential. The question should also be asked whether there is strategic thinking in the strategic plan. The same weight should apply for each factor, and the model could serve the SA context very well. The logic behind PIs should be integrated into the strategic plan, as opposed to a stand alone approach.

7.2.9 Concluding Comments

Arising from the in-depth discussions, it was clear that a milestone was reached, but the work needs to be contextualized and placed into a system and a plan. The following was acknowledged

- The SATN has a basic generic cluster of performance indicators already in place for a macro overview of the sector
- The characteristics and performance indicators need to be integrated into a Balanced Score Card indicating which performance indicators drive other performance indicators e.g. what are the indicators that drive throughput.
- The issue of resourcing and infrastructure needs to be addressed to ensure that UoTs reach their benchmarks.
- SATN could publish their own journal to accelerate the rate of publications. This is being done by CUT, DUT and others.

The attributes, criteria, KRAs and PIs arising from the SATN (2008) report are presented below.

The following tables are a summary of the discussions in the SATN meeting and will be discussed later in more detail in the context of the balanced score card. However, a brief description of the headings will be given. The main heading refers to the main five pillars as determined by the SATN. Each objective or “pillar” is further described by an ‘Action’ column, which refers to what action needed to be taken to achieve this. The “Key Result Area” is the result that should arise from the action. The “No.” column is a unique code/number that is allocated to the “Measurable Performance Indicator” which will be referred to as PI. The “Measurable Performance Indicator” determines how the KRA will be measured. The “SATN Classification” refers to the model used by SATN whether it is an input, output, or process component... The

“BSC Classification” refers to the classification given by the researcher to identify the BSC perspective of the action or plan needed. The “PI-Unique or Higher Education wide” refers to whether the PIs are unique to UoTs or to all HE institutions.

Table 7.1: Technology Focused Programmes

A. Technology Focused Programmes						
Action	**Key Result Area**	**No**	**Measureable performance indicators**	**SATN Classification**	**BSC Classification**	**PI-Unique or Higher Educ. wide**
	(Cv) Technology driven PQM	AA1	Percentage of curriculum requiring technological competency from learners		Customer perspective	
	(Fi) Financial Perspective	AA2	Actual expenditure on technology per FTE student in support of teaching and learning		Customer perspective	
UG **Develop Career Programmes with a technology bias**	(Cv) Technology driven PQM (Ixi) Professional bodies approved (Iiv)Responsiveness "Just in time education" (IiV) Relevance to Market needs (Ci) Job readiness (Iiii) Learner centered (Ix) Innovative educational approaches (Lii) Industry exposure and experience of staff (Liii) Staff abreast of new developments technology	A1	Percentage headcount enrolments in fields of SET, Bus and Man, Education and other Humanities	Input	Internal process	HE
		A2	Percentage of UG qualifications approved/accredited by professional bodies (where applicable)	Input	Internal process	Unique
		A3	Percentage of programmes where active advisory boards/committees are involved	Input	Internal process	Unique
		A4	Ratio of new UG and PG programmes introduced per year	Input	Internal process	HE
		A5	Percentage of qualifications revised per year.	Input	Internal process	HE
		A6	Percentage of students employed (including self-employment) in their field of study within one year after graduation.	Output	Customer perspective	HE
		A7	Percentage of employer satisfaction	Outcome	Customer perspective	HE
		A8	Percentage of undergraduate qualifications that contain learning in the workplace (WIL, EL, etc).	Process	Internal process	Unique
		A9	Ratio of FTE permanent instructional staff	Process	Learning and growth	HE
		A10	Ratio of staff development interventions to embed innovative teaching approaches	Input	Learning and growth	HE
		A11	Percentage of instructional/research staff affiliated to professional bodies/associations	Input	Learning and growth	HE
		A12	Percentage of instructional/research staff with at least 3 years recent industry experience / *who has spent at least 1 week per year gaining industry experience to familiarize themselves with new development in industry.*	Process	Learning and growth	Unique

A. Technology Focused Programmes						
Action	**Key Result Area**	**No**	**Measureable performance indicators**	**SATN Classification**	**BSC Classification**	**PI- Unique or Higher Educ. wide**
The use and development of technology in the delivery of teaching and learning	(Li) UTILISING technology within the teaching methodology, including IT-integration and e-learning (Ix) Leading edge technology	A13	Ratio of FTE students to computer work stations on campuses and in residences	Input	Internal process	HE
		A14	Percentage of curriculum requiring ICT / technological competency from learners	Input	Internal process	HE
		A15	Percentage expenditure on ICT in support of teaching and learning as proportion of total operational expenditure	Process	Learning and growth	HE
		A16	Percentage of expenditure on CPD and skills training with regard to technological advances, per permanent instructional/research staff headcount	Input	Learning and growth	HE
	(Ui) Increased graduation	A17	Improved graduation Rates		Strategic goals	

Table 7.2: Research and Innovation in and through technology and technique in strategic areas

B. Research and Innovation in and through technology and technique in strategic areas						
Attributes	**Criteria**	**No**	**Measureable performance indicators**	**SATN Classification**	**BSC Classification**	**PI- Unique or Higher Educ wide**
KPI	(Uiii) Applied Research and Innovation	BB1	Percentage research income over total income		Customer perspective	
		BB2	Percentage of postgraduate headcount enrolment by race and gender		Strategic goal	
Research and Innovation expertise	(Liv) R and I staff with doctorates (Cv) Nationally rated researchers and innovators (Ivii) Internationally recognized R and I leaders	B1	Number of <u>international</u> collaborations (staff exchanges, research projects, fellowships, joint professorships, cross-institutional projects, research chairs, NRF rated personnel)	Process	Internal process	HE
		B2	Number of <u>national</u> collaborations (research projects, fellowships, joint professorships, cross-institutional projects, research chairs)	Process	Internal process	HE
		B3	Ratio of total research and innovation output, relevant to a UoT, to permanent instructional/research staff / and permanent staff with a doctorate	Output	Strategic goal	HE
		B4	Ratio of external funding attracted for R and I projects to total research funding.	Process	Financial perspective	HE
Technology Transfer	(Iii)New inventions	B5	Number of prototypes, patents, processes, artistic outputs and products registered as IP (Part of the "Innovation" output)	Output	Internal process	HE
		B6	Number of completed and sustainable community problem-solving research projects	Output	Internal Process	HE
Postgraduate studies	(Ixii) M and D students in relevant R and I projects	B7	Percentage of postgraduate enrolments per total headcount	Input	Internal process	HE
		B8	Percentage of postgraduate qualifications awarded	Output	Internal process	HE
		B9	Percentage of postgraduate students participating in contract research	Process	Internal process	HE
		B10	Percentage of staff with doctoral qualification	output	Customer Perspective /internal process	HE

Table 7.3: Entrepreneurial and innovative

C. Entrepreneurial and innovative ethos						
Attributes	**Criteria**	**No**	**Measureable performance indicators**	**SATN Classification**	**BSC Classification**	**PI- Unique or Higher Educ wide**
KPI	(Ii) Entrepreneurship and Innovation	CC1	Number of registered IP outputs turned into commercial ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artifacts and designs)	Output	Strategic goal/ Customer perspective	
		CC2	Number of SMMEs, incubators, and technology stations established	Output	Strategic goal	
		CC3	Percentage of third stream income, related to commercial ventures, as part of overall income	Output	Strategic goal	
Enabling Environment	(Ii) Create Enabling environment for Entrepreneurship for • Registered patents and artifacts • Established business ventures, Partnerships, contracts • SMME support • 3rd stream income	C1	Number of established business ventures (partnerships, joint ventures and contracts)	Output	Customer perspective	HE
Commercial Ventures		C2	Number of SMMEs, incubators and technology stations established	Output	Customer perspective	HE
		C3	Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artifacts and designs)	Output	Internal process	HE
		C4	Number of SMME's supported (count incidences rather than volume)	Output	Internal process	HE
		C5	Percentage of third stream income, related to commercial ventures, as part of overall income	Output	Strategic goal	HE
Student Entrepreneur-ship	(Iviii) Programmes with entrepreneurship content and projects	C6	Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications	Output	Internal process	HE

Table 7.4: National and International impact and recognition

D. National and International impact and recognition						
Attributes	**Criteria**	**No**	**Measureable performance indicators**	**SATN Classific ation**	**BSC Classificati on**	**PI- Unique or Higher Educ wide**
KPI	**(Uii) Impact on National, Industry and Community**	DD1	Percentage annual growth in student headcount in fields of specialization		Customer perspective	
		DD2	Percentage annual growth in graduates in SET		Customer perspective	
		DD3	Percentage of undergraduate headcount enrolments in foundation provision		Internal process	
National Impact (Service to the Industry, community, society)	(Iix) Widening access to HE –thru (alternative routes of access) • Throughput • Nationally prioritized skills and development • Job creators	D1	Percentage of SA learners, with SC/NSC/FET qualifications and enrolled at UoTs as first time entering students.	Input	Internal process	HE
		D2	Percentage of undergraduate headcount enrolments in foundation provision	Input	Internal process	HE
		D3	Percentage females and percentage by race of student headcount per field of specialization namely SET, Business and Management, Education and other Humanities	Institution al - Input	Strategic goal	HE
		D4	Percentage of undergraduate students admitted on the basis of RPL	Input	Internal process	Unique
		D5	Percentage of first time entering undergraduate students who graduate in minimum time plus 1 year	Output	Strategic goal	HE
		D6	Percentage of annual growth in student numbers and in graduates in national priority	Process	Internal Process/ Strategic goal	HE
		D7	Number of jobs created through SMME's	Outcome	Internal Process	HE
International Recognition and Exposure	(Ivii) International Collaboration	D8	Percentage of international and SADC students	Input	Internal Process	HE
		D9	Number of international collaborations (staff and Students exchanges, research projects, fellowships, joint professorships, cross institutional projects, research chairs, key note addresses, presentations, post doctorates).	Process	Internal Process	HE

Table 7.5: Sustainability in Engagement and Practice

E. Sustainability in Engagement and Practice						
Attributes	**Criteria**	**No**	**Measureable performance indicators**	**SATN Classification**	**BSC Classification**	**PI-Unique or Higher Educ wide**
KPI	(Ciii) 3rd Stream Income	EE1	Ratio of third stream income versus number of engagements	outcome	Customer Perspective	
		EE2	Ratio of third stream income as a proportion of total income	outcome	Customer Perspective	
Government, Business and Industry Engagement	(Ivii) Regional collaboration and embedment	E1	Number of regional, national and SADC collaborative partnerships	Process	Internal Perspective	- HE
	(Lii) Professional and Industrial Dev	E2	Ratio of credit bearing short courses (CPD programmes) to staff FTEs	Input	Learning and growth	HE
Community Involvement (Social Responsibility)	(Ivi) **Develop Community Engagements (**Mutually beneficial partnerships for sustainable development)	E3	Ratio of projects (including community and service learning) to FTE staff	Process	Internal Process	HE
School and post school engagement	• Technology and knowledge transfer	E4	Number of learners from school participating in co-curricular (vacation/weekend schools) activities	Output	Internal Process	HE
		E5	Number of capacity building/upgrading programmes offered to FTE college staff and other teaching professionals	Input	Internal process/ customer perspective	HE
		E6	Participation rate of FET learners	Process	Internal Process	HE
Sustainability	(Fi) Financial sustainable	E7	Total direct cost per FTE student	- A - Generic	Financial Perspective	Generic
		E8	(Subsidy / block grants + tuition fees = income) per FTE student	- A - Generic	Financial Perspective	Generic

7.3 FOCUS GROUPS

The purpose of the focus groups was to obtain and define the key result areas that drive the characteristics and performance indicators. The UoT characteristics and performance indicators as themselves will not solve all problems experienced by UoT type institutions, but by integrating this into a methodology and a system, these organisations will be able to indentify drivers and enablers that will produce key results at milestones on this journey to being a fully fledged UoT. Also while the characteristics are generic across the UoTs, the PIs will have to be customized to each institution's strategic plan. For example, the characteristic of Research and Innovation through Technology transfer has up to 12 performance indicators, but these indicators are not described in a systemic manner (SATN, 2008: 6-7). Similarly, the same is applicable for the other characteristics and performance indicators. But it is clear that there are indicators that drive other indicators and these cause and effect indicators and several indicators work together to cause another indicator to produce an outcome. Therefore, the performance indicators need to be described in terms of goals or key result areas (KRAs) and activities to produce a characteristic. These are then placed in a systemic configuration through a Balanced Score Card (BSC) to develop a systems model to highlight the cause and effect within an organization. The Durban University of Technology was chosen as an institution to develop the model. Focus groups were used to collect data with regard to KRAs and associated activities/ plan to provide information with regard to producing outputs described in terms of performance indicators.

7.3.1 Selection of Focus Groups

The focus groups were clustered together in terms of the institutional structure of DUT. Firstly, the characteristics and performance indicators needed to be introduced at an executive level. This was Executive Focus Group. The other focus groups were the made of the three ambits namely, Academic, Institutional Support, and Technology, Transfer and Partnership (TIP).

The participants were chosen on the basis of the line managers/Heads reporting to the respective Vice Chancellor or Deputy Vice Chancellor. This is important in understanding how the characteristics and PIs produce the outcomes and the responses from the respective sectors and departments. With respect to the TIP and Institutional Support Focus Groups the departments requested to bring two staff members each in making responses.

Figure 7.1: Organogram of the Executive Structure

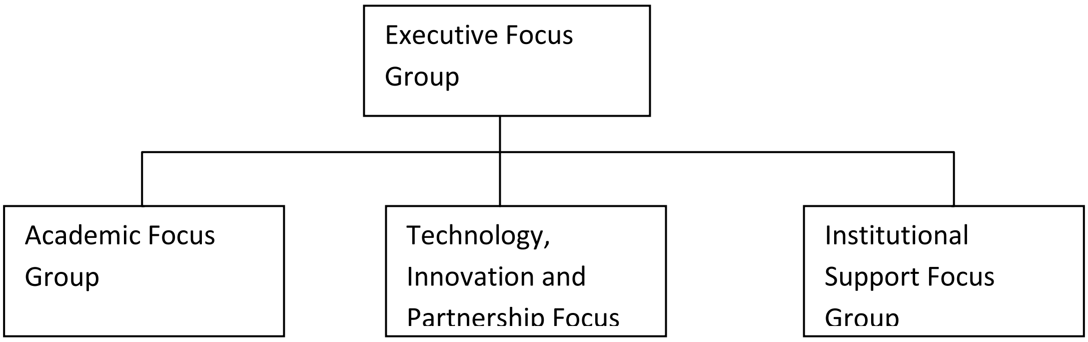


Table 7.6: Focus Groups

The focus groups were composed as follows:

Name of Focus Group	**Group Leader**	**Participants**	**Questions asked**
Executive Focus Group	Vice Chancellor	• Deputy Vice Chancellor (Academic) • Deputy Vice Chancellor (TIP) • Deputy Vice Chancellor (Institutional Support) • Director: Centre for Quality Promotion • Registrar: Student Services	• What are the KRAs that drives the characteristics/goals of DUT • What are the planned activities or objectives that drive each KRA
Academic Focus Group	Deputy Vice Chancellor (Academic)	• Executive Dean Faculty Acct and Informatics • Executive Dean Faculty Management Sciences • Executive Dean Faculty Art and Design • Executive Dean Faculty Health Sciences • Executive Dean Faculty Applied Sciences • Executive Dean Faculty Eng. Built Environment • Director Centre for Higher Education Development • Director Library •	• What are the KRAs that drive the characteristics/goals of DUT • What are the planned activities or objectives that drive each KRA
Technology, Innovation and Partnership Focus	Deputy Vice Chancellor (TIP)	• Director: Post Graduate Development • Director Research Management Development • Director International Education Partnerships • Director Cooperative Education • Director: Technology, Transfer and Innovation	• What are the KRAs that drive the characteristics/goals of DUT • What are the planned activities or objectives that drive each KRA
Institutional Support Focus Group	Deputy Vice Chancellor (Institutional Support)	• Director: Human Resources • Head: MI • Manager Maintenance • Manager Security • Director Student Services	• What are the KRAs that drive the characteristics/goals of DUT • What are the planned activities or objectives that drive each KRA

Table 7.7: Cascading of Key Result Areas from VC to other Executive Managers

VC	DVC ACADEMIC	DVC TIP	DVC ISS	Director CQPA	Director CFO	The Registrar	Executive Officer
KRA 1 Graduation Rates	KRA 1 Graduation Rates	KRA 1 Graduation Rates	KRA 3 Staff Development	KRA 3 Staff Development	KRA 3 Staff Development	KRA 1 Graduation Rates	Legal compliance
KRA 2 Increase in PG enrolments	KRA 2 Increase in PG enrolments	KRA 2 Increase in PG enrolments	KRA 6 Improved Student experience	KRA 8.3 Market survey – from student and industry	Efficient and effective Finance systems	KRA 2 Increase in PG enrolments	
KRA 3 Staff Development	KRA 3 Staff Development	KRA 3 Staff Development	KRA 7 Improved Management and Governance systems	Program Management	Budget and financial planning	KRA 3 Staff Development	
KRA 4 Research Output	KRA 4 Research Output	KRA 4 Research Output	KRA 8.1 Marketing and Branding strategy	Fit for purpose	Risk Management	Conducive environ for Exams	
KRA 5 Technology Transfer, innovation and partnership	KRA 5 Technology Transfer, innovation and partnership	KRA 5 Technology Transfer, innovation and partnership	Equity	Quality Ass and Enhancement of T and L, Research	AFS	System support	
KRA 6.2 Improved library services	KRA 6.2 Improved library services	KRA 6 Improved Student experience		External Community Engagement	Equity	Student selection and registration	
KRA 6.3 Introduce common foundation course and student assistance	KRA 6.3 Introduce common foundation course and student assistance	KRA 7 Improved Management and Governance systems		Equity		Student record keeping	
KRA 7 Improved Management and Governance systems	KRA 7 Improved Management and Governance systems	Equity				Community administration	
KRA 8 DUT as a first choice DUT	KRA 8 DUT as a first choice DUT Equity					Student academic discipline Equity	

Table 7.7 shows the results of the Executive Management Focus Group. This is the key grouping of DUT which set the strategic framework which emerged from the strategic plan. From this framework the group workshopped the KRAs for the Vice Chancellor. On the first row of table 7.7, indicates the executive team which includes the three Deputy Vice Chancellors, the row also includes non executive members who are Directors who report directly to the VC.

After workshopping the VC"s KRAs these were listed under the VC in column 1. Each KRA was then workshopped for the other managers. The principle used was that for the VC to meet his KRA, will this KRA feature in the list of the other DVCs. For example "Graduation Rates" was flagged as KRA for the VC; this was cascaded to two of the other DVCs. Similarly the other KRAs were cascaded to the other management members of the team. In this manner the strategic goals are aligned to the performance goals.

In the next section the focus groups unpack the KRAs just discussed into objectives with performance indicators

7.3.2 Agenda for the Focus Group

The researcher presented each group with the characteristics of UoTs. The benchmarks for UoTs as set down by the DOE were shown. The focus groups were interviewed from the executive level to departmental level. The responses to the questions were either done in the main group for the Executive Focus Group and Academic Focus Group. The other focus groups were broken into working groups because the groups were large in excess of twenty. To allow for cascading of the characteristics and PIs from a strategic level to operational level, the Executive Focus Group was held first then followed by the other focus groups. The results of the Executive Focus Group was presented to the other focus groups at a more operational level.

7.3.3 Collection and Reporting of Responses

The outcome of the focus groups was collected in the form of a Performance Plan template. At an executive level, the VC presented a strategic plan in response to the UoT characteristics. This was further delineated into KRAs and written into the VC's Performance plan. The VC's performance plan was cascaded to all DVCs and managers reporting to him. These line managers then cascaded their performance plans to their respective middle and lower managers.

Each focus group produced a plan for the sector and from this performance plans the question was answered.

Table 7.8: Focus Groups and Outcomes

Focus Group	What are the KRAs that drive the characteristics of DUT?	What are the planned activities or objectives that drive each KRA?	Is the planned activity described by the UoT PIs?
Executive Focus Group	KRA: E1 Graduation Rates	E1.1 Increase student retention from 50% to 55%	No
		E1.2 Increase pass rate Success rate from 72% to 76%. Y1 – 72%	No
		E1.3 Improved pass rate in bottleneck subjects e.g. mathematics	No
		E1.4 Improve selection process to improve retention	No
		E1.5 Establish compulsory referrals to financial aid to assess and support academically sound students prevent them dropping out	No
	KRA: E 2 Increase in PG enrolments	E2.1 Increase Post graduate enrolment by 10%	Yes
	KRA: E 3 Staff Development	E3.1 250 staff to be registered for Masters	Yes
		E3.2 60 staff to be registered for Doctorates	Yes
		E3.3 Provide ongoing skills development to build skills amongst staff e.g. improve teaching and research skills	Yes
	KRA E 4 Research Output	E4.1 Increase in Research O/p registration from 50 to 55	Yes
		E4.2 Increase in proposals for submission of articles, patents, projects, for recognition as research output by 20	Yes
		E4.3 Increase in post graduate enrolments in M and D	Yes
	KRA E 5 Technology Transfer, innovation and partnership	E5.1 Number of Technology Transfer Projects registered	Yes
		E5.2 Number of Technology Transfer converted to viable projects	Yes
		E5.3 Number of partnerships/MOUs/BU	Yes
		E5.4 Number of innovations converted to viable projects/registered	Yes
		E5.5 Number of patents, intellectual property rights registered	Yes
	KRA E 6 Improved student experience	E6.1 Improved student facilities plan	No
		E6.2 Implementation of Plan	No
		E6.3 Improved Library services	No
		E6.4 Introduction of common foundation course and student assistance	Yes

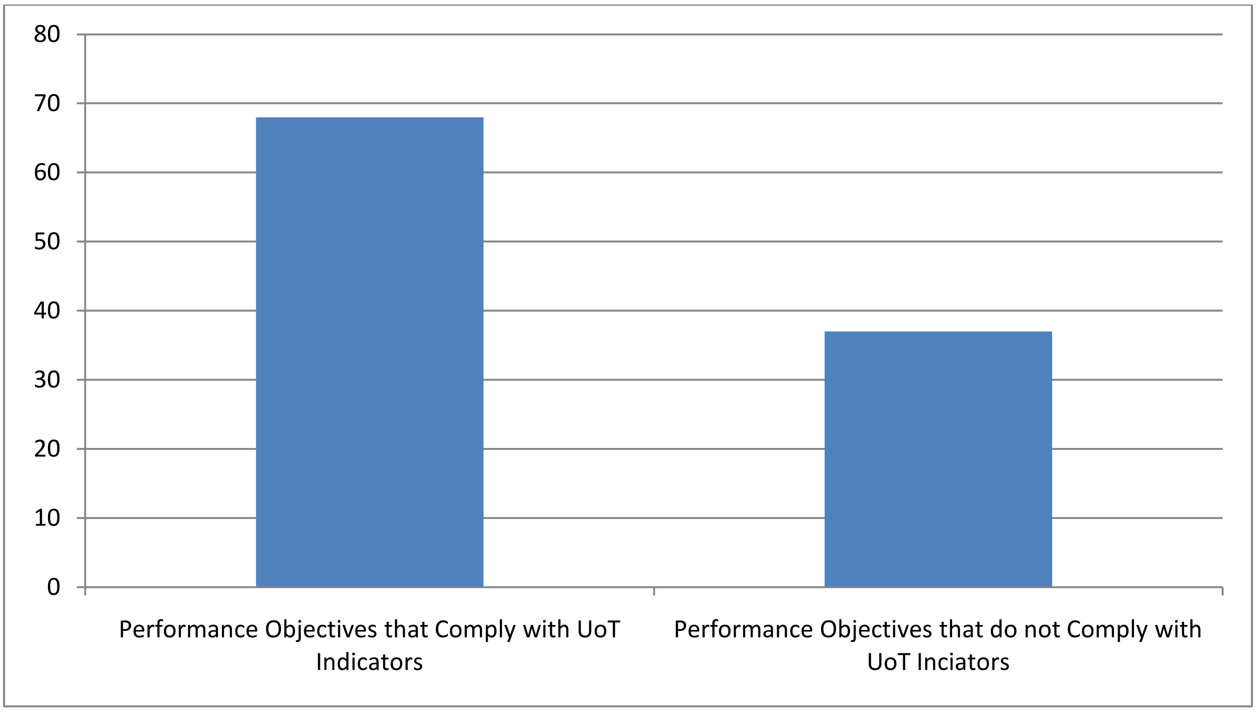
Focus Group	What are the KRAs that drive the characteristics of DUT?	What are the planned activities or objectives that drive each KRA?		Is the planned activity described by the UoT PIs?
	KRA E7 Improved Management and Governance systems	E7.1	Approved DUT Strategic Plan, Faculty and Departmental Plans	No
		E7.2	Sign performance agreements with each executives	No
		E7.3	Review performance of executives	No
		E7.4	Strengthen areas identified in Quality review	No
		E7.5	Every executive to have a performance plan	No
		E7.6	Purchase a Dashboard of Management Info System to steer the organisation	No
		E7.7	Quicker turnaround time for finance – 48hrs	No
		E7.8	Increased 3rd Income by 10% pa	Yes
		E7.9	Attract and retain scarce skills (retention index)	No
	KRA : E8 DUT as a first choice DUT	E8.1	Marketing and branding strategy	No
		E8.2	Segmented marketing to industry, students and donors	Yes
		E8.3	Survey market to assess views of potential views of students and industry	Yes
Academic Focus Group	KRA: A1 Graduation Rates	A1.1	Improve graduation rate by 0.5% per annum to 19.5%	Yes
		A1.2	Increase success rate by 1% from 71% to 72% (target 76%)	Yes
		A1.3	Design a single core Foundation Course to assist first year entrants at DUT	Yes
		A1.4	Set up a student development system that automatically identified underperforming students and refer them for Student development	Yes
		A1.5	All academic staff to be subject to training and development in teaching and learning skills, to improve pass rates and throughput in terms of the stated targets	Yes
		A1.6	Improved pass rate in bottle neck subjects	No
		A1.7	Improve student retention from 50% to 55%	Yes
	KRA: A 2 Research Output	A2.1	2.1 Improve Research output by 15 p.a. (from 50 to 55) Target : 260	Yes
		A2.2	Provide Research incentive e.g. Sabbaticals, funding to improve research output. New ideas to enhance research	Yes
		A2.3	Link 10 research projects to community projects	Yes
		A2.4	Design internal DUT journal for new researchers	Yes

Focus Group	What are the KRAs that drive the characteristics of DUT?	What are the planned activities or objectives that drive each KRA?		Is the planned activity described by the UoT PIs?
		A2.5	Increase registration of research projects by 15%	Yes
		A2.6	Train 100 potential researchers in research methods and publication skills	Yes
		A2.7	Increase library resources and journal collection by 10% to support research in conjunction with Research Department	Yes
	KRA : A3 Staff Development	A3.1	Co-ordinate a clear project to train and employ junior lecturer from the under represented group – cost R2,5million	No
		A3.2	Ensure that number of staff registered for Masters increase to 165 from 150 (Target : 400)	Yes
		A3.3	Ensure that number of staff registered for Doctorates increase to 43 from 38 - (Target : 100)	Yes
		A3.4	40 new registration for Masters are finalised.	Yes
		A3.5	Seven new registration for doctorates are finalised.	Yes
	KRA : A4 Quality Teaching and Learning	A4.1	Co-ordinate a clear project to train and employ junior lecturer from the under represented group – cost R2,5million	No
		A4.2	Ensure that number of staff registered for Masters increase to 165 from 150 (Target : 400)	Yes
		A4.3	Ensure that number of staff registered for Doctorates increase to 43 from 38. (Target : 100)	Yes
		A4.4	40 new registration for Masters are finalised.	Yes
		A4.5	Seven new registration for doctorates are finalised.	Yes
	KRA : A5 Community Engagement	A5.1	Ensure that at least 20 community projects are held every year	Yes
		A5.2 A5.3	Each faculty and dept must have a community aligned project Each faculty to promote community service amongst students	Yes
	KRA:A 6 Governance	A6.1	Detailed strategic plans with operational plans targets with planned enrolments for following year	Yes
		A6.2	Complete Academic restructuring	No
		A6.3	Each Executive Dean to ensure that a performance System is operating in their sector with signed Performance Agreements	No

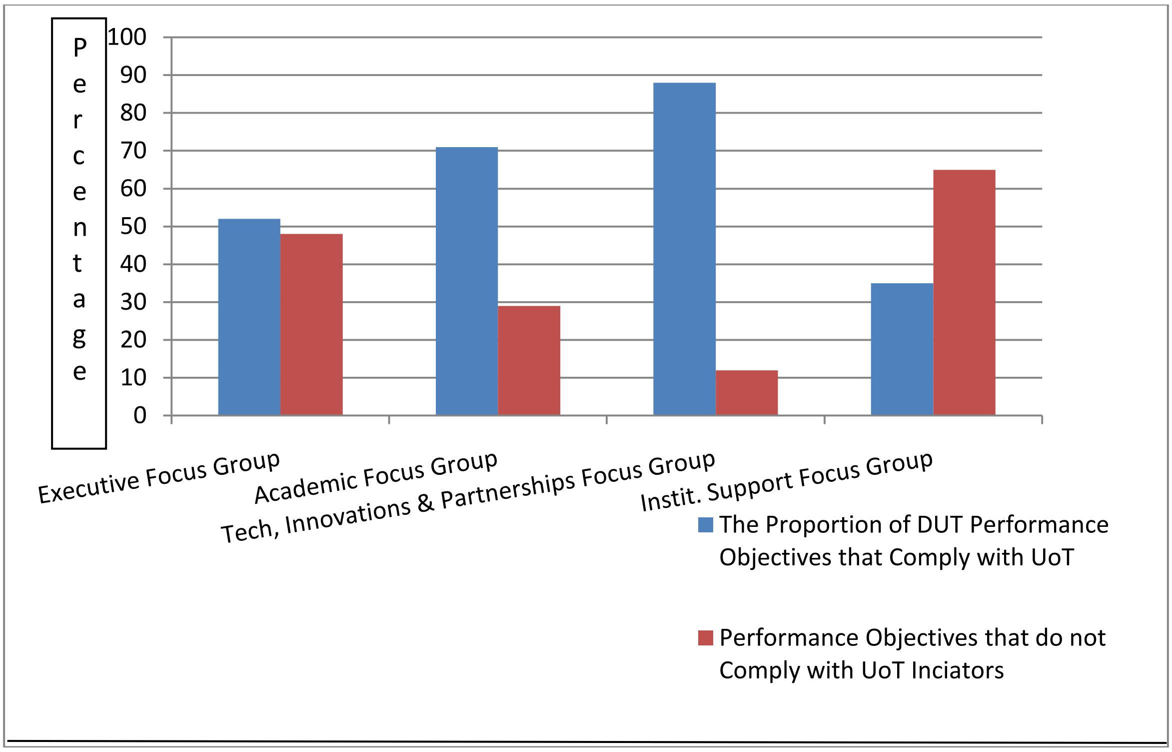
Focus Group	What are the KRAs that drive the characteristics of DUT?	What are the planned activities or objectives that drive each KRA?		Is the planned activity described by the UoT PIs?
		A6.4	Improved systems to implement applications, registrations, examinations, graduations, certification process – improved turnaround times	Yes
TIP Focus Group	KRA : T1 Technology Transfer	T1.1	Number of TT proposals received and solicited	Yes
		T1.2	Number of TT proposals converted to registered viable projects/agreements	Yes
		T1.3	Number of projects converted to viable/ commercial projects	Yes
		T1.4	1.4 Number of partnerships/BUs	Yes
	KRA: T 2 Innovation	T2.1	Twenty proposals received and assessed	Yes
		T2.2	Ten of proposals converted into viable application of Technology / Agreements	Yes
		T2.3	Five fully operational innovation projects	Yes
		T2.4	Ten partnership collaboration with industry /Civil society	Yes
		T2.5	Three patents registered	Yes
	KRA: T3 Partnerships	T3.1	Five international Partnerships concluded	Yes
		T3.2	Fifty staff /students participating in exchanges/partnerships	Yes
		T3.3	Five National partnerships agreements concluded	Yes
		T3.4	Fifty staff / students engaged in national partnership	Yes
		T3.5	Five collaborations /initiatives with industry Civil/Society	Yes
		T3.6	Fifty agreements/WIL opportunities with industry	Yes
		T4.1	Increase in proposals for submission of articles, patents, projects, for recognition as research output by 20	Yes
		T4.2	Increase in post graduate enrolments in M and D from 188 to 208	Yes
		T4.3	Increase in research O/p registration from 50 to 55	Yes
	KRA :T5 Increase postgraduate enrolment	T5.1	Increase Post graduate enrolment by registering 10% of student into postgraduate programs	Yes
	KRA: T 6 Improved Management and Governance System	T6.1	Improve service delivery – 48 hours turnaround time	No
		T6.2	Develop and Implement Strategic Plan – (a plan or the university plan)	No

Focus Group	What are the KRAs that drive the characteristics of DUT?	What are the planned activities or objectives that drive each KRA?		Is the planned activity described by the UoT PIs?
		T6.3	Sign Performance Plans for Executive Directors, Directors, Managers	No
	KRA : T7 Staff Development (Increase PhD from 38 to 100 and Masters from 150 to 400 by 2012)	T7.1	250 staff to be registered for Masters	Yes
		T7.2	60 staff to be registered form PhD.	Yes
		T7.3	Provide ongoing skills development to build skills amongst staff e.g. improve teaching and research skills	Yes
Institutional Support Focus Group	KRA: IS1 Increased graduation rate by 0.5% (from 14% to 19.5%, targeted 22.5%)1:	IS1.1	Review Financial Aid processes to ensure deserving students receive financial support	No
	KRA: IS 2 Staff Development (Increase PhD from 38 to 100 and Masters from 150 to 400 by 2012)	IS2.1	Support deserving applicants to access support from HEEAS	Yes
		IS2.2	Provide developmental workshops to assist staff writing proposals	Yes
		IS2.3	Implement Policy and budget for Skills development equitably	Yes
	KRA:IS 3 Improved student and staff experience	IS3.1	Develop Student Facilities Plan – Including self sustainable student Housing	No
		IS3.2	Develop Residence Maintenance Plan	No
		IS3.3	Create a safe and secure environment by reducing incidents of crime by 30% pa	No
		IS3.4	Create a healthy environment by reducing accidents by 30 % pa	No
	KRA: IS 4 Improved Management and Governance System	IS4.1	Improve service delivery – 48 hours turnaround time	No
		IS4.2	Develop and Implement Strategic Plan - (a plan or the university plan)	No
		IS4.3	Sign Performance Plans for Executive Directors, Directors	No
		IS4.4	Improve recruitment to attract and retain skilled UoT staff	No
		IS4.5	Improve customer services by implementing/introducing HEAT system	Yes
		IS4.6	Employ Institutional Planner	No
	KRA: IS 5 Durban University of Technology as a first choice UoT	IS5.1	Review Marketing and Branding Strategy	No
	KRA: IS 6 Durban University of Technology as a truly technological institution	IS6.1	Each Dept to have a technological intervention to improve service delivery	Yes
		IS6.2	Establish 3rd stream income infra structure	Yes

Graph 7.1: DUT Performance Objectives that Comply with UoT Performance Indicators



Graph 7.2: DUT Performance Indicators that Comply with UoT Performance Indicators as per Ambit



At an institutional level 64% of the performance objectives comply with the UoT performance indicators. Other performance indictors adopted are unique to DUT and are aligned to the strategic plans of the institution. The indicators, however do not give an indication on which indicators are inputs, outputs or process measurements. This will be remedied later through the design of a balanced score card.

On an intra-institutional level there are four ambits, with the executive ambit setting the strategic agenda of the institution. Slightly over 50% of the indicators comply with the external UoT performance indicators, while slightly less than 50% is made up of unique performance indicators aligned to the strategic plan. On the DVC levels, the picture changes with the TIP Focus Group containing close to 90% of the performance indicators of UoTs. This is expected given that the unique performance indicators arising from the UoT typology is concentrated in this ambit. This ambit includes technology transfer, Innovations, partnerships, Cooperative Education, applied research as the five pillars of a UoT. The academic ambit contains as much as 70% of a UoT performance indicators. This is encouraging given that the UoT characteristics need to be integrated into the faculty, departmental and PQM of the academic sector. Lastly, the Institutional Support Focus Group has about 33% of the UoT performance indicators in its ambit. This is expected as many of the functions in this ambit are support services and do not relate directly to academic functions. The majority of its functions are administrative and logistical in nature and will be unique to the institution.

7.4 INTERVIEWS WITH UoT SPECIALISTS

The analysis and interpretation of the data in this section explores the perspectives and analysis from experts in the UoT Performance Indicator project in South Africa. Five key participants from four South African UoTs, namely Central University of Technology, Tswane University of Technology, Cape Peninsular University of Technology and Durban University of Technology were selected. They were selected on the basis of representation on the UoT Performance Indicator project as selected by their respective institutions for their expert knowledge on UoTs. The participants in the interviews were:

- Director: Management Information System (Cape Peninsular University of Technology). Interview conducted on the 18 May 2009
- Director: Management Information Services
  (Central University of Technology). Interview conducted on the 16 April 2009
- Manager: Management Information (Durban University of Technology). Interview conducted on 5 March 2009
- Vice Chancellor and Chair of SATN (Durban University of Technology). Interview conducted on 23 April 2009
- Director Institutional Planning (Tshwane University of Technology). Interview conducted on the 2 April 2009

Since UoTs are in their formative stages and that the major discussions are being held in the Performance Indicator project, the researcher felt that it was important to interview the above representatives because of their in-depth knowledge of UoTs and also since they represented their institutions on the Typology Committee and therefore they bring a particular perspective to the study. The data represented in this study was based on the key cause and effect relationships between the different characteristics or attributes of a UoT in developing a UoT system. Responses are grouped into seven main research questions in terms of themes:

1. What are the main external forces influencing the development of UoTs?
2. What are the main differences between UoTs and other higher education institutional types in South Africa?
3. How are the goals of the NPHE being articulated in the stipulations set by DOE for UoTs?
4. What are the main characteristics or attributes of UoTs and how will they address the skills, human resources and economic development of the country?
5. How are the characteristics of technology, knowledge transfer and innovation integrated in the delivery of teaching and learning, research, and external engagements at a UoT?
6. How will student access be advanced in a UoT and how different is it from a traditional university?

7. How should DOE funding be changed to support UoTs and sustain their unique contribution to the HE sector?

The development of the UoT system tends to emerge from different perspectives guided by the interviewee's responses and presented them into themes guided by the data.

Question 1: What are the main external forces influencing the development of UoTs in South Africa?

- **National Priorities**

The environmental forces that impact on UoTs are primarily driven by the need for economic growth to ensure prosperity of the country. This places a responsibility on universities to provide skilled labour to industry and government. The Governments Human Resource Strategy is to ensure that there is a constant supply of highly skilled staff to support the country's development. To translate this into operational targets, the DOE has designated that UoTs provide undergraduate courses in the Diploma and Degree qualification areas. Increased postgraduate enrolment is a long-term goal because UoTs are in the early stages of development and it will take about 3 to 5 years for these institutions to build their capacity so as to significantly increase postgraduate enrolment (Director IP, Interview, 2 April 2009). UoTs have positioned themselves between FETs and traditional universities in terms of meeting the human resources needs of South Africa. The world needs skills that fit into the middle category. The UoTs with a strong WIL component are in a position to fulfill this need. Developed countries like U.K, Germany, Ireland, Australia, rely heavily on skilled employees from UoTs. Previously, South Africa's education system was characterized by the inverted pyramid, in which there appeared to be more students in universities rather than FETs and Technikons. This is slowly changing, however strong perceptions exist to jealously guard the status of universities as exclusive zones of "excellence". The world has acknowledged that universities cannot survive if it continues with its "ivory tower" mentality. It needs to be part of society and contribute to its development through job creation, human resources development, problem solving etc. UoTs have challenged the assumptions and notions that made traditional universities rigid and resistant to change (Vice Chancellor, Interview 23 April 2009).

- **Restructuring of the Higher Education Landscape**

The higher education landscape was significantly changed initially through the National Plan for Higher Education. Previously, higher education was separated on the basis of race. After democracy in 1994 there was no need for the duplication and inefficiencies that plagued higher education. This resulted in mergers throughout the country. The DOE's policy sets the framework for higher education described as a single but differentiated system (Manager MI, Interview, 5 March 2009). In 2004, Technikons were redesignated as Universities of Technology. However, there was no indication what the new role of UoTs would be. The SATN committee comprising of vice chancellors from the majority of UoTs began to put together the profile of a UoT in South Africa. This was based on overseas models and local developments and experiences (Vice Chancellor, Interview 23 April 2009).

- **Academic Drift**

With the creation of UoTs and its unique programs characterised by WIL, and partnerships with industry, there appears to be shift by traditional universities to go the same way. It confirms the thinking and the mandate of UoTs to embark on this journey as the correct way into the future for all universities. It is also a threat to the UoT sector to motivate for its existence as a distinct group since its claim to existence is that they produce a different type of graduate, more in tune with the needs of society (Director, Interview 16 April 2009).

- **Resourcing**

To meet the goals and benchmarks of a UoT requires large financial resources. Universities require highly qualified masters and doctorates staff. Infrastructure is required to train student in SET and postgraduate qualifications. UoTs need to produce research as other universities and many of these newly designated institutions were never meant to be research oriented universities. It may take many years and huge injection of finance for them to produce high level research outputs.

Funding for UoTs does not attract a subsidy for experiential learning and as a result this places these institutions at an disadvantage. Also obtaining additional income from student fees is not possible given that there is a limit to how much fees can be increased (Director, Interview 18 May 2009).

Question 2: What are the main differences between UoTs and other higher education institutional types in South Africa?

- **Education and Training**

Traditional universities educate for the sake of education, UoTs train students so that they graduate and become knowledge workers, and problem solvers. UoTs have programs which students can choose depending on the needs of their career. Qualifications awarded are from certificates to Doctor of Technology. Universities have rigid qualification with very little relevance to their careers. UoTs prepare graduates for the workplace, traditional universities prepare graduates for society in general (Vice Chancellor, Interview 23 April 2009).

Co-operative education and WIL are unique features of the previous technikons, which was incorporated into UoTs. Advisory boards provide a link between the university and industry in the respective disciplines. Emphasis on SET is characteristic of UoTs. (Director, Interview 18 May 2009).

- **Research and Innovation**

UoTs apply research to the world of work to solve real world problems. They use technology in being inventive and add value by commercializing there research output. Some of the outputs that may be categorized as research are patents, IP, incubators, technology transfer stations.

- **Technology, Innovation and Partnership**

The UoTs believe that they are equal but different from the traditional universities. The emphasis of UoTs is to be technologically focused. This means that technology has to be integrated into the Program Quality Management (PQM). The UN definition of technology is the use of innovative means to solve problems. This definition has been adopted by UoTs in their quest for being leaders in technology (Van Staden, Interview 2 April 2009). The DOE has set a benchmark for UoTs in that 50% of students enrolled must be in Science, Engineering and Technology (SET) (Manager MI. Interview 5 March 2009; Director MIS, Interview 18 May 2009).
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The formation of incubators, IP, community engagement has been important in ensuring that the knowledge generated is applied in a practical situation. Commercialization of UoT projects are prioritized. Partnerships are seen as an innovative intervention of sharing knowledge and resources (Director MIS, 16 April 2009).

- **The Future**

The differences between the university types may disappear in the future as traditional universities start to employ cooperative education methods and programs which were the exclusive programs offered by the previous technikons and the present UoTs (Director MIS, 16 April 2009).

The backlog of infrastructure funding places UoTs in a disadvantaged position in competing with traditional universities, given their strong infrastructure that was built over hundred years ago. For the newly formed UoTs, this has resulted in less than optimum performance and therefore may not qualify for funding that rewards high performing institutions.

There is a huge cost in trying to attract professionals and highly skilled staff to UoTs. Furthermore, the lack of resources may deprive UoTs of high level talent in research and teaching disciplines. Even if there are skilled persons available they may not be attracted to institutions with sub standard facilities (Director MIS, 16 April 2009).

<u>Question 3: How are the goals of the NPHE (National Plan for Higher Education) being articulated in the stipulations set by DOE for UoTs?</u>

- **Technikon to UoT**

The NPHE only makes reference to technikons. UoTs have since developed their technology focus from what was envisaged in the NPHE. The NPHE also categorised technikons as Degree Awarding institutions (Vice Chancellor, Interview 23 April 2009). In 2004, the DOE designated Technikons as UoTs. They were subject to university benchmarks but were not allocated additional funding to reach these targets and further the DOE did not clearly articulate their roles and functions.

To some extent, the merging of institutions and the change of designation from "Technikon" to "University of Technology" has strengthened the UoTs as a sector within higher education. The changes have resulted in a smaller number of UoTs, but they are generally large institutions with diverse student populations and a common commitment to career-oriented education, SET, applied research, innovation, and community outreach. As such, they are able to contribute positively to the main objectives of the NPHE and the earlier White Paper – viz. human resource development, high-level skills training, and the production, acquisition and application of new knowledge (Director MIS, Interview 18 May 2009).

- **NPHE Goals**

Several targets for higher education were set and UoTs have met many but are struggling with others.

The equity target for students as set by the NPHE was met. However, the staffing targets for UoTs have taking longer.

The NPHE has emphasized increased access and success of students. While admissions have widened, the quality of school entrants have not been encouraging, resulting in poor success rate. The gap between matriculation and university has widened. The DOE needs to provide further funding to bridge this gap if the targets are to be met. At the moment the development grants are not sufficient to address the problems associated with poor schooling. This particular grant is made available to all qualifying institutions. However, there is no special recognition of the UoTs attempts to accept students through alternative access routes which cost these intuitions a lot of money which is not catered for in the subsidy formula.

The NPHE has set clear enrolment targets for universities and UoTs have stayed within these targets. The increased graduation rate from UoTs contributed to the NPHE (Director IP, Interview 2 April 2009). However, it was felt that the funding guidelines by DOE were too prescriptive because of capping of postgraduate enrolments, resulting in lower subsidy to the institution. Further postgraduate enrolment should be encouraged to create new knowledge through research (Director MIS, Interview 18 May 2009).

The goals set by the DOE could result in UoTs not achieving many of them, because of lack of funds that is needed in HR developments, physical infrastructure, operational costs and other recurring costs. If the input is poor, then the chances are that the output will be poor and it would be largely because of poor resourcing (Director MIS, 16 April 2009). It is anticipated that in the long term experiential learning will attract DOE funding. This goal was included in proposals submitted to the DOE which includes the funding framework for UoTs (Director IP, Interview 2 April 2009).

- **Solutions to Improve Access and Success**

Attracting the correct type of student requires focused marketing for UoTs in schools and not only state schools but also private schools. This requires appropriate career counseling. To improve access the interviewee suggests that UoTs establish a long-term relationship with High Schools and communicate consistently with these students (Manager MI. Interview 5 March 2009).

The present drop-out rate in Higher Education is 50%. One of the causes of drop-out is that students cannot afford the student fees. Another factor impacting on the poor graduation rates is the issue of bottleneck subjects that prevent students from graduating in certain key subjects e.g. Mathematics and Statistics. The impact of HIV/AIDS and poor quality of matriculants entering Higher Education contribute to poor graduation (Manager MI, Interview 5 March 2009). Foundation courses, bridging programs and expanded degrees are interventions that can improve pass rates and consequent graduation rate. UoTs take on an equal number of students as traditional universities and notwithstanding the problems experienced it is able to produce similar throughput to traditional universities. Another way of increasing access is through FET articulation (Director IP, Interview 2 April 2009). .

Question 4: What are the main characteristics or attributes of UoTs and how will they address the skills, human resources and economic development of the country?

- **Unique Access**

UoTs have lower admission requirements than traditional universities, which aids and widens access as discussed elsewhere. UoTs provide alternative access to students. More historically disadvantaged students come to UoTs. They are able to provide support and ensure that they graduate. The graduation rate is the same for traditional universities as for UoTs, notwithstanding the less rigid entrance requirements. UoTs provide for RPL, to widen access to H.E (Vice Chancellor, Interview 23 April 2009; Director MIS, Interview 18 May 2009).

- **Unique Course Structure and Integration**

The cooperation with SETAs and professional bodies in many courses enhances the country's skills development initiatives. The ASGISA (Accelerated Skills Growth Initiative of South Africa) and JIPSA (Joint Initiative Programme of South Africa) are national initiatives by Government to build the country's human capital so that it can accelerate economic development. This falls within the mandate of UoTs.

Flexible courses suitable for local needs (short courses, wider mix of expertise) result in quicker response to changes in the discipline and incorporation of the growth of knowledge. Flexible courses provide for different exit levels depending on the need of the individual. This allows students to choose a suite of courses relevant to their jobs and careers.

Entrepreneurship culture is developed, not only to get jobs but to create jobs. Entrepreneurship is integrated into the curriculum to stimulate job creation

Experiential learning helps with quicker productivity of students through industry partnership, WIL, service learning, industry exposure. These enhance knowledge and skills transfer. However, traditional universities are also adopting WIL into their program. UoTs provide for quick employability of students. The old thinking that UoT prepares a student for a job and universities prepare a student for a career, is changing as the borders get blurred. However, certain UoT programs can lead to higher careers (Director MIS, Interview, 18 May 2009).

- **Unique Typology**

There are five characteristics of UoTs: Technological Leadership, Research and Innovation, Entrepreneurship, Partnerships, and Impact on the National Landscape. Sustainability is achieved through partnerships with community, government, networks, etc. The characteristics of UoTs are also strategic goals that need to be realized (Director IP, Interview 2 April 2009).

Question 5: How are the characteristics of technology, knowledge transfer and innovation are integrated in the delivery of teaching and learning, research, and external engagements at a UoT?

- **Translating UoT Pillars into Programmes**

The UoT has several pillars namely:

- Partnerships with industry and community engagement;
- International and national partnerships;
- Technology leader;
- Entrepreneurship;
- Applied Research;
- Work integrated learning.

These pillars have to be endorsed by all stakeholders from a strategic level to a program level. Systems need to be created. Programs need to be reviewed to integrate technology, WIL, and relevance into the curriculum. More regular updates of curriculum review and if content changes more than 50% then program must be referred to the Council for Higher Education (CHE), otherwise it can be done in-house (Director MIS, 16 April 2009).
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Integration of technology in PQM is key in advancing the technological ethos of a UoT. Qualified staff are crucial in providing this type of education. Therefore it is incumbent on them to be trained in technology and innovation techniques, to ensure that they advance leadership through technology. Staff need to be trained and their qualifications need to be improved in terms of masters and doctorates. Finally these need to be supported financially to achieve the targets defined by the performance indicators that have been adopted. (Vice Chancellor, Interview 23 April 2009).

The type of research should also have technology integrated within it so that research can be applied to solve problems. Service learning is part of curriculum credits and it forms part of a system to provide community services and engagement (Director IP, Interview 2 April 2009). Applied research and technology expose academics to science parks, technology stations, as means of applying knowledge. These initiatives can help students to also obtain practical training (Director MIS, 16 April 2009; Director MIS, 18 May 2009).

Community partnerships help to transfer and apply knowledge and innovation to solve practical problems in communities. It also helps UoTs and staff to become aware of needs of communities to focus on training, capacity building and knowledge transfer. It also helps academics and researchers to appreciate community problems and inculcate a positive attitude in developing a partnership culture (Director MIS, 16 April 2009).

An Executive management portfolio was created in some of the UoTs with the specific purpose to drive “Research, Technology Innovation and Partnerships” with the intention of promoting such aspects as technology, knowledge transfer, and innovation throughout the institution (Director MIS, Interview 18 May 2009).

<u>Question 6: How will student access be advanced in a UoT and how different is it from a traditional university?</u>

Access is advanced through agreement with FET Colleges. Marketing UoTs in schools is an important strategy in developing long-term relationships with schools and learners.

Foundation courses, extended courses are interventions designed to support students who are struggling in certain subjects or as a result of poor matric passes. The extended four year degree program is a new approach to improve the success of students.

RPL is the latest intervention to encourage recognition of prior learning. All these together provide UoTs with important entry points to access UoT Courses.

The admission point score system used by UoTs is the same as traditional universities. However the requirements to enter a UoT is much more flexible (Bleazard, Interview 18 May 2009). This opens the door for UoTs to articulate their technikons/technology programs to the university's engineering discipline in the 4th year (Director IP, Interview 2 April 2009).

This was also discussed in question 3.

Question 7: How should DOE funding be changed to support UoTs and sustain its unique contribution to the HE sector?

- **The Funding Problem**

The subsidy formula does not do justice to the type of teaching and learning and research produced by UoTs. Some of the matters highlighted were that with regard to the 3 year diploma, the WIL component does not attract a subsidy, yet staff have to mentor, visit and assess these students.

Secondly, the type of research that UoTs are engaged in, is not all recognized for subsidy purposes. For example artifacts, patents and IP (Intellectual Property) are not recognized as legitimate outputs (Manager MI, Interview 5 March 2009).

- **Funding Framework**

The current funding framework makes provision for the following three funding categories:

(i) Funded student places;

(ii) Institutional outputs, including student and research output;

(iii) Development grants as per agreement with the DoE.

It also makes provision for an 'institutional factor' which takes into consideration the institutional size amongst other things.

The impact of UoT's Restrictions on Financial Sustainability

(i) As indicated by the enrolment targets UoTs will have a range of at least 74% to 87% of headcount enrolments in undergraduate diplomas, and 10% to 19% in undergraduate degrees;

(ii) The proportion of enrolments in postgraduate qualifications must not exceed 7%;

What is clear here is that there is a strict upper limit to postgraduate enrolments and a flexible upper limit for undergraduate diplomas. This suggests that the DoE prefers that UoTs concentrate on diplomas only instead of opening the university to postgraduate study. If the argument above is followed, then it indicates that funding of UoTs will never reach adequate levels to meet its obligations. So, if UoTs have to be essentially diploma-awarding institutions, the DoE should allow adequate debate and discussion on the financial impact of these constraints (Vice Chancellor, Interview 23 April 2009). .

- **Future Funding Requirements**

The DoE needs to allocate more resources for capacity building to facilitate the upgrading of skills so that UoTs as a university can develop its staff to masters and doctorate levels.

The DoE expects 50% of the enrolments to be in SET, but for this to happen, institutions require massive financial injection to build infrastructure to sustain this benchmark in terms of provision of laboratories, teaching facilities and recurring operational costs.

UoTs envisage that the type of research they should be engaging in is through the application of knowledge, instead of trying to aspire to be "research universities". However, the type of research that UoTs will engage in has to be designated as research output to attract funding. The development grants which universities receive are temporary funding; however it is felt that, given that UoTs are new to research, these type of institutions require additional funding to develop infrastructure and capacity to improve their research output and culture. Many traditional, mainly Historically White Universities have highly developed research infrastructure that was built over the last 100 years. For UoTs to produce significant research output (0, 5 per academic staff) the DOE needs to inject significant funding targeted at key growth points (Vice Chancellor, Interview 23 April 2009).

UoTs feel that decisions taken by DOE to relegate this sector to be primarily diploma/degree awarding institutions will disadvantage UoTs. The capping of postgraduate enrolments, will rob them of the ability to build their research profile and the potential funding that comes with it. This should be placed on the table for debate and discussion (Vice Chancellor, Interview 23 April 2009).

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The way development grants are used by the DoE may disadvantage institutions since these grants are made only if the research output conforms to certain requirements. Thus the non-awarding of a development grant constitutes a state decision about the scope of academic engagement for a particular institution. It is important for UoTs that the conclusion of the differentiation debate will also conclude the avenues for development grants. In this respect, it is important for these institutions to develop alternative system development demands as well as the accompanying performance matrix and measures to be funded under this category (ice Chancellor, Interview 23 April 2009).

- **Special Funding and Third Stream**

Development grants are not given to high research output universities or to those universities that are improving their research output. This needs revision as there are other infrastructural needs that are critical inputs into research development. The Government and the DOE need to investigate another mechanism to supplement research infrastructure so that the playing fields are even in terms of comparison with long standing traditional universities (Director MIS, 16 April 2009)

To facilitate increased accommodation of experiential learning in industry the Government should introduce tax deduction or incentives to encourage the employment of experiential learners.

Patent, IP, experiential learning to be included as a basis for funding in future. These outputs need to be designated as forms of research so that it may attract a subsidy.

Closer links with FET will result in new students being admitted to UoTs through articulation agreements and will increase both input and output grants.

In assessing research output for funding, DOE needs to factor in poor resourcing, infrastructure and pro rata funding grant (Van der Merwe, 16 April 2009). An HR Development plan should be formulated to address shortage of skills and ways of subventing salaries to retain and attract scarce skills. This may require special funding (Naicker. Interview 5 March 2009).

The interviewee suggested that an input grant be given to UoTs for the third year using their major subjects for weighting. This would go a long way in addressing ways of improving throughput and research infrastructure through increased subsidy. A further recommendation is that earmarked funding be given to UoTs to build research infrastructure, and improve learning facilities for a period of five years (Manager MI . Interview 5 March 2009).

7.5 SUMMARY

This chapter contains data from the observation, focus groups and the interviews.

Observations were made of the discussions and presentations of the Typology Committee to the SATN Board and the Finnish delegation. The final report was tabled, which contained the typology factors for the development of UoT in South

Africa. These formed the building blocks of the UoT and defined the type of results expected from this sector.

The main factors that emerged from the observations that form the basis for UoTs are the following Technology Focused Programmes, Research and Innovation, National and International impact and recognition, Entrepreneurial and innovative and Sustainability in Engagement and Practice

The factors and the descriptive elements were then tested at DUT with focus groups configured according to the structure of the institution. The attributes, criteria, KRAs and PIs were presented to three focus groups, which identified the cause and effect drivers and applied these into an operational setting and integrating into an operational and performance plan. The data from the research found that a significant number of the elements of the UoT typology were applicable to the DUT. The KRAs and PIs were then integrated into the performance plans of the focus group members.

The results of the observation and the focus groups were further validated through interviews with UoT specialists. The attributes, criteria, KRAs and PIs were then integrated into the Balanced Score Card, which will be discussed in the next chapter.

The interviews identified many drivers of a UoT, which enhances the model. The interviewers highlighted the differences and commonalities between the Traditional universities and UoTs, One of the key findings is that there are many common features in the two types of universities but the main difference lies in how UoTs go about teaching, learning and research. The emphasis is on application and knowledge transfer. The biggest difficulty experienced by UoTs is that they require massive funds to build infra structure and attract talent, since they are now universities and will be assessed like Traditional universities. In many ways they will have to offer competitive salaries to attract high caliber staff from other institutions. The other obstacle in achieving maximum funding is that the subsidy model does not include subsidy for WIL, yet many of the courses at UoTs have a compulsory WIL component.

The loss of the research development grant has deprived some of the universities of an important source of funding. The principle adopted by the DOE is that even though they have not met the DOE research benchmarks these universities have managed to show improvement and therefore do not qualify for this grant. Interviewees felt that other mechanisms be sort to provide some continuity of funding so that these universities do not lose momentum in reaching the research outputs. Generally all the interviewees appear to have a shared notion of what UoTs really mean.

CHAPTER 8

BUILDING THE UoT MODEL: BALANCED SCORE CARD APPROACH

8.1 INTRODUCTION

This chapter integrates the research findings arising from the interviews, focus group discussions, and documents. This requires a systemised approach to ensure that value is added at each stage and the appropriate outputs and goals are achieved throughout the process of developing a UoT. However, to produce an output the system requires drivers at each input and output stage. This is then aligned to performance measures that clearly and unambiguously identify what is expected from a UoT.

One of the problems is that while many organisations have performance measures they do not know if or when a performance measure is an output of a process or an input to another process, or further is it a final outcome of the organisation's strategic plan or is in an interim stage. In a production line it is relatively easy to see the inputs and outputs, but where services are required and where the timelines are more than one year (for example in higher education students graduate between 3-5 years), then these performance measures need to be clarified in the value added process.

This aspect will be discussed in designing a system that will address these anomalies.

8.2 THE FOUR UoT PILLARS

The outcome of the research has produced data which was consolidated into four pillars on which the concept of a UoT has emerged. Each of these pillars were termed strategic goals since these are long term goals that will need to be achieved to distinguish UoTs from traditional universities. The strategic goals that support the concept of a UoT include:

- Impact on National, Industry and Community
- Applied Research and Innovation
- Entrepreneurship and Innovation
- Increased Graduates (specifically in the technology driven programs)

While each of those is listed as separate they operate within a system and have a synergistic relationship. To understand how they operate and relate to one another, one has to look at systems theory. Senge (1990) advocated many key components in systems are connected and there are cause and effect relationships that exist and these need to be identified within a system, so as to understand how it works and what type of results to expect. Further, it helps in the design and planning of institutional performance.

To comprehend the systems thinking approach as enunciated by Peter Senge it is helpful to reiterate the principle that universities are part of the environment and society and therefore there is a strong cause and effect relationship that exist. This brought home the stark reality that economic development has to factor in the environment as a resource that needs to be protected. The cause and effect relationship of economic development and its impact on the environment, are two systems that are interdependent. Producing at all costs will ruin all natural resources and could endanger life on earth. On a more micro level, institutions need to know how to manage change and produce in a sustainable and responsible manner. Organisations operate in a global village, in which the environment is subject to constant change, adaptation and modification. Customer's tastes are also continually changing. Therefore, internal systems will have to change to align to new challenges, expectations and aspirations. Kaplan and Norton (1996) recognized the constant changing world that organizations and institutions have to operate within. The new type of worker termed the knowledge worker characterized the world of work. The specialty for this type of worker is to solve problems and provide highly focused information to add value to the design, development and improvement of products. The actual number of workers directly involved in production plants have declined as mechanisation and mass production techniques increased. The knowledge worker has to provide solutions to the myriad of problems and challenges to ensure value is enhanced in the face of change and competition. The Balanced Score Card was introduced as a way of integrating the various changing components and timeframes into a single effective system.

8.3 HISTORY AND BACKGROUND OF PERFORMANCE ASSESSMENT

Report cards have become a common device for assessing the performance of governments, organizations, and individuals in a range of policy arenas. Governments, commercial enterprises, academics, and public interest groups, think tanks, and foundations are the primary issuers and users of report cards (Coe, and Brunet, 2006).

Achieving long-term competitive advantage in the marketplace is the aim of prevalent management initiatives such as total quality management, learning organizations, reengineering, six-sigma, and business process redesign. Recently, innovative firms have come to recognize that a comprehensive performance measurement system is an essential component for the integration and monitoring of a firm's strategic objectives throughout its business processes (Park and Gagnon, 2006). The management by objectives (MBO) philosophy of Drucker (1955) and the Balanced Scorecard approach of Kaplan and Norton (1992) are based on 'strategic measurements,' and 'goal congruence,' as a means to improve firm performance

(Hoffecker and Goldenberg, 1994; Newing, 1995; Dinesh and Palmer, 1998). The Balanced Scorecard is based on 'rational goal model' and incorporates 'human relations model.' The difference between the two approaches is that while MBO is more 'open-ended,' the Balanced Scorecard is 'more explicit and focused' as it incorporates the perspectives of customers, shareholders, internal business processes, learning and growth. The reason why MBO failed was that it was only used as a performance evaluation tool, and the focus on goal congruence and human element was missing (Anand, Sahay, Saha, 2005; Dinesh and Palmer, 1998).

Previous research has suggested that report cards generally serve one or two purposes (Gormley and Weimer 1999). On an organisational level report cards facilitate consumer choice. For example, state-required hospital, health maintenance organization (HMO), physician, and Medicare report cards assist consumers in making health care decisions. On a national level report cards, are designed to influence public policy (Coe, and Brunet, 2006). In South Africa, many private enterprises have targets and objectives and are assessed regularly. These form part of the employee's performance contarct. In 2009 the South African Government has formed a Ministry of Planning and a Ministry of Performance and Monitoring in the Presidency. These structures will be tasked with planning and monitoring the performance of the various Ministries, Departments and local governments in terms of their delivery of services.

According to Kaplan and Norton (1996: 4), the information age has ushered in a new set of assumptions. The way we solve problems is through a multidisciplinary approach. The changing tastes of customers and the ability to respond quickly to these changes places a huge responsibility on organisations. Physical borders are no more barriers to modern businesses because of the ability of information to transcend boundaries.

8.3.1 Inadequacy of Financial Measures

The inadequacy of financial measures as performance measures is well documented. Where performance measurement reports are dominated by financial measures, performance evaluation is weakened by the inherent limitation of financial information. Unfortunately, for performance measurement, the measures are typically too irrelevant due to the accounting period delay, and too summarized due to the length of the accounting period, which is one year (Park and Gagnon, 2006).

The financial-reporting process is used widely to measure success but it does not incorporate the company's intangible and intellectual assets. Further, financials tell the story of past events but not how the organization is going to create future value through customers, suppliers, employees, process, technology and innovation. On the other hand, the top ten performance measures in Japan do not include any financial measures. Also firms using financial measures tend to focus on short term goals and may compromise on long term goals, because they may have no other way of tracking intangibles like human resources development, customer loyalty (Anand, Sahay, Saha, 2005: 13). These are often ignored because they cannot be readily assessed in the short term and therefore not reported as is the case with the annual financial statements.

From these inadequacies of financial measures, the Balanced Score Card was born. The BSC measures the balance between external measures for shareholders and customers, and internal measures of business process, innovation, learning and growth. The second significant aspect is the balance between the past efforts and the drivers of future performance (Gumbus and Lussier, 2006; Kaplan and Norton, 1996).

Kaplan and Norton (1992: 29) contend that a broader set of measures are seen to provide a more representative reflection of the true complexity of an organization. Since the Balanced Scorecard (BSC) was introduced in 1992, many organizations both private and public have adopted it as a strategic tool for systematic performance improvement (Salterio and Webb, 2003; Kaplan and Norton, 2001a). A survey found that approximately 50 percent of Fortune 1000 companies in North America and 40 percent in Europe use a version of the BSC (Kaplan and Norton 2001a). The editors of the Harvard Business Review identified the BSC as one of the most significant management ideas of the past 75 years (PR 2003). It is being used to help change organizational culture (Simpson and Cacioppe 2001); and several companies have reported improved operational efficiency and profitability as a result of using the BSC (Atkinson and Epstein 2000; Gumbus, Bellhouse, and Lyons 2003).Researchers have clearly stated that companies of all sizes are good at developing mission statements and strategies but poor at implementing operational strategies to achieve them, and that they are poor at measuring whether they are achieving their mission and strategy (Gambus and Lussieer, 2006).

In South Africa service industries such as banks, airlines, universities and hospitals have incorporated the BSC tool in their planning activities.

8.4 THE BSC

The BSC is more than a traditional measurement system, but a strategic management system which translates the vision and mission into objectives and targets. It is organized into four perspectives: financial, customer, internal business process, and learning and growth. Kaplan and Norton (1996:25) describe the function of BSC to “communicate mission and strategy; it uses measurement to inform employees about the drivers of current and future success. By articulating the outcomes the organization desires, and the drivers of those outcomes, senior executives have to channel the energies, the abilities and the specific knowledge of people throughout the organization toward achieving this long - term goal".

8.4.1 Four Perspectives

The four perspectives of the BSC produces a balance between short and long term objectives, between outcomes desired and performance drivers. The four perspectives of financial, customer, internal process and learning and growth, work in a systemic manner in achieving strategy (Huges, et al 2005: 34). The customer perspective asks the question how the organisation should look from the point of view of the customer. The internal process describes what the organisation must do to satisfy the needs of the customer ((Anand, Sahay, Saha, 2005; Gumbus and Lussier, 2006). The learning and growth perspective asks the question what expertise and experience does the organisation require to deliver customer value to the client (Gambus and Lussieer, 2006; Zelgalve, undated). The financial perspective indicates the performance of the company but for a non-profit organisation the financial perspective represent the funding of the organisations core business.

The advantage of BSC is in its entirety and systematic character, which clearly indicates the integration of strategy, operations and performance indicators.

8.4.1.1 The Financial Perspective

The financial perspective measures whether the company's strategy, implementation and execution are contributing to bottom-line improvement. The financial objectives typically relate to profitability, operating income, return on investment, return on capital (Kaplan and Norton, 1996: 21).

The cause and effect of the perspectives are dependent on the type of business in which the organisations is operating. For profit driven organisations the finance perspective is the outcome and all the other perspective drive this strategic outcome eg net profit, ROI. In non-profit organisations, like government, universities, customer value or services, are strategic outcomes and all other perspective are drivers of strategic outcomes.

For UoTs this perspective will be measured not as an outcome but as a driver of value, because the institution receives funding which allows it to meet its institutional goals.

8.4.1.2 Customer Perspective

In this perspective, managers identify the customer and market segments in which the business will compete and the measures of the business unit's performance in these targeted segments (Huckestein and Duboff, 1999; Park and Gagnon, 2006).

The core outcome measures are customer satisfaction, customer retention, new customer acquisition, customer profitability, and image. Customer value proposition is those drivers which customers value e.g. short lead times, quality programs. For A UoT, this could mean higher pass rates for students, higher research production, economic development of the country. The performance measures would be graduation rates, research output, for example the DOE benchmark for graduation rates is 22.5%, and for research it is 0.5 units per staff member.

Developing a profile that would attract the right customers, is a major challenge for organisations, since they operate within a highly competitive environment in which price, quality, need and image are major distinguishing factors. For a UoT, branding and image are major considerations in carving a niche in the higher education landscape. Developing the appropriate brand, image and marketing requires normally 3 to 5 years. Ensuring brand loyalty needs to be backed up with evidence of quality, price, reliability, which help position the institution not only in the market but in the minds of students, parents, funders, industry and Government. Also there are many external variables that may be outside the direct control of the institution and attempting to control them may be difficult. In contrast transforming the organisation through internal processes is well within the institution's control and may take a much shorter timeline like less than 2 years.

8.4.1.3 Internal- Business-Process Perspective

The internal process enables the business to deliver the value proposition that will attract and retain customers in targeted market segments, and in the case of non profit enterprises service provision will be the outcome of internal processes

For an organization to be competitive, it may require new processes or need to modify old processes. For long-term financial success an organization may require entirely new products and services that will meet the needs of current and future customers (Park and Gagnon, 2006: 92). .

This internal business processes perspective is unique to the BSC. Traditional systems identify measures that serve as controls for discrete parts of the business. The BSC encompasses all of the key business functional areas and processes. Effective internal business processes provide high quality products and services and satisfy customers' needs. The internal process measures of the BSC can provide early monitoring of process effectiveness and efficiency (Park and Gagnon, 2006). In the UoT context, internal systems refer to processes that produce value outcomes which in turn drive customer value.

8.4.1.4 Learning And Growth Perspective

This perspective illustrates the learning and growth necessary to drive the other perspectives.

Organization's learning and growth come from three principal sources: people, systems and organizational intelligence. The BSC typically will reveal large gaps between existing capabilities of people, systems and procedures and what will be required to achieve breakthrough performance. To close these gaps, the organization needs to invest in re-skilling. IT and innovation are also components of this perspective since they are important intellectual resources and tools that are used as instruments by human resources to produce the appropriate strategic outcomes (Kaplan and Norton, 1996: 28).

8.5 INTEGRATION WITH UoT PERFORMANCE INDICATORS

The customer outcome measures are lagging indicators because it may take years to achieve changes in customer habits, attitudes and behaviours, when compared to other interventions. Typical measures will be customer acquisition, customer satisfaction, customer loyalty, customer profitability.

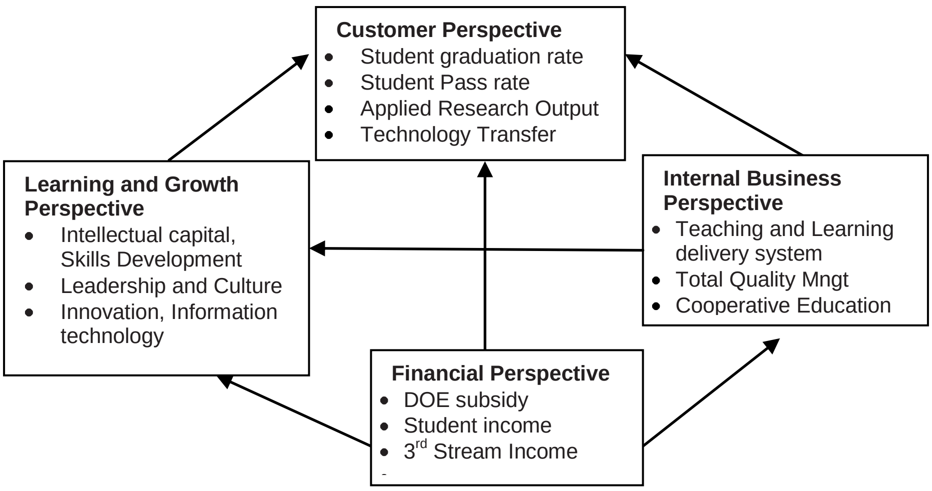
A strategy is a set of hypotheses about cause and effect. The measurement system should make the relationships (hypotheses) among drivers and objectives (and outcome measures) in the various perspectives explicit so that they can be managed and validated. The chain of cause and effect should pervade all four perspectives of a Balanced Scorecard (Anand, Sahay, Saha, 2005; Gumbus and Lussier, 2006; Watt, 2004). For example, higher graduation rates may be driven by the provision of foundation courses. The graduation rates may be a scorecard measure in the customer perspective. The driver of this measure could be provision of foundation courses to first year students in the internal process perspective. This in turn is driven by quality teachers and second language specialists in the learning and growth perspective. This is further driven by the finance perspective which provides the financial resources for to pay staff and provide the physical resources to sustain and advance the improvement of graduation rates.

8.5.1 Beginnings of the UoT Model

The figure below illustrates the relationship of the different perspectives in a UoT. Compared with the private industry, strategic performance measurement systems in the UoT sector is still in the development stages. With the absence of good conceptual models and instruments that test and validate the strategic performance measurement systems for UoTs, understanding and evaluating the effectiveness of these systems over the sector's multiple performance measures is a priority task. In view of the needed research in this area, the researcher examined the strategic performance measurements of UoTs using the BSC framework (Park and Gagnon, 2006). This study seeks to find out whether Kaplan and Norton's BSC (1996), which compensates for the weakness of relying solely on finances, can be used to evaluate and improve UoT performance. First, we review key variables of the BSC using the characteristics and performance indicators as developed by SATN and used by the Focus Groups at DUT. Second, we examine the causal relationships between BSC perspectives through an empirical study based on the interviews and observations and recommend specific approaches for the implementation of the BSC in UoTs. The Focus Groups provided data that determined the performance objectives in operations that drive Key Result Indicators.

There are the three important processes of the BSC that translate strategic objectives into operational practices. First, strategic objectives are linked to the customer perspective or customer value proposition, for example in terms of graduation rates, pass rates and research outcomes. The BSC allows an organization to use strategic initiatives as an effective means to develop entirely new capabilities, reach new customers and markets, and make radical improvements in existing processes and capabilities. Second, information feedback systems comprehensively communicate necessary changes to support these strategic objectives. By adopting open reporting systems, the performance results are made available to everyone in the organization. Third, the strategic hypotheses make the cause-and-effect linkages explicit. The action and feedback of the BSC, reports on actual results and the organization tests the underlying assumption of its strategy (Kaplan and Norton, 2000). The BSC is an integrated set of cause and effect relationships between outcomes (lag indicators) and the critical drivers (lead indicators) of those outcomes (Kaplan and Norton, 1996: 31-32).

Figure 8.1: Simplified Model of BSC Perspective in a UoT Organisation



Balanced Scorecard (Adapted from: Kaplan and Norton, 1996:9)

The purpose of Higher Education is to develop the country's human resources so that they can participate in the economic development of the country. Many of the developed countries of the world eg Japan, and Germany have few natural resources but have a wealth of human talent which they are able to develop to grow the economy and ultimately the nation. The model is designed to show the customer perspective as the strategic objective. UoTs exist to develop the country's human resources by training and developing its students, hence graduation rates are crucial outcomes. This is called a lag indicator since this is a result of all the other interventions and drivers and the lagging results may come much later, normally after three or more years. The drivers are lead indicators and provide an early indicator to whether the strategic objectives will be met.

Hughes, et al (2005: 34), advocates the development of scorecards with groups with a facilitator, since they are able to reach consensus with regard to the strategy and how it cascades and correlates with the expected outcomes and performance measures. The BSC maps out the positions and relationships of the various sections to produce the desired results of the organisation. The research from the various sources in this study from overseas institutions, the SATN Performance Indicator research, interviews and the focus groups have produced characteristics and performance indicators for the UoT sector and from these a strategic map can be formulated. The characteristics and performance indicators represent the outcomes while the plan is the road map in arriving at this outcome or destination. These will be clearly systemised into a model that can show the drivers, processes, learning and growth perspectives.

8.6 LINKING THE BALANCED SCORE CARD MEASURES TO STRATEGY

According to Kaplan and Norton (1996), the BSC translates the strategy into performance measurements. Three principles as already alluded to enable the BSC to be linked to strategy:

- Cause and effect relationships
- Performance drivers
- Linkage to financials

These will be discussed in greater detail.

8.6.1 The Workings of Cause and Effect, Performance Drivers and Financials

A strategy in the BSC is a set of hypotheses about cause and effect. Cause-and-effect relationships can be expressed by a sequence of if-then statements. For example increased graduates can be linked to a sequence of hypotheses. If an institution increases the number of students admitted to foundation courses then this will reduce failures in subjects, and ensure that students graduate earlier and then this will increase the institution's subsidy income and will help meet national benchmarks.

A properly constructed scorecard should tell the story of a business unit's strategy through a sequence of cause-and-effect relationships. The cause-and-effect relationships sit between outcome measures and performance drivers. The drivers are inputs in the value chain or the system. Every measure selected for a BSC should be an element in a chain of cause-and-effect relationships that communicates the purpose of the business strategy (Kaplan and Norton, 1996).

8.6.2 Coding of the Data

The Table 8.1 contains 6 columns. The number column contains the code, with the first alphabet referring to the BSC perspective and is as follows:

U – UoT strategic goal
C - Customer value perspective
I – Internal process
L – Learning and Growth
F – Financial perspective

BSC Perspectives differentiated by Roman numerals

A, B, BB, C, CC, D, DD, E, EE, F followed by ordinary number represents the performance indicator

The Roman number next to the alphabet distinguishes from similar BSC perspective. For example Ci and Cii are both customer perspectives represented by a capital "C" and the Roman numeral gives it a unique code, similarly for the other perspectives.

The "Driver/objective" column identifies the driver and its position is indicated on the BSC chart in Figure 8.2, which demonstrates its relationship in the value chain.

The "Department, Functionary Responsible in a Uot" refers to the likely persons responsible for that outcome in a normal UoT structure.

The "Timeline" column indicates the likely time period that a UoT will take to reach this goal in its formative years. This should decrease as it matures.

The "Performance Indicators" column refers to the outcome of the drivers in "Driver/Objective" column.

This coding will apply to the BSC maps and tables that contain the drivers and performance indicators.

Each of the UoT strategic goals will be discussed and placed within the BSC, while integrating the four perspectives of the BSC. It is envisaged that the codes will be integrated into a computer package that will be made available to UoTs for application, as a strategic development tool.

8.7 UoT STRATEGIC GOALS THAT DEFINE ITS TYPOLOGY

This study revealed four strategic UoT goals that drive the UoT typology, as follows:

- Impact on National, Industry and Community
- Applied Research
- Entrepreneurship and Innovation
- Increased Graduates

For UoTs to be recognised within the higher education landscape, research indicates many cause and effect relationships exists, that drive the various components, and this in turn produces outputs which in turn become drivers to other outputs. To understand the interactions and interdependencies of the system through the BSC, the coded data was mapped out.

In the tables and figures below in this chapter, are the outcome of the research. The BSC first asks why the university exists and what specifically does a UoT do. The research explores exactly that, in our quest in establishing the characteristics and goals of a UoT.

Each of the four goals (or pillars) of a UoT will now be discussed in the context of a BSC.

8.7.1 Strategic Goal: Impact on National, Industry and Community

Today, in South Africa the universities including UoTs have a major role to play in the economic development of the country through human resources development (Chen, 2008). They produce skilled graduates and applied research, in developing the innovative spirit of the country.

The model shows how UoTs contribute to the economic development of a country, by training and development of its human capital and the development of new knowledge. Within the UoT system there are single drivers and their multivariate drivers that work together in achieving the strategic goals of determining impact.

To determine impact on the national level, industry and community, as a strategic goal, it is important to identify the drivers that produce customer value in terms of graduates and research output. The main customers to the university are government, students, community and industry. Each of these sectors have expectations from the institution. The Government provides funding in terms of subsidies and in exchange Government requires that UoTs provide skilled graduates for the job market and also provide research outputs to develop new knowledge and apply it to solve new problems. The three principal drivers for the customer value proposition are increased graduates; partnerships with Government, industry and community; and Increased research output. The intensity of impact of UoT on the national level, industry and community can be measured through performance measures. This is indicated in figure 8.2.

The Table 8.1 below contains the drivers of the strategic goal of UoT. It indicates the performance indicators which each BSC perspective is expected to produce. It further includes the department or functionary responsible and the expected time it will normally be expected to be realized given the resources and support. Normally strategic initiatives take 3-5 years, expansion of the customer base and developing and marketing the organisation’s image take 3 years and more. While internal processes take 1- 2 years, since it is within the control of the organisation

Table 8.1: Strategic Goal: Impact on National, Industry and Community

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
U2	**1Uii Impact on National, Industry and Community C5**	VC, DVC (Academic), DVC (Technology, Innovations and Partnership), Head Coop Education, Director (International Partnerships)	3-5 year	strategic	A17 Improved graduation Rates C1 Number of established business ventures (partnerships, joint ventures and contracts) C2 Number of SMMEs, incubators and technology stations established C3. Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs)
U1.	**1Ui Increased Graduates A17;B10 ;D3;D5;D6;D8;D9**	VC, DVC (Academic), DVC (Technology, Innovations and Partnership)	3-5 year	strategic	A17 Improved graduation Rates B10 Percentage of staff with doctoral qualification D3 Percentage females and percentage by race of student headcount per field of specialization namely SET, Business and Management, Education and other Humanities D5 Percentage of first time entering undergraduate students who graduate in minimum time plus 1 year D8 Number of jobs created through SMME's D9 Number of international collaborations (staff and Students exchanges, research projects, fellowships, joint professorships, cross institutional projects, research chairs, key note addresses, presentations, post doctorates).
Cii.	**Cii Partnerships with government, Industry, Community B1;B2;B6**	DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, Director (International Partnerships), Head (Coop Education)	2-3 year	Customer value proposition	B1 Number of international collaborations (staff exchanges, research projects, fellowships, joint professorships, cross-institutional projects, research chairs, NRF rated personnel) B2 Number of national collaborations (research projects, fellowships, joint professorships, cross-institutional projects, research chairs) B6 Number of completed and sustainable community problem-

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
					solving research projects
Ciii.	**Ciii 3rd Stream Income EE1; EE2**	Executive management, Deans, HODs, Director (Finance)	2-3 year	Customer value proposition	EE1 Ratio of third stream income versus number of engagements EE2 Ratio of third stream income as a proportion of total income
Civ.	**Civ Increase applied research output @ 0.5 per academic staff C1;C2; C3;C4 (Cv) Rated researchers and Innovators**	VC, DVC (Academic), DVC (Technology, Innovations and Partnership), Director (Research), Exec. Deans, HODs, teaching and research staff	3-5 year	Customer value proposition	C1 Number of established business ventures (partnerships, joint ventures and contracts) C2 Number of SMMEs, incubators and technology stations established C3. Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs) C4. Number of SMME's supported (count incidences rather than volume)
Cv.	**Cv Technology Focused Programs AA1; DD1;DD2**	DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff	3-5 years	Customer value proposition	AA1 Percentage of curriculum requiring technological competency from learners AA1. Percentage of curriculum requiring technological competency from learners DD1 Percentage annual growth in student headcount in fields of specialization DD2 Percentage annual growth in graduates in SET
Iii.	**Iii Development of, IP, patents , prototypes, Procedures B5**	VC, DVC (Academic), DVC (Technology, Innovations and Partnership), Director (TTI), Director (Research), Exec. Deans, HODs, teaching and research staff	1-2 years	Internal processes and systems	B5. Number of prototypes, patents, processes, artistic outputs and products registered as IP (Part of the "Innovation" output)

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Iiv	**Iiv Review of UG and PG courses to integrate market relevance and Input from professional bodies-A2,A3,A5; A8, A4,C6**	DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director CPQA	1-2 years	Internal processes and systems	A2 Percentage of UG qualifications approved/accredited by professional bodies (where applicable) A3 Percentage of programmes where active advisory boards/committees are involved A4 Ratio of new UG and PG programmes introduced per year A5 Percentage qualifications revised per year A8 Percentage UG qualification that contains Workplace learning (WIL) C6 Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications
Iv	**Iv Cooperative Industry partnerships E3, D6;D7**	DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director CPQA, Head Coop Ed.	1-2 years	Internal processes and systems	D6 Percentage of annual growth in student numbers and in graduates in national priority areas D7 Number of jobs created through SMME's E3 Ratio of projects (including community and service learning) to FTE staff
Ivi.	**Ivi Develop Community Engagements B6; E3; E4; E5**	DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director CPQA, Head Coop Ed.	1-2 years	Internal processes and systems	B6 Number of completed and sustainable community problem-solving research projects E3 Ratio of projects (including community and service learning) to FTE staff E4 Number of learners from school participating in co-curricular (vacation/weekend schools) activities E5 Number of capacity building/upgrading programmes offered to FTE college staff and other teaching professionals

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
lvii.	**lvii International and National partnerships D8,D9;B1,B2; E3**	Director (International Partnerships), DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, Head (Coop Education)	1-2 years	Internal processes and systems	B1 Number of international collaborations (staff exchanges, research projects, fellowships, joint professorships, cross-institutional projects, research chairs, NRF rated personnel) B2 Number of national collaborations (research projects, fellowships, joint professorships, cross-institutional projects, research chairs) D8 Percentage of international and SADC students D9 Number of international collaborations (staff and Students exchanges, research projects, fellowships, joint professorships, cross institutional projects, research chairs, key note addresses, presentations, post doctorates). E3 Ratio of projects (including community and service learning) to FTE staff
Lv	**Lv Staff to have industrial experience-A12**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A12 Percentage of instructional/research staff with at least 3 years recent industry experience / who has spent at least 1 week per year gaining industry experience to familiarize themselves with new development in industry.
Li	**Li Integrate innovative teaching approaches. A10**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A10 Ratio of staff development interventions to embed innovative teaching approaches
Lii	**Lii Professional Dev - Academic Staff to affiliate to Professional bodies -A11; A9**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A11. Percentage of instructional/research staff affiliated to Professional bodies A9 Ratio of FTE permanent instructional staff

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Liv	**Liv Increase development of postgraduate staff and students (B7;B8:B9;B10)**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	B10 Percentage of staff with doctoral /masters qualification B7 Percentage of postgraduate enrolments per total headcount B8 Percentage of postgraduate qualifications awarded B9 Percentage of postgraduate students participating in contract research
Lv	**Retention and recruitment of skilled staff**	DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F1 Staff turnover rate F2 Satisfaction survey
Lvi	**Instilling an achievement organisational culture to support UoT**	VC DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F3 Culture survey F4 Number of new UoT processes installed
Lvii	**Employee Productivity**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs	1--3 years	Strategic/Learning and growth	F5 Ratio of revenue to number of staff F6 Ratio of total salary to number of staff F7 Ratio number of graduates to number of academic staff F8 Ratio of total research to number of academic staff F9 Ratio of administrative staff to academic staff
Lviii	**Technology infrastructure**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership	1--3 years	Strategic/Learning and growth	F10 A fully accessible MIS feedback system in real time F11 Computerised reports on UoT key outputs. F12 Research output to expenditure on computers

STRATEGIC GOAL: Impact On National, Industry And Community					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Fi	**F1 Financial sustainability**	VC, CFO, DVCs	3 year	Financial	EE1 Ratio of third stream income versus number of engagements EE2 Ratio of third stream income as a proportion of total income AA2. Actual expenditure on technology per FTE student in support of teaching and learning B4 Ratio of external funding attracted for R and I projects to total research funding. E7 Total direct cost per FTE student B4 Ratio of external funding attracted for R and I projects to total research funding. E8 (Subsidy / block grants + tuition fees = income) per FTE student

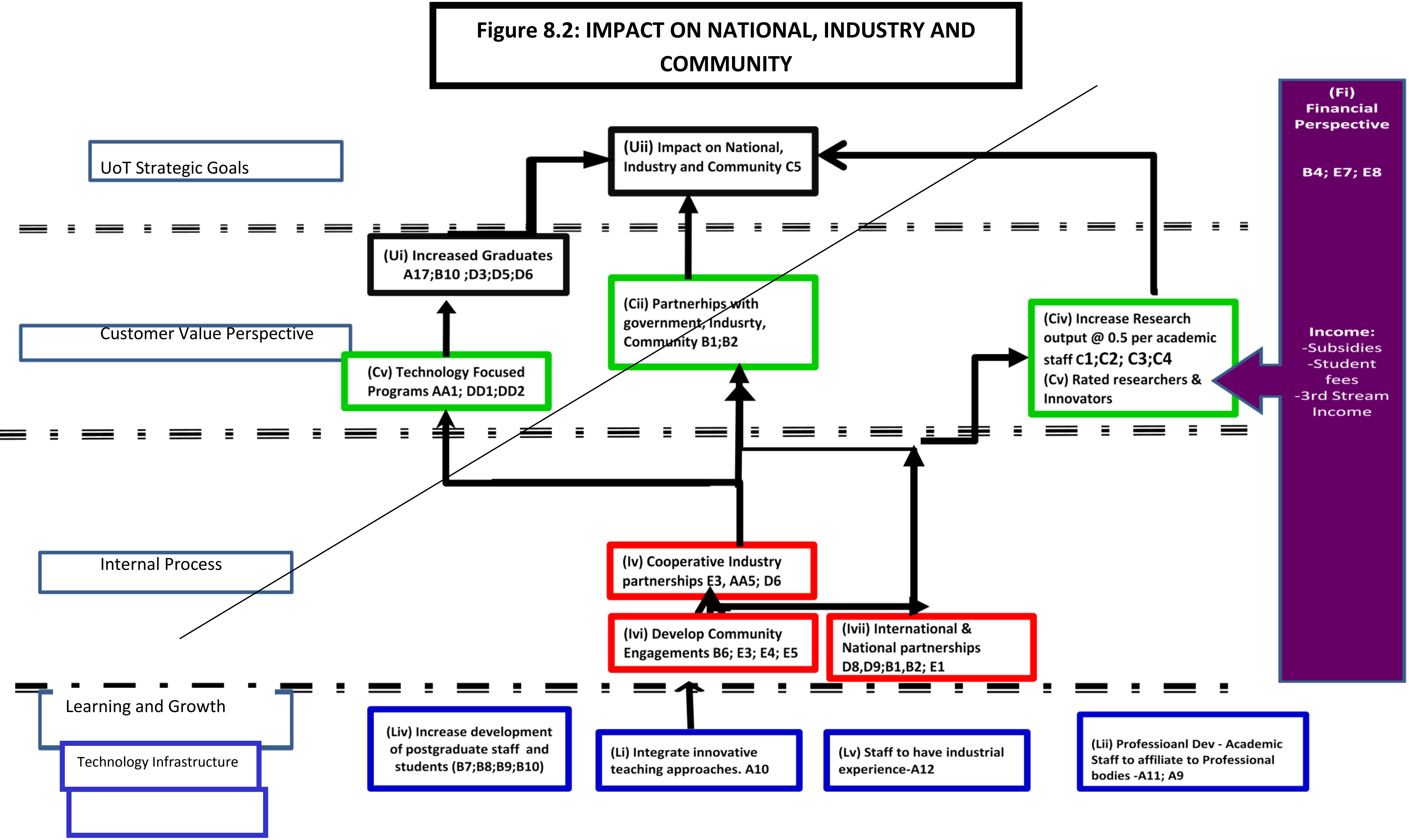


Figure 8.2: IMPACT ON NATIONAL, INDUSTRY AND COMMUNITY
UoT Strategic Goals
(Uii) Impact on National, Industry and Community C5
(Fi) Financial Perspective
B4; E7; E8
(Ui) Increased Graduates A17;B10 ;D3;D5;D6
(Cii) Partnerhips with government, Indusrty, Community B1;B2
Customer Value Perspective
(Cv) Technology Focused Programs AA1; DD1;DD2
(Civ) Increase Research output @ 0.5 per academic staff C1;C2; C3;C4
(Cv) Rated researchers & Innovators
Income:
-Subsidies
-Student fees
-3rd Stream Income
Internal Process
(Iv) Cooperative Industry partnerships E3, AA5; D6
(Ivi) Develop Community Engagements B6; E3; E4; E5
(Ivii) International & National partnerships D8,D9;B1,B2; E1
Learning and Growth
Technology Infrastructure
(Liv) Increase development of postgraduate staff and students (B7;B8;B9;B10)
(Li) Integrate innovative teaching approaches. A10
(Lv) Staff to have industrial experience-A12
(Lii) Professioanl Dev - Academic Staff to affiliate to Professional bodies -A11; A9

Figure 8.2 contextualises the first strategic goal that characterises a UoT, namely Impact on Nation, Industry and Community. To achieve this goal, the institution firstly requires skilled human capital, which has four distinct drivers and is represented in blue under the Learning and Growth perspective. The skills and human capital is deployed into the internal processes of the institution to transform this into customer value. This is represented by the red blocks and is indicated under Internal Process. The outcome of internal processes drives Customer Value which has arrows indicating direction of the outcome. This is illustrated in green and is under the heading called Customer Value. This value ultimately drives the strategic goal of the UoT.

The BSC perspectives will be discussed individually, and aligned to their respective performance indicators.

8.7.1.1 Customer Value Perspective

The impacts of increased graduates, research, partnerships are expectations of stakeholders. Each of these has an influence on the strategic direction of UoTs.

- **Measuring Impact of Increased Graduates**

The Government provides funding in terms of subsidies and in exchange Government requires that UoTs provide skilled graduates for the job market. Students need to be trained for the job market and to embark on careers, so that they can contribute to the economy.
The performance measures for increased graduates are in Table 8.1 (U1):

These performance indicators demonstrate that not only should students be successful, but should be employable and find jobs to make a positive influence on society.

- **Measuring Impact of Increased Research**

Increased research increases the knowledge pool. Applied research goes one step further by applying research to solve problems through innovation. The BSC figure 8.2 demonstrates the cause and effect relationship between national impact and increased research

The performance measures for Increased Research are in table 8.1(Civ)

These performance measures specifies that research needs to be of an applied nature, and it describes how research can be effectively implemented to impact on other sectors of the economy through job creation, entrepreneurship (SMMEs) etc.

- **Measuring Impact of Partnerships with Government, Industry and Community**

The relationship of the impact of UoTs on the country (nationally). Industry and community can be achieved by forming partnerships with Government, Industry, and Community as can be seen in figure 8.2**.** The community needs the expertise of universities to solve real world problems.

Table 8.1(Cii) contains the performance indicators that show the measures to be employed to act as a guide in determining the type of evidence to look for:

Applied research should be measured by how effective it was used in solving real world problems through knowledge application.

8.7.1.2 Internal Process

The internal process is a BSC perspective that drives customer value. Figure 8.2 outlines the key cause and effect relationships between various internal processes and customer perspective components. To produce optimum customer value, internal processes need to operate at maximum efficiency to produce high outputs.

In terms of figure 8.2 the BSC indicates three internal process drivers that need to be in place to create customer value. Cooperative agreements and partnerships with industry are unique to UoTs and therefore these processes are imperative for UoTs to have in place. These drive the technology focussed programs and qualifications that are offered at UoTs as illustrated in the customer perspective. Development of community engagement initiatives with NGOs and civil society are important in driving community partnerships. Creation of international and national partnerships in terms of agreements and joint projects are concrete interventions that will increases impact of UoTs outside traditional borders. Customer value is the outcome of the internal process that organisations create through internal systems, procedures, operating practices and policy.

The performance indicators provide a yardstick to measure outputs from internal processes for Cooperative industry partnerships which are indicated in Table 8.1(Iv). The processes ensure that the institutions network and create partnerships with industry so that they can work on joint projects and also provide experiential training for students.

The performance indicators for development of community engagements are in table 8.1 (Ivi). This measures the output of internal processes that seek to develop community collaboration and to facilitate the transfer of technology so that society can benefit.

The performance indicators for internal process to produce international and national partnerships are indicated in table 8.1 (Ivii).

The three internal processes work together in creating systems that produce performance measures that ensures the impact of UoT is felt as extensively and intensively as possible, more especially through partnerships, agreements and networks. This is characteristic of UoT.

8.7.1.3 Learning and Growth

Learning and growth includes the human capital (recruitment, retention and development), leadership, organizational culture, and information technology which are inputs into organizational processes that produce customer value outcomes. The inputs are critical resources necessary to be transformed through internal processes to produce strategic outcomes. These learning and growth inputs of postgraduate development of staff, exposure to industrial experience, innovative teaching development and affiliation to professional bodies, are illustrated in Figure 8.2 and can be measured as indicated in Table 8.1.

The performance measures for the learning and growth component to increase development of postgraduate staff and students are indicated in table 8.1(Liv).

The performance measures for learning and growth component to ensure staff have industrial experience are illustrated in table 8.1(Lv):

The performance measures for learning and growth component to integrate innovative teaching approaches are indicated in table 8.1(Li). These drive internal processes to create customer value.

The performance measures for learning and growth component to ensure academic staff affiliate to professional bodies are:

- A9 Ratio of FTE to permanent instructional staff
- A11 Percentage of instructional/research staff affiliated to Professional bodies

Institutions require postgraduate staff with masters and doctorates to produce applied research and skilled graduates to make sufficient impact on the national stage The methodology used by UoTs is through its unique offering in WIL and technologically driven programs. These PIs reflect the outputs required to drive this strategic goal.

UoTs will have to recruit high caliber of skilled staff to ensure that all have the required academic qualifications to teach up to postgraduate level. Having recruited the appropriate staff, they require a package of benefits and remuneration to retain such employees. Regular satisfaction surveys will have to be carried out to gauge employee's attitude to the institution and based on these surveys the institution will have to develop strategies to address these.

The state of technology infrastructure will also drive strategic initiatives of research output and graduation outputs. These enrich the total organization and enhance productivity. Information technology connects the organization and its decision makers and also gives feedback in terms of strategy implementation.

8.7.1.4 Financial Perspective

The financial perspective in the context of a UoT is an enabler, since the institutions receive income in the form of subsidies, student fees and donor funding. However, its commercial activities in the form of third stream income are starting to form a vital source of income. Universities are not for profit organisations and therefore justification for their existence is born out of the government's recognition of their ability to develop and train the country's human capital. The Government subsidies are increasingly being based on their performance in terms of research outputs and graduation rates. Hence, the emphasis in developing performance indicators as a basis to inform the type of typical functions that characterise UoTs. These indicators are also a basis for funding its functions.

The performance measures for financial perspective to ensure financial sustainability are shown in table 8.1(Fi).

8.7.2 Strategic Goal: Increased Graduates

UoTs have a major role to play in shaping the national stage through its partnership with industry and participation with the community. The strategic goal of increasing its graduate output is a significant indicator of the extent that UoTs can impact on the economy and community development. To fully understand how this works, each of the objectives that define the UoT are inserted into the balanced score card in terms of customer value proposition, internal process, learning and growth and financial perspectives.

The Government provides funding in terms of subsidies and in exchange Government requires that UoTs provide skilled graduates for the job market. Students need to be trained for the job market and to embark on careers, so that they can contribute to the economy. However, UoTs are very specific in the type of education and training they offer. The programs must consist of a significant percentage of technological components. Students should be able to find employment in their field of study. Employability is a major requirement of UoT programs. Also, UoTs seek to provide alternative access routes to higher education, through expanded degree programs, bridging courses etc.

The performance measures for strategic goal in increasing graduates output are illustrated in table 8.2(Ui).

To understand the expectations of UoT in terms of graduates, students must not only graduate but must be employable and further be able to create jobs and contribute to growing the economy.

8.7.2.1 Customer Value Perspective

Two major drivers impact on the institution’s ability to increase graduates can be seen in figure 8.3 and they are: the type of technologically focused programs which is subject to continuous review in terms of integrating new knowledge and, secondly, the UoT’s particularly distinctive offering in work integrated learning programs. These types of programs ensure that students are adequately prepared to enter the world of work and this is different from what the traditional universities offer.

The performance indicators for students employed in their field of study recorded in table 8.2(Ci)

The performance indicators for technologically focused programs are shown in table 8.2(Cv):

The type of programs on offer must possess the characteristics of a UoT in terms of being technologically driven and consisting of WIL components.

8.7.2.2 Internal Process

The next BSC perspective is the internal processes that drive customer value. Figure 8.3 outlines the key cause and effect relationships between various internal processes and customer perspective components. To produce optimum customer value the internal processes need to operate at maximum efficiency to produce high outputs.

In terms of Figure 8.3 the BSC indicates seven internal process drivers that need to be in place to create customer value in terms of providing access and increasing graduates with UoT type of qualifications. Cooperative agreements and partnerships with industry are unique to UoTs and therefore it is imperative for UoTs to put these processes in place. These drive technology focussed programs and qualifications that are offered at UoTs as illustrated in the customer perspective. To advance this relationship with industry, institutions will need fully functioning industry Liaison Committees and relationships with professional bodies to help update knowledge and technology to incorporate into programs. These partnerships also provide experiential learning for students and the outputs arising from these relationships help aid 'just in time' education, contributing to the vision of UoTs to be leaders in technology and innovation.

Development of community engagement initiatives with NGOs and civil society are important in driving community partnerships, which can provide service learning opportunities. Customer value is the outcome of the internal process that organisations create through internal systems, procedures, operating practices and policy.

Providing technology oriented learning and preparing students for the world of work is an imperative and equally important is that these institutions need to adopt access programs to widen participation in higher education. This is also a requirement by DOE. Further, students need to be successful. UoTs need to provide processes to offer foundation courses, bridging programs, expanded degrees and develop creative systems to facilitate participation eg recognition of prior learning (RPL). These processes are described individually and included in table 8.2.

- **Community and Industry Partnerships Processes**

The performance indicators as indicated in Table 8.2 for internal process for cooperative industry partnerships are:

- D6 Percentage of annual growth in student numbers and in graduates in national priority areas
- D7 Number of jobs created through SMME’s
- E3 Ratio of projects (including community and service learning) to FTE staff

The performance indicators for internal processes to deliver on the development of community engagements are illustrated in table 8.2(Ivi)

These processes provide for forging relationships with communities through applying knowledge to find solutions to societal problems. These processes also allow for the establishment of relationships and partnerships with industry to ensure that students are able to be employable in industry.

- **Access**

The performance indicators for internal process as indicated in Table 8.2 are to produce student development interventions to widen access to higher education through non-traditional means:

The performance indicators for internal process as indicated in Table 8.2(Iix) to widen access.

The PIs provide for processes to give effect to access to higher education that delivers specifically foundation courses, RPL and expanded degrees.

- **Technology and WIL Processes**

Industry needs students who can bring innovation and knowledge to the workplace and this can be achieved through integration of technology into UoT programs and teaching.

The performance indicators for internal process as indicated in Table 8.2(Ix) are to produce technology integrated programs that are relevant to industry and community.

Performance indicators to seek recognition with professional bodies and develop Advisory bodies are percentage of programmes where active advisory boards/committees are involved.

Performance indicators for review of undergraduate and post graduate courses to integrate market and industry relevance, and elicit input from professional bodies, are shown in table 8.2(Ivi).

8.7.2.3 Learning and Growth

Learning and growth is the same as for the other UoT goals and similarly includes the human capital (recruitment, retention and development), leadership, organizational culture, and information technologies are inputs into organizational processes that produce customer value outcomes. The inputs are critical resources necessary to be transformed through internal processes to strategic outcomes. These learning and growth inputs of postgraduate development of staff, exposure to industrial experience, innovative teaching development and affiliation to professional bodies, are illustrated in figure 8.3 and can be measured as indicated in Table 8.2

The performance measures for learning and growth are the same for the other UoT goals.

8.7.2.4 Financial Perspective

The financial perspective in the context of a UoT is an enabler and is the same for the other UoT goals. The performance measures for financial perspective are also the same as for the other goals and will not be repeated:

Table 8.2 shows the drivers, the timeframe, department/functionary responsible, the BSC perspective and the performance indicators.

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Table 8.2: Increased Graduates

STRATEGIC GOAL: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Ui	**Ui Increased Graduates A17;B10 ;D3;D5;D6**	VC, DVC (Academic), Deans, HOds, Lecturers, Director CHED	3-5 years	strategic	A17 Improved graduation Rates B10 Percentage of staff with doctoral qualification D3 Percentage females and percentage by race of student headcount per field of specialization namely SET, Business and Management, Education and other Humanities D5 Percentage of first time entering undergraduate students who graduate in minimum time plus 1 year D6 Percentage annual growth in student numbers and in graduates in national priority areas
Ci	**Ci Increase of Students employed in Field of study- A6, A7,BB2**	DVC (Academic), DVC (TIP) Deans, HOds, Lecturers, Coop Ed.	3 years	Customer value proposition	A6 Percentage of students employed (including self-employment) in their field of study within one year after graduation. A7 Percentage of employer satisfaction BB2 Percentage of postgraduate headcount enrolment by race and gender
Cv	**Cv Technology Focused Programs AA1; DD1;DD2**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	3 years	Customer value proposition	AA1 Percentage of curriculum requiring technological competency from learners DD1 Percentage annual growth in student headcount in fields of specialization DD2 Percentage annual growth in graduates
Iiii	**Iiii Student dev interventions- Foundation, expanded degree D2**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-2 years	Internal processes and systems	D2 Percentage of undergraduate headcount enrolments and success rate in foundation provision

STRATEGIC GOAL: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Iiv	**Iiv Review of UG and PG courses to integrate market relevance and Input from Prof Bodies- A2,A3,A5; A4;A8,C6**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-2 years	Internal processes and systems	A4 Ratio of new UG and PG programmes introduced per year C6 Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications A2 Percentage of UG qualifications approved/accredited by professional bodies (where applicable) A3 Percentage of programmes where active advisory boards/committees are involved A5 Percentage of qualifications revised per year. A8 Percentage of undergraduate qualifications that contain learning in the workplace (WIL, EL, etc). A1 Percentage headcount enrolments in fields of SET, Bus and Man, Education and other Humanities
Ix	**Ix Integrate Entrep. , WIL, Technology Driven PQM - A1,A13,A14, C6,**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Coop Ed	1-3 years	Internal processes and systems	A1 Percentage headcount enrolments in fields of SET, Bus and Man, Education and other Humanities A13 Ratio of FTE students to computer work stations on campuses and in residences A14 Percentage of curriculum requiring ICT / technological competency from learners C6 Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications

STRATEGIC GOAL: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
lix	**lix Widening access to HE - thru Agreements with FET colleges, RPL processes, Provision of courses D1; D4; E6, E5,**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Coop Ed	1-3 years	Internal processes and systems	D1 Percentage of SA learners, with SC/NSC/FET qualifications and enrolled at UoT's as first time entering students. D4 Percentage of undergraduate students admitted on the basis of RPL E5 Number of capacity building/upgrading programmes offered to FTE college staff and other teaching professionals E6 Participation rate of FET learners
lvi	**lvi Develop Community Engagements B6; E3; E4; E5**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Coop Ed	1-2 years	Internal processes and systems	B6 Number of completed and sustainable community problem-solving research projects E3 Ratio of projects (including community and service learning) to FTE staff E4 Number of learners from school participating in co-curricular (vacation/weekend schools) activities E5 Number of capacity building/upgrading programmes offered to FTE college staff and other teaching professionals
lxi	**lxi Seek recognition with Prof Bodies and dev Advisory Boards A3**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-2 years	Internal processes and systems	A3 Percentage of programmes where active advisory boards/committees/professional are involved
Li	**Li Integrate innovative teaching approaches. A10**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-3 years	Strategic/Learning and growth	A10 Ratio of staff development interventions to embed innovative teaching approaches

STRATEGIC GOAL: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Lv	**Lv Staff to have industrial experience-A12**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A12 Percentage of instructional/research staff with at least 3 years recent industry experience / who has spent at least 1 week per year gaining industry experience to familiarize themselves with new development in industry.
Lii	**Lii Professional Dev - Academic Staff to affiliate to Professional bodies -A11; A9**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A11. Percentage of instructional/research staff affiliated to Professional bodies A9 Ratio of FTE permanent instructional staff
Liv	**Liv Increase development of postgraduate staff and students (B7;B8:B9;B10)**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	B10 Percentage of staff with doctoral /masters qualification B7 Percentage of postgraduate enrolments per total headcount B8 Percentage of postgraduate qualifications awarded B9 Percentage of postgraduate students participating in contract research
Lv	**Retention and recruitment of skilled staff**	DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F1 Staff turnover rate F2 Satisfaction survey

STRATEGIC GOAL: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Lvi	**Instilling an achievement organisational culture to support UoT**	VC DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F3 Culture survey F4 Number of new UoT processes installed
Lvii	**Employee Productivity**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs	1--3 years	Strategic/Learning and growth	F5 Ratio of revenue to number of staff F6 Ratio of total salary to number of staff F7 Ratio number of graduates to number of academic staff F8 Ratio of total research to number of academic staff F9 Ratio of administrative staff to academic staff
Lviii	**Technology infrastructure**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership	1--3 years	Strategic/Learning and growth	F10 A fully accessible MIS feedback system in real time F11 Computerised reports on UoT key outputs. F12 Research output to expenditure on computers
Fi	**F1 Financial sustainability**	VC, CFO, DVCs	3 year	Financial	EE1 Ratio of third stream income versus number of engagements EE2 Ratio of third stream income as a proportion of total income AA2. Actual expenditure on technology per FTE student in support of teaching and learning B4 Ratio of external funding attracted for R and I projects to total research funding. E7 Total direct cost per FTE student B4 Ratio of external funding attracted for R and I projects to total research funding. E8 (Subsidy / block grants + tuition fees = income) per FTE student

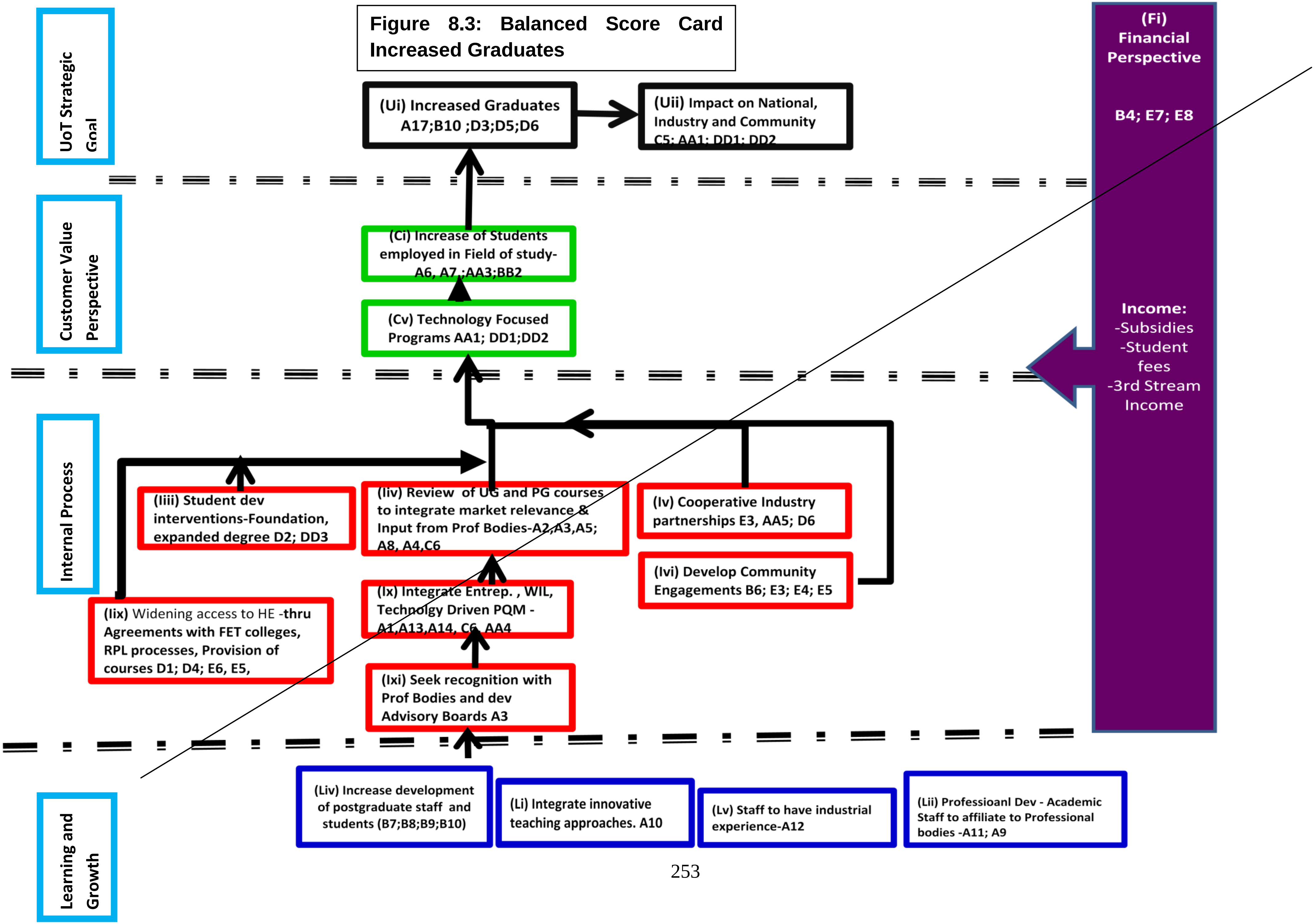


Figure 8.3: Balanced Score Card Increased Graduates

8.7.3 Strategic Goal: Applied Research

Applied research represents the next pillar on which the UoT concept is built. UoTs have a two pronged mandate namely teaching, learning and research. The type of research UoTs are engaged in is one of applied research. Applied research refers to the application of knowledge to solve real world problems. It is envisaged that from applied research, could emerge commercialisation of research projects. These projects could be in the form of patents, intellectual property rights, technology stations, technology parks. Application of innovation and knowledge could be used to find solutions together with communities. To participate in applied research, it is necessary to have a critical mass of masters and doctorates staff members who are able to use their expertise and knowledge to drive applied research projects. Another crucial requirement is that institutions require appropriate systems and processes to transform knowledge into customer value.

The performance measures for strategic goal producing applied research and innovation output are recorded in table 8.3(Uiii).

To understand the synergies and how the systems interact and produce outcomes, the components are placed into the BSC.

8.7.3.1 Customer Value Perspective

Customer value defines exactly what is expected from UoTs in terms of applied research. Customer value is a major driver which impacts on the institution's ability to produce applied research and innovation i.e. increased research output to the benchmark of 0.5 output per academic staff member. The DOE has set this target which is slightly lower than that of traditional universities. UoT staff should engage in applied research to comply with a UoT profile.

The performance indicators for students and staff engaged in applied research are shown in table 8.3(Civ).

8.7.3.2 Internal Process

Internal processes drive customer value. The BSC in Figure 8.4 outlines the key cause and effect relationships between various internal processes and customer perspective components. To produce optimum customer value then internal processes need to operate at maximum efficiency to produce high outputs.

- **Entrepreneurship**

In terms of Figure 8.4 the BSC indicates six internal process drivers that need to be in place to create customer value. It is necessary to create an enabling environment to bring about a mindset to give effect to applied research. This is unique to UoTs and therefore these processes are essential for UoTs to have in place. These drive technology focussed projects like patents, intellectual property etc that are offered at UoTs as illustrated in the customer perspective. The performance indicators for creating, enabling entrepreneurship is illustrated in table 8.3(Ii)

- **PQM (Program Quality Management)**

To create customer value, processes must be engineered to deliver on patents, IP technology stations as in the BSC. Entrepreneurship, WIL and technology must be integrated at an early stage into the PQM, so that it can act as a vehicle to produce innovation at a later stage. This process must be sharpened to produce very specific outcomes. The performance indicators for this can be seen in table 8.3(Iviii).

- **Intellectual Property, Patents, Technology Stations Processes**

Setting up of programs and systems to reflect how UoTs intend to develop IP, patents etc will go one step further by exactly defining expectations of the process for each typical intellectual property vehicle that the UoT will use. Actual development of enterprises and innovation processes will be developed and their performance measures are presented in table 8.3(Iii).

- **Community Engagement Process**

Development of community engagement initiatives with NGOs and civil society are important in driving community partnerships, which can provide service learning opportunities and be beneficial in many other ways. Customer value is the outcome of the internal process that organisations create through internal systems, procedures operating practices and policy. Performance measures are illustrated in table 8.3(Ivi).

- **Partnership Processes**

Applied research can be enhanced through partnerships, both international and national. The sharing of information and knowledge can only build and accelerate innovation and save on resources. The performance measures for setting up processes for partnerships are shown in table 8.3(Ivii).

- **Postgraduate Processes**

Applied research can be underpinned by the development of postgraduate students to participate in this type of research. Performance indicators for this process are in table 8.3(Ixii).

8.7.3.3 Learning and Growth

Learning and growth is the same as for the other UoT goals. Learning and growth includes the human capital (recruitment, retention and development), leadership, organizational culture, and information technologies are inputs into organizational processes that produce customer value outcomes. The inputs are critical resources necessary to be transformed through internal processes to strategic outcomes. These learning and growth inputs of postgraduate development of staff, exposure to industrial experience, innovative teaching development and affiliation to professional bodies, are illustrated in Figure 8.4 and can be measured as indicated in Table 8.3

The performance measures for learning and growth component is the same for other UoT goals and will not be repeated.

8.7.3.4 Financial Perspective

This perspective is the same for the other goals. The purposes of performance measures for financial perspective, is to ensure financial sustainability and are the same as for the other goals and will not be repeated.

Table 8.3 shows the drivers, the timeframe, department/functionary responsible, the BSC perspective and the performance indicators.

Table 8.3: Applied Research and Innovation

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Uiii	1Uiii Applied Research and Innovation B3;BB1/2	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**3–5 years**	**Strategic**	B3. Ratio of total research and innovation output, relevant to a UoT, to permanent instructional/research staff / and permanent staff with a doctorate BB1 Percentage research income over total income BB2 Percentage of postgraduate headcount enrolment by race and gender
Civ	Civ Increase Research output @ 0.5 per academic staff C1;C2;C3;C4 (Cv) Rated researchers and Innovators	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**3–5 years**	Customer value proposition	C1. Number of SMMEs, incubators and technology stations established C2. Number of established business ventures (partnerships, joint ventures and contracts) C3 Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs) C4 Number of SMME's supported (count incidences rather than volume) Ii Create Enabling environment for Entrep.TTI project, , incubators, SMMEs
Ii	Ii Create Enabling environment for Entrep.TTI project, , incubators, SMMEs C3; C4; D7	DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	1-3 years	Internal processes and systems	D7 Number of jobs created through SMME's C4. Number of SMME's supported (count incidences rather than volume) C3. Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs)

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Iii	Iii Development of, IP, patents , prototypes, Procedures B5;B6	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**3–5 years**	Internal processes and systems	B5. Number of prototypes, patents, processes, artistic outputs and products registered as IP (Part of the “Innovation” output) B6. Number of completed and sustainable community problem-solving research projects
vi	Ivi Develop Community Engagements B6; E3; E4; E5	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**1-2 years**	Internal processes and systems	E3 Ratio of projects (including community and service learning) to FTE staff E4 Number of learners from school participating in co-curricular (vacation/weekend schools) activities E5 Number of capacity building/upgrading programmes offered to FTE college staff and other teaching professionals B6. Number of completed and sustainable community problem-solving research projects

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Ivii	Ivii International and National partnerships D8,D9;B1,B2; E1;E2	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**1-2 years**	Internal processes and systems	B1. Number of international collaborations (staff exchanges, research projects, fellowships, joint professorships, cross-institutional projects, research chairs, NRF rated personnel) B2. Number of national collaborations (research projects, fellowships, joint professorships, cross-institutional projects, research chairs) D8.Percentage of international and SADC students D9. Number of international collaborations (staff and Students exchanges, research projects, fellowships, joint professorships, cross institutional projects, research chairs, key note addresses, presentations, post doctorates). E1 Number of regional, national and SADC collaborative partnerships E2 Ratio of credit bearing short courses (CPD programmes) to staff FTEs
Iviii	Iviii Integrate Entrep. , WIL, Technology Driven PQM - A1,A13,A14, C6	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**1-3 years**	Internal processes and systems	A1. Percentage headcount enrolments in fields of SET, Bus and Man, Education and other Humanities A13. Ratio of FTE students to computer workstations on campus and in residences A14. % of curriculum requiring ICT/technological competency from learners C6. Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Ixii	Ixii Develop new Postgraduate students B7,B8,B9,B3, B10	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	**2-5 years**	Internal processes and systems	B10. Percentage of staff with doctoral qualification B3. Percentage of postgraduate headcount enrolment by race and gender B7. Percentage of postgraduate enrolments per total headcount B8. Percentage of postgraduate qualifications awarded B9. Percentage of postgraduate students participating in contract research
Li	Li Integrate innovative teaching approaches. A10	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-3 years	Strategic/Learning and growth	A10 Ratio of staff development interventions to embed innovative teaching approaches
Lv	Lv Staff to have industrial experience-A12	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A12 Percentage of instructional/research staff with at least 3 years recent industry experience / who has spent at least 1 week per year gaining industry experience to familiarize themselves with new development in industry.

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Lii	Lii Professional Dev - Academic Staff to affiliate to Professional bodies -A11; A9	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A11. Percentage of instructional/research staff affiliated to Professional bodies A9 Ratio of FTE permanent instructional staff
Liv	Liv Increase development of postgraduate staff and students (B7;B8:B9;B10)	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	B10 Percentage of staff with doctoral /masters qualification B7 Percentage of postgraduate enrolments per total headcount B8 Percentage of postgraduate qualifications awarded B9 Percentage of postgraduate students participating in contract research
Lv	**Retention and recruitment of skilled staff**	DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F1 Staff turnover rate F2 Satisfaction survey
Lvi	**Instilling an achievement organisational culture to support UoT**	VC DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F3 Culture survey F4 Number of new UoT processes installed
Lvii	**Employee Productivity**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs	1--3 years	Strategic/Learning and growth	F5 Ratio of revenue to number of staff F6 Ratio of total salary to number of staff F7 Ratio number of graduates to number of academic staff F8 Ratio of total research to number of academic staff F9 Ratio of administrative staff to academic staff

STRATEGIC GOAL: Applied Research and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Lviii	**Technology infrastructure**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership	1--3 years	Strategic/Learning and growth	F10 A fully accessible MIS feedback system in real time F11 Computerised reports on UoT key outputs. F12 Research output to expenditure on computers
Fi	F1 Financial sustainability	VC, CFO, DVCs	3 year	Financial	EE1 Ratio of third stream income versus number of engagements EE2 Ratio of third stream income as a proportion of total income AA2. Actual expenditure on technology per FTE student in support of teaching and learning B4 Ratio of external funding attracted for R and I projects to total research funding. E7 Total direct cost per FTE student B4 Ratio of external funding attracted for R and I projects to total research funding. E8 (Subsidy / block grants + tuition fees = income) per FTE student

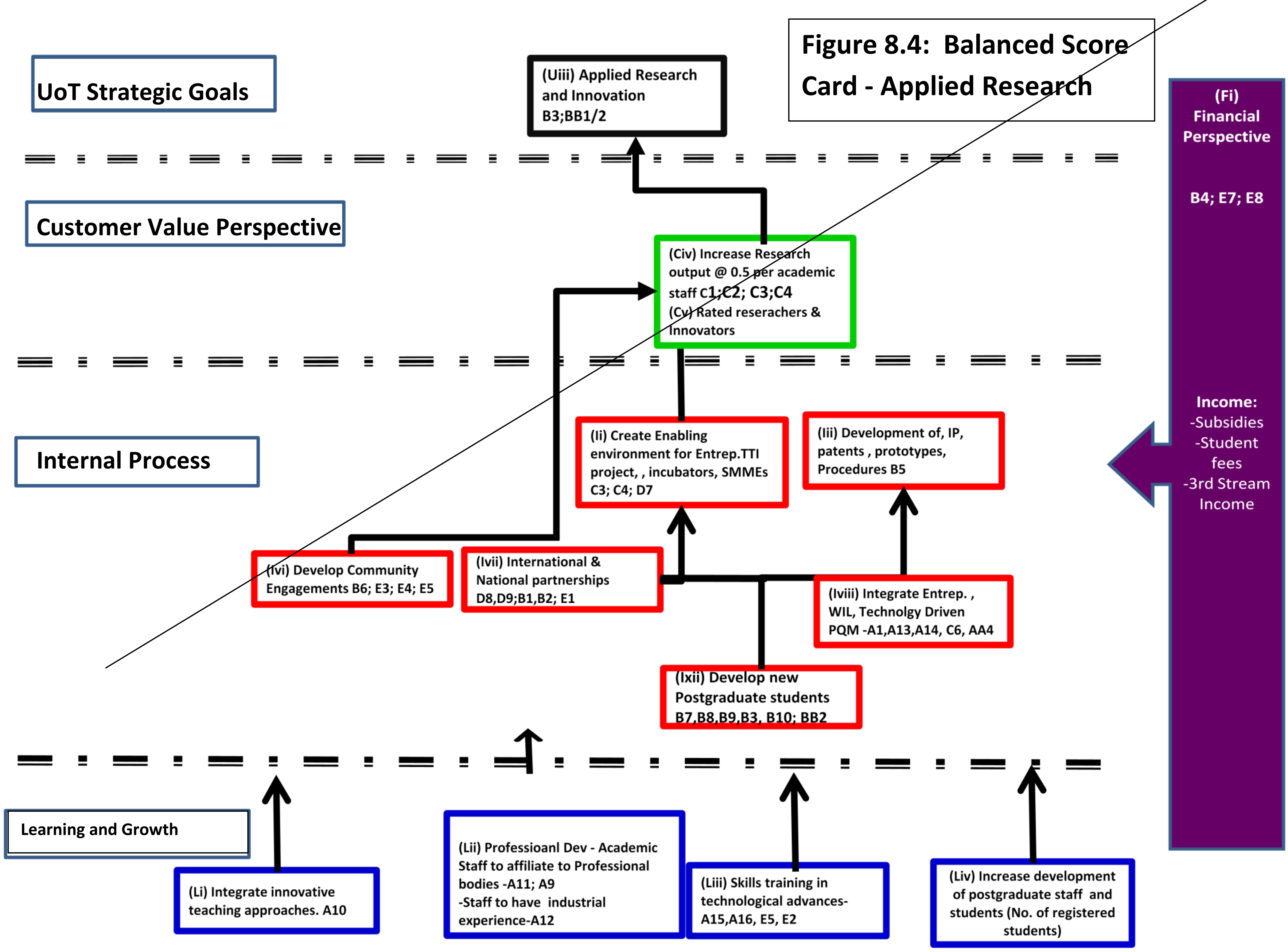


Figure 8.4: Balanced Score Card - Applied Research

8.7.4 Strategic Goal: Entrepreneurship and Innovation

Entrepreneurship and innovation is a very significant pillar in the UoT model. As stated earlier UoTs have a distinctive mandate in translating knowledge into finding solutions for real world problems whether in society or in the world of work. However, training students only for a job is futile since the acceleration of knowledge and the fast pace of change in technology and the external environment will soon result in jobs being changed significantly to reflect new realities. This could lead to unemployment. Therefore, it is incumbent on universities of technology to train students to generate new knowledge and apply it to solve real world problems. The emphasis should be on application and acquisition of knowledge. Research generated should foster a spirit of entrepreneurship in staff and students, so that they can create jobs in society. UoTs can provide the knowledge to develop incubators and associated training to cushion newly formed enterprises, and as soon as these initiatives become viable they are then allowed to function as a going enterprise. This will then create space for new enterprises to be formed. Students should be taught how to identify opportunities for entrepreneurship. The ability to use knowledge to identify problems can be part of the training of UoTs. This transfer of knowledge and technologies to industry or communities requires vehicles and systems to ensure that the expertise is translated into tangible and sustainable results. This is then translated into commercial activity.

The UoT will have to produce certain types of outputs if it has to know whether it has successfully met its strategic goal of entrepreneurship and innovation. These outcomes will be described by performance measures as indicated in table 8.4(Uiv).

To understand the synergies and how the systems interact and produce outcomes, the components are placed into the BSC.

8.7.4.1 Customer Value Perspective

Customer value drives the institutions ability to achieve entrepreneurship and innovation goals by increasing research output. However, research will have to be redefined to include patents, IP, technology stations, incubators as legitimate research outputs. At the moment these have to be designated as research in a UoT. This fits well with the applied research characteristic and typology that is unique to UoTs.

The performance indicators for applied research as a driver to entrepreneurship is shown in table 8.4(Civ).

To meet the entrepreneurship and innovation goal the institution must produce various entrepreneurship projects. This could be categorized as research, if the DOE so desires. UoTs will have to advocate for this categorization if this sector has to strengthen its commercialization arm.

8.7.4.2 Internal Process

Internal process forms another perspective of the four BSC perspectives. Internal process drives customer value. Figure 8.5 outlines the key cause and effect relationships between various internal processes and customer perspective components. To produce optimum customer value then internal processes need to operate optimally to produce high outputs.

In terms of figure 8.5 the BSC indicates four internal process drivers that need to be in place to create customer value. It is necessary to create an enabling environment to bring about a mindset to give effect and produce value in applied research and entrepreneurship. This is unique to UoTs and therefore these processes are essential for UoTs to have in place, since these drive technology focussed projects like patents, intellectual property etc that are offered at UoTs as illustrated in the customer perspective. An enabling environment needs to be created to act as a vehicle to translate value from the knowledge workers in the learning and growth perspective.

The performance indicators for creating an enabling environment through systems and processes to drive entrepreneurship are described in table 8.4(iI).

To create customer value, processes must be engineered to deliver on patents, IP technology stations as indicated in the BSC. Entrepreneurship, WIL and technology must be integrated at an early stage into the PQM, so that it can act as a vehicle to produce innovation at a later stage. This process must be sharpened to produce very specific outcomes. The performance indicators for integrating WIL, entrepreneurship, and technology into the PQM process are shown in table 8.4(Iviii).

Setting up of programs to reflect how UoTs intend to develop IP, patents etc will go one step further by exactly defining expectations of the process for each typical enterprise that the UoT will use. Actual development of enterprises and innovation will be developed and their performance measures are:

- B5. Number of prototypes, patents, processes, artistic outputs and products registered as IP (Part of the “Innovation” output)
- B6. Number of completed and sustainable community problem-solving research projects

8.7.4.3 Learning and Growth

Learning and growth component will be the same for the other goals.

The performance measures for learning and growth are the same for the other goals and are illustrated in table 8.4.

8.7.4.4 Financial Perspective

The financial perspective in the context of a UoT is an enabler and will be similar to the other goals. Since the institutions receive income in the form of subsidies, student fees and donor funding it is not an output but is an input into the process to drive strategic goals.

The performance measures for financial perspective are the same for the other goals and will not be repeated.

Table 8.4 shows the drivers, the timeframe, department/functionary responsible, the BSC perspective and the performance indicators

Table 8.4: Entrepreneurship and Innovation

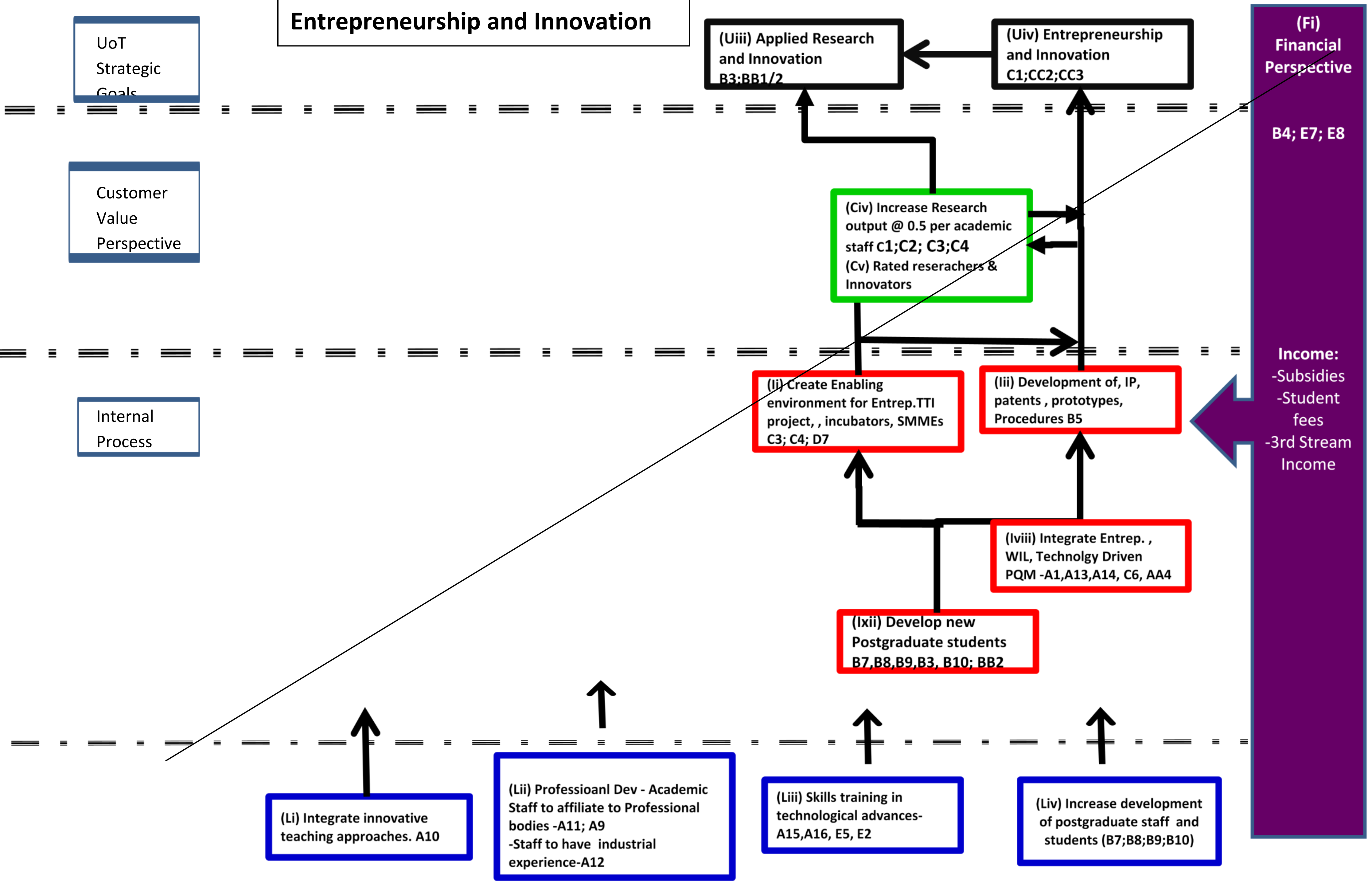
STRATEGIC GOAL: Entrepreneurship and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Uiv	**1Uiv Entrepreneurship and Innovation C1;CC2;CC3**	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	2-5 years	**Strategic**	C1 Number of established business ventures (partnerships, joint ventures and contracts) CC2 Number of SMMEs, incubators, and technology stations established CC3 Percentage of third stream income, related to commercial ventures, as part of overall income
Civ	**Civ Increase Research output @ 0.5 per academic staff C1;C2; C3;C4 (Cv) Rated researchers and Innovators**	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	2-5 years	Customer value proposition	C1. Number of SMMEs, incubators and technology stations established C2. Number of established business ventures (partnerships, joint ventures and contracts) C3. Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs) C4. Number of SMME's supported (count incidences rather than volume)
Ii	Ii Create Enabling environment for Entrep.TTI project, , incubators, SMMEs C3; C4; D7	VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	1-3 years	Internal processes and systems	C3. Number of registered IP outputs turned into commercial, (business) ventures divided by the total number of IP outputs (products, prototypes, processes, patents, artefacts and designs) C4. Number of SMME's supported (count incidences rather than volume) D7 Number of jobs created through SMME'
Iii	**Iii Development of, IP, patents , prototypes, Procedures B5**	VC, DVC Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	1-3 years	Internal processes and systems	B5. Number of prototypes, patents, processes, artistic outputs and products registered as IP (Part of the "Innovation" output)

STRATEGIC GOAL: Entrepreneurship and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Iviii	Iviii Integrate Entrep., WIL, Technology Driven PQM - A1,A13,A14, C6	DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI) VC, DVC (Academic), DVC (TIP), Director Research, Deans, HOD, Director PG, Director (TTI)	1-3 years	Internal processes and systems	A1. Percentage headcount enrolments in fields of SET, Bus and Man, Education and other Humanities A13. Ratio of FTE students to computer workstations on campus and in residences A14. % of curriculum requiring ICT/technological competency from learners C6. Percentage of qualifications with entrepreneurship as an exit level outcome to the total number of UG qualifications
Li	**Li Integrate innovative teaching approaches. A10**	DVC (Academic), DVC (TIP) Deans, HODs, Lecturers, Director CHED	1-3 years	Strategic/Learning and growth	A10 Ratio of staff development interventions to embed innovative teaching approaches
Lv	**Lv Staff to have industrial experience-A12**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A12 Percentage of instructional/research staff with at least 3 years recent industry experience / who has spent at least 1 week per year gaining industry experience to familiarize themselves with new development in industry.
Lii	**Lii Professional Dev - Academic Staff to affiliate to Professional bodies -A11; A9**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	A11. Percentage of instructional/research staff affiliated to Professional bodies A9 Ratio of FTE permanent instructional staff

STRATEGIC GOAL: Entrepreneurship and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
Liv	**Liv Increase development of postgraduate staff and students (B7;B8:B9;B10)**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs, teaching and research staff, Director HR	3 year	Strategic/Learning and growth	B10 Percentage of staff with doctoral /masters qualification B7 Percentage of postgraduate enrolments per total headcount B8 Percentage of postgraduate qualifications awarded B9 Percentage of postgraduate students participating in contract research
Lv	**Retention and recruitment of skilled staff**	DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F1 Staff turnover rate F2 Satisfaction survey
Lvi	**Instilling an achievement organisational culture to support UoT**	VC DVC (Institutional Support) Director HR	3 year	Strategic/Learning and growth	F3 Culture survey F4 Number of new UoT processes installed
Lvii	**Employee Productivity**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership), Exec. Deans, HODs	1--3 years	Strategic/Learning and growth	F5 Ratio of revenue to number of staff F6 Ratio of total salary to number of staff F7 Ratio number of graduates to number of academic staff F8 Ratio of total research to number of academic staff F9 Ratio of administrative staff to academic staff
Lviii	**Technology infrastructure**	DVC (Institutional Support) DVC (Academic), DVC (Technology, Innovations and Partnership	1--3 years	Strategic/Learning and growth	F10 A fully accessible MIS feedback system in real time F11 Computerised reports on UoT key outputs. F12 Research output to expenditure on computers
Fi	**F1 Financial sustainability**	VC, CFO, DVCs	3 year	Financial	EE1 Ratio of third stream income versus number of engagements EE2 Ratio of third stream income as a proportion of total income AA2. Actual expenditure on technology per FTE student in support of teaching and learning B4 Ratio of external funding attracted for R and I projects to total research funding. E7 Total direct cost per FTE student B4 Ratio of external funding attracted for R and I projects to total research funding.

STRATEGIC GOAL: Entrepreneurship and Innovation					
No.	**DRIVERS/ OBJECTIVES**	**DEPARTMENT, FUNCTIONARY RESPONSIBLE IN A UoT**	**TIME-FRAME**	**BSC PERSPECTIVE**	**PERFORMANCE INDICATORS**
					E8 (Subsidy / block grants + tuition fees = income) per FTE student

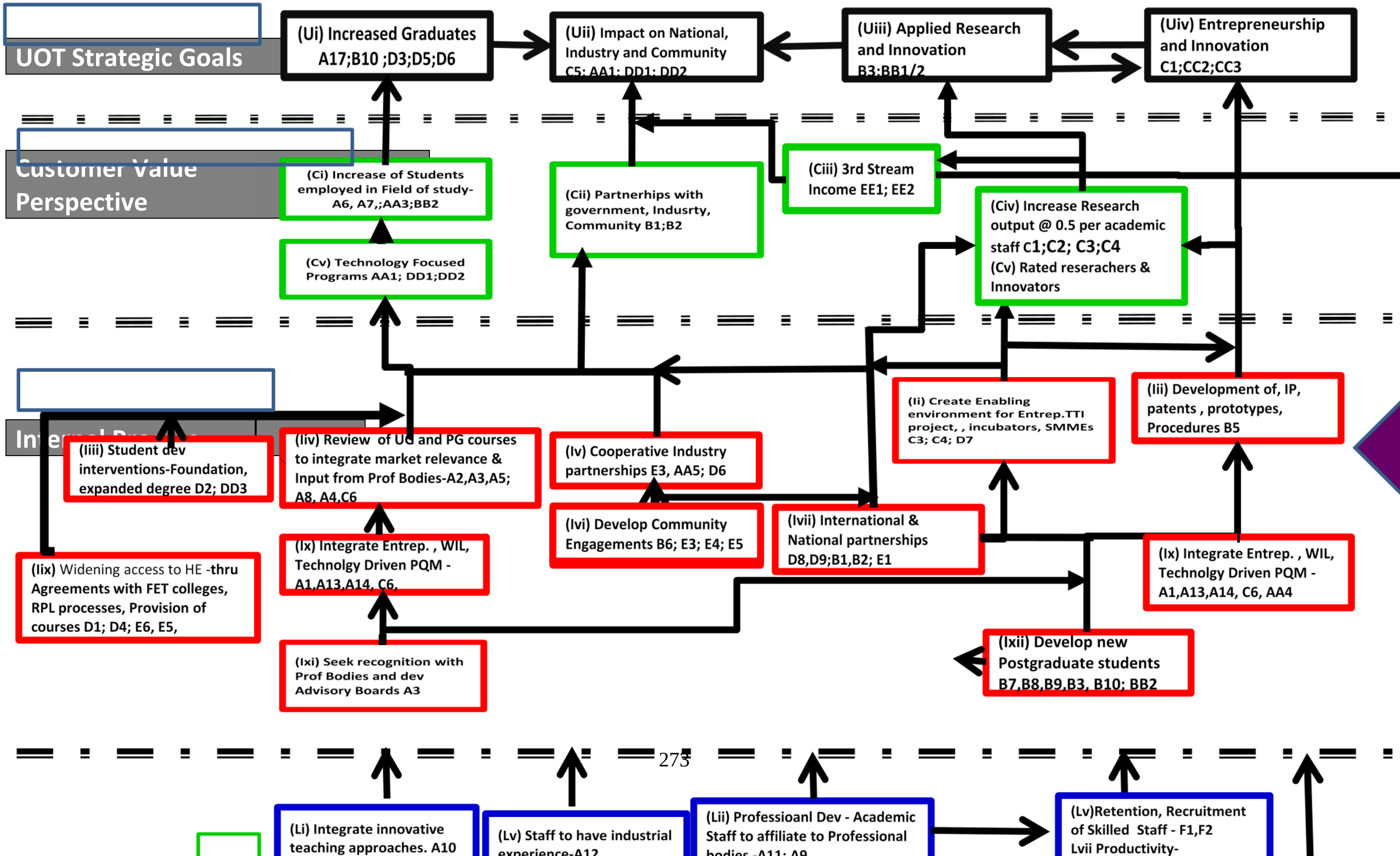
Figure 8.5 Balanced Score Card - Entrepreneurship and Innovation



8.7.5 The Complete UoT Balanced Score Card Model

Figure 8.6 is the complete balanced score card for UoTs in South Africa that comprehensively describes the process from strategic goals to operational goals and plans and eventually cascades down to individual performance plans. Each BSC perspective is attached to performance indicators to ensure that they produce very focussed and clear outcomes. Each perspective drives other perspectives which ultimately create strategic value to customers and stakeholders. To significantly influence the economy and society UoTs need to produce skilled graduates ready for the world of work, and applied research (Customer value perspective). This requires learning and growth perspective represented on the BSC as skilled human capital (recruitment, retention and development) and organisational intelligence (organisational culture, leadership and information technology). This is represented in figure 8.6 and it drives internal processes and systems to produce specific performance outcomes that define a UoT. The Internal Processes in figure 8.6 drive customer value and strategic goals. These are underpinned by funding through subsidies and student fee income. The complete operations are summarised below.

Figure 8.6: BALANCED SCORE CARD FOR A UOT



8.8 SUMMARY

This chapter integrates the outcome of several research methods into the balanced score card configuration in forming a UoT model.

In chapter 6 and 7 the cause and effect relationships, attributes, KRAs and goals of UoTs, and PIs were studied and interviews were conducted with UoT specialists from various UoTs in South Africa and abroad. The results of the various forms of research were then integrated into a Balanced Score Card. The BSC provides a template which identifies the cause and effect relationships, the resources, internal processes and systems, and the customer value proposition that drives the strategic goal or the “pillars” of UoTs. Each of the perspectives described are attached to performance indicators. A model was then designed and mapped out by incorporating the goals, KRAs and performance indicators into the perspectives of the BSC.

Figure 8.6 acts as a blue print for institutions wishing to transform to a UoT type of university. Universities exist to generate and apply knowledge and make an impact on the economy and society at large. For a UoT to function optimally and meet the DOE benchmarks, firstly it requires a critical mass of highly skilled and qualified researchers and lecturers to be able to drive the various internal processes in the BSC. This produces customer value through increase skilled graduates, applied research, entrepreneurship and innovation. To make a major strategic impact in the economy and in society at large the focus for UoTs is in the “how” UoTs perform their functions. The programs should focus on problem solving through knowledge application, technology transfer. Entrepreneurship should be well integrated into the curriculum to encourage job creation through innovative projects. Research in UoTs is expected to deliver innovation through IP, patents, technology stations etc. These are indicated under internal processes attached to clearly defined performance indicators in the BSC in figure 8.6.

Application of knowledge is underpinned by collaborations and partnerships with industry, and community so that the solutions are focussed and relevant. The performance indicators are the benchmarks to describe the evidence and how it should be measured to ensure UoTs stay true to its mission.

CHAPTER 9

APPLYING THE UoT MODEL TO THE DURBAN UNIVERSITY OF TECHNOLOGY

9.1 BACKGROUND

The model as explained in the previous chapter will be applied to the Durban University of Technology to test its systems, learning and growth, and resourcing. This chapter attempts to apply only key aspects of the model and is not meant to be exhaustive, since using the model is a comprehensive exercise and is an investigation on its own. Its serves as an example and demonstrates how this model can work in an application.

Further it has to ascertain whether this model produces customer value and its readiness to develop a genuine character of a UoT, not only in name but in terms of its vision and long term strategic goals.

9.2 THE DEVELOPMENT TRAJECTORY OF DURBAN UNIVERSITY OF TECHNOLOGY

The Durban University of Technology is a product of the merger of the Natal Technikon and the ML Sultan Technikon. These institutions have a rich history and played a sterling role in contributing to Higher Education in South Africa, notwithstanding the fact that these were formations under apartheid. In understanding DUT’s present challenges, transformation agenda and its vision, it is necessary to delve into the history of these former institutions and more recently the merger to understand the organisational behaviour and trends.

9.2.1 History of the M.L.Sultan Technikon

The M.L.Sultan Technikon had its early beginnings as an adult education institution. It was started in 1927 by the Natal Worker’s Congress and the South African Indian community. They approached Mr Hajee Mulak Sultan, a former indentured labourer himself, to make a donation towards the building of a high school. He donated twelve thousand five hundred pounds towards the building of the institution. The main aim of this initiative was to provide education to the children of the former indentured labourers, seeing that the Government did not adequately provide for their educational and social needs.

During the 1950s and 1960s the institution began offering vocational courses to the mainly Indian community with the assistance of volunteers. The community managed this initiative from the early beginnings till the National Party Government, who was in power at that time, placed the institution under the Minister of Indian Affairs in terms of its Apartheid policies. The Government specified that the institution was for the exclusive use of the Indian community.

In 1969 the institution became known as a College for Advanced Technical Education in terms of the Indian Advanced Technical Education Act which paved the way for the institution to offer post matriculation Diplomas and certificates in selected disciplines. In 1979 the institution became a Technikon, with its own Council. However, the Minister appointed over half of its members in terms of the Act, resulting in Government control over the affairs of the institution. From 1989 the institution was plagued by often violent protests and boycotts. The main demands centred on the issues of access to education, affordability of fees and the slow pace of transformation, which mirrored the same issues that were being, experienced at most other tertiary institutions.

9.2.2 History of Natal Technikon

The Natal Technikon was founded in 1907 by Dr Samuel George Campbell. It was first known as the Durban Technical Institute. Its first principal was Dr Benjamine Narbeth.

After vigorous campaigning for a Technical College, Dr Campbell was successful in getting the Government to invest in a Technical College in Natal. In 1912 new premises were opened at the corner of Warwick and Smith streets. In accordance with the Higher Education Act of 1923, the College became the Natal Technical College. The College grew through the generous donations that were received. In 1939 the Central Organisation of Technical Training was formed to train to service machinery for "modern" warfare, during the last World War (DUT, 2009).

In 1948, the coming to power of National Party, the College was removed from the jurisdiction of the province to the National Government.

In 1967, legislation was introduced to provide education to white students only. Also in 1967 the College was declared a College for Advanced Technical Education and students were admitted on the basis of a senior certificate. This classified the College as a post-school institution of higher education and the College set about improving the qualifications of its staff.

In 1979 the College was designated as the Natal Technikon and the institution started offering higher diplomas.

In 1981, due to the increase in students and demand for more space, Natal Technikon started to plan for a new expanded campus on the Berea. In 1983, the new facility became ready for occupation and also the new principal, Prof Andre du Preez took office. Under his guidance the number of courses increased and the Technikon pursued a close association with industry.

In 1996, Prof Benny Koapa was appointed principal of the Natal Technikon. He played a major role in the consolidation of the institution as a technikon and preparing it for merger with the ML Sultan Technikon.

9.2.3 Single Technikon Act for the Post Apartheid Period

In 1992 the Committee of Technikon Principals (CTP) lobbied the former Government to scrap racially based Technikon education and repeal all such legislation and bring Technikons under a single Act. In 1993 Parliament passed the Technikon Act 125. This legislation provided for democratic Councils and recognition of all stakeholders to participate fully in all forums and committees of the institution. However, student organisations and unions did not believe these measures were sufficient in bringing about transformation of higher education institutions, which included Technikons. In 1995 the Minister of Education set up the National Commission for Higher Education (NCHE). Its brief was to advise the Minister of the state of higher education, and make recommendations after consultations with relevant stakeholders. The Commission found that higher education was characterised by enormous duplication, wastage, and gross inequalities between technikons on one hand and universities on the other. This was further aggravated by the division between Historically White Institutions (HWIs) and Historically Black Institutions (HBIs). This disparity arose because of decades of under-resourcing of HBIs during the apartheid era. The NCHE made detailed recommendations with regard to the following:-

- Efficiency and effectiveness of higher education
- Equity and redress
- Quality of programs and qualifications
- Governance of institutions

In 1997 a white paper was published containing key recommendations made in the NCHE document and the Higher Education Act was passed in the same year. The Act introduced wide ranging legislation which enabled the formation of structures and policies to implement the transformation program mentioned in the NCHE report. The common thread running through the various provisions and legislation is the call for fundamental change in the face of globalisation, competition, diversity, quality, development needs and urgent redress. For the first time, funding was based on performance and outcomes of student successes. The Act also specifies that a body called the Institutional Forum be constituted to oversee transformation and advise the respective Councils on transformational policy issues.

9.3 The Merger of Natal and ML Sultan technikons into Durban Institute of Technology

Prof Dan Ncayiyana the Vice Chancellor of the ML Sultan Technikon in his Annual Review (2001: 4) concluded that the "momentous achievement this year has been the conclusion of the merger with our neighbour, Natal Technikon"

The end of apartheid rule in 1994 provided a new set of opportunities, especially for the higher education sector. The Councils of the former ML Sultan Technikon and Technikon Natal vowed to knock down the fence that separated the two institutions for the better part of the last century. By the time that Education Minister, Kader Asmal, first announced his bold proposals in 2001 to turn apartheid education on its head, the governing councils of the two neighboring technikons had declared themselves well on the road to setting the trend in the transformation of Higher Education. The official merger of ML Sultan Technikon and Technikon Natal on 1 April 2002 was South Africa's first. It marked an exciting turning point for higher education in representing the first of several mergers in the tertiary sector.

However, since this was the first merger, there were not enough local mergers that could be referred to. The only other merger was the Veterinary Faculty at Onderstepoort and Medunsa, which was incomplete and fraught with difficulties. Other more successful mergers were the South Australia University, where 12 institutions merged into a single entity.

To understand the respective institution's positions and perspectives, it was necessary to investigate their respective visions. According to the Pricewaterhouse Coopers (1999: 11) at the time of the merger the Natal Technikon's vision read:

"To be leading technological education institution in Africa"

The ML Sultan Technikon's vision read as:

"be a world class higher education institution for the innovative development of leadership through technology for Africa"

Both the visions seem to overlap. However, it is significant they both contain emphasis on technology. However their strategic plans provide no evidence that these institutions were purposefully pursuing a technological focus. Some staff members were cynical in having a vision of being the best in Africa in the vision when these institutions were struggling to make a mark in South Africa let alone Africa. Others argued that however unrealistic the vision may be to the present it is important that we set a long term vision and work towards it.

9.3.1 Post-Merger 2002-2005

During 2002-2005 DIT suffered form a multiple personality condition. It was christened as Durban Institute of Technology in 2002, while its peers were still technikons. It could not associate with universities since it was not legislated as such, but there was an expectation that it deserved a higher status since it shed its technikon name and had volunteered to merge. However while it was named DIT it continued to follow the technikon philosophy, culture, procedures and systems. In 2004 it started to include the objective of a University of Technology in its vision (Durban Institute of Technology, 2004:1). This was very confusing and in the absence of clear direction, the institution appeared to stagnate in its “Technikon” comfort zone.

9.3.1.2 Merger Treatments

The merger agreement was signed by the ML Sultan and Natal Technikons resulting in the birth of the Durban Institute of Technology. The first Vice Chancellor was Prof Dan Ncayiyana This era was characterised by attempts to harmonise conditions of service and benefits. DIT developed plans to remove duplication of services and consolidate the different academic programs. Notwithstanding these challenges, in 2003 DIT made the top spot in the Central Applications Office (CAO) regional tables, ranking as the first choice academic institution by prospective students (DUT, 2009).

It also addressed the different organizational cultures and systems that were pulling the new organisation in different directions. There was much distrust between management and unions. Also unions from the respective technikons disagreed on various matters. Another major issue was the major financial pressures experienced by Natal technikon in meeting its commitments which threatened the affordability of the merged institution.

One of the drivers of the merger was ability to obtain the finance to complete key tasks in the merger process. While the Pricewater Cooper model indicated savings in cutting huge duplication in services, these benefits could only be realised in seven to ten years. The DOE provided short term funding to meet merger costs; however the affordability of the merger soon passed all estimates as hamonisation benefits soared. The consequences of that is still being felt as DUT continues to debate outstanding benefits demanded by staff arising from the merger, namely post retirement medical aid and the issue of paying staff out their accumulative leave.

The DIT developed an identity crisis, since in every form it was still a Technikon but in name. There were suggestions that DIT should be modeled on the world renowned Massachusetts Institute of Technology. Many argued that this was highly ambitious and the institution should be more realistic and investigate more local models as examples. Students felt that their qualifications would be devalued since there was no equivalent institution in status in South Africa. During this period there were several unsuccessfully attempts to develop a strategic plan to chart the way forward for DIT. However, during 2003/4 a vision was published as:

"A leading University of Technology in Africa that nurtures holistic education and the advancement of knowledge" (Durban Institute of Technology, 2004:1)

It is significant that this vision and the goals emerged about a couple of months after DIT was declared a UoT. During this period many staff were not even aware that DIT was a university let alone a University of Technology. The vision could have belonged to any university in South Africa and did not include the key features of the characteristics of a UoT, namely leadership in technology, application of knowledge, innovation and partnerships. The DVC Academic, Prof Du Preez, believed that DIT maintains its status quo and felt it would be premature to make extensive changes to the institution to incorporate the characteristics of a university, as a result the institution continued operating as a Technikon.

During this period at least three executives exited the system and were filled by one permanent appointment and two acting incumbents. This temporary set up created further uncertainty, and lack of teamwork amongst the executive management. Several consultants were contracted to manage various projects. A notable project was the AIMS project which investigated the affordability of the institution's commitments. It became clear according to their assessments that many of the benefits of staff were unaffordable and that DUT would not be able to afford it in the long term. Many recommendations were made and prominent of these was the proposal to reduce staff. This created a further chasm in the management-labour relations. Several turnaround strategies were proposed as alternatives to staff retrenchment, but few were successfully implemented. However, one major success was that the institution now had information that could be used to make informed decisions in future. The AIMS project became a preoccupation of the Executive, to the point that when the matter of changing to a UoT was introduced by the DOE the Executive Deans were told to continue as normal as if nothing was changed.

The AIMS project further aggravated the poor relations with unions and this typified the negotiations with labour. Staff protested about the slow rate of change and lack of information. Management attempted to correct this through a newsletter; however it did little to develop trust with the various stakeholders. Staff were fearful of losing their jobs and were not interested in building a united institution of a UoT for that matter. This was understandable because to obtain their buy-in employees needed to feel secure to obtain their support in building a new institution. This period was characterized by crisis after crisis, poor employer-employee relations and little vision and planning.

This period ended with the exit of the Vice Chancellor Prof Dan Ncayiyana.

9.3.2 Organisational Neurosis: Post-Merger 2005-2007

This period started with a lot of promise and expectations but soon deteriorated to sense of ineffectiveness, unhappiness and fear. Freud described neurosis as intra psychic approach-avoidance conflict. It is acquired during a developmental process involving excessive, impulse-generated anxiety to cope with development (Lazarus, 1995). On an organizational level the merger generated deep anxiety as the merged institution started to take baby steps. Its development was soon stunted due to conflict and divided governance structures. Council and Executive Management structures became dysfunctional and the Minister had to intervene to provide urgent therapy.

This period began in April 2005 with Prof B Goba being appointed as Vice Chancellor to steer the Durban University of Technology. His tenure as CEO was characterized by one of prolonged consultation with stakeholders to determine a plan and a shared vision. He also terminated the contracts of all previous consultants that were appointed by the previous management. All merger-related restructuring was done in-house. In determining the path forward he became mired in unending consultations with Unions and committees and there was a lack of a clear direction. Notwithstanding that he took office two years after being declared a UoT, there was still little discussion on what constitutes a UoT.

The vision in the DUT Annual Report (2005: 1) contained the same vision from the previous year when it still operated as a Technikon. Clearly, there was very little understanding of what direction the institution needed to embark on. Notwithstanding the VC's termination of many consultants, more consultants were hired to develop an operational plan to realize the vision of “A leading University of Technology that nurtures holistic education and the advancement of knowledge”. Dr Mark Orkin and Dr Mike Gering were appointed as consultants to assist in developing the operational plan for DUT. Majority of proposals from this exercise were not implemented due to poor communication and no buy-in from staff. In the VC's Annual Report (2005) there is no mention of what a UoT is and lack of identification which goals will drive the transformation to a UoT, while for all intents and purposes the DIT was classified on paper as a UoT. It can be argued this confusion was due to the institution being formally named the Durban University of Technology much later in March 2006.This lack of understanding could be that DUT had great difficulty in embracing a university concept and further the leadership still saw a UoT as an extension of a technikon. Also there appeared to be no criteria at that time in differentiating UoT from other higher education institutions. This created a crisis as DUT started to model itself on the traditional university system. Invitations to participate in SATN which is an association of UoTs, were not treated seriously. There was no evidence to indicate that the decisions taken at SATN were given any serious consideration at DUT.

An operational plan was submitted to the DUT community for implementation. However about the same time there was a major break in the governance system at DUT. There was conflict between Council and Management. Council appointed forensic auditors to investigate allegations that were made against staff members. This investigation consumed management's time to the point once again the institution was busy dealing with crises. Council was accused of meddling in the management of the institution and even ignoring the executive in communicating directly with vendors and staff. Council accused the Vice Chancellor of being indecisive and levied various allegations against management. The Minister intervened and appointed an Assessor to report on many allegations that were made to the Minister.

In 2006 following a damning Assessor's report and the formal dissolution of Council, the highest decision-making body at a university, the Minister appointed an administrator, Professor Jonathan Jansen, in August 2006. The task of the Administrator was to carry out the functions of Council, conclude a forensic audit that began with previous Council, institute effective management practices, and eventually appoint a new Council. The report revealed widespread interference of Council in the day-to-day running of the University. There was poor governance and compromised management. The report described the management situation as:

"Governance had, in key areas, become indistinguishable from management. There were all kinds of questions within and outside DUT about the financial integrity of the institution; staff morale was at a dangerous low; and the public had a negative impression about this merged "university of technology" (Merger Unit Report to Minister, 2006; Durban University of Technology, 2009: web page).

It was clear that staff and students alike were tired of the uncertainty and lack of decisive leadership. At the end of 2006, the Vice Chancellor and Principal of DUT, Professor Bonganjalo Goba, decided to resign after many years of service to higher education. Around this time Prof Slammert was appointed as DVC Academic. He brought some stability to the academic sector that had acting appointments for about three years, however the UoT concept was still not driven with any conviction.

Under difficult conditions, lecturers continued to teach, secretarial and administrative staff maintained operational systems, and the management of DUT tried, at considerable cost, to keep the university functioning. In the same year DUT began the process of developing an Operational Plan. Through an inclusive process, the plan was produced and approved by the university. This plan sought to address seven imperatives:

- Throughput
- Relevant Research
- Staff Development

- Student Experience
- Improved Management
- Community Partnership
- Enabling System

While the goals referred to a UoT, it still lacked a clear direction in terms of a UoT. It still was driven by technikon systems and philosophy. This situation could be partly attributed to the DOE. In their haste to create a new type of university, it did not adequately develop a set of characteristics and criteria for a UoT. They merely took certain benchmarks that were applicable to traditional universities and applied them to UoTs. Many of these university criteria could only be achieved in the long terms. For example the DOE required that sixty percent of academic staff must have masters and forty percent must have doctorates by 2012. This is an ambitious requirement, given the fact that technikons employed lecturers more for their practical experience than for qualifications, however more recently there has been increased emphasis on qualifications. Also, UoTs are required to produce research at a 0.5 output per academic staff member. By 2012 DUT must produce 268 outputs per annum. The present output is 50 per annum.

While this era was brief it was traumatic for the institution. The Administrator was required to create a new Council and employ a new Principal. For almost a year the institution operated without a full governing structure, but it allowed DUT the space to reorganise itself and set upon a direction with purpose.

9.4 DUT on the Journey to be a University of Technology

In 2007, Prof Roy Du Pre was appointed Vice Chancellor and Principal. In his first Annual Report (2007), he firmly set the UoT direction for DUT,

“ As a University of Technology, DUT will prioritise the quality of teaching and learning by ensuring, amongst others, that its academic staff possess the highest possible qualification that they can get” (p5).

“As a university of technology, DUT will focus on applied research and move strongly towards technology transfer and innovation” (p5).

He highlighted the challenges facing DUT since it would appear that this institution was late in adopting the benchmarks and criteria of a UoT, "DUT is starting late, and from a low base because, firstly, it came from a technikon background and, secondly, it had to divert its time and energy in the last five years towards the merger" (p5)

9.4.1 DUT Position in Terms of DOE Benchmarks

Table 9.1: Comparative Benchmarks DUT

INDICATORS	BENCHMARKS FOR UoT BY 2012 AND TARGETS	DUT as at December 2007	DUT as at October 2008
% doctorates among academic staff	40% (203)	7.5% (38)	8.7% (50)
% Academic Staff with M degree	60%(317)	29% (150)	26% (136)
Research Outputs	0,5 pl (260)	0.1pl (51)	61
Success Rates	80%	71%	75%
Graduation Rates	22,5%	19%	21%
% of Student FTEs in SET	50% for UoTs	40%	40%
Student Enrolment	Capped Growth at 22226	20785	21763
Percentage of qualifications with WIL	All qualifications should have WIL	50%	50%
Number of students in SET	50%	50%	50%

Adapted from DUT. 2009. Strategic Goals and Objectives for 2009 to 2018.

The above table consists of the key benchmarks set by the DOE. The third and forth columns contain the DUT figures as at 2007 and 2008 respectively. As can be observed there is a wide gap between the DOE target and the actual for DUT to reach. In chapter 7, the researcher conducted four focus groups to test the UoT performance indicators and its applicability. The studies found that majority of the UoT indicators were acceptable at DUT. The outcome of the focus group included the cascading of the strategic plan to faculties and departments. There appeared to be difficulty in operationalising the UoT strategic plan without a model. While the strategic plan of DUT has all the features of the UoT, its systems, structures and policies still reflected technikon characteristics. For example DUT does not comply with DOE targets in research output and postgraduate qualification requirements for academic staff. The DOE benchmarks for academic staff are sixty percent masters and forty percent doctorates.

What is worth noting from the above table is that there steady movement from 2007 to 2008 towards the DOE targets in 2012. However the number of staff with masters had decreased from 150 in 2007 to 136 in 2008 and the number of doctorates have increased from 38 to 50 in the same period. It can be assumed that the decrease in masters was due to those staff having completed their masters have went on to completing their doctorates in 2008. This resulted in doctorates increasing and a corresponding decrease in masters for that period.

9.5 PROCESS OF MODEL APPLICATION

The majority of UoTs were products of restructuring of the Higher Education in South Africa. Also, all were former technikons and were part of the restructuring process. DUT was selected as a case study because it is similar to other UoTs in South Africa, since it was a merger of two former technikons and further it was designated as a UoT. However, it is significant that notwithstanding its classification as a UoT in 2003, DUT made little progress towards embracing the characteristics of a UoT. This made it an appropriate candidate to test this model. The model was tested to determine the institution's readiness and progress in transforming itself from a former Technikon to a UoT.

In applying the model, two of the main distinguishing features of the consolidated UoT model will be used namely:

- increasing graduates with a bias in technology, WIL and entrepreneurship (UoT-type programs),
- applied research and innovations,

Each of these UoT attributes will be applied using the model to measure the transformation process from a strategic level to operational level by assessing the presence of UoT systems, structures, learning and growth, financial sustainability, to ultimately create customer value and impact at a national economic level.

The learning and growth perspective will be investigated, since the key to a UoT is the ability of the organization to have the human capital to embark on this journey to be a UoT. Secondly, it needs to have the organizational intelligence in terms of organizational culture, leadership, and the information technology. Often these are ignored in favour of financial results, which are considered easy to quantify.

Once the human capital and organizational matters are finalized then systems and structures will have to be tested. If they exist already then the systems must produce outputs in terms of standards defined by the performance indicators. Otherwise the system must be removed or modified to produce in terms of UoT specification. The human and organizational resources are inputs into the system.

The UoT characteristic will be mapped to assess the learning and growth components to drive UoT goals of "Increasing Graduates with UoT qualifications" and "Applied research and Innovation"

9.5.1 The Map

The maps as indicated by the tables show the scope and direction, and the areas that will be discussed. In Table 9.1 and 9.2 the UoTs attribute are identified in column 1, it is then verified for its presence in the strategic plan in column 2. Under the heading "Customer Value Performance Indicator" the characteristic is defined in terms of what measurable value the customer expects. Under the heading "Learning and Growth", the human and organizational capital is identified to bring about the transformation. In "Systems and Processes", the systems are identified to produce the results/outcomes, using the human and organizational capital as inputs. And finally "Finance/ Sustainability" is also an outcome, in that if the results are achieved then the institution is able to sustain itself through subsidies, student fees and third stream income.

The columns have typical questions that can be used in the inquiry.

9.6 INCREASING GRADUATES WITH A BIAS IN TECHNOLOGY, WIL, ENTREPRENEURSHIP

Apart from ensuring that students have access to HE institutions, they have to ensure that these students succeed. Over and above this, UoTs distinguish themselves from other types of universities by the type of programs they provide. The components of their programs must include technology, entrepreneurship and WIL. A significant component of the programs should have experiential/WIL learning so that students can quickly transfer their skills to the workplace.

Table 9.1 shows the direction of implementation and how DUT will produce graduates with UoT programs. While the diagram appears to be linear, its operation is highly systemic in nature since all the goals interact with one another.

9.6.1 Customer Value

Government requires that Higher Education institutions perform to certain benchmarks. The DOE has set targets for graduation rates (22.5%), success rate (80%), research output (0.5 pl), number of students in WIL (50%).

Industry requires students that are able to adapt quickly to the world of work and their changing technologies. Society requires students that are able to find solutions to everyday problems by using their intellectual capital and technology to contribute to development of communities.

9.6.2 Learning and Growth

To become a university, DUT needs a critical mass of qualified academic staff to comply with the DOE benchmarks and DUT targets. As already discussed all academic staff require a minimum qualification of masters and forty percent of these to have a doctorate by 2012. DUT has provided a range of interventions to help reach this target. The Tertiary Education Subsidy is provided to staff to obtain the required qualifications. The Postgraduate Development Support department provide grants to B.tech, M.tech and D.tech students and staff. It is envisaged that this will increase the number of staff studying for their postgraduate qualifications. However, many staff may not reach this benchmark by 2012, since some staff are on the brink of retirement and see no purpose in studying at this late stage institution, however there are staff who are not studying further for no apparent reason, even though DUT has provided ample support in terms of resources. DUT will require a plan to address this matter and consider all labour issues and DOE requirements. The management committees need to develop a plan for 2012 in consultation with stakeholders on how to address the non attainment of this target. Many of these staff were former technikon lecturers who were recruited for their industrial and practical skills and experience rather than their academic qualifications.

Staff need to be equipped with innovative teaching practices in line with being a technologically driven university. Staff development will have to introduce new methodologies in line with the new generation of learners who have access to latest technologies. The application of knowledge through technology is the philosophy that should underpin all teaching and research activities. New systems and resources will have to be integrated.

The Center for Education and Leadership in Technology Departments has an education technology section that provides training in the use of technology in teaching. The Center provides training in teaching and learning and in the use of e-learning. However, since it is voluntary, attendance is poor , as low as 1% and there appears to be a lack interest in how to embrace technology. Staff development and academic management will have to instill the will and also construct policies and systems to drive technology in education.

To be a technological university will require highly skilled academics and support staff. Clear recruitment and retention strategies need to be in place to attract high caliber staff and retain them by offering competitive reward strategies. The institution needs to build an environment in which their expertise can flourish and grow.

DUT can improve its achievement of UoT strategic outcomes by building an organizational culture conducive for innovation, and the creation and transfer of knowledge. DUT requires a learning culture to support openness to new thinking, knowledge and subjecting it to constant review. The institution needs to look out for opportunities for converting knowledge into communities of practice. Shared values and beliefs of how to generate, acquire and apply knowledge should be integrated in teams, structures, systems and recruitment of new talent. Structures and systems should be formed to support new learning, innovation and creativity. However, once these structures have fulfilled their purpose they may be dismantled. In this way bureaucracy and unnecessary committees are kept to a minimum. Structure should as far as possible be a function of strategy and not vice visa.

In a learning organization staff initiate performance reviews. DUT has introduced a Performance Management System and this is gradually being rolled out to all departments. This is in the early stages of implementation. The strategic plan is being cascaded to all levels to improve accountability and service delivery. The institution's subsidy is based on its own performance in terms of research and graduate output. Staff are expected to produce publications and research which forms part of their KRAs.

Table 9.2: Process Chart to Assess the UOT Model at DUT: Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship

1. UOT ATTRIBUTE (What UoT attribute needs to be addressed)	2. DUT STRATEGY (Is the UoT attribute integrated in the strategic plan?)	3. LEARNING AND GROWTH (What human capital, development needs, IT and org culture is required?)	4. SYSTEMS AND PROCESSES (What systems and processes can best translate human and intellectual capital into customer value?)	5. CUSTOMER VALUE (What are the expectations of Government, industry, community and the nation?)	6. FINANCE/SUSTAINABILITY (What resources are required to ensure sustainability?
Increased Graduates (with qualifications featuring technology, WIL and entrepreneurship)	This is included in the DUT strategic Plan	• Integrate innovative teaching approaches. • Staff to have industrial experience • Professional Dev - Academic Staff to affiliate to Professional bodies • Increase development of postgraduate staff and students • Retention and recruitment of skilled staff • Instilling an achievement organisational culture to support UoT • Employee Productivity • Technology infrastructure	• Student development interventions-Foundation courses, expanded degree • Review of UG and PG courses to integrate market relevance and Input from Prof Bodies • Integrate Entrepreneurship. , WIL, Technology Driven PQM • Widening access to HE - thru Agreements with FET colleges, RPL processes, Provision of courses • Develop Community Engagements • Seek recognition with Prof Bodies and dev Advisory Boards	• Increased graduation rate in programs featuring technology, WIL and entrepreneurship • Improved access • Increase Students employed in Field of study Technology Focused Programs	Financial sustainability

9.6.3 Systems and Processes

Systems and processes translate human capital, technology and resources into value. The systems should be specific to enhancing UoT attributes.

9.6.3.1 Integrating Technology, WIL and Entrepreneurship into UoT Programs

UoT's unique character can be observed in the type of graduates that are produced. DUT is required to produce graduates with an emphasis in the ability to transfer knowledge to the workplace. DUT has already strong links with industry and many courses particularly in the SET (Science, Engineering and Technology) and some management courses have Work Integrated Learning has part of the curriculum. The Health Sciences have service learning components in certain of its programs. However, about 20% of qualifications do not have WIL has a requirement.

There are three drivers in advancing the integration of technology, WIL and entrepreneurship into the DUT programs. They include the incorporation of knowledge transfer components into programs, incorporating new knowledge into programs and knowledge transfer through community engagement.

9.6.3.2 Incorporating Knowledge Transfer Components into Programs

Not all courses at DUT have a WIL or service learning component in the qualification. The requirement for UoTs is that ideally all courses should have service learning or WIL to be built into the PQM. Similarly, entrepreneurship and technology should be part of all courses at DUT, to build innovation, creativity and the ability to create jobs. The PQM process must be modified to ensure that all courses subscribe to this requirement. The performance indicators of the type of outcome that is expected is indicated in detail in the Balanced Score Card and accompanying spreadsheet in chapter 7. Policies need to be developed to reflect the procedures and systems to ensure the integration of UoT characteristics in all courses, with clearly defined standards and delivery time frames. Faculties and departments should be including this in their operational plans and performance plans.

9.6.3.3 Incorporating New Knowledge into Programs

DUT does not have annual reviews to incorporate new knowledge into the curriculum. Regular reviews of programs need to be conducted, since the philosophy of UoTs is "just in time education", therefore it needs to integrate new knowledge into the program without going through time consuming bureaucracy. If less than 50% of the course needs to be changed, it can be done internally at DUT. Professional bodies and Liaison committees are an excellent source of new knowledge and best practice. Systems and policies need to be formed to link up the external bodies so that it can communicate to faculty and departmental staff to reach the program review committees at least twice a year. Faculties at DUT should seek recognition for all their courses either formal or informal, with professional bodies, and industry associations. This improves relationship with industry and widens the knowledge network. Students benefit in terms of work opportunities.

Courses should be flexible and portable to facilitate the development of new types of jobs and careers in the market place, as opposed to the highly structured discipline based program structure. The use of inter-disciplinary qualification should be encouraged and built into the strategic plans of the faculties. However these are long terms goals which the SATN have identified as niche areas for UoTs and are in discussions with DOE.

9.6.3.4 Knowledge Transfer through Community Engagement

DUT has a several community based organizations on campus. However it lacks coordination in linking the work of these organizations into a well articulated program with the academic sector.

Community engagements are part of the network to facilitate the transfer of knowledge and technology to communities and in the process assist communities in solving real world problems. DUT has inherited many community organizations e.g. Centre for Education Skills Development, Satyagraha Movement, International Centre for Non-Violence (ICON). This is a good foundation to involve faculty and students in community development projects and service learning. DUT requires a policy and a system to integrate these organizations into the faculty, department and program level. Presently the International Centre for Non- Violence is designing a curriculum for Peace studies which will include mediation and other peace resolution mechanisms. Peace in their definition goes further than the absence of war but addresses poverty, and sustainable living. The aim is to integrate such courses into qualifications to ensure that graduates are sensitive to community and the environment when using technology or when participating in any development process. Building these relationships with community based organizations will also provide opportunities for service learning for DUT students.

9.6.3.5 Access to HE

DUT as with other UoTs have historically provided access to a range of students including those with no matriculation endorsement. This is a significant strength since traditional universities take students with matriculation endorsements only. With the relatively small pool of matriculation endorsements every year they are unable to have the flexibility of increasing access, which favours UoTs. Notwithstanding this the graduation rate has steadily improved at DUT despite the participation of students described as “high risk”. The present graduation rate as at 2007 stood at 19% and the

DOE benchmark is at 22.5% (DUT, 2009). This is remarkable since the graduation rate started at 17% in 2003 and has improved steadily. Graduation rate refers to the number of students graduating in a year as a percentage of students enrolled. The reasons why there is a gradual increase in the graduation rate is not immediately clear, but it could be because of capping of enrolment, more selective recruitment of students, more flexible funding arrangements for students who excel.. This is an area for more research at DUT to advance access and success further in terms of the DOE's strategy, several measures have been stipulated in the model to address the twin evils of poor quality of students entering HE, and the fifty percent dropout rate. To improve success rate i.e. proportion of students passing per subject, firstly DUT needs to design a common foundation course with good correlation with student success at DUT. The second intervention is that students must be automatically referred to mentors, remedial assistance as soon poor results are observed. The IT system should be designed to automatically highlight below par performance and bring it to the attention of the respective Executive Deans and HODs. This is an important driver to prevent dropout and failure at an early stage.

9.6.3.6 The Expanded Program

The expanded program is an important intervention to improve graduation rates. Most students take four years or more to complete a three year qualification. It would be better to plan this into the curriculum and resource this accordingly so that students improve the chances of graduating in a more flexible time line. East London University in the UK has an expanded degree as part of their access intervention. There is reluctance in some faculties in accepting this concept at DUT to offer the expanded qualification as part of its plans to improve graduation rates. However, this needs to be expedited so that it would help students to pass. This program now attracts DOE funding

Another intervention is to offer a seamless qualification including the diploma and degree together with exit points at certificate level, diploma and degree level or even at masters level. These can be designed and marketed as such. Students can exit at any stage to work and return later to continue their qualification. In this way they would not be considered as dropouts but will represent continual learning. This is also was identified in the research as types of qualifications that overseas UoTs offer. This was favoured by Du Pre (2009) as a way of improving postgraduate study.

9.6.3.7 Articulation Agreements

Articulation agreements with Further Education and Training Colleges can be an important feature of UoTs. DUT does not yet have any formal agreements with FETs. The institution requires an agreement to facilitate the rollout of this form of access. The policy should indicate the level and credits that DUT will recognize.

A policy should also address the accreditation of qualifications obtained through other institutions, including national and international universities.

9.6.3.8 Postgraduate Enrolment

The DOE benchmark for UoT postgraduate enrolment stipulates that it should not exceed 2% of total enrolment. Postgraduate qualifications attract a very high subsidy; therefore DUT needs to encourage postgraduate enrolment. However the systems of postgraduate enrolment needs to be reviewed to facilitate an efficient process from the proposal stage to the approval at the Higher Degrees Committee. Some of the functions of postgraduate enrolment are centralized in the Postgraduate Development Services while other administrative functions are vested in the faculty. The approval of the proposal is subject to certain processes that require further modification to expedite it, without compromising the rigor of scrutiny. There needs to be a coordinated process from the postgraduate office to the faculty office. There is tremendous potential for certain departments to improve their postgraduate, research and financial profiles.

To increase postgraduate enrolment the faculties will have to increase the number of staff with masters and doctorates to be able to supervise and lecture at postgraduate level. This is a major constraint to be addressed.

9.6.3.9 Multidisciplinary Approach

In some aspects DUT is structured along the lines of traditional universities. This entrenches the discipline based study. UoTs are expected to engage in multi disciplinary research and study. This is very much part of a holistic problem solving philosophy, as opposed to the silo approach. Most UoT programs are even more specialized than the traditional universities. While university programs have at least two majors from different disciplines, there is no such flexibility in UoT programs. This is a legacy of the former technikon programs. However, there are strong moves by the SATN to transform this situation in making programs flexible and relevant to the world of work.

DUT has a process called Conferment of Status which in many ways frustrates any attempt at a multidisciplinary approach in UoT programs. The Process requires students to apply for approval from Senate if they want to study outside their discipline. In the context of multidisciplinariasm the conferment of status policy needs serious and urgent review to allow students to study other disciplines.

Serious debate is required at DUT whether a person from a Management discipline can engage in study of aspects of Engineering in the context of multidisciplinary approaches. Questions whether it is necessary to have “conferment of status” should be debated. If a student wants to study outside of his/her discipline is it necessary if DUT adopts the multidisciplinary approach, to apply for permission? What alternative forms of processes would be more appropriate in this context? These require answers from DUT in attempting to use multidisciplinary knowledge to solve real world problems, in which knowledge is not pre-packed into neat disciplines but require a range of disciplines and subject matters to resolve issues.

The role of administrative systems and rule books in determining whether a student qualifies for conferment of status should be avoided. Where a qualitative assessment is needed it must be referred to a specialist in the field. Qualitative assessment of research and its categorization cannot be delegated to administrative processes but requires active participation by academic managers/heads and specialists. As DUT transcends traditional boundaries of knowledge, academics will have to embrace this philosophy and apply their minds to this challenge. The management of a faculty belongs to the Executive Deans and HODS and senior academic staff, and they are responsible for academic leadership.

9.6.4 Financial Sustainability

Increased graduation rates and lower dropout translates to higher subsidies resulting in improved income for the institution. Also it improves the image of the institution as a UoT in the industrial world. It is anticipated that UoT students are able to quickly transfer their skills to the workplace and contribute to the economy of the country.

Income from Government subsidies have been steadily decreasing, and university expense have been steadily increasing. For example, the DOE has stipulated that staff salaries should not be more than 60% of the total budget. Yet universities are expected to employ staff for their skills to generate and transfer knowledge as its core business. Attracting highly skilled and qualified researchers and innovators to universities require huge resources. Most universities spend about 70% of their budget on salaries. Clearly this appears unrealistic to spend 60% on salaries, especially since these institutions employ staff for their knowledge and expertise.

Universities are also not allowed to charge excessive student fees so as not to make higher education unaffordable. This leaves institutions to raise their own funds through third stream income. This is where DUT can play a role by commercializing knowledge transfer into commodities that can be patented and converted into products that can be manufactured and sold. Overseas institutions have been very successful in raising third stream income through this avenue. However, in South Africa to build this capacity and infra structure will take time.

9.7 APPLIED RESEARCH AND INNOVATION

The second objective of this inquiry is to test to what extent that applied research and innovation is being implemented at DUT and what needs to be implemented in terms of the model. Table 9.2 outlines the direction and scope of the inquiry. UoTs are characterized by research that is applied to solve real world problems, whether in industry or community. It can take the form of entrepreneurial projects, Intellectual property and the formation of technology stations. Collaborative projects are potential research projects.

9.7.1 Customer Value

The DOE research benchmark for UoT is 0.5 per academic staff member. Presently DUT produces 55 research outputs per annum; the target is 260 per annum. Clearly, this target is very ambitious but is much lower than the traditional universities. There are many key drivers identified in the model that can improve DUT's research profile.

9.7.2 Learning and Growth

Research needs to be driven by a critical mass of researchers with innovative ideas and skills. DUT must attract these skills by offering higher remuneration and better conditions for employment, if it has to meet the research output targets by 2012. The development of its present staff to obtain postgraduate qualifications will make substantial progress in reaching these research targets. Having a postgraduate qualification also builds research capacity.

The development of an information technology architecture that is extensively networked and pervasive will facilitate communication, partnerships and knowledge sharing.

The other learning and growth perspectives of organizational culture, and staff recruitment and retention strategies are important to build a research profile at DUT. These have been discussed in the previous section.

9.7.3 Systems and Processes

Systems and processes need to be designed to give effect to input resources to produce research at the desired level.

9.7.3.1 Creating an Enabling Environment for Entrepreneurship, Technology transfer and Incubators

DUT will have to ensure that research is able to be applied in wider society. The ways of implementing this is through technology transfer stations, entrepreneurship projects and incubators etc. These functions belong to the Technology, Innovations and Partnership sector at DUT. This was created recently. While there is a central structure it is yet to systemize its functions to faculty, department and research level. It should develop policies, procedures and systems to coordinate the conversion of research into applied research through the various interventions described.

DUT will have to patent its intellectual property and transform these into commercial activities. All promoters and supervisors should be trained to advise on patents, and identify research that can be used to transfer technology into useful tools to contribute to the betterment of society. Research should aim to be multidisciplinary and collaborative. Community participation in research will provide a legitimate platform in addressing problems experienced by communities. DUT has to strengthen its community links to widen its impact.

9.7.3.2 International and National Partnerships

DUT has formed a structure to drive international and national partnerships. It is expected that the more staff and students collaborate the more research will be enhanced, resulting in knowledge generation and transfer. Here too the work and contacts made should cascade to department level to facilitate collaborative research.

9.7.4 Financial Sustainability/Resourcing

DUT like all other public universities and colleges is dependent largely on state subsidy for income. Over the last ten years state subsidy has steadily deceased in real terms, placing universities in a very precarious situation. They will have to develop alternate 3rd stream income to fund salaries, operational costs and capital expenditure. However UoTs in other countries and some South African universities have converted their research and innovation into highly commercialized ventures that produce third stream income. This income is used to further develop researchers, teaching and learning and form technology stations, incubators and intellectual property rights. However, the majority of universities and most of the UoTs have not developed systems or neither are presently in a position to undertake significant large scale commercialisation of their offerings.

DUT should provide facilities for incubators and start up SMMEs so that the products and services from these initiatives can be commercialized and the income generated can be directed to other development and strategic areas in the UoT trajectory.

Table 9.3 Process Chart to Assess the UOT Model at DUT: Applied Research and Innovation

1. UOT ATTRIBUTE (What UoT attribute needs to be addressed)	2. DUT STRATEGY (Is the UoT attribute integrated in the strategic plan?)	3. LEARNING AND GROWTH (What human capital, development needs, IT and org culture is required?)	4. SYSTEMS AND PROCESSES (What systems and processes can best translate human and intellectual capital into customer value?)	5. CUSTOMER VALUE PERFORMANCE INDICATOR (What are the expectations of Government, industry, community and the nation?)	6. FINANCE/SUSTAINABILITY (What resources are required to ensure sustainability?
Applied Research and Innovation	This is included in DUT strategy	• Increase the development of postgraduate staff and students	• Create Enabling environment for Entrep.TTI project, ,incubators, SMMEs • Development of, IP, patents, prototypes, procedures • Develop Community Engagements • Develop new Postgraduate students • Integrate Entrep. , WIL, Technology Driven • International and National partnerships	Research output @ 0.5 per academic staff. This works to 260 outputs pa. The actual for DUT is 55 pa	Ratio of third stream income as a proportion of total income

9.8 RECOMMENDATIONS ARISING FROM THE PARTIAL APPLICATION OF THE MODEL AT DUT

The UoT model is a system and it is this systemic approach that was used. To achieve the characteristic of a UoT, the study looked at the core business of DUT, namely producing graduates and conducting research. These two core functions are generally what most universities engage in, however DUT will have to meet very clear prerequisites for it to comply with the requirements of a UoT. The recommendations are listed below and centre on two critical areas of improved graduates with UoT qualifications and applied research.

The recommendations follow the model in terms of increased graduates, and applied research.

9.8.1 To produce graduates in UoT type programs, DUT will need to consider the following recommendations.

Phase 1: Human and Organisational Capital (Learning and Growth)

- A critical mass of skilled academic staff is required. The institution needs to comply with the 2012 benchmarks for minimum qualifications as discussed earlier in this chapter.
- Develop a learning culture so that knowledge is continuously generated and shared and incorporated into the program as discussed in chapter 3 and 8.
- Information technology to be fully accessible to all staff and students. Consideration should be given to ensuring all academic staff are given lap tops. Lectures should be converted to podcasts and placed on the internet for students. Use should be made of internet sites of Facebook, blogs and Twitter to look at ways of enhancing communication and access to knowledge.
- Academic staff should be trained in all aspects of innovative teaching and learning incorporating the latest technology. A teaching and learning approach should prepare students for a career as opposed to a single job. Since knowledge and technology is continually changing, students should be taught how to update knowledge and solve problems as discussed in paragraph 8.7.1.3.
- Lecturers should be released for forty hours every two years to observe and study technology in industry as is the case in the German Fachoshule system .
- Clear recruitment and retention strategies are required to attract good researchers, skilled staff and scarce skills. DUT needs to recruit certain scarce

skills from overseas as means of improving its research capacity (paragraph 8.7.1.3).

Phase 2: System, Structures and Procedures

- All faculties and departments to incorporate WIL, technology and entrepreneurship into their programs. Systems and procedures to be developed to affect this up to faculty level and program level as discussed in the model in chapter 8.
- All courses to be updated at least once a year to incorporate new knowledge into the curriculum
- Build relationships with all relevant professional bodies and associations to widen knowledge and best practice networks (paragraph 8.7.2.2).
- Programs should be flexible and portable and contribute to a “cafeteria” approach to career development in which students can choose their courses based on their career aspirations, as opposed to present restrictions and inflexible clusters of courses.
- More structured approach is required in working with communities. Policies need to be developed that will guide the development of relationship with communities at faculty level (paragraph 8.7.2.2) .
- DUT requires policies and systems to create a common foundation program to help complement the problems due to poor schooling. Articulation agreements, and expanded degrees are critical interventions for DUT (paragraph 8.7.2.2) .
- The development of seamless education in which students are exposed to continuous education with several exits and entry points. Policies and plans are needed. Presently, the DOE directives prevents this from being implemented, however the SATN is in negotiations with the DOE in adopting the multiple exit approach.
- A more coordinated postgraduate system is required especially since DUT has to meet a target of about 2% of its total enrolment. Since this is relatively new the systems are scattered between the central postgraduate office and the faculty(paragraph 8.7.1.3).

9.8.2 Applied Research and Innovation

Phase 1: Human and Organisational Capital (Learning and Growth)

Human and organisational capital requirements are similar for the goal mentioned in 9.5.1.

- Staff should be encouraged to complete their post graduate qualifications, since this will build their capacity to do research.
- DUT must meet their target of 260 research outputs per annum by 2012.

Phase 2: System, Structures and Procedures

- Develop policies outlining systems and structures in faculties to facilitate the formation of incubators, technology stations, and intellectual property rights.
- Training of supervisors and promoters to advise researchers on IP, commercializing of research and technology transfer opportunities
- Coordination between the central TIP office and faculties are required to promote technology and entrepreneurship type of research and student projects
- To promote third stream income, staff to be given incentives to allow them to be creative and innovative and thereby contributing to the income of DUT.

9.8.3 General

Many policies in technology transfer, innovation, and community engagement are yet to be developed and approved. Where policies exist, for example Cooperative Education, the structure at the central level does translate well into the faculty structure, who are ultimately responsible for WIL.

More functions need to be decentralized to faculties. The central structure should play a coordinating function especially in advocacy, capacity building and promotion. This applies to many functions in the Technology, Innovation and Partnership sector, where central structures exist but does not cascade to faculty and departments, as there appear to be no system to affect this. Presently administrative services like Human Resources and Finance have been decentralized to faculties. This improves turn around time and empowers the Executive Dean, in ensuring that the appropriate support is available and can be managed at a local level.

Another glaring problem is that many of the UoT characteristics that are in the DUT strategic plan are not fully cascaded into the performance plans of the Academic and TIP ambits. This is due to the fact that there are acting DVCs in these ambits and it is envisaged that the process will be speeded up when the permanent appointments are made. However this requires to be addressed to avoid slowing down the transformation process. The model has very clear guidelines to address this situation by ensuring that UoT performance indicators also feature in faculty operational and performance plans of academic managers.

9.9 SUMMARY

This chapter applied aspects of the UoT Development Model at DUT. It revealed several gaps that require attention. It is noted that all the criteria for a UoT is in the DUT strategic plan, however the plan is highly conceptual and needs to be operationalised. The model provides a basis to bring about tangible transformation in an efficient and coordinated manner. The proposed model works as a system and must be implemented in a systemic manner.

Arising from this assessment, several recommendations have been made to operationalise the strategic plan. It requires human and organizational capabilities which drive systems, which in turn produces value in terms of the specified performance indicators. The impact can be observed in the value obtained in the UoT-type of research and graduates produced. The impact can be qualitatively assessed using the models performance indicators and benchmarks.

The model is both transformative and also has the ability to cascade the conceptual plan to more concrete results.

CHAPTER 10

RECOMMENDATIONS AND CONCLUSIONS

10.1 BACKGROUND

The purpose of this research was to ultimately create a model for the development of UoTs in South Africa. To this end the external and internal forces, strategy, operational instruments and performance measures were studied. This model would provide South Africa with the building blocks to redesign and reposition the UoT sector to be a significant driver of economic, industrial and community development. Ultimately, it is envisaged that this type of institution would make a significant impact on the economy of the country. Thereby, addressing the concerns and criticism directed at Higher Education, for it not being relevant to the country's needs due to the bureaucracy and long delays in its organisational systems and structures and conceptual model. This resulted in institutions not being quick in responding to the growth in knowledge and technology, and a general insensitivity to the needs of the external environment.

Global changes and the acceleration of knowledge have influenced the agenda for managing and governing higher education around the world. The rapid globalization and the strong demands for the development of national economies, influence the agenda for social and economic developments and reforms. South African higher education institutions (HEIs) are no exception and are subject to constant change pressures. The South African Government mandated the Department of Education to devise a plan to transform education. Several plans and reviews were developed by the DOE which were investigated to obtain a background to this study. Significant milestones in the history of Higher Education include the inheritance of an apartheid education system characterized and separated along racial and ethnic lines. The White Paper 3 and the NPHE (2001) where significant documents, that set out a plan for transformation of universities.

Another important conclusion in the study was while the DOE attempted to address the racial inequities and resourcing imbalances in funding institutions it did not significantly address issues of growth of knowledge, shortage of skills, technology and innovation, application of knowledge to solve real world problems. This led Lategan (2005: 183-184) to criticise the Size and Shape Report (2000) and National Plan for Higher Education (NPHE 2001) in the way they dealt with the restructuring of the HE landscape. He pointed to the lack of understanding of what a University is, as well as the diversity of University functions with respect to its social goals.

10.2 ENVIRONMENTAL FORCES

The first objective of the research was to study the environmental forces influencing UoTs and its development. To face the challenges of the 21st century, institutions need to address problems experienced by the modern world; it needs to be aware of the changes in demands made by their customers represented by Government, society, and industry and the external environment. To respond quickly in addressing problems, requires the effective use of technology and innovation. This is not new since the early humans began with the conversion of natural resources into simple tools during the time of the Stone Age. However, the nature of modern work is changing and continually increasing, with knowledge, information and education (Eldik and Fowler 2004: 140). According to Du Pre (2009: 18), as we move further into the information and knowledge age, the workforce will require enhanced education and training to sustain competitiveness. This poses an important challenge to HE.

South Africa has many environmental pressures that continue to impact on its economic growth e.g. low skills base, unemployment, inflation. Its economic policies were developed to increase economic growth to ameliorate the effects of poverty and under development. In terms of Accelerated Shared Growth Initiative of South Africa (ASGISA) (2006) and JIPSSA (2006), the Government plans to grow the economy by 4.5% till 2009 and plans to grow by 6% from 2010 to 2014. There are three major objectives that emerged from the study which the model addresses:

- Shortage of skilled professionals, managers and artisans, and the uneven quality of education
- The economy is concentrated in production of primary commodities of mining, iron and steel etc. There is a need for more value added services and development of knowledge workers through technology and innovation
- A need for small, medium and micro business sector to make a substantial impact in the economy

This research highlighted the leverage and potential of UOTs in delivering the skills necessary to accelerate the economy in terms of the growth targets. Key benchmarks and performance criteria were described in the model and they include the quality of interaction with people and environments in solving social problems. The criteria further provide a basis for differentiation of the HE sector. However, it became clear that a unitary HE system need not be a uniform system, but rather dependent on the type of mission and typology that is informed by the external environment.

10.3 SOCIETY AND COMMUNITY CONTEXT

Since a UoT is very much part of society it was important to study the context in which learning and teaching take place to obtain a clear sense of the forces that impact on UoTs. This analysis is important so that this sector can respond appropriately through strategic interventions, and position itself in contributing to the human capital development in the country.

Postmodernism defined how institutions relate to their environment and how they are positioned within society. The context and experiences of the social setting help in learning and finding solutions to world problems through reflection and critical thought. A UOT in a postmodern era will have to be dynamic and responsive to the needs of society. This requires critical and cutting edge research and an interdisciplinary approach to society's dynamic needs and problems.

The walls of the university and wider society must be broken down to fully fulfil its mandate. Further, this requires collapsing of the mental and physical barriers between Arts, Engineering, Commerce, Education, Medicine, and so forth. Staff are encouraged to work across their traditional borders (Thathiah, 2007: 757). For example to study and make recommendations for rural development in a targeted agricultural area might require the joint expertise of planners, health workers, water specialists, training specialists and others.

'It is only by subjecting practices to intense and scholarly scrutiny that universities of technology will be able to achieve excellence in their teaching and research missions' (Winberg 2005, 199). Moreover, she states that universities of technology 'have a responsibility to analyse, debate and deconstruct technology. Their mission should not only be to make a contribution to technological innovation, but to make a contribution to the ability of society to control and manage the development of technology' (Winberg 2005, 198).

The study addressed lack of a theoretical construct when UOTs were declared. The study profiled the type of students that are entering Higher Education and the didactic principles that would be appropriate to accelerate knowledge transfer and enhance learning and innovation. The nature of UoT-type education and training was investigated and was shown to be underpinned by application of knowledge through technology, partnerships and innovation. Much of the transfer of knowledge should be through assignments and projects that test not only knowledge but use of knowledge in a variety of contexts.

10.4 UOT MODEL

Arising from research local and overseas, the following characteristics of UoTs have emerged:

- A strong industry focus and partnerships
- Service to the community and community partnerships;
- UoTs are part of a unitary but differentiated higher education system with certain unique ways of achieving its teaching and research
- Programs must be relevant to the world of work and reviewed regularly to incorporate new knowledge
- Responsiveness to and fulfilment to the needs of industry, community and society
- Appointment of experts acknowledged by industry (not necessarily academics)
- Strong attention to niche areas
- Emphasis on scholarship, innovation and R and D to develop new technologies
- The acknowledgement that technology transfer forms the core of curriculum and research
- Preparation of a new generation of knowledge workers

From these characteristics four primary goals for UOTs were formulated:

- Impact on National, Industry and Community
- Applied Research and Innovation
- Entrepreneurship and Innovation
- Increased Graduates

These strategic goals arose from the study and formed the pillars of the model. These four goals were driven by 41 drivers or objectives. These are further defined in terms of 48 performance indicators. The UoT model is based on the balanced score card, which clarifies the relationships, and maps out the cause and effect linkages from a strategic level to an operational level and ultimately to a performance management system.

The drivers fall into four perspectives namely, customer value proposition, internal process, learning and growth, and financial. The research provided data to categorise these drivers into specific cause and effect relationships. These drivers are characterised by providing an output which can be measured in against a standard.

Research into the performance indicators show no substantial difference in the indicators between a UoT and a traditional university, but it is in "how" UoTs function that separates them from other traditional universities and this "how" is captured in the UoT model.

The strategic goals of a UoT are discussed separately to allow for ease of understanding, but all of the goals work as one system.

The research identified principles to act as a foundation to link theory and practice.

10.4.1 Underlying constructs and theory and its expression through Systems and Structures

The next major question that was answered in this research is the development of constructs and theories that underpin UoTs. Organizational learning is more than a metaphorical vision that resides in the minds of individuals. From an organic perspective, an organization can be compared to a learning system with distinctive characteristics that are able to meet the demands of its internal and external environments. As reinforced by Argyris (1993) and Senge's (1990) systemic approach, learning involves a variety of contexts and paradigms involving individuals, teams, processes, structures and strategies. What is important is the interactive dynamics of these contexts that influence organizational learning. System thinking is the unifying force that can adequately account for the complexity of these interactive dynamics in organizational learning. It is no wonder Senge places systems thinking as his fifth discipline because it integrates all activities that enhances learning into a learning organisation that may involve processes and people (Yeo, 2005).

The future of the learning organization is firmly established and well-accepted concepts in organizational sciences. They also favour, that instead of investigating the ideal learning organisation model, more energy should be spent on identifying the key drivers of learning in an organisation. The organizational structure may change without active planning as each individual's role within the organization evolves. As the organization gets closer to its goals, the more fluid the roles of hierarchy and power will flow and as such, the organizational structure will adapt to new challenges. In a learning education organisation for example, power becomes a non-issue as teachers empower themselves to create learning environments within their classrooms and within their disciplines. Structural change needs to be preceded by cultural change where teachers do not have restructuring imposed on them but pursue it together as staff relationships become more collaborative (Fullan, 1993; Newmann, 1996).

The study attempts to influence a shift in the behaviour of both the individuals and the performance of the organization (Kirkpatrick, 1994). Behaviour is a function of thoughts and values. Organizational learning is a process that demands restructuring and the first artificial walls exist in the minds of people need to be broken (Mitchell and Sackney, 2000). Researchers have focused on the processes that need restructuring and the mental models that need to change to foster the creation of a new state. Randeree (2006) posits that concepts need to be coupled with a changing structure to create space for a learning organisation. This means that the traditional top down structure needs to be reassessed to make the organization responsive to student needs. It therefore requires a dynamic structure that can adapt and change to facilitate learning from the environment.

Twenty first century education institutions cannot employ outdated methods and assumptions to cope with the exponential growth in knowledge, new technology and innovation. The learning organisation provides certain principles that help in designing new organisations.

The internal structure should be fluid with flexible teams, engaged in discovering new knowledge and systemising it through communities of practice and consequently developing a learning organisation. The teams should encourage personal mastery but always subscribing to a shared vision. All knowledge must be subject to review and reflection and systemised to facilitate communities of practice so that it can be applied in a practical situation by providing solutions to industry and society. The BSC model in chapter 8 is underpinned by the learning organisation and system thinking principles. Therefore it is able to find expression in application of research and knowledge, thereby finding solutions in industry and society. To ensure that UoTs carry out their national mandate they need clear roles and functions to meet their social and community mandates.

Recommendations:

- UoTs should adopt a learning organisation concept, which pursues knowledge and applies it for the greater good of society. It starts with embracing a shared vision through teamwork, partnerships and cooperation. This must be mentally mapped in the minds of employees and partners to drive stakeholders to develop competencies to achieve the shared vision. At all times realising that the organisation is a system, which is part of a bigger macro system.
- UoTs should create systems and structures to ensure that they form partnerships with communities and industry to facilitate knowledge transfer and acquisition of new knowledge.
- Each strategic goal should be mapped into a BSC model to identify the main drivers and the performance indicators required to realise the stated goals.
- Institutions need to create an organisational culture to underpin and support the concept of a UoT through continuous reviews and feedback to accept change and improve performance. A team and learning culture is needed with a rewards system to go with it.
- All staff and students should have a problem centred approach in defining problems and applying knowledge to provide solutions.

10.4.2 Knowledge Transfer

The study described knowledge as an organizational resource that can be created and applied. This gives an organisation tremendous strategic advantage. The more an organisation knows, the more it can learn and sustain competitive advantage (Kalkan, 2008: 392). The ability to acquire, integrate, store, share and apply knowledge becomes the most important capability for building and sustaining competitive advantages.

Learning occurs when understanding, insight and explanations are connected with action, which indicates that reflection over imposed actions is a prerequisite for conscious learning. In this type of learning, the individual changes his/her thinking and/or action in relation to the task to be performed (Argyris, 2003; Döös, 2007). The individual then learns to achieve things he or she was not able accomplish previously. Experiential learning can therefore be said to take place when an individual experiences new ways of doing things while undertaking certain actions. This theory underpins the way new knowledge is obtained and translated into applied knowledge through experiential learning and work integrated learning (Argyris, 1993, 2003).

Recommendations:

- All courses should have an experiential and/or service learning component included in their courses.
- UoTs need constant reflection and review of courses to ensure experiential training and new knowledge is continuously incorporated to make courses relevant to provide "just in time education". This requires close partnerships with professional bodies and formation of Liaison bodies made of industry and university specialists to ensure that courses are relevant and updated in terms of new knowledge and technology, and its application.
- Entrepreneurship should be included in all qualifications, either as a course or a module, to build the student's ability to create jobs and also identify opportunities to translate knowledge into a usable commodity that can be of commercial value.
- New knowledge must be integrated into the mainstream academia within six months of it being introduced and approved to fit into the 'just in time education".
- The drivers of new knowledge are the lecturers, researchers and specialists in the institution. The institution need to recruit, retain and develop its staff. Staff performance should be rewarded through promotions, recognition interventions when they pursue UoT related work and achieve key milestones. This would give impetus to a new organizational culture to support the changes towards a UoT.
- Information technology needs to be designed to be more widely used to share knowledge and to automate systems. IT systems need to provide real time feedback and report on performance objectives and targets.

10.4.3 Impact on National, Industry and Community

Why do universities exist? This question is important since this question was asked hundreds of years ago and the answer was different and depended on the society within which these were created.

If we accept that we are living in a postmodern society in which institutions of learning are part of a wider society, then it is incumbent on institutions to reflect this in their programs and research outputs. The data reveals that universities are formed to contribute to the economic development of a country, by training and developing its human capital, and advance the development of new knowledge. Within the UOT system, there are drivers that work together in achieving the strategic goals by maximising impact on a national, industry and community levels.

Figure 8.2 **(**in chapter 8) contextualises the impact of national, industry and community. To achieve this goal, the institution firstly requires skilled human capital, equipped with postgraduate qualifications. It requires transformational leadership and an organisational culture that allows for flexible structures and more team based learning. The institutions need technology and information systems to accelerate learning and sharing of information. These are termed learning and growth perspectives. The organisational skills and human capital are deployed into the internal processes of the institution to transform this into customer value. The first step in enhancing impact is to put in place human and financial resources. The model then identifies for four systems that are driven by human capital to produce customer value i.e. Cooperative industry partnerships, community engagement systems and international and national partnerships.

Recommendation

To create customer value in terms of impact on national, industry and community levels, the following systems drivers need to be installed.

- Cooperation agreements with government, industry and community partnership,
- Increased applied research
- Technology focused programs
- Increased graduation rate.

Each perspective has a set of drivers and performance measures that represent the level of outcomes that are expected. This accumulatively impacts on national, industry and community levels. This is mapped out in the model in figure 8.3.

10.4.4 Increased Graduation Output

UoTs have approximately 125 000 students enrolled at their institutions. Also there are a large percentage of its students who come from the previously disadvantaged sectors. Fifty percent of UoT students are enrolled in Science, Engineering and Technology, according to DOE.

One of the benchmarks set by the DOE and which initially emerged from the Size and Shape document and NPHE, was the requirement that universities improve their access and success of students. The model provides for alternative access systems and support programs through foundation course, RPL, articulation agreements with FETs, expanded degrees. The model ensures programs are subject to regular reviews in creating mechanism to incorporate input from industry, professional bodies, and community engagements. These systems are clearly described in terms of performance indicators to ensure students are engaged in technologically focussed programs and work integrated learning, resulting in improved graduation and employability. To produce these outputs UoTs require skilled postgraduate staff to integrate new teaching methodologies in technology and innovation. Faculties need to liaise with industry through Advisory Boards to produce graduates that are employable in the world of work.

As a university, the institution is required to produce postgraduates. However, as a former technikon its core qualifications were diplomas and as a result teaching staff were recruited from industry. Many had only an undergraduate qualification. To meet the DOE benchmark for a university, sixty percent of staff must have masters and forty percent must have a doctorate by 2012.

Recommendations

- To improve access and success all UoTs need to have access type of interventions for example foundation courses, RPL processes, articulation agreements with FET institutions, expanded degrees. These interventions will widen participation of youth and also provide alternative entry into higher education for those who may have not met the normal requirements to enter university.

- All programs should contain an experiential component to allow students to apply knowledge in the workplace. This will require fully functioning Liaison committees and close cooperation with the relevant professional bodies.
- All staff to have a minimum qualification of masters with 40% with doctorates. To reach this target, the institution requires funding and postgraduate development and training to support staff in their study endeavours. These need to be in place in 2009 for it to deliver in 2012.
- The human capital requirements, organisational culture and technology have already been recommended in chapter 8. These underpin all organisation processes

10.4.5 Applied Research

In figure 8.4 in chapter 8 the model maps out the strategy for applied research and innovation. Engaging in applied research for UoTs means participating in research that can be applied in solving real world problems. This could either be in industry, society or community. The DOE has set a benchmark of 0.5 research output per academic staff member for UoTs.

Firstly, all research requires a critical mass of skilled researchers and post graduate staff to create and drive key processes necessary in a UoT. The model calls for targeted recruitment and development of skilled staff to develop the requisite skills. UoTs need to develop the research capacity at these institutions through the provision of courses in proposal writing, statistics, and research methodology. Infra structure development is a top priority to support research.

Key processes need to be in place. The institution requires firstly to identify the vehicles to give effect to applied research. They are technology transfer initiatives, incubators, SMMEs, technology stations, IP, patents, prototypes etc.

Recommendations

- Recruitment, retention and development of skilled researchers to improve research output
- The provision of research developmental courses to build research capacity in publications and other outputs
- Create processes to develop technology transfer initiatives as research outputs for example IP, patents, prototypes, SMMEs, incubators.

- Research to comply with the essential characteristics of a UoT. Research should be of an applied nature, it should be multidisciplinary for it to fulfill its problem solving capabilities.
- Form partnerships with national and international organizations to enrich its output to enable its research to be applied in real life situations.
- Increased expenditure on infrastructure and technology to support research.
- Market the institution to industry as a place where research is applied and partnerships can be formed.
- Provide basic infrastructure to support incubators, SMME development, laboratories, conference venues to attract projects and conferences.
- Provide basic facilities to attract community engagement projects e.g. prefab huts, basic training in management etc. These relationships can be used to provide service learning or joint research with community organizations.

10.4.6 Entrepreneurship and Innovation

As stated earlier, UOTs have a distinctive mandate in translating knowledge into finding solutions for real world problems whether in society or in the world of work. However, training students only for a job is wasted since the acceleration of knowledge and the fast pace of change in technology and the external environment will soon result in jobs being changed significantly to reflect new realities. This could lead to unemployment. Therefore, it is incumbent on universities of technology to train students to learn to solve problems by acquiring and generating new knowledge and translating them into a commercial commodity to generate income. Research generated should foster a spirit of entrepreneurship in staff and students, so that they can create jobs in society.

The strategic maps in figure 8.5 indicate the synergies and relationships. The recommendations are the same as for the other goals discussed above.

Recommendations

- As in the other strategic goals, the main driver to produce entrepreneurship and innovation is the intellectual capacity that drives processes. The performance outcomes or measures for entrepreneurship and innovation are indicated in the model. These skills need to be recruited and retained.

- The processes required to produce these performance outcomes are the establishment of systems to produce IP outputs (patents, prototypes, artefacts, and designs), SMMEs support, and integration of entrepreneurship into the program. The commercialisation of knowledge application through product development etc can be an important source of 3rd income.
- These processes are so designed so that students learn to become job creators and not employees only. Each of these in the model has their respective performance measures which regulates how that sub system works and what outputs are expected.
- All programs should contain entrepreneurship as a component or module in their studies. Also entrepreneurship should include business projects as part of their outcomes.

10.5 APPLYING THE MODEL

In chapter 7 the performance indicators were tested at DUT. The performance indicators were workshopped in four focus groups. A significant proportion of the indicators were found to be acceptable and used in the performance plans of the participants.

In chapter 9 the full model was applied to the DUT to test its compliance by using the balanced score card. The model identified areas for transformation and produced plans and standards for implementation to meet the requirements for a UoT.

10.6 MISSION OF UOTS

In the postmodern world, knowledge is power that has been translated into commercial products and services. This has resulted in huge empires from global conglomerates to SMMEs being formed to capitalise on the quest for unique products that can exploit knowledge through technology and innovation. Competition in the market place has spawned an industry driven by inventions and huge investment in research and training to develop products and services based on changing environmental and customer needs.

This investigation reveals universities are no more the sole creators and generators of knowledge. However, universities have expertise in the dissemination of knowledge, which places them in a unique position in knowledge sharing and knowledge management. It is in this area that UoTs have made an impact, more especially since they were formerly Technikons, where students were trained to be employed by industry. However, Technikons were meant to train students for a job, and was never intended to be creators of new knowledge. Their teaching staff were employed for their industrial experience rather for their academic and research expertise. UoTs are now expected to be creators of new knowledge and to apply this knowledge. This requires a cadre of skilled researchers with postgraduate experience. Application of knowledge in a UoT context requires the use of innovation and technology through partnerships while using a multidisciplinary approach. This ensures a holistic approach to problem solving and avoids the silo approach that has resulted in poor coordination and implementation of knowledge. To operationalise a problem solving approach also requires flexible structures. These structures should now be constructed around themes or key result areas or objectives that characterise a UoT. The operationalisation should cascade from a strategic level to a faculty, department and ultimately at a program level. Programs are reviewed regularly to incorporate technology and new knowledge. Performance reviews are held to monitor and track agreed targets.

Recommendations

- The new mission should include the creation and application of knowledge to contribute to sustainable economic development through innovation and technology. Sustainable refers to the responsible use of natural resources and the preservation of the environment and sensitive to the communities and society's concerns.
- Structures should not be rigid but be dependent on the strategy. It should be flexible to deliver on the objectives that characterise the advancement of society through knowledge production and application. After the structure has delivered on its mandate the structure can be reconfigured or dismantled.

10.7 SUMMARY OF CONCLUSION

The study suggests that universities are very much part of society and community. In terms of Senge's systems thinking, universities form part of the larger macro system. It therefore means that whatever they do must aim to impact on the development of greater society. In South Africa, HE has been through various form of restructuring. It addressed issues of funding, access and other political considerations, and considered the roles and function of the different types of Higher Education institutions in South Africa. This study highlighted the unitary but differentiated aspects of the higher education system. Three types of universities were declared, namely traditional universities, UoTs and comprehensive universities. This study focussed on the development of UoTs. It produced a set of strategic objectives, characteristics and performance indicators that in many ways distinguished it from the other two types of universities. However it became clear that the UoTs were different not in “what” they produce but in “how” they go about producing research and graduates. It is in the methodology that UoTs find their niche area.

Key distinguishing factors are that students are taught to apply knowledge through experiential learning. Partnerships with industry are a vital component of training. UoTs provide a variety of access points into higher education, which increases participation of society at large, as opposed to a narrower admissions policy of traditional universities. UoTs form networks and partnerships with communities and international linkages.

From the interviews and study of overseas institutions it was found that UoTs engage in applied research, in which problems are identified and knowledge is acquired and applied to find solutions. Technology is a tool to find innovative solutions. Knowledge generation and acquisition is a continuous process in ensuring that the institution is providing relevant education for the world of work. Research ensures that new knowledge is generated and incorporated into the curriculum. Technology transfer projects are vehicles to produce patents, technology stations, new products, product development.

UoTs seek to inculcate an entrepreneurship spirit in its programs, students and employees. Commercialisation of knowledge is a key function. It also contributes to 3rd stream income to the university.

The impact on national, industry and societal levels are dependent on the number of graduates and applied research emerging from UoTs. The expertise through technology, innovation and entrepreneurship accelerates economic growth and development. The UoT model is mapped in terms of the balanced score card, which clarifies the relationships and illustrates the cause and effect linkages. This model identifies perspectives which are the key drivers from a strategic level to an operational level. It provides a roadmap in coordinating the processes, resources that produce customer value. Each process and perspective is defined by performance objectives (milestones) to ensure that standards and expectations are met from the strategic level to the program level.

This balanced score card format is so designed so that UoTs can be formed and built by using this model. In order to achieve the strategic goals, UoTs require the human and intellectual capital. This is the main driver and is categorised as learning and growth. Since universities are in the knowledge business and are training knowledge workers, recruiting, development and retention of skills are vital initial strategies to drive internal processes and systems. The customer value perspective ultimately contributes to the achievement of strategic goals. The research produced very specific performance outcomes for these BSC perspectives and processes to ensure that a clear cause and effect relationship exists to reach the strategic goals. This template can be applied to universities or former technikons aspiring to change to a UoT typology.

10.8 RECOMMENDATIONS FOR FURTHER RESEARCH

This research investigated the underlying concepts and philosophy underpinning the development of UoTs. It further studied the strategic goals and the drivers that provide milestones in the path to reach these goals. The study produced many cause and effect relationships. However some of these relationships need to be further tested for its applicability to other Higher Education institutions. The full application of the model needs to be implemented to further fine tune this tool in practice.

While there has been extensive work in developing the model, the implementation of this in an organisation is very dependent on the prevailing organisational culture and the leadership styles within the institution. More research is required in determining an appropriate and conducive culture to facilitate the implementation of this model.

UoTs are dependent on a very special type of knowledge workers especially in the teaching and research areas. However given the unique outputs that these institutions are expected to produce, further studies are required to establish the type of competencies and skills that will distinguish this type of institution and whether it will meet the wider national priorities.

A more detailed study needs to be undertaken to determine whether the performance indicators selected correlate with actual performance and whether the performance indicators have a relationship with the strategic goals of the university.

Another possible area is to examine how far UoTs are delivering what is expected of them by the South African state. Initiatives such as ASGISA and JIPSA have implications for UoTs which could usefully be studied further.

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