THE PHD STUDY

An Evidence-based Study on how to meet the Demands for High-level Skills in an Emerging Economy

ASSAf
ACADEMY OF SCIENCE OF SOUTH AFRICA

CONSENSUS REPORT

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List of Acronyms

AERC	African Economic Research Consortium
AgriSETA	Agricultural Sector Education Training Authority
ARC	Agricultural Research Council
ASSAf	Academy of Science of South Africa
CEO	Chief Executive Officer
CHE	Council on Higher Education
CIRGE	Center for Innovation and Research in Graduate Education
CoE	Centre of Excellence
COSATU	Congress of South African Trade Unions
CPP	Collaborative PhD Programme
CPUT	Cape Peninsula University of Technology
CRC	Cooperative Research Centre
CREST	Centre for Research on Science and Technology
CSIR	Council for Scientific and Industrial Research
CUT	Central University of Technology, Free State
D	Doctoral
DHET	Department of Higher Education and Training
DST	Department of Science and Technology
DUT	Durban University of Technology
EHEA	European Higher Education Area
EU	European Union
EUA	European University Association
GCALL	Graduate Certificate in Advanced Learning and Leadership
HEI	Higher Education Institution
HEMIS	Higher Education Management Information System
HEQC	Higher Education Quality Committee
HEQF	Higher Education Qualifications Framework
HESA	Higher Education South Africa
HSRC	Human Sciences Research Council
ICCT	Information computer and communication technologies
IGERT	Integrative Graduate Research and Training Programme
M	Masters
MRC	Medical Research Council
NECSA	South African Nuclear Energy Corporation
NGO	Non-governmental organisation
NLRD	National Learners' Records Database
NMMU	Nelson Mandela Metropolitan University
NRF	National Research Foundation
NSF	National Science Foundation
NSTF	National Science and Technology Forum
NWU	North-West University
OECD	Organisation for Economic Co-operation and Development
PAS	Permanent academic staff

PG	Postgraduate
R&D	Research and development
RU	Rhodes University
SADC	Southern African Development Community
SAQA	South African Qualifications Authority
SARChI	South African Research Chairs Initiative
SET	Science, engineering and technology
SETA	Sector Education Training Authority
SU	Stellenbosch University
THRIP	Technology and Human Resources for Industry Programme
TUT	Tshwane University of Technology
UCT	University of Cape Town
UFH	University of Fort Hare
UFS	University of the Free State
UJ	University of Johannesburg
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UL	University of Limpopo
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNISA	University of South Africa
UNIVEN	University of Venda
UP	University of Pretoria
USA	United States of America
UWC	University of the Western Cape
UZ	University of Zululand
VUT	Vaal University of Technology
Wits	University of the Witwatersrand
WSU	Walter Sisulu University

Foreword

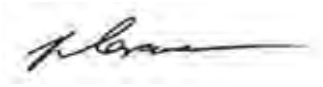
The Academy of Science for South Africa (ASSAf) has as specific mandate the provision of evidence-based advice to government on matters of crucial scientific questions; evidence-based study project activities thus form the core of the Academy's function and are a key area of future development. This is the eleventh report of studies of this nature which the Academy has commissioned.

As an independent body that holds the membership of many of the most prominent scientists in the country, the Academy is well-placed to address questions of science capacity within the national system of innovation and is fortunate to be able to draw on a pool of committed expertise across disciplines and across universities and other science-based organisations. Access to this resource proved invaluable in the production of this Report.

This is the first really comprehensive report on PhD training in South Africa, covering all the aspects that may influence such training in the country. The diverse nature of the research questions led to a broad research approach – several interlinked studies were carried out to gather and collate both quantitative and qualitative data for the PhD Study Report. The Report provides invaluable detail about the challenges and opportunities of South African postgraduate education.

The Report should be used as a guideline for policy-makers to do something concrete to improve the quantity and quality of PhD students in the country. Although specifically focused on South Africa, the Report's collation and analysis of international practice as well as South African conditions could constitute a substantial resource for other countries on the African continent seeking to strengthen their PhD programmes.

The Report was developed and guided to its successful conclusion by a Study Panel of experts, under the able leadership of Professor Jonathan Jansen. The members of the Study Panel and the authors of the various constituent study reports are thanked for the care and attention with which they carried out their task.



Professor Robin Crewe
President: Academy of Science of South Africa (ASSAf)

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This Study was a collaborative endeavour involving many people from start to finish. Although not an exhaustive list, we wish to thank the following people and organisations for their participation in one way or another to ensure the success of the Study.

- The Council of ASSAf for their foresight in commissioning this evidence-based study and their ongoing support during the entire process.
- The NRF for their financial support of the project.
- The nine members of the Study Panel for their diligent commitment to ensuring the success of the project. Particular thanks to Professors Kay Harman and Maresi Nerad for their additional contributions in the form of commissioned papers which provided a much-needed international perspective to the Study.
- Professors Johann Mouton and Chaya Herman who so competently led the research teams that conducted the series of studies which form the basis of this Report.
- All the participants (current doctoral students and graduates as well as the educators of South Africa) without whose generosity and time the Study would not have been possible.
- The peer reviewers who made well-founded and valuable suggestions regarding the improvement of the draft of the Report.
- Lise Kriel and Cheryl Lombard for their assistance with the collation and compilation of the Report.
- Professor Grant Harman for his additional and valuable inputs into the Study.
- The editor, Dr Andrew Graham, ASSAf staff and Boldesign for the production of the Report.
- And finally, to the support staff, Ms Zuki Mpiyakhe (study director), Dr Nthabiseng Taole and Professor Roseanne Diab for their contribution and assistance throughout the project.

Professor Jonathan Jansen
Chair: ASSAf PhD Consensus Study



Biographies of Study Panel Members

Ahmed Bawa

Ahmed Bawa is a faculty member of the Department of Physics and Astronomy at Hunter College and of the Graduate Centre of the City University of New York. He also serves as Associate Provost at Hunter College. He is a Distinguished Lecturer. Until recently he served as Deputy Vice-Chancellor at the University of Natal and then at the University of KwaZulu-Natal. Between 2002 and 2004 he was Programme Officer for Higher Education with the Ford Foundation. His work focused mainly on grant-making to support the development of systems and institutions. He holds a PhD in theoretical physics from the University of Durham. Most of his work was in the area of theoretical elementary particle physics and he now works in quantum information theory. In the post-1994 period he served on a number of South African policy development teams. He was an inaugural member of the National Advisory Council on Innovation and is a Fellow of the Royal Society of South Africa and of the Academy of Science of South Africa.

Sakhela Buhlungu

Sakhela Buhlungu joined the University of Johannesburg's Sociology Department as a Professor in July 2008. Prior to that he worked at the University of the Witwatersrand for nearly 15 years and in his final years at that institution was a Professor of Sociology, serving briefly as Head of the Sociology Department and Co-director of the Sociology of Work Unit, which he had joined in 1994. He worked in the unions and in labour-supporting organisations until 1994. His main research interests are in the area of labour studies and the sociology of work, areas of expertise that he has developed since his time as a union activist in the 1980s and early 1990s. He has published widely in these areas in local and international academic and popular journals, books, magazines and newspapers. A theme that runs through his work is an examination of the centrality of the labour movement in the democratic transition, as well as an exploration of the ways in which unions have, in turn, been impacted upon by the transition. This was examined in his PhD thesis as well as in numerous journal articles. The most comprehensive and up-to-date examination of this theme is to be found in his recent book, *A Paradox of Victory: COSATU and the democratic transformation of South Africa, 1973 – 2006*. He recently edited a book examining the political attitudes of COSATU workers based on a longitudinal study conducted over a fifteen-year period. The book, T*rade Unions and Democracy: COSATU workers' political attitudes in South Africa*, makes a major contribution to the understanding of trade unions during democratic transitions. He also served as a Co-editor of the influential *State of the Nation* published by the HSRC Press. He serves on the editorial boards of a number of academic journals and until 2001 was on the editorial board of the *South African Labour Bulletin*. Until recently he was a member of the governing Board of the National Labour, Economic and Development Institute.

Kay Harman

After an academic career spanning over 20 years, Kay Harman now exercises two roles at the University of New England in Australia. She has a professorial appointment as Dean of Graduate Studies with responsibility for all higher degree research training and management at doctoral and research masters levels. Her research role lies within the School of Business, Economics and Public Policy where she is a member of the research group, the Centre for Higher Education Management and Policy (CHEMP). As part of this role, she is the National Coordinator of the Australian Network for Higher Education Policy Research. Her main research interests and publications focus on higher education and research policy, research training and research culture, academic culture and work, mergers in higher education and university-industry links. She has substantial teaching responsibilities at the masters level both within Australia and offshore (particularly in Hong Kong and Vietnam), having supervised over 40 doctoral and research masters students to successful completion. Her supervision and teaching are dedicated to helping students produce high-quality research and learning outcomes; her consultancy work has been mainly overseas and includes being the Research Evaluation Specialist on the 2005-2006 World Bank-sponsored Second Higher Education Project (Preparation) in Vietnam; working on mergers of higher education for the South African University Vice-Chancellors' Association; and contributing to restructuring and planning efforts in higher education in Thailand and Papua New Guinea.

Jonathan Jansen

Jonathan David Jansen is Rector and Vice-Chancellor at the University of the Free State. He is a recent Fulbright Scholar to Stanford University (2007-2008) and former Dean of Education at the University of Pretoria (2001-2007); he was made an Honorary Doctor of Education by the University of Edinburgh. He is a former high school biology teacher and achieved his undergraduate education at UWC (BSc), his teaching credentials at UNISA (HEd, BEd) and his postgraduate education in the USA (MS, Cornell; PhD, Stanford). He serves as Vice-President of the South African Academy of Science and from this vantage point currently leads three major studies on behalf of the Academy, including an inquiry into the role of the South African PhD in the global knowledge economy and an investigation into the future of the humanities in South Africa. He recently served on the Boards of bodies such as the Centre for the Study of the Internationalisation of Curriculum Studies (University of British Columbia); the International Commission on the Child (Washington DC, USA); and is a member of the General Assembly of the International Association for the Advancement of Curriculum among others. Jansen has chaired Ministerial Committees on Further Education and Training (appointed by former Education Minister Asmal) and, currently, School Evaluation and Teacher Appraisal (appointed by former Education Minister Pandor). In addition, he has advised provincial governments on school change. He has extensive experience in higher education as Professor, Head of Department, Dean, (acting) Deputy Vice-Chancellor and, at two South African universities he has worked as Senate Representative on the Council (UDW and UP). He has chaired committees at all levels of the university, and conducts extensive training for deans and for young scholars. His most recent books are *Knowledge in the Blood* (2009, Stanford University Press) and (as co-author) *Diversity High: Class, Color, Character and Culture in a South African High School* (2008, University Press of America). In these and related works he examines how education leaders balance the dual imperatives of reparation and reconciliation in their leadership practice.

Johann Mouton

Johann Mouton is Director of the Centre for Research on Science and Technology and the African Doctoral Academy at the University of Stellenbosch. He received his doctorate in philosophy at the Rand Afrikaans University in 1983. His career includes teaching at the Rand Afrikaans University, working at the HSRC in various positions between 1983 and 1994 and subsequently as Professor of Sociology at Stellenbosch University. He is the author of seven books on research methodology, including *Understanding Social Research* (1996), *The Practice of Social Research* (2002, with E. Babbie) and *How to Succeed in Your Masters and Doctoral Studies* (2001). He is Programme Director for the masters and doctoral programmes in Social Science Methods, in Science and Technology Studies and for the postgraduate diploma in Monitoring and Evaluation Methods at Stellenbosch University. He is on the editorial board of five international journals including the *International Journal of Research Methodology*, *Science and Public Policy* and *Minerva*. He has published more than 50 articles in peer-reviewed journals, written more than 60 research and evaluation reports and presented more than 100 papers at national and international conferences. He has received two awards from the *Akademie vir Wetenskap en Kuns* in South Africa, including one for his contribution to interdisciplinarity in the social sciences in South Africa. His main research interests are science policy, higher education knowledge production, philosophy and methodology of social research and monitoring and evaluation studies.

Maresi Nerad

Maresi Nerad is the founding Director of the national Center for Innovation and Research in Graduate Education (CIRGE), the first centre for studies on graduate education in the USA and worldwide, and Associate Professor of Higher Education in the Educational Leadership and Policy Studies Programme College of Education at the University of Washington, Seattle. Nerad received her doctorate in higher education from the University of California-Berkeley in 1988. From 1988 until 2000, she directed research in the Graduate Division at the University of California-Berkeley and spent the 2001 as Dean in Residence at the Council of Graduate Schools, in Washington, DC. In 2001 she joined the University of Washington in Seattle and opened CIRGE in 2002. She served as Associate Dean of the Graduate School at the University of Washington from 2003 to 2009. In 2005 she received the Mie-

gunyah Fellowship and spent three months at the University of Melbourne, Australia. She is the author or editor of four books on higher education: *Towards a Global PhD? Changes in Doctoral Education Worldwide* (2008,) *The Academic Kitchen: a Social History of Gender Stratification at the University of California* (1999), *Graduate Education in the United States* (1997), and *Feministische Wissenschaft und Frauenstudium. (Feminist Research and Women's Studies in the U.S.)* (1982).

Priscilla Reddy

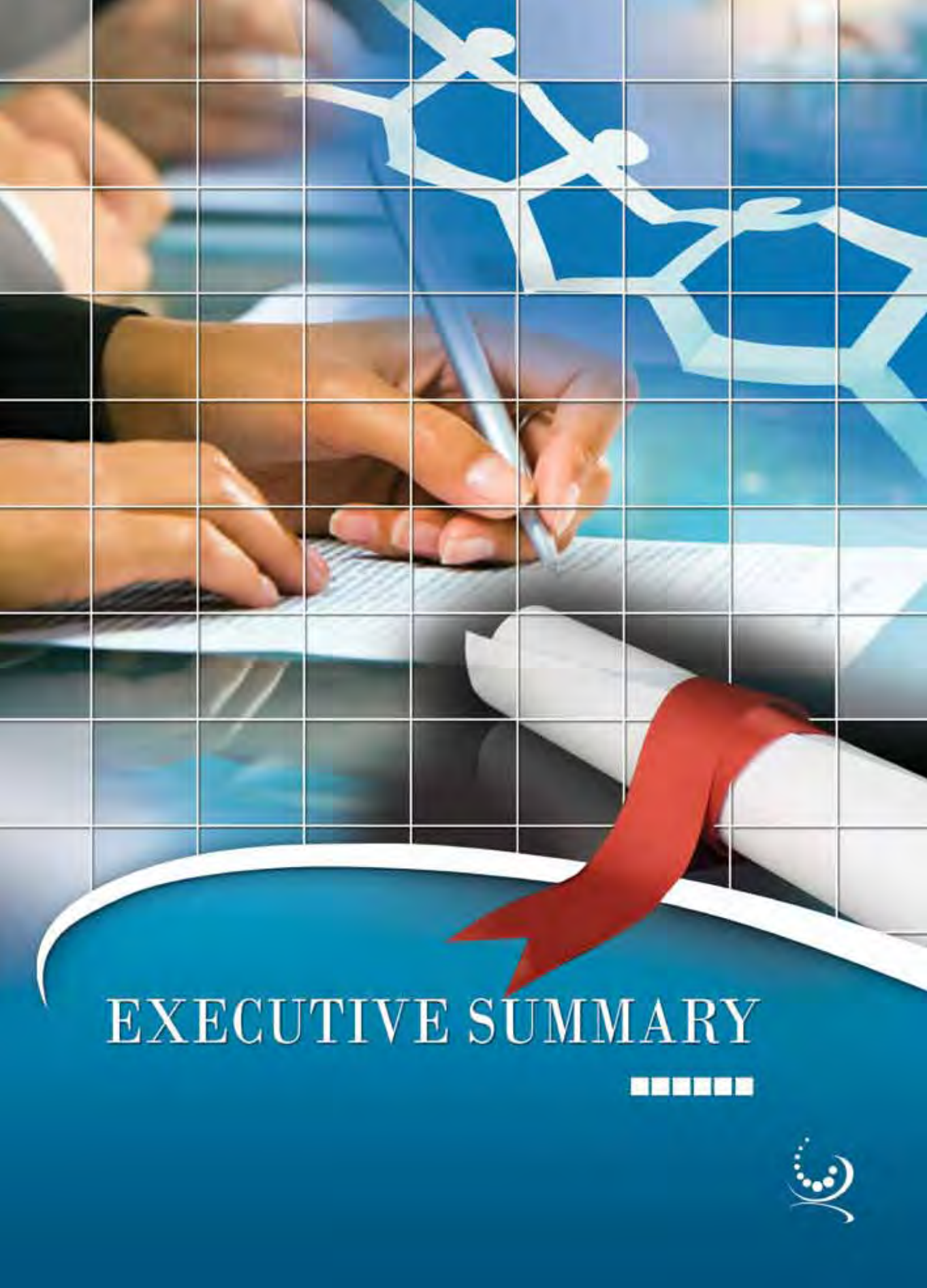
Priscilla Reddy is Professor and Director of the Health Promotion Research and Development Group at the Medical Research Council. She received a leading award from the National Science and Technology Forum for her national role in research capacity building among young black scholars. Reddy, MPH, PhD, is Director of the Health Promotion Research and Development Group at the Medical Research Council of South Africa. She is a leading expert on the behavioural science of HIV, AIDS, and STDs. She is also Visiting Associate Professor in the Department of Behavioral Science and Health Promotion at the Rollins School of Public Health at Emory University. She is a Member of the Academy of Science of South Africa.

Michael Samuel

Michael Samuel is the Dean at the Faculty of Education, University of KwaZulu-Natal. His doctoral work "Words, Lives and Music: On becoming a teacher of English" focuses on teacher identity studies, documenting the life-histories of student teachers as they become teachers of English within a multilingual context. His international research projects include the Department for International Development (UK) multi-site teacher education research (MUSTER) project, involving Ghana, Malawi, Lesotho, Trinidad and Tobago, and South Africa (1998-2003), and a project focusing on who sits at the margins of schooling in India and South Africa (2002). He was part of the Ministerial Committee on Teacher Education responsible for the development of a National Policy Framework for Teacher Education 2006). His recent book *Lifehistory Research: Epistemology, Methodology and Representation* (2009) documents his own writings and the work of postgraduate students involved in lifehistory research as a methodology for exploring how teachers and other developing professionals understand and experience their curriculum at school level and within the higher education system. He serves on numerous national educational advisory bodies and editorial boards. He is also the present Chair of the Higher Education South Africa Education Deans' Forum. He has published in national and international journals including the *International Journal of Education and Development* and the *International Journal of Educational Research*.

Dwight Triegaardt

Dwight Triegaardt has been in the position of AFRICON General Manager of the South African regions since 1997, but has announced his retirement in 2008. As a Physical Chemist (kinetics and spectroscopy), he has been an academic and research scientist for most of his working life. He has been attached to universities and technikons in the USA, Cape Town and Johannesburg. He has supervised numerous masters and doctoral degrees and is the author of several articles in highly refereed international journals. Some of his industrial related scientific projects included investigations into water pollution, skin lighteners and sun blocks. Projects also included the deliberate contamination of wines and forensic studies relating to the presence of heavy metals in human hair, nails and teeth. More recently, Triegaardt has been involved in science education, particularly the retraining of science and mathematics teachers, where he has for five years been the Executive Director of the Science Education Project. Triegaardt has been a Manager for more than 13 years, responsible for budgets in excess of R15m/year in organisations with more than 100 staff. He has considerable experience in conflict resolution, proposal writing, strategic planning and various commissions of enquiry. Triegaardt will remain active in the organisation as shareholder and member of the Aurecon Board. He will continue to offer valuable strategic input to the CEO's office and provide assistance in developing and nurturing client relations in all South African regions.



EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Executive summary

There is a broad consensus in the science community in South Africa that not enough high-quality PhDs are being produced in relation to the developmental needs of the country. The Council of the Academy of Science of South Africa (ASSAf) constituted a Study Panel of experts to generate evidence-based advice on the status of the South African PhD and what concretely needs to be done to escalate the numbers and quality of doctoral graduates to meet the high-level skill demands in this emerging economy.

This Study combines urate quantitative and qualitative data on doctoral students, doctoral training programmes, doctorate-producing institutions, and employers who hire doctoral graduates. These varied but integrated sources of data are used to give an account on the status of the PhD in South Africa and specific recommendations of what needs to be done to scale up the numbers of doctoral graduates produced in the country.

Approach

Two research teams were commissioned to conduct a series of studies and compile interconnected data sets that would enable the Study Panel to provide the evidentiary basis for making firm claims about the status of the South African doctorate and the capacity of the science system to scale up production of high-quality graduates. Professor Johann Mouton led one set of largely quantitative studies with his colleagues at the Centre for Research on Science and Technology (CREST) at the University of Stellenbosch, while Dr Chaya Herman led another set of largely qualitative studies with her colleagues at the University of Pretoria. These segmental studies that together comprised the data for this Report were the following:

1. statistical profiles of doctoral students in South Africa;
2. destination studies of doctoral students across fields and institutions;
3. employer surveys of doctoral graduates across sectors;
4. attrition studies that explain why doctoral students drop out of the system;
5. analyses of system blockages i.e. the structural, legal and organisational barriers to increasing the number of doctoral students and graduates in South Africa;
6. student experience surveys that document how doctoral students experience the PhD process;
7. case studies of exemplary doctoral training programmes that offer lessons for the escalation of doctoral output in South Africa;
8. capacity to train studies which examine the roles of various agencies in training doctoral students;
9. capacity to fund studies which describe the current and possible future models of funding doctoral students;
10. policy analyses on the purposes of the doctorate in South Africa's education and training system.

Key questions

This body of work represents a groundbreaking advancement in our knowledge of doctoral education in South Africa. The research conducted addressed a number of key questions:

1. How many doctorates does South Africa produce?
2. Who are the doctoral graduates by demographic characteristics?
3. In what fields are doctorates being produced?
4. Which institutions are producing the doctorates?
5. What is the capacity for doctoral supervision?
6. What are the conversion rates from masters to doctoral degrees?
7. What is the time-to-degree for doctoral students?
8. Why do students drop out of doctoral programmes?
9. How do doctoral students experience doctoral education?
10. What do employers expect from PhDs?
11. Where do doctoral graduates go?
12. What are the features of highly productive PhD programmes?

13. What are the systemic barriers to increasing the productivity of PhD programmes?
14. What can we learn from other countries with respect to escalating the production of PhDs?
15. How much do we know about doctoral education in South Africa?

Main findings

In addressing these questions, the following emerged as the main findings:

Finding 1: South Africa produced 1 274 doctoral graduates in 2007 (or 26 doctorates per million of the country's total population).

Finding 2: Most of the doctoral graduate class of 2007 were white South African men in their 30s.

Finding 3: Significant improvements observed in terms of racial representation among doctoral graduates may be offset by similar increases in the number of non-South African graduates.

Finding 4: The vast majority of doctoral graduates are 30 years of age or older.

Finding 5: Most doctoral graduates are produced in the social sciences, with the headcount figure for these graduates being almost five times that for engineering sciences, materials and technologies.

Finding 6: Education, economic and management sciences, and religion produce the largest share of all doctoral graduates.

Finding 7: In 2007, 80% of all graduates were produced by Universities (as opposed to Universities of Technology and Comprehensive Universities).

Finding 8: The top nine South African public higher education institutions in terms of PhD production were responsible for 83% of the doctoral graduates in 2007.

Finding 9: Half of doctoral students select a particular PhD programme or institution based on the research focus of a department or programme.

Finding 10: About a third of all permanent academic staff members at public higher education institutions in South Africa holds a doctoral qualification.

Finding 11: The average ratio of doctoral students to supervisors in 2007 was about 2:1 across all South African higher education institutions.

Finding 12: It is evident that the traditional apprenticeship model may not be an efficient approach for the purpose of rapidly increasing the production of doctoral graduates in South Africa.

Finding 13: Major blockages along the educational route towards the doctorate severely limit the pool of potential PhD graduates.

Finding 14: From 2000 to 2006, the average conversion rate from masters to doctoral degrees is estimated to have been 37%.

Finding 15: The average time-to-degree completion for doctoral students was 4.8 years in 2007, up from 4.6 years in 2000.

Finding 16: Risk factors for non-completion (attrition) of doctoral candidates in South Africa are reported as:
(i) the age of the student at time of enrolment, coupled with professional and family commitments;
(ii) inadequate socialisation experiences;
(iii) poor student-supervisor relationships;
(iv) insufficient funding.

Finding 17: There seems to be a balance between those students who portray their experience of doctoral education as positive and those who portray it as negative.

Finding 18: Employers note as the salient weaknesses in the skills and abilities of doctoral graduates from public higher education institutions in South Africa, a lack of
(i) exposure to international expertise, theories and debates;
(ii) methodological competence; and
(iii) 'real world' relevance.

Finding 19: More than half of doctoral graduates in

South Africa are employed in the higher education sector.

Finding 20: A third of non-South African doctoral students studying in South Africa intends to stay in the country after graduation, while a relatively small number of South African-born graduates migrate to other countries.

Finding 21: The most salient feature of a productive doctoral programme in South Africa is the level and diversity of funding.

Finding 22: The primary barriers to increasing the productivity of PhD programmes at South African higher education institutions are
(i) financial constraints;
(ii) the quality of incoming students and blockages in the graduate and post-graduate pipeline;
(iii) limited supervisory capacity; and
(iv) certain government rules and procedures.

Finding 23: Other countries have attained success with respect to escalating the production of doctoral graduates through six ' promising practices'. These include:
(v) developing a strategic increase in postgraduate education that addresses multiple needs;
(vi) embracing 'brain circulation';
(vii) differentiating the higher education system;
(viii) ensuring international exposure for doctoral students through national initiatives;
(ix) building cooperation and collaboration in doctoral training across different types of organistions;
(x) introducing graduate or research schools to coordinate postgraduate training.

Finding 24: More research is required to develop a comprehensive understanding of the dynamics of doctoral education in South Africa.

Recommendations

After due consideration of the findings of the Consensus Study on the status and place of the South African doctorate in a global knowledge economy, the following recommendations are made with regard to the ten key actions to escalate the production of high-quality doctoral graduates in South African public higher education institutions:

1. Escalate the numbers of doctoral graduates through external intervention programmes, for which there is successful precedent in recent South African history. (This refers to PhD education of South Africans at institutions in other countries where there is strong capacity to provide high-quality PhD education.)

2. Expand significantly the levels of funding for doctoral studies in South Africa, with a particular focus on shifting the balance of students towards full-time study.

3. Create an overarching and interconnected national planning strategy for dealing with high-level skills production, such as the doctorate, so that all parts of the system work in the same direction.

4. Address the pipeline issues as a matter of urgency, for in the long term it will not be possible to sustain high levels of doctoral entrants into advanced training without a sharp increase in the numbers of students coming into undergraduate education, early postgraduate education, and eventually into PhD programmes. In this regard the following recommendations for immediate action are put forward:

   a. strengthen the quality of the school system at its foundations, ensuring that literate and numerate students with greater confidence in their own learning proceed to high school;
   b. increase sharply the number of high-school matriculants with high-quality university-entrance passes, especially in science and mathematics;
   c. build on existing awareness among high-school graduates about careers requiring doctoral qualifications for the highest levels of perfomance;
   d. build stronger incentives into early postgraduate programmes for students to continue studies towards masters and doctoral qualifications;

e. target at an early stage the most promising honours and masters students to enter doctoral programmes;
f. create innovative programmes that attract and retain larger numbers of post-baccalaureate students into masters and doctoral studies.

5. Eliminate the multiple barriers – bureaucratic, administrative, political, legal and structural – that stand in the way of increasing the pool of doctoral candidates in the system and the pool of competent supervisors for doctoral students in South African universities.

6. Apply strong quality assurance measures to the doctorate, on the one hand to prevent irresponsible massification of the degree in the light of the substantial funding incentives for graduating PhDs; and, on the other hand, to deepen the quality of this final qualification across universities.

7. Advocate public support for, and understanding about, the PhD so that there is greater awareness and acceptance of its significance in social and economic development, beyond personal gains for the successful student. Developing this shared meaning about the value of the doctorate is vital for garnering public support for it.

8. Target specific institutions with existing capacity and established track records for scaling up the production of PhDs even as selected programmes are funded within universities that are not strong overall in producing doctorates.

9. Recognise and reward the diversity of doctoral programmes in practice, and adapt national policy to these realities rather than impose a one-size-fits-all model of the traditional PhD on a system that has long moved in the direction of multiple models of training for the doctorate in traditional academic as well as professional degrees.

10. Strengthen and elaborate the relationship between universities and industry, as well as science councils, so that larger numbers of doctoral students are trained and supported through learning in practice while at the same time supplementing academic advisorships on campus with those working in the field.






CHAPTER 1

Introduction

CHAPTER 1

Introduction

1.1 The brief

The Council of the Academy of Science of South Africa (ASSAf) constituted a Study Panel of experts to generate evidence-based advice on the status of the South African PhD and what concretely needs to be done to escalate the numbers and quality of doctoral graduates to meet the high-level skill demands in this emerging economy.

In this context, a coherent set of strategic questions guided the investigation and the collection of evidence:

1. What is the state/status of the South African PhD? In other words, what do we know empirically about the production, distribution, significance and impact of doctoral graduates in the national science system?
2. What is the capacity of the national science system for escalating the production of well-trained doctoral graduates to the levels expressed in government policy?
3. What is the character, approach to, and content of doctoral education and training in South Africa – and what does this portend for the ambition to escalate the growth and production of doctoral graduates in the country?
4. What are the key inhibiting factors that stand in the way of the goal of increasing the number and quality of doctoral graduates in the national science system?
5. What can and should be done to achieve the scale and quality of doctoral graduates required to meet the high-level skills required for the economy and society in South Africa?

1.2 The rationale

There is a broad consensus in the science community in South Africa that not enough high-quality PhDs are being produced in relation to the developmental needs of the country. Studies show a clear link between the economic wealth of nations and their 'citation intensity'[1]. According to this analysis, South Africa is clustered with countries such as Poland, Russia and Brazil, and the Department of Science and Technology (DST) in its Ten-Year Innovation Plan urges South Africa to increase its knowledge output substantially if it is to join the ranks of wealthier countries. Put differently, for South Africa to be a serious competitor in the global knowledge economy, and to achieve standards that are internationally comparable, both the quality and quantity of PhDs need to be expanded dramatically. The production of high-quality PhDs requires both quality of input (e.g. supervision, facilities, environment, student) and quality output – that is the graduate.

Available data show that South Africa produces only 23 to 27 PhDs per million of the population per annum, and the projection of the DST is that 6 000 PhDs of which 3 000 would be science, engineering and technology (SET) PhDs (5 x 1 200 per annum), are required by the year 2018; in other words a five-fold increase in SET graduates alone.

This ambition to escalate the number of well-trained PhDs in South Africa raises fundamental questions about national capacity, critical partners, innovative programmes, strategic investments and cross-sectoral cooperation. Clearly such goals cannot be achieved by relying only on national universities doing what they do at the present time; nor will such goals be achieved by simply requiring them to increase the enrolment of

[1] King, D.A. (2004)

PhDs in the future. To move the entire science system in the direction of these ambitions will require a clear assessment of existing production capacity, a realistic account of resource capacities to deliver on these goals, and a creative plan for moving the different elements of this system in the same direction.

1.3 The strategic position of the Academy

With its specific mandate to provide evidence-based advice to government on matters of crucial scientific questions, ASSAf is well-placed to address questions of science capacity within the national system of innovation. As an independent body that holds the membership of many of the most prominent scientists in the country, the Academy can draw on a pool of committed expertise across disciplines and across universities and other science-based organisations to address questions related to the production of high-level capacity for South African society and its economy.

The bodies with a related interest in the subject, such as the National Research Foundation (NRF), the Council on Higher Education (CHE) and the DST, have recognised and accepted the critical role of ASSAf in leading this Study on behalf of the national science system.

1.4 The significant background issues

In recent times, advanced economies have launched similar studies to assess the nature, relevance and impact of (post) graduate education and training in the face of the demands on human capital within an increasingly competitive global economy, and against the background of critical skills shortages exacerbated by the accelerated transnational migration of educated labour. Moreover, much of the national policy attention in South Africa has been on improvements in the school system; this is important. However, such attention to pre-university education must be done in concert with studies on the terminal degree (the doctorate) and its relationship to economic development and global competitiveness.

It is very important, therefore, that South Africa also makes this assessment of doctoral training and capacity if it is to remain an interested and competitive partner in this important indicator of development capacity: the PhD.

1.5 The status of previous studies and their outcomes in South Africa

Very little has been published on the status of the doctorate in South Africa. A report to the Rockefeller Foundation[2] on PhD programmes in various African universities deals with the issues relating to the recognition of the university as a crucial source of transformation, specifically addressing PhD programmes in African (including South African) universities and possible means of strengthening them, specifically in the social sciences, arts, and humanities.

However, until now, there have been no comprehensive studies on the doctorate in South Africa. A study currently underway tries to document the history of the South African PhD, largely in quantitative terms, and its expression in the kind of knowledge to surface within the field of education. Much of the data that does exist is dispersed in government strategic plans and parastatal snapshot studies to determine policy for implementation and targets for delivery. A new study quantifies changes in postgraduate student enrolments and graduations over time; this study lacks qualitative data to accompany this competent analysis of the numbers of students coming into and leaving the university system.

After careful scrutiny, it became clear that existing data is not sufficiently comprehensive, organised, or integrated to answer, systematically, the critical questions related to the status, significance and impact of the South African doctorate on knowledge, society and development.

1.6 The conduct of similar studies elsewhere

There are a number of studies among developed nations that recently addressed the subject of the PhD and the knowledge economy in the context of national development. These studies all point to the importance of the PhD in securing a competitive advantage for a national government that is seeking to compete in a global economy. Such studies include *Rising above the Gathering Storm* (USA), *The Race to the Top* (UK), and *Mobilising Science and Technology* (Canada). What makes the South African Study necessary is not only the existence of such national assessments of graduate education and economic competitiveness elsewhere, but also the fact that no equivalent studies exist for

[2] Szanton, D.I. & Manyika, S. (2001)

developing economies with high levels of inequality in both the society in general and in the higher education system in particular; a national economy in which the graduate output is unstable in terms of quantity and untested in terms of quality; and in which the foundations of school and undergraduate education remain a crucial problem in making reliable projections about the future of the doctorate. Since historical levels of inequality on the basis of race, gender and discipline (or field of study) reflect in society and in different kinds of universities, there are important legacies that must simultaneously be redressed in the somewhat unique situation of a newly established democracy with still fragile institutions. For these reasons and more, a South African Study is necessary and critical if human capital requirements are to be met on a rational, planned and systematic basis in the future, and if the South African economy and society are to keep up with the rapid pace of globalisation which demands, above all else, a strong and expanding class of top-quality PhD graduates.

1.7 Outline of approach

This Study combines the most recent and accurate quantitative and qualitative data on doctoral students, doctoral training programmes, and doctorate-producing institutions, and employers who hire doctoral graduates. These varied but integrated sources of data are then used to give an account on the status of the PhD in South Africa and specific recommendations of what needs to be done to scale up the numbers of doctoral graduates produced in the country.

The Study was designed by an expert group, the Study Panel, which also supervised the ongoing investigation and interrogated the emerging study components as they were received in the course of the research. Three multi-day Study Panel meetings were convened for these purposes, including a national conference of stakeholders, especially government agencies, to present the preliminary results. The members of the Study Panel, approved by the Council of the Academy, were:

Professor Jonathan Jansen, University of the Free State (Chairperson)
Professor Maresi Nerad, University of Washington (USA)
Professor Kay Harman, University of New England (Australia)
Dr Dwight Triegaardt, AFRICON
Professor Ahmed Bawa, Hunter College, New York (USA)
Professor Priscilla Reddy, Medical Research Council
Professor Michael Samuel, University of KwaZulu-Natal
Professor Sakhela Buhlungu, University of Johannesburg

Two research teams were commissioned to conduct a series of studies identified as critical and compile interconnected data sets that would enable the Consensus Study Panel to provide the evidentiary basis for making firm claims about the status of the South African doctorate and the capacity of the science system to scale up production of high-quality graduates. Professor Johann Mouton led one set of largely quantitative studies with his colleagues at the Centre for Research on Science and Technology (CREST) at the University of Stellenbosch, while Dr Chaya Herman led another set of largely qualitative studies with her colleagues at the University of Pretoria.

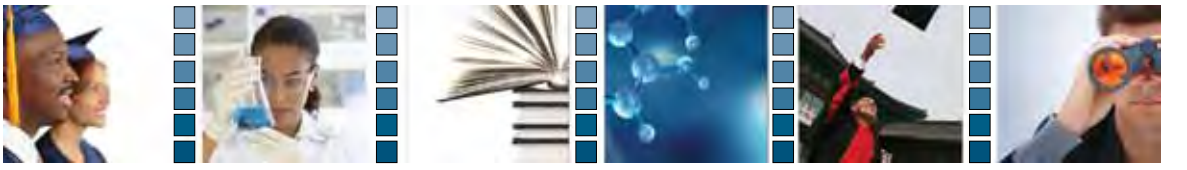
These segmental studies that together comprised the data for this report were the following:

1. *statistical profiles* of doctoral students in South Africa;
2. *destination studies* of doctoral students across fields and institutions;
3. *employer surveys* of doctoral graduates across sectors;
4. *attrition studies* that explain why doctoral students drop out of the system;
5. analyses of *system blockages* - the structural, legal and organisational barriers to increasing the number of doctoral students and graduates in South Africa;
6. *student experience surveys* that document how doctoral students experience the PhD process;
7. *case studies of exemplary doctoral training programmes* that offer lessons for the escalation of doctoral output in South Africa;
8. *capacity to train studies* which examine the roles of various agencies in training doctoral students;
9. *capacity to fund studies* which describe the current and possible future models of funding doctoral students;
10. *policy analyses* on the purposes of the doctorate in South Africa's education and training system.

1.8 Critical (Peer) Reviewers

The Academy of Science of South Africa, in its conduct of evidence-based consensus studies, requires that outside and independent reviewers critically examine the product of the studies. For this purpose the following respected individuals provided their useful input:

Professor Candace Lang – University of Cape Town; Professor Maryke Labuschagne – University of the Free State; and Professor Akilagpa Sawyyer – Secretary-General, AAU (retired).



CHAPTER 2

Approach and Methodology

CHAPTER 2

Approach and Methodology

The Academy of Science of South Africa commissioned a number of research studies related to a Consensus Study on the status and place of the South African doctorate in a global knowledge economy; the broader purpose of which is to generate evidence-based national advice on how to increase the number of PhDs in South Africa in the context of the global economy. The findings from this overarching Study aim to guide education policy on how South African public higher education institutions can produce more and better PhDs.

1.1 Operational Questions

The operational questions, informed by the broader and strategic research questions, which underpinned the entire Study and which are addressed in the Main Findings section of this report, are:

1. How many doctorates does SA produce?
2. Who are the doctoral graduates by demographic characteristics?
3. In what fields are doctorates being produced?
4. Which institutions are producing the doctorates?
5. What is the capacity for doctoral supervision?
6. What are the conversion rates from masters to doctoral degrees?
7. What is the time-to-degree for doctoral students?
8. Why do students drop out of doctoral programmes?
9. How do doctoral students experience doctoral education?
10. What do employers expect from PhDs?
11. Where do doctoral graduates go?
12. What are the features of highly productive PhD programmes?
13. What are the systemic barriers to increasing the productivity of PhD programmes?
14. What can we learn from other countries with respect to escalating the production of PhDs?
15. How much do we know about doctoral education in South Africa?

1.2 Study Segments and Associated Methods

The methods used in each segment of the Study are elaborated on below.

1. Destination study: a survey of doctoral graduates across a sample of fields and institutions

The main objective of this study was formulated as determining the destination of doctoral graduates once they complete their studies. The study further aimed to collect information about doctoral graduates' employment status and experiences.

Taking into consideration time and cost constraints, and in an effort to increase the potential accessibility of PhD graduates, it was decided to conduct a web-based survey. For the design of the questionnaire various examples from similar studies in the USA, Canada and UK were utilised. The web-based survey consisted of a sample of approximately 5 000 doctoral graduates from 12 South African higher education institutions.

The main methodological challenge of any tracer study – under conditions where there is no systematic maintenance of a PhD database (as is the case in the UK, Canada and USA for example) – is the development of the sample frame. Two main strategies were investigated for the identification of survey candidates. The first option considered the possible utilisation of the National Learners' Records Database (NLRD) of the South African Qualifications Authority (SAQA). The database houses information on all persons who complete doctoral studies at South African universities. Currently, the NLRD houses data as far back as 1914 and a full data set from 1986 to 2004. SAQA does not release any names or addresses to third parties and the option

offered to CREST at the Stellenbosch University which was responsible for managing and administering the survey, was that SAQA would distribute e-mails to the doctoral graduates on behalf of ASSAf. Once the first list of potential contacts was extracted it was established that only 54 of the potential respondents had relevant e-mail addresses. A postal survey was also suggested by SAQA but this option would have been too costly and time-consuming. Subsequently, it was decided to pursue an alternative strategy.

The alternative strategy involved working through university-specific data sources as well as internet information sources in an attempt to compile a unique database of PhD graduates. This strategy included targeting the top 15 doctorate-producing institutions in South Africa. The final list consisted of: Nelson Mandela Metropolitan University (NMMU), North-West University (NWU), Rhodes University (RU), Stellenbosch University (SU), University of Cape Town (UCT), University of the Free State (UFS), University of Johannesburg (UJ), University of KwaZulu-Natal (UKZN), University of Limpopo (UL), University of Pretoria (UP), University of South Africa (UNISA), University of the Western Cape (UWC), University of the Witwatersrand (Wits), University of Zululand (UZ) and Tshwane University of Technology (TUT). Each of these institutions was contacted to establish the availability of data sources that contained up-to-date contact details of PhD graduates. The exercise revealed that the contact details of PhD graduates were largely kept and maintained by the respective alumni offices.

In order to access the alumni data and to adhere to the institutional requirements of the various institutions a formal request was sent to the Vice-Chancellors, informing them of the overarching Study and requesting their participation. The Vice-Chancellors were also requested to identify a contact person with whom CREST could liaise regarding the logistical arrangements for the study. This approach had the desired result because all institutions agreed to participate. It did however result in some significant delays in terms of roll-out, given that, in some institution, the request was circulated to various individuals before the crucial task (of extracting the details of doctoral alumni) could proceed.

The institutions differed significantly in terms of the time taken to grant permission and to reach a conclusion concerning ethical clearance. It was therefore decided to follow a step-wise implementation procedure: immediately after an institution granted permission for the survey, an e-mail request for participation was sent to the doctoral graduates of that institution. The first e-mails were distributed on the 9th of April 2009 and the last dispatch was made on the 23rd of June 2009. The closing date for the last batch of survey responses was the 28th of June 2009.

The institutions forwarded the e-mail requests on behalf of ASSAf/CREST to PhD graduates on their system requesting participation in the study. The initial request made to institutions was that the e-mail should only be forwarded to individuals who had obtained a PhD in the last ten years. This however was not adhered to in all instances and subsequently a broader sample was included in the final analysis. The literature does however suggest that a survey five years after the PhD completion is the optimal time to reflect on the PhD programme in which one has studied, because the programme experience is still relatively fresh in the respondents' mind[3]. All completed questionnaires were captured automatically on a central database at CREST and no further administrative assistance was required from the participating institutions.

For the design of the questionnaire, various examples from similar studies in the USA, Canada and the UK were utilised. The final version of the questionnaire covered the following areas:

- PhD studies (start date, completion date, country, institution, field of study, reasons for pursuing a PhD, age at time of obtaining PhD);
- employment status at time of pursuing PhD (employment status after completion of PhD, preparation for work, career planning, employer at time of pursuing PhD, role of employer in pursuing PhD, support from employer);
- benefits of doctoral qualification;
- skills for employment;
- employment history (type of organisation, title, nature of work, involvement in the higher education sector);
- current employment (type of organisation, title, nature of work);
- further studies and other activities;
- mobility;
- demographic information (gender, age, nationality, race).

[3] Center for Innovation and Research in Graduate Education (CIRGE)

2. Doctoral attrition study

The purpose of the study was to establish the reasons for students dropping out of or discontinuing doctoral programmes from universities within South Africa. Understanding doctoral attrition is important for three reasons. First, attrition at the doctoral level is poorly understood, even the rates are difficult to ascertain. Second, consistently high levels of attrition may signal underlying problems in a department, university, or discipline. Third, research on attrition is motivated by economic and psychosocial costs of attrition[4].

Conducting qualitative research on attrition poses a problem for a researcher or institution, that is locating individuals who have left or who are considering leaving. When students are intending to leave, they seldom voice their intentions. By the time the institution or graduate school knows that a student has gone, a great deal of time has elapsed, and current address and telephone information may be unavailable[5].

In the South African context there is currently no national database with names and contact information of students who have discontinued their doctoral studies. The lack of adequate information regarding students in the system – how many leave university without having graduated (for academic or non-academic reasons), how many graduate, how many proceed to higher degrees – is clearly an issue that must be addressed[6].

The methodology for this study therefore was to approach heads of departments and directors of doctoral programmes at the 'top ten' doctoral graduating higher education institutions in South Africa with a request to provide us with the names of doctoral students who have been part of their programmes and who have not completed their studies. A database of heads of department and professors from each university was created, and formal letters were sent to these individuals from March to May of 2009. Close to 1 000 e-mails were sent out to the heads of department and professors from the different institutions. In total, 85 names of students (who had discontinued their studies) were received from the 10 different institutions.

Based on the contact information provided by different persons from each institution, the individuals were then contacted (either by email or telephone) requesting their participation in the study, in the form of a short telephonic interview. In attempting to contact possible respondents it was found that e-mail addresses were incorrect in certain cases or respondents wished not to participate in the study for various reasons. Of the 85 names that we received, 21 respondents finally agreed to be interviewed for the purposes of the study. The telephonic interviews were recorded, with the respondents' permission, and subsequently transcribed and analysed.

3. Doctoral students in South Africa: a statistical profile

The purpose of this study was to establish a statistical profile of doctoral students at South African public higher education institutions for the period 2000 to 2007. The statistical profile aims to shed some light on the state of affairs by highlighting patterns of change and relevant distributional shifts.

In this report the distribution and relative shares of graduates were considered in terms of variables that are included in the Higher Education Management Information System (HEMIS) of the Department of Higher Education and Training (DHET).

4. Employer study report

This study sought to identify why employers specifically seek PhD graduates and what skills and attributes they expect them to have mastered. Thereafter employer satisfaction with the actual performance of PhD graduate employees was assessed. Comparisons were made to determine findings that are generally applicable or sector-specific. A number of pertinent issues were also investigated, including employer perceptions of the available pool of PhD graduates, employer relations with higher education and other professional research institutes, and intellectual property issues.

Locating the employers of PhD graduates is not unproblematic. For the purposes of this study, newspaper advertisements placed in the *Sunday Times* and the *Mail and Guardian* (10 March 2006 – 11 March 2007) specifically seeking PhD graduates for employment were inspected. A list of all the non-academic employers was compiled and relevant e-mail addresses and telephone numbers were recorded. Thirty-two institutions were identified and contacted by e-mail and telephone.

A total of 70 e-mails (including 24 referrals) were sent and six (first-time contact) telephone calls made; 20 employers (representing 16 different institutions)

[4] Golde, C.M. (2005)
[5] Nerad, M. & Sands Miller, D. (1996)
[6] Watson, P. (2008)

eventually agreed to be interviewed. Semi-structured interviews were conducted by phone, audio-taped (with the consent of the interviewee) and subsequently transcribed. The semi-structured interviews were conducted around eight questions:

- Why do employers specifically seek out PhD graduates for employment?
- What do employers want from a PhD graduate?
- What benefits have specific PhD graduate employees brought?
- What further training or professional development do PhD graduate employees receive?
- What weaknesses do employers perceive with regard to the training of PhD graduates?
- What suggestions do employers have for universities to better prepare PhD graduates for the work environment?
- What relationships are maintained by employers with universities and professional networks?
- What comments do employers have regarding the available pool of PhD graduates and their relevant skills?

Respondents were divided into two major categories: (i) social sciences employers (located in fields characterised by social science and humanities concerns); and (ii) natural sciences employers (located in fields characterised by natural science and agricultural concerns). This is by no means a clear division and some employers are involved in initiatives that may cross this divide. The distinction is, however, considered sufficiently accurate and useful for the present analysis.

5. Exemplary PhD programmes

The main research questions that directed the study were:

- What models of training are used in highly regarded PhD programmes and what are their purposes?
- What are the strengths, weaknesses and threats of these models?
- What are the barriers as well as the enabling factors for students' success in these programmes?
- What would it take to scale up these models?

In order to address these questions the following methodology was employed: The leaders of 16 PhD programmes were interviewed between February and June 2009. To ensure the selection of exemplary programmes, the sample was chosen from:

- DST-NRF Centres of Excellence;
- recipients of National Science and Technology Forum (NSTF) awards specifically commended for graduating doctoral students;
- Chairs of Research with an exemplary doctoral graduate track record.

Elements of snowball and convenience sampling were also employed. The sample includes programmes from nine different universities. A conscious effort to include more programmes from previously disadvantaged universities was often unsuccessful. In-depth interviews lasting between one and two hours were conducted with each programme leader. The interviews were recorded, transcribed *verbatim* and analysed using *AtlasTi*. In addition, relevant documents were consulted, such as audit reports, promotional literature and websites for each PhD programme.

The analysis was based on the programme leaders' perceptions, reflections and experiences with regard to the production of quality doctoral graduates and how these outcomes could be scaled up. The report does not evaluate the programmes or explore them from other stakeholders' points of view.

6. A survey of the experiences of current PhD students in South African universities

The purpose of the study was to explore the experiences of PhD students in higher education institutions in South Africa. The aims of the survey were three-fold, namely:

- To provide a descriptive analysis of doctoral students currently studying at South African universities. This analysis includes age, parents' education, race, gender, enrolment status, nature of studies, supervisory arrangements and motivation to pursue a PhD.
- To assess the impact of these variables on outcomes, such as on-time completion, socialisation into academia, publications and skills acquired.
- To provide baselines for follow-up studies that examine trends and issues in doctoral education in South Africa.

The study was based on a web-designed survey of about 950 PhD students currently enrolled in the top 12 PhD-producing universities in South Africa (2009). These universities produce roughly 90% of all PhDs in the country. The survey initially targeted the top 15 doctorate-producing institutions in South Africa namely:

- Nelson Mandela Metropolitan University (NMMU)
- North-West University (NWU)

- Rhodes University (RU)
- Stellenbosch University (SU)
- Tshwane University of Technology (TUT)
- University of Cape Town (UCT)
- University of the Free State (UFS)
- University of Johannesburg (UJ)
- University of KwaZulu-Natal (UKZN)
- University of Limpopo (UL)
- University of Pretoria (UP)
- University of South Africa (UNISA)
- University of the Western Cape (UWC)
- University of Zululand (UZ)
- University of the Witwatersrand (Wits)

Each of these institutions was contacted by CREST at the Stellenbosch University, which was responsible for managing and administering the survey. Requests were sent to the Vice-Chancellors informing them of the overarching Study and requesting their participation.

A liaison person at each institution was selected to organise the logistical arrangements for the study. All the institutions specified the ethical process they preferred and this was adhered to. This approach had the desired effect, with all institutions agreeing to participate in the study. It did however cause some delays in terms of roll-out as the request circulated to various persons within the institution before the actual fieldwork could proceed. The other factor that took up a considerable amount of time was the process of ethical clearance by a number of institutions.

The precondition for this web-design survey was internet connectivity for both participants and institutions. This requirement excluded from participation two previously disadvantaged universities with poor internet connectivity – the University of Limpopo and the University of Zululand. It also excluded UNISA students as they were notified about the survey after the data was analysed. However, we have captured the data for future analysis.

For the design of the questionnaire, various examples from similar studies were consulted, in particular Nettles and Millett (2006) from the USA[7]. The survey comprised 11 sections, as follows:

Section 1 (Questions A-B):	Identified the university and the field of study of the respondents.
Section 2 (Questions 1-11):	Demographic and background questions, such as age, gender, race, marital status, parents' education and nationality.
Section 3 (Questions 12-23):	Students' motivation to pursue doctoral studies, their choice of universities and their occupation before commencing their studies.
Section 4 (Questions 24-29):	Nature of the students' studies, whether they included course work, the selection of topic, and the hours per week that were dedicated to study.
Section 5 (Questions 30-35):	Funding the PhD and students' employment and part-time studies.
Section 6 (Questions 36-42):	Supervision (number of supervisors, the quality of supervision and the hours of supervision).
Section 7 (Questions 43-47):	Students' access to the research environment and their academic development, as well as their socialisation process into academic life (such as participation in conferences, publication, networking and skills acquired).
Section 8 (Questions 48-49):	Students' future plans after their doctorates.
Section 9 (Questions 50-51):	Students' level of satisfaction with their choices and with various aspects of their doctoral programmes.
Section 10 (Questions 52-53):	Students' perceptions of the main obstacles to on-time completion of their doctoral studies.
Section 11 (Question 54):	Allowed students to recount any positive or negative experience of their doctoral studies.

As a result of a technical fault, the responses to Questions 41, 42, 47, 50, 51, and 52 were only captured for the last 438 entries, which included four universities, namely SU, NMMU, UCT and Wits.

All completed questionnaires were captured automatically on a central database at CREST, then analysed by ACCESS and SPSS. Two levels of analysis were employed in this report, namely univariant and bivariant. By cross-tabulating the variables we were able to see the relationships between certain input factors and desired outcomes.

[7] Nettles and Millett, (2006)

7. Systemic blockages in postgraduate education and training

The aim of this component of the overall PhD Study was to "identify the structural, legal, policy and organisational blockages in postgraduate education and training that might impede the escalation in the number of PhDs in South Africa". In our interpretation of this brief, which essentially involved a desktop study of the relevant literature and debates, we developed a conceptual framework in which we distinguished between the normative and policy contexts which frame current actions and initiatives in doctoral education and the structural factors that constrain such actions.

8. The capacity to train doctoral students

The aim of this segment of the Study was to establish the capacity of the national system for training more doctoral students outside of the universities. This study involved in-depth interviews with leaders in science councils knowledgeable about and responsible for doctoral training or the supervision of doctoral students/graduates. The target groups included the Human Sciences Research Council (HSRC), the Council for Geosciences, the Agricultural Research Council (ARC), the Council for Mineral Technology (MINTEK), the Council for Scientific and Industrial Research (CSIR), the Medical Research Council (MRC), and the South African Nuclear Energy Corporation (NECSA).

9. The capacity to fund doctoral students

In this segment of the Study the goal was to determine what funding sources outside of government and its research agencies, such as the NRF, were available to fund doctoral studies in an expanded programme as proposed in the recommendations. In-depth interviews were conducted with lead-persons in agencies such as the Ford Foundation, the Volkswagen Foundation, the German Embassy, the US (American) Embassy, the British Council, the Royal Netherlands Embassy, the French Embassy, the Bank- and AgriSETA, and three selected universities – the University of Fort Hare, the University of Cape Town, and Rhodes University.

10. The purposes of the doctorate – policy analysis

This final segment examined a range of higher education and training policy documents from the Department of Education (now reconstituted in part as the Department of Higher Education and Training), SAQA, the CHE and DST, among others. The goal was to determine what could be extracted about the purposes of the doctorate over time and in the current period, and how such goals and conceptions of the doctorate could impact on a recommended growth and escalation in the number of doctoral graduates in South Africa.

A quick reference summary of the methodologies employed and sample data of source reports is provided in the following table.

Table 1: ASSAf-commissioned reports: Summary of main methodologies employed and sample data of source reports

Destination study: a survey of doctoral graduates across a sample of fields and institutions	Centre for Research on Science and Technology (Stellenbosch University)	2009

- The report is based on qualitative and quantitative analyses of a web-based survey of doctoral graduates from 15 South African higher education institutions, conducted during 2009.
- A total of 1 076 completed questionnaires were received.
- Comparison of the sample against the population of doctoral graduates for the period 2000 to 2007 indicates that:
  - the sample is representative for field of study (with natural science graduates slightly overrepresented) and nationality (South African students slightly underrepresented);
  - male students are overrepresented (60% versus 42%);
  - the majority of respondents are between 36 and 45 years of age (30%) and between 46 and 55 years of age (29%);
  - 65% of respondents indicated that they are white, 8% black, 4% Coloured and 3% Indian (20% of respondents did not provide details about their race);
  - the majority of respondents (64%) graduated after 2000, a further 12% between 1994 and 1999 and about 25% before 1994;
  - the average time-to-degree of the survey respondents (four years) was significantly shorter than the average for the population;
  - the average age at completion for the sample is 36 and the majority of respondents were 29 at the time of graduating.

Doctoral attrition study	Centre for Research on Science and Technology (Stellenbosch University)	28 July 2009

- The report is based in a thematic analysis of in-depth interviews conducted with 20 doctoral candidates who studied at six South African higher education institutions, but did not complete their studies or graduate.
- More than half of the 13 men and eight women interviewed were white.

Doctoral students in South Africa: a statistical profile	Centre for Research on Science and Technology (Stellenbosch University)	16 July 2009

- The profile presented in the report is based on the 2000 to 2007 records of the Higher Education Management and Information System (HEMIS) of the South African Department of Education.
- HEMIS was introduced in 1999/2000 and requires all state-subsidised higher education institutions to submit annual data returns on their students and staff members.

Employer study report	Centre for Research on Science and Technology (Stellenbosch University)	2009

- The report is based on a qualitative analysis of semi-structured interviews conducted with 20 staff members at 16 organisations that employ doctoral graduates outside of the higher education sector in South Africa.
- The interviewees represented national science councils and research facilities; non-profit, non-governmental and charitable organisations; the private sector; and government.
- The sample was selected from employers who advertise positions in two national newspapers.

Exemplary PhD programmes	Dr Chaya Herman (University of Pretoria)	July 2009

- The report is based on computer-assisted qualitative analysis of in-depth interviews conducted during 2009 with 16 leaders of doctoral programmes from nine different South African higher education institutions.
- Programmes were selected from Department of Science and Technology (DST)-National Research Foundation (NRF) Centres of Excellence, recipients of National Science and Technology Forum (NSTF) awards specifically commended for graduating doctoral students, and Research Chairs with an exemplary doctoral graduate track record.
- Relevant documents (such as audit reports, promotional literature and websites) were also consulted for each programme.

A survey of current PhD students in South African universities	Dr Chaya Herman (University of Pretoria)	September 2009

- The report is based on qualitative and quantitative analyses of a web-based survey of doctoral students enrolled during 2009 at 12 South African higher education institutions. The 12 institutions produce approximately 90% of all doctorates in the country.
- A total of 936 responses were received.
- As a result of a technical fault, the responses to six of the survey questions were only captured for the last 438 respondents, which included only four institutions. These are referred to as sample 2.
- Comparison of the main sample (N = 936) against the population of 2 007 doctoral enrolments across all 12 institutions indicate that:
  - social sciences are underrepresented and natural and agricultural sciences are overrepresented in this sample;
  - women, white students and younger students are also overrepresented;
  - the sample is fairly representative for nationality;
  - 57% of the respondents were married or in permanent relationship, and 45% had children.
- Comparison of sample 2 (N = 438) against the main sample indicates that sample 2:
  - is slightly biased towards the natural sciences and social sciences are underrepresented;
  - is representative of main sample ito respondents' gender, but white students are slightly overrepresented and respondents slightly younger;
  - includes more full-time students than the main sample.

Systemic blockages in postgraduate education and training	Prof Johann Mouton (Stellenbosch University) and Ms Lise Kriel (University of the Free State)	28 September 2009

- The report is based on a desktop study of literature and debates relevant to the aim of the study, i.e. to "identify the structural, legal, policy and organisational blockages in postgraduate education and training that might impede the escalation in the number of PhDs in South Africa".

The capacity to train doctoral candidates	Dr Chaya Herman	June 2009

- This study involved in-depth interviews with leaders in science councils knowledgeable about and responsible for doctoral training or the supervision of doctoral students/graduates aimed at establishing the capacity of the national system for training more doctoral students outside of the universities.

The capacity to fund doctoral candidates	Dr Carlton McLellan	April 2009

- In-depth interviews were conducted with lead-persons in agencies such as the Ford Foundation, the Volkswagen Foundation, the German Embassy, the US (American) Embassy, the British Council, the Royal Netherlands Embassy, the French Embassy, the Bank- and AgriSETA, and three selected universities to ascertain what funding sources outside of government and its research agencies were available to fund doctoral studies in an expanded programme as proposed in the recommendations.

The purposes of the doctorate - policy analysis	Prof Jonathan Jansen	2009

- A range of higher education and training policy documents were examined to determine what could be extracted about the purposes of the doctorate over time and in the current period, and how such goals and conceptions of the doctorate could impact on a recommended growth and escalation in the number of doctoral graduates in South Africa.

CHAPTER 3

The case for the doctorate

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As a core function of universities, doctoral research provides invaluable education and training aimed at producing highly skilled knowledge workers capable of transferring their intellectual and technical expertise to wide-ranging global contexts. The PhD gained in this process is arguably the key qualification defining the quality of research standards of a country[8], and is particularly acknowledged as a means for acquiring, generating and using research-based knowledge. It is also viewed as a driver of research and development and innovation, a generator of knowledge and skills in key strategic areas of national innovation systems, a contributor to industrial and social resources and a vehicle for addressing the gap between postgraduate study and the needs of the labour market[9 & 10]. New knowledge generated via doctoral education is widely acknowledged as an important strategic and economic resource[11 & 12]. The capacity of a knowledge system to reproduce itself and for it to be sustainable in the medium- to long-term, depends on the capacity of that system to produce new PhDs at a rate which is suitable for that system.

It seems that the history of the doctorate may have, in a sense, come full circle. For the first six centuries, following its conception at the University of Paris in the middle of the twelfth century, the doctorate was directed toward training for professions, and doctorates in theology, law and medicine predominated[13 & 14]. It was only at the end of the eighteenth century that a reformation of the university system was initiated first in Germany and Sweden, thereafter spreading to other parts of Europe and the USA[15]. The nineteenth century marked the rise of the modern research university – popularly ascribed to the reforms of Wilhelm von Humboldt.

The eighteenth century concern was the preparation of an administrative elite and in particular the development of professions. In opposition to this in Germany, the Humboldt reforms envisaged a new type of university knowledge, founded on enlightenment principles and reflecting a desire by the university to engage in a search for a form of universal truth that set it apart from society and placed itself in a position of authority with regards to the production of knowledge[16].

A new methodology of research was practiced according to these 'enlightenment principles' which resulted in the exaltation of research (for its own sake) over professional training. Accordingly, research became the central component of the modern PhD. It would be misleading, however, to believe that the development of the doctorate worldwide was uniform. Variations in research methods and procedures as well as in the structure and 'weighting' of the PhD dissertation occurred[17]. But despite these variations a common thread was evident. Nineteenth century shifts in European knowledge production had emphasised the development of disciplinary knowledge. The role of the PhD (worldwide) was transformed to "license scholars to profess a discipline, to replenish communities of scholars within universities and to advance disciplinary knowledge production"[18].

[8] Gallagher, M. (2007)
[9] Harman, K.M. (2008a)
[10] Harman, K. (2008b)
[11] Kehm, B.M. (2007)
[12] Harman, K. (2008b)
[13] Noble, K. A. (1994)
[14] Bourner, T., Bowden R. & Laing, S. (2001)
[15] Jonsson, I. (2006)
[16] Scott, D.; Brown, A.; Lunt, I. & Thorne, L. (2004)
[17] Boud, D. & Lee, A. (eds). (2009)
[18] Boud, D. & Lee, A. (eds). (2009)

The modern PhD found form at the University of Berlin in the nineteenth century, from where it spread across German universities and attracted many foreign students, notably from the USA[19]. By 1861, the first PhD was awarded at Yale University and not until 1920 was a PhD awarded in England (Oxford University).

Subsequent decades have seen renewed interest and inquiry into the function and goal of higher education. South Africa is not alone in taking a fresh look at doctoral education. Since the 1990s, nations around the world have been increasing doctoral degree production and introducing initiatives to reform their masters and doctoral programmes. Nations may be as small as Iceland or as large as China, with long traditions of doctoral education, such as Germany, or shorter traditions, such as Australia, Brazil or Malaysia. Why are such initiatives occurring at the same time around the world? Why are both resource-rich countries with highly developed higher education systems and countries with emerging economies and young advanced higher education systems reforming postgraduate education?

A multitude of factors may be identified that have encouraged this reconsideration of the identity and procedures of higher education. Many of these factors are also interrelated and these relations may be variously stated.

Economic theories of the knowledge economy are embraced by governments worldwide. These theories argue that knowledge is crucial to national economic growth and increased prosperity. Theories of the 'knowledge economy' locate the causes of economic growth in novel ideas leading to scientific, technical, organisational, environmental or health innovations[20] & [21]. Natural resources are no longer the key factors in economic growth. Rather innovations and technical changes are seen as the principal means of economic growth and sustaining international competitiveness.

As the knowledge economy theory has spread around the world, national governments in many places have turned to masters programmes and doctoral education as a way of educating scientific and technical innovators. Higher education has been widely recognised as a primary factor sustaining and invigorating economic growth and there are calls from various sectors for greater transparency and evaluations of higher education systems to ensure efficiency and effectiveness. Postgraduate education and academic research are now global endeavours, and so not only nations but also supranational organisations (OECD, EU, UNECSO, the World Bank) are developing policies to enhance the contribution of doctoral education to national and regional economic growth.

Within the context of hope for economic growth, national capacity building, and international cooperation and competition, governments are allocating substantial funds to increase the research and development capacities of their countries. Postgraduate education is included in these funding allocations. The education of high-quality scholars and professionals who are able to bring innovative changes to their workplaces – be these in business, government, academe or non-profit sectors – is increasingly considered part of research and development activities and included in national innovation policies. It is believed, and empirical evidence now suggests, that not only the supply of highly skilled people, but also how widely academic knowledge is disseminated, has an influence on the economic and social development of a nation[22]. Put differently, new knowledge must be effectively disseminated and absorbed if innovations and economic growth are to proceed from it. In addition, in order to attract investment and create new jobs and markets, governments want their countries to be known for having world-class research capacities.

The large-scale growth in the number of students entering higher education and doctoral studies, coupled with decreasing public expenditure on higher education, have placed strain upon the freedom and autonomy previously experienced by universities. Increased student mobility has also necessitated greater standardisation between various institutions in various regions.

There have simultaneously been advances in our conceptualisations of or about knowledge. A deeper appreciation of complexity has given rise to new theories of knowledge production. A prime example of this is the proposed 'Mode 2' knowledge presented by Gibbons *et al*[23]. These authors postulate that we have moved from Mode1 to Mode2 knowledge production signified by many of the changes discussed above. For research this change has resulted in a more "interdis-

[19] Bourner, T., Bowden, R. & Laing, S. (2001)
[20] Powell, W.W. & Snellman, K. (2004)
[21] Slaughter, S. & Rhoades, G. (2004)
[22] Dill, D. & Van Vught, F. (2009)
[23] Gibbons, M.; Limoges, C.; Nowotny, H.; Schwartzman, S.; Scott, P. & Trow, M. (1994)

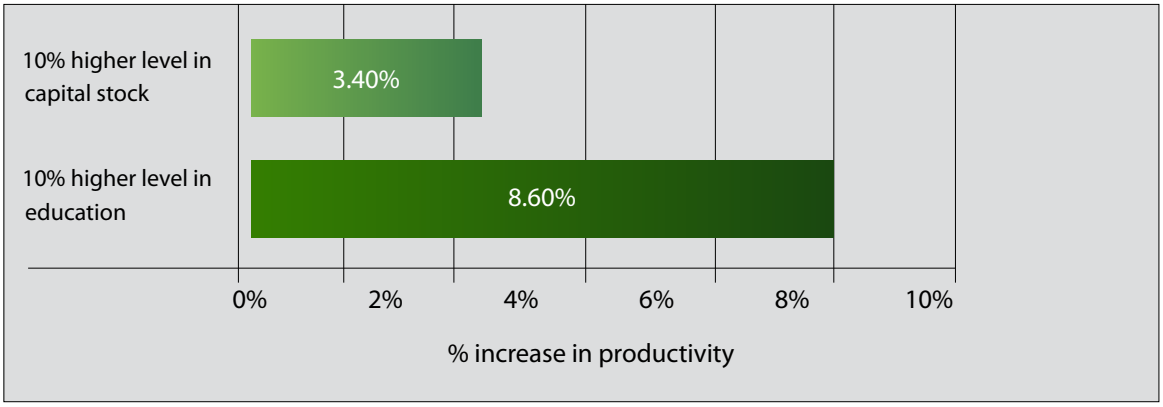
ciplinary, pluralistic, 'networked' innovation system, in contrast to the previous system in which major corporate or academic research institutions were less closely linked with other institutions"[24]. The 'Triple Helix' similarly describes how universities, the state and private enterprise interact and overlap in national and global knowledge production and innovation systems and this interaction can create an environment conducive to technology-based enterprise[25 & 26]. The relationship between universities, the state and business has therefore become increasingly complex and interdependent. This has also led to the proposition of the so-called 'Third Mission' of universities with a greater mandate for contributing to innovation and technology transfer.

Transferable professional skills development – such as knowing how to present and teach complex knowledge to a diverse audience, how to write for multiple audiences, how to manage time, people, projects, and budgets, how to deal with ethical questions in one's research and field – has become an accepted and sought-after component of doctoral education. Career planning and development have been introduced into doctoral education as graduates are needed and hired in many employment sectors. Career planning and development has also been introduced as a means of attracting people to postgraduate studies. Today's students need to learn how to look for jobs inside and outside of academia. Academic and non-academic employment today includes interactions with, trips to, and periods of living in other countries and cultures. Postgraduate education increasingly includes preparation to be able to function in international settings.

"We need to educate doctoral students who are world citizens, who cross national boundaries without seeking to assimilate and homogenise but instead accept differences and embrace diversity". (Nared:2005)

The NRF, the official national funding agency of the state which has the primary responsibility for postgraduate and research support in the country, has recognised that education increases productivity far more than investment in capital stock.[27]

Figure 1: Factors associated with productivity growth



Source: US Department of Commerce *et al. 21st Century Skills for 21st Century Jobs,* January 1999

There is a 'global hunt for talent'. In the USA the Committee on prospering in the Global Economy of the 21st Agenda (of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine) endeavoured to answer the following questions[28]:

[24] Mowery, D. C. & Sampat, B. N. (2005)
[25] Etzkowitz, H. & Leydesdorff, L. (2000)
[26] Etzkowitz, H. (2003)
[27] Van Jaarsveld, A.S. (2009)
[28] National Academy of Sciences, National Academy of Engineering, Institute of Medicine (2006)

- What are the top ten actions, in priority order, that federal policy-makers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st century?
- What implementation strategy, with several concrete steps, could be used to implement each of those actions?

This congressionally requested report by a pre-eminent committee makes four recommendations, along with 20 implementation actions, that federal policy-makers should take if they are to create high-quality jobs and focus new science and technology efforts on meeting the nation's needs; these include:

- increase America's talent pool by vastly improving K-12 mathematics and science education;
- sustain and strengthen the nation's commitment to long-term basic research;
- develop, recruit and retain top students, scientists, and engineers from both the United States and abroad;
- ensure that the United States is the premier place in the world for innovation.

The development of a country's postgraduate education system is beneficial for knowledge production but has economic and development implications too. If a nation does not have sufficient numbers of adequately educated and trained workers, either: a) it will need to increase the PhD production of knowledge workers (as has happened in Europe, Asia, Australia and New Zealand), however, this is costly, and time-consuming; or b) governments will need to liberalise short-term immigration of highly skilled labourers – bringing skilled workers to capital and technology[29].

As doctoral education is transforming from a national to a global system, it is being confronted with rapid and radical changes. Existing research on patterns of these changes is minimal and little information on the rapidly changing forms of doctoral education around the world is available. (CIRGE, University of Washington)

This radical reconsideration of the role of the research university has led to a corresponding inquiry into the status and place of doctoral programmes. In South Africa, and internationally, there is a need for empirical data on doctoral education that can help us understand local, national and international trends and assist us in making informed policy decisions.

Over the past few years doctoral education has faced criticism about its relevance in preparing students for the careers they pursue after graduation. Some believe that doctoral students are educated too narrowly and are not prepared to work in broader interdisciplinary fields and teams. The main criticism for a career in academia relates to a lack of adequate teaching, publishing, writing and presenting skills. There are also those who emphasise a lack of PhDs for the labour market, as opposed to those who feel that the supply of PhDs is sufficient but not always well suited for the positions they enter.

In interesting national and regional developments, destination studies have been institutionalised in the USA and Canada; inquiry into new forms of the doctorate have proliferated in the UK, New Zealand, Ireland and Australia; and in Europe debates have centred around diversity and convergence of doctoral programmes[30]. Denecke[31] underlines two major issues that have to be addressed. "First, how well are doctoral programmes doing to ensure that talented and able students successfully complete their PhDs? And second, how well are they preparing those students to succeed in their subsequent careers as scholars and researchers in both academic and non-academic settings?" In this latter regard, graduate and employer surveys are important assessment tools.

Findings from these and related studies have generated a number of criticisms. These include that the doctorate is too specialised and not multidisciplinary enough, that too much time is taken to complete the degree and to find subsequent employment, that it is not conducive to collaborative work (specifically in the social sciences and humanities), and that it does not allow for the development of knowledge and broad skills necessary in industry, particularly underlining a lack of organisational and managerial skills[32 & 33]. Concern regarding the appropriateness of doctorates has mounted as studies show that fewer graduates are entering the academic profession[34]. Studies show that in the UK only about a third of doctoral students pursue academic careers[35].

[29] Nerad, M. (2006)
[30] Boud, D. & Lee, A. (eds). (2009)
[31] Denecke, D. D. (2006)
[32] Nerad, M. (2004)
[33] Scott, D.; Brown, A.; Lunt, I. & Thorne, L. (2004)
[34] Thompson, J.; Pearson, M.; Akerlind, G.; Hooper, J. & Mazur, N. (2001)
[35] UK GRAD (2004)

A similar tendency is distinguishable in the USA, where less than half of the doctoral graduates surveyed entered academia[36]. This has led various commentators to call for the development of a broader skills set. Boud and Lee[37] call for the development of graduates who are "work-ready and knowledgeable about research policy, including such matters as intellectual property and commercialisation".

Various universities and departments have sought changes within their doctoral programmes to respond to these challenges. Park[38] discerns the development of alternative doctoral models in the UK that have been introduced to allow for greater workplace relevance. The PhD by publication includes peer-reviewed academic papers, a new route PhD includes significant taught elements; the professional doctorate also includes significant taught elements and usually has specific learning outcomes (work-focused); and the practice-based doctorate (usually in the performing arts) incorporates other outputs, e.g. a novel or a performance. Scott *et al*[39] distinguish three ideal models of doctorate study. The first is a pure model firmly located in a designated disciplinary division resembling traditional notions of the PhD. The second has features similar to the first, but begins to transgress disciplinary and regulatory (including outside agencies) boundaries. Ideas positioned in contexts outside the university are considered that allow for greater workplace application and contextualisation. The final model completely transcends the traditional boundaries of the conventional PhD so that the notion of universalising truth is abandoned in favour of workplace needs.

Unfortunately, not all actors have pursued similar goals. This may hamper the strategic development of doctoral reform. Lee and Boud[40] (2009) report that:

> There have been substantial developments in doctoral education at governmental, institutional and local levels, but they often work to different agendas: at the policy level, to needs for workforce planning and economic development; at the institutional level, to needs for accountability and risk management; and at local level, to needs for disciplinary maintenance, reproduction and transformation and for appropriate experiences for doctoral students.

Scott and Brown[41] identify three ideal models of doctorate study. The first model, which they refer to as 'the pure model', is located within the disciplinary arm of the university. The knowledge is produced within the discipline; it is accredited by its criteria and protected by it.

> [Academia] acts as the guardian to this type of discourse... [It] seeks to preserve insularity and elitism. Its intention is to influence the practicum in the long term and thus it has no desire to change practice in the immediate sense.

The second model has many features of the first but it is beginning to include notions of transdisciplinary and looser boundaries between disciplines and between itself and other regulating bodies and outside agencies. There is acknowledgment that ideas could be better understood from the context of application. Subsequently, new models of PhD were advanced whereby knowledge could be developed at the workplace outside of a university.

The third model is the servicing model, described by Scott and Brown as a model whereby the "university and the doctoral student on behalf of the university abandons notions of universalising truth, and adopts a more modest role in relation to society as a whole"[42]. The student as practitioner is required to make sense of his or her workplace and to develop a new, original and more productive way of working. The outcome of this PhD is a commodity the value of which is decided in the marketplace.

Different understandings of the purpose of the PhD lead to different types of programmes and expectations in terms of product (the quality of the dissertation), process (models of delivery), partnerships and collaborations, funding, ideal completion time, scaling up, and blockages in the system. In South Africa there appear to be three prevalent understandings as to the purpose of the PhD:

1. as training for an academic career;
2. as training for industry;
3. as training for a profession.

In accordance with the Higher Education Qualifications Framework (HEQF), the research dissertation or thesis is at the centre of each PhD programme. This corre-

[36] Wulff, D. H.; Austin, A. E. & Associates. (2004)
[37] Boud, D. & Lee, A. (eds). (2009)
[38] Park, C. (2007)
[39] Scott, D.; Brown, A.; Lunt, I. & Thorne, L. (2004)
[40] Boud, D. & Lee, A. (eds). (2009)
[41] Scott, D. & Brown, A. (2004)
[42] Scott, D. & Brown, A. (2004)

to the concept of the PhD as training for academia. According to the HEQF, the graduate is required to "demonstrate high-level research capability and make a significant and original academic contribution at the frontiers of a discipline or field" and "must be able to supervise and evaluate the research of others in the area of specialisation concerned"[43].

"*The PhD is about becoming an academic; and that's about understanding, about knowledge production, and about critically thinking about things.*"
(Interviewee: Exemplary PhD programmes)

Undoubtedly, this traditional view of the PhD as training for academia within the qualification framework has a strong impact on the way academics in South Africa view the doctorate. According to this view the purpose of doctoral education is educating "stewards of the discipline", defined as "those to whom we can entrust the vigour, quality and integrity of the field"[44]. It is regarded as the main purpose of the PhD in various disciplines, such as humanities, engineering, medicine, education or astrophysics.

In the understanding of the doctorate as training for industry, the main benefit attributed to the PhD is its application to industry. PhD programmes in the sciences forge different partnerships with industry, ranging from programmes that are established around the needs of the industry to those that attempt to find a comfortable balance between applied and fundamental research. Furthermore, most of the students are funded by industry, or by international donors, and are expected to return to the workplace.

In the understanding of the doctorate as training for a profession, doctorates include programmes associated with education, business, psychology, health, engineering and social work, where the student cohort is usually made up of working professionals within the subject areas of the programmes. In the USA, Australia and, since the 1990s also in the UK, these students could have applied for professional doctorates[45]. In these countries, a number of different models have been developed for the provision of programmes whose defining feature is the recognition that work-based learning could be extended to the highest level of academic qualification, namely the doctorate. They have different outcomes, such as portfolios of work, or they may be using evaluation criteria different from those of academia.

Dissatisfaction with traditional forms of doctoral education and training, long considered exclusively as the disinterested pursuit of knowledge associated with training for an academic career[46], is gaining momentum. As more doctoral graduates are employed outside academe, new academic jobs become fewer and the demand from users of research for integrated learning and skill development to serve a wider range of workforce needs is growing, modes of doctoral education and training have received greater criticism from many academic sources over the last decade or so. The traditional model of doctoral training is viewed as increasingly difficult to sustain.

The major limitations of traditional systems of doctoral research training are seen by critics to be that[47, 48, 49, 50 & 51]:

- training is too narrowly (disciplinary) focused;
- supervisory modes are often limited to a 'master/apprentice' relationship;
- there is a lack of integration of knowledge across traditional knowledge boundaries;
- training is too fragmented, which reduces its impact;
- the research environment often lacks critical mass;
- graduates lack key professional, organisational and managerial skills;
- candidates are not well informed about employment outside academia;
- graduates are unable to demonstrate 'industry readiness' and to apply their skills to employment outside academia;
- completion times are too long and non-completions are common;
- graduates are ill-informed about how to teach.

[43] Department of Education (2007)
[44] Golde, C.M. & Walker, G.E. (eds). (2006)
[45] Scott, D. & Brown, A. (2004)
[46] Kehm, B.M. (2007)
[47] Murray, B. (2000)
[48] Harman, K.M. (2004)
[49] Nerad, M. (2004)
[50] LEHRU (League of European Research Universities) (2007)
[51] Kehm, B.M. (2007)

There is thus mounting pressure for higher education institutions to change their traditional role in knowledge production, move from the traditional 'Humboldtian model' of research training[52] and adopt in their doctoral programmes a more integrated and competence-based approach to handling knowledge as advocated by Hövels[53].

The redefinition of doctoral education is therefore a work in progress. It remains to be seen what alternatives to the traditional PhD will be accepted and what the explicit function and goals of PhD education will be.

The professional doctorate is the most prevalent alternative to the traditional PhD, however, as with the PhD there exists little consensus regarding its form and structure. Innovations in the doctorate in the USA that incorporated a structured taught component with the absence of single professional control and a shorter dissertation are seen by Scott *et al*[54] to be the forerunner of the professional doctorate in the UK and Australia. Although the USA offered its first professional doctorate in 1921, Nerad[55] stresses that "the primary purpose and goal of doctoral education has been preparation of the next generation of university professors who will become productive researchers and innovators, and in turn become teachers of the following generation". This is not the same purpose of more recent professional doctorates. Costley and Stephenson[56] define the professional doctorate:

> The DProf is built around individual professional profiles by the practitioners themselves and has been designed specifically to engender high-level performance in a professional context, and to fit structurally and operationally into the nature of the professional context in which it is demonstrated even when they do not map on to established professional forms.

Professional doctorates have proliferated, especially in the UK and Australia. Introduced in the UK in the 1990s, they have been adopted by an increasing number of fields and universities so that "[by] the end of the decade, professional doctorates could be found in over three-quarters of the 'old' universities and a third of the 'new' universities"[57]. In 1990 the Australian Higher Education Council of the National Board of Employment, Education and Training encouraged the adoption of professional doctorates and subsequently Australia saw similar growth. Green *et al*[58] make a distinction between what they call first- and second-generation professional doctorates in Australia. These authors maintain that around the turn of the 21st century a new 'type' of professional doctorate became recognisable in which "the realities of the workplace, the knowledge and the improvement of the profession and the rigour of the university are being brought together in new relationships"[59]. According to these authors the professional doctorates are sites of development for Mode 2 knowledge[60].

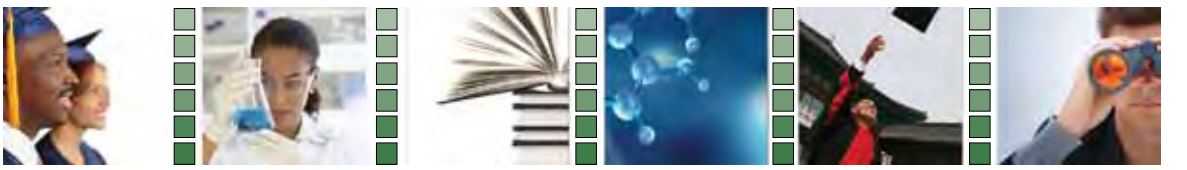
Many critics, however, argue that professional doctorates do not constitute a radical departure from the PhD. Scott *et al*[61] observe that although sharing a number of characteristics (taught courses, specification of learning outcomes often in the form of employment related skills, cohort-based pedagogies, and a reduced thesis length) "the professional doctorates appear to continue to reproduce existing forms of academic and professional practice and reinforce established relations between academic and professional discourses". Similarly Neumann[62] (2009), in a study on the differences between professional doctorates and PhDs in social sciences/humanities (also undertaken in Australia in 2003), could not distinguish between the structure of the PhD and professional doctorates. Furthermore, she notes that "the lack of involvement of professional doctorate programmes in industry, workplace or profession was striking". Other critics are sceptical of the quality and scope of professional doctorates[63].

The potential for expansion may lie outside academia – in a doctorate that aims to serve the workplace or the industry and thus relate directly to the needs of the knowledge economy. The potential for expansion may lie in the differentiation between a doctorate and a PhD.

52 Enders, J. (2004)
53 Hövels, B. (2003)
54 Scott, D.; Brown, A.; Lunt, I. & Thorne, L. (2004)
55 Nerad, M. (2008)
56 Costley, C. & Stephenson, J. (2009)
57 Bourner, T., Bowden R. & Laing, S. (2001)
58 Green, B.; Maxwell, T.W. & Shanahan, P. (eds). (2001)
59 Maxwell, T. W. (2003)
60 Green, B.; Maxwell, T.W. & Shanahan, P. (eds). (2001)
61 Scott, D.; Brown, A.; Lunt, I. & Thorne, L. (2004)
62 Neumann, R. (2009)
63 Bitusikova, A. (2009)

This would mean diversification of doctoral degrees, modes of delivery and funding. It would mean that we might need at least two types of doctorates, one to prepare students for an academic career and one to prepare students for a career in industry or the professions.

To conclude, escalation in the number of PhDs does not necessarily have to happen in the same manner and at the same pace for each type of PhD. This means expansion with differentiation. It has implications for policy. It also means that a single-purpose qualification does not fit all.



CHAPTER 4

Main Findings

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The findings and discussion in this chapter draw directly on and integrate data from the ten ASSAf-commissioned studies which investigated various facets of doctoral education and training in the national science system of South Africa. The researchers examined the statistical profiles and qualitative experiences of the country's PhD students and supervisors; they considered employment and other post-graduation activities, as well as attrition or the 'drop-out' phenomenon; they explored the factors that make an exemplary PhD programme and those that contribute to blockages within the PhD production system; and they related their findings to the international literature on the subject of the PhD.

The following sections present a synthesis of the ten study reports, answering key questions based on the research conducted. It must be kept in mind that each report refers only to public higher education in South Africa and is based on a specific methodology and sample which limits the generalisability of the findings in some cases (refer to Appendix 1).

1.1 How many doctorates does SA produce?

Finding 1: South Africa produced 1 274 doctoral graduates in 2007 (or 26 doctorates per million of the country's total population).

During the last fifteen years PhD production has increased worldwide. Between 1991 and 2004, China had an 817% rate of increase in PhD production, increasing the number of PhDs granted from 2 556 to 23 446[64 & 65] (Chinese Statistical Yearbook 1992, 2005, NSF 2008, appendix table 2-43). In the same period, the number of PhDs awarded in Taiwan climbed from 410 to 1 964 for a 379% increase (this and the following country statistics were retrieved from NSF 2008). South Korea's rate of PhD production increased 166% from 2 984 PhDs in 1991 to 7 946 in 2004. Japan had a 57% increase from 10 758 PhDs to 16 909. Individual European countries with mature and relatively large doctoral education systems also showed an increase in their PhD production, although smaller. Germany had a 3% rate of increase between 1991 and 2004, awarding 22 462 doctoral degrees in 1991 and 23 138 doctoral degrees in 2004. In these 13 years the UK had an 82% increase from 8 390 to 15 260. The US experienced a 12% increase from 37 530 to 42 117. Australia, within a shorter period, between 1998 and 2004 increased their PhD production by 46% from 3 271 to 4 763[66] (OECD 2008)[67].

South Africa produced an average of 1 039 doctoral graduates per year from 2000 to 2007, reflecting a 54.8% increase in graduates with an average annual growth rate over the same period of 6.1% (see Table 25 of Appendix 2).

As a share of all postgraduates in South Africa, doctoral graduates remained more or less constant at about 4% a year during this period, but displayed a markedly higher average annual growth rate than that for masters graduates (6.1% compared to 4%; see Table 2, below).

[64] Chinese Statistical Yearbook 1992 (2005)
[65] National Science Foundation (2008)
[66] OECD (2008)
[67] Note the numbers for the annual PhD production provided by the US NSF Science and Engineering (S&E) Indicators 2008 and numbers provided by OECD statistics show various discrepancies. The largest discrepancies are in the numbers provided for US doctorates. While the US NSF S&E statistics provide numbers for PhDs in all fields, not just in science and engineering fields, these statistics do not include medical and law doctoral degrees (MDs and JDs) as they are considered professional degrees and not research degrees. Most European countries include these degrees

Table 2: Comparative statistics for masters (M) and doctoral (D) graduates in relation to all postgraduates (PG) at public higher education institutions in South Africa, 2000-2007

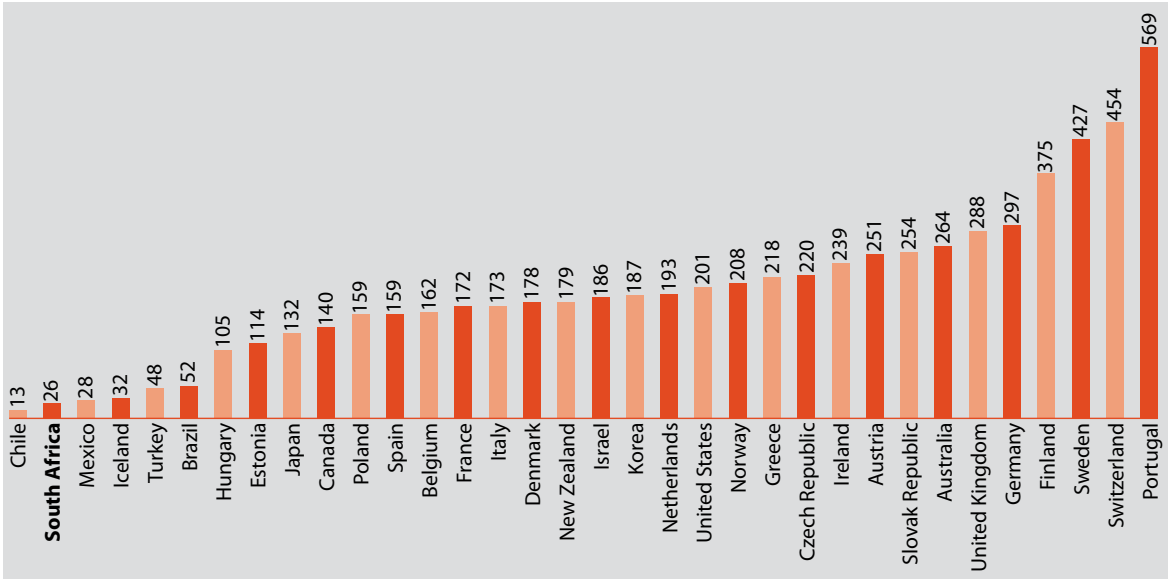
	2000	2001	2002	2003	2004	2005	2006	2007	Average annual growth* 2000-2007
All PG	23182	25092	27862	29665	31573	30,803	30,634	30,629	4.0%
M	5795	6426	6871	7396	7536	7881	7883	7516	4.0%
D	823	843	981	1031	1087	1176	1100	1274	6.1%
M as % of All PG	*25%*	*26%*	*25%*	*25%*	*24%*	*26%*	*26%*	*25%*	-
D as % of All PG	*4%*	*3%*	*4%*	*3%*	*3%*	*4%*	*4%*	*4%*	-
D as % of M	*14%*	*13%*	*14%*	*14%*	*14%*	*15%*	*14%*	*17%*	-

* The average annual growth rate was estimated by fitting a linear regression trend line to the annual values once the values were converted into logarithmic values and the exponents (number of years) of the values taken.

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix1)

Despite positive growth in the production rate, South Africa continues to produce a very small number of doctorates per million of the total population (26 doctorates per million in 2007). This compares very unfavourably with other countries such as Portugal (569 per million), Australia (264 per million), Korea (187 per million), and Turkey (48 per million) (see below and Table 25).

Figure 2: Comparison of ISCED 6[68] graduates per million of total country population in 2007



[68] International Standard Classification of Education Level 6 (ISCED 6) refers to tertiary education programmes that lead directly to the award of an advanced research qualification, e.g. PhD. For a detailed description of the ISCED, refer to http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf

1.2 Who are the doctoral graduates by demographic characteristics?

Finding 2: Most of the doctoral graduate class of 2007 were white South African men in their 30s.

While the age of doctoral graduates and ratio of male to female graduates in South Africa has remained fairly constant over recent years (with men outnumbering women on average at about three to two), there have been fairly significant shifts in the racial composition – with a greater proportion being black[69] and non-South African[70]. As far as nationality of students is concerned, we witness an increase in the number of non-South African students amongst doctoral graduates at South African higher education institutions. The overall share of South African students decreased from 89% in 2000 to 73% in 2007, and equally significant decreases occurred in the individual fields (see Table 3 below and Table 26 of Appendix 2).

Table 3: Gender, race, age and nationality of doctoral graduates, 2000 and 2007

Demographics	2000	2001	2002	2003	2004	2005	2006	2007
Gender								
Female	41%	37%	39%	39%	38%	44%	43%	42%
Male	59%	63%	61%	61%	62%	56%	57%	58%
Race								
Black African	19%	22%	23%	23%	27%	29%	30%	32%
Coloured	5%	3%	5%	5%	5%	6%	5%	6%
Indian	6%	6%	7%	9%	9%	7%	8%	8%
White	70%	69%	65%	63%	59%	59%	56%	54%
Age at graduation								
<30	15%	17%	17%	18%	15%	13%	14%	12%
30-39	43%	37%	38%	36%	38%	41%	38%	39%
40-49	29%	31%	30%	30%	30%	29%	30%	30%
50+	13%	16%	15%	16%	18%	17%	18%	19%
Nationality								
South African	84%	81%	80%	78%	78%	74%	72%	71%
Other SADC* countries	4%	4%	4%	4%	6%	8%	8%	9%
Other African countries	2%	3%	7%	7%	7%	9%	9%	9%
Rest of world	4%	6%	7%	9%	8%	8%	8%	9%
Unknown	6%	6%	2%	2%	2%	2%	2%	3%

* Southern African Development Community
Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Women are particularly well-represented among doctoral graduates in both health and social sciences (see Table 4, below). However, only about a third of graduates in natural and agricultural sciences and in humanities are female. The trend over time is reversed for these two fields – in humanities the share of women increased from 2000 to 2007, and in natural and agricultural sciences it deceased over the same period. In engineering sciences, materials and technologies the share of female graduate remains critically low (only 15% in 2007).

[69] Black students refer to African, Coloured and Indian students combined
[70] These demographic characteristics are discussed in more detail in subsequent findings

Table 4: Gender parity of doctoral graduates at public higher education institutions in South Africa by broad field of study, 2000 and 2007

Field of study	% female students	
	2000	2007
Health Sciences	59%	62%
Social Sciences	48%	51%
Natural & Agricultural Sciences	41%	36%
Humanities	27%	32%
Engineering Science, Materials & Technologies	17%	15%
Total	**41%**	**42%**

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Table 5 (below) investigates the extent to which the interaction of field and race changes the values of the other demographic indicators (shares of female students, students younger than 30 years, and South African students). This analysis was done only for the year 2007.

Table 5: Profiles of doctoral graduates in terms of selected demographic indicators by race and broad field, 2007

Race	All fields			Nat & Agric Sciences			Eng Sc, Mat & Tech		
	%	%<30	%	%	%<30	%	%	%<30	%
	Female	years	SA	Female	years	SA	Female	years	SA
Afr/Col/Ind	33%	7%	54%	21%	16%	44%	22%	19%	36%
White	48%	16%	88%	47%	27%	87%	11%	30%	92%
Total	*42%*	*12%*	*73%*	*36%*	*22%*	*68%*	*15%*	*26%*	*70%*
Race	Health Sciences			Social Sciences			Humanities		
	%	%<30	%	%	%<30	%	%	%<30	%
	Female	years	SA	Female	years	SA	Female	years	SA
Afr/Col/Ind	65%	10%	63%	41%	0%	64%	24%	1%	51%
White	60%	25%	89%	63%	7%	94%	38%	4%	79%
Total	*62%*	*19%*	*79%*	*51%*	*3%*	*78%*	*32%*	*3%*	*68%*

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Female representation is significantly better among white doctoral graduates in all fields with the exception of two. In engineering sciences, materials and technologies only about 11% of female graduates are white compared to 22% of black graduates, and in health sciences the representation of women among black and white graduates can be regarded as equally good (65% and 60%).

Compared to black graduates, relatively larger shares of white graduates are younger than 30 years (e.g. 27% of white graduates in natural and agricultural sciences fall into this age group, compared to 16% of black graduates). However, in social sciences and humanities the representation of younger people is critically low for all races.

The representation of non-South Africans is highest among black graduates, especially in engineering sciences, materials and technologies where only 36% of doctoral graduates in 2007 were South African nationals. This suggests that the dramatic increase in the share of black graduates in this field is largely the result of an intake of students from elsewhere on the African continent.

Finding 3: Significant improvements observed in terms of racial representation among doctoral graduates may be offset by similar increases in the number of non-South African graduates.

Significant improvements can be observed in terms of race, where the pool of black graduates has increased from just 30% in 2000 (N=246) to 46% in 2007 (N=680). In particular the numbers of African graduates has increased most markedly, from 160 (19%) in 2000 to 405 (32%) in 2007 (see Table 6, below).

The field which would appear to be the most attractive to black students is that of social sciences (both in terms of numbers and percentages) with 53% (N=228) of the 2007 graduate cohort being black – having increased from 33% in 2000. The most substantive increase, however, occurred in engineering sciences, materials and technologies, where the representation improved from 16% in 2000 to 40% in 2007; however this should be seen in the context of starting from a very low base (10 in 2000) and the numbers of black graduates in these disciplines remains low (36 in 2007).

However, while this pleasing improvement in racial representation among doctoral graduates is to be welcomed, it should be noted that the number of non-South African students graduating from public higher education institutions in South Africa has also increased significantly, and the representation of non-South Africans is highest among black graduates.

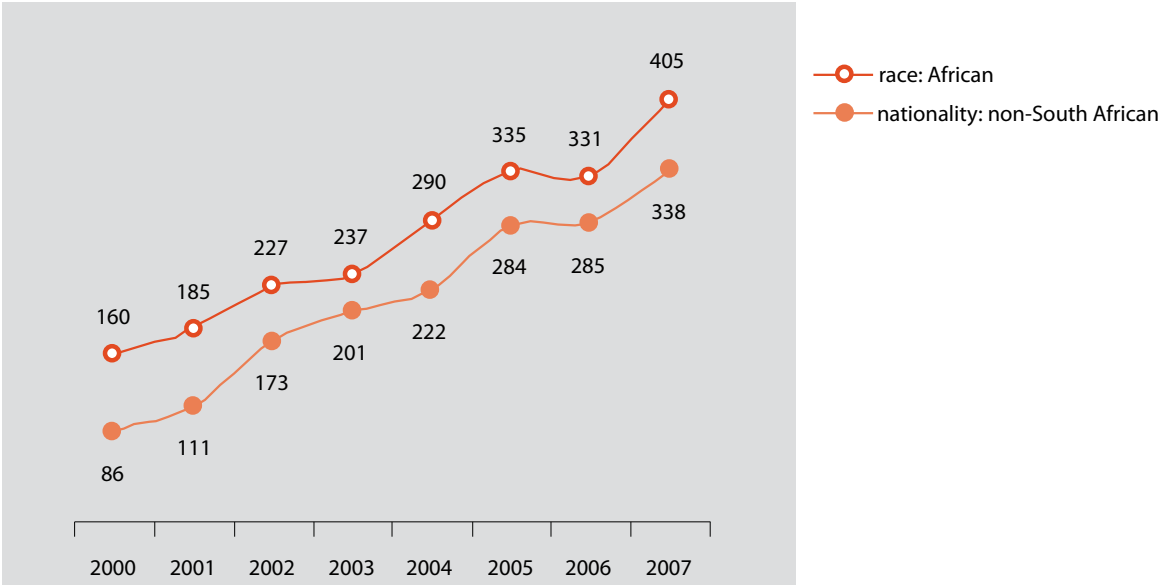
Table 6: Race of doctoral graduates by broad field of study, 2000 to 2007

Race	2000		2001		2002		2003		2004		2005		2006		2007	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Natural & Agricultural Sciences																
Black	55	26	93	34	128	43	113	36	115	39	137	45	139	46	156	43
White	150	73	172	65	165	56	194	63	174	60	169	55	166	54	206	57
Total	*205*	*100*	*265*	*100*	*293*	*100*	*307*	*100*	*289*	*100*	*306*	*100*	*305*	*100*	*362*	*100*
Engineering Sciences, Materials and Technologies																
Black	10	16	12	16	10	12	13	17	18	22	26	33	36	33	36	40
White	55	85	66	85	77	89	64	83	63	78	52	67	72	67	56	61
Total	*65*	*100*	*78*	*100*	*87*	*100*	*77*	*100*	*81*	*100*	*78*	*100*	*108*	*100*	*92*	*100*
Health Sciences																
Black	34	31	30	33	23	24	48	38	48	39	69	41	38	36	49	39
White	77	69	62	67	71	76	76	61	75	61	96	58	69	64	81	62
Total	*111*	*100*	*92*	*100*	*94*	*100*	*124*	*100*	*123*	*100*	*165*	*100*	*107*	*100*	*130*	*100*
Social Sciences																
Black	85	33	77	36	118	37	140	39	176	46	157	41	184	46	228	53
White	176	67	143	65	197	63	220	61	206	54	233	60	220	54	209	48
Total	*261*	*100*	*220*	*100*	*315*	*100*	*360*	*100*	*385*	*100*	*390*	*100*	*404*	*100*	*437*	*100*
Humanities																
Black	61	34	52	29	70	35	65	39	80	38	92	39	82	47	111	45
White	116	66	132	72	131	65	101	61	130	62	143	61	90	52	140	56
Total	*177*	*100*	*184*	*100*	*201*	*100*	*166*	*100*	*210*	*100*	*235*	*100*	*172*	*100*	*251*	*100*

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

While African students have increased by 245 graduates, the number of international graduates has increased by 252 (see Figure 3, below). This suggests that the dramatic increase in the share of black graduates may be due to the intake of students from elsewhere on the African continent.

Figure 3: Headcount of African doctoral graduates compared to non-South African graduates at public higher education institutions in South Africa, 2000-2007

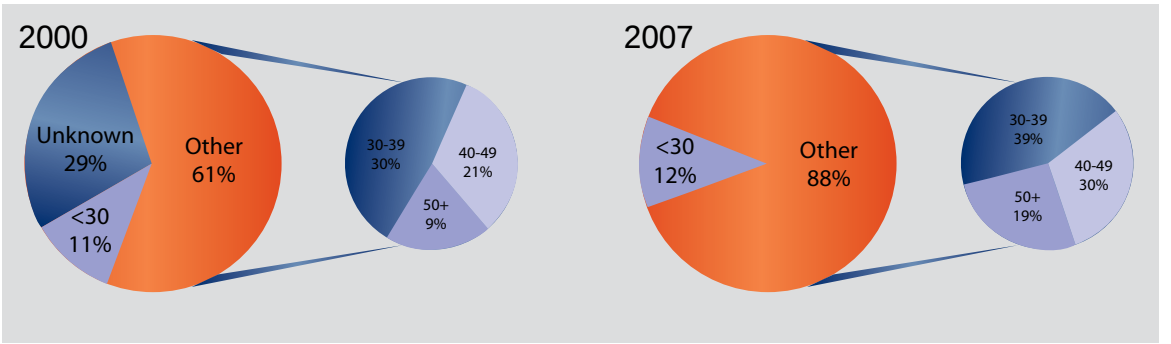


Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Finding 4: The vast majority of doctoral graduates are 30 years of age or older.

In 2007, only 12% of doctoral graduates were under 30 years old, with the average age at graduation being 40 years. While the share of graduates in this younger age group has remained relatively constant since 2000, the cohort of students over 30 years of age has increased, with almost one in five graduates being 50 years of age at graduation (see Figure 4, below). The average age of doctoral students at South African universities is high compared to international trends.

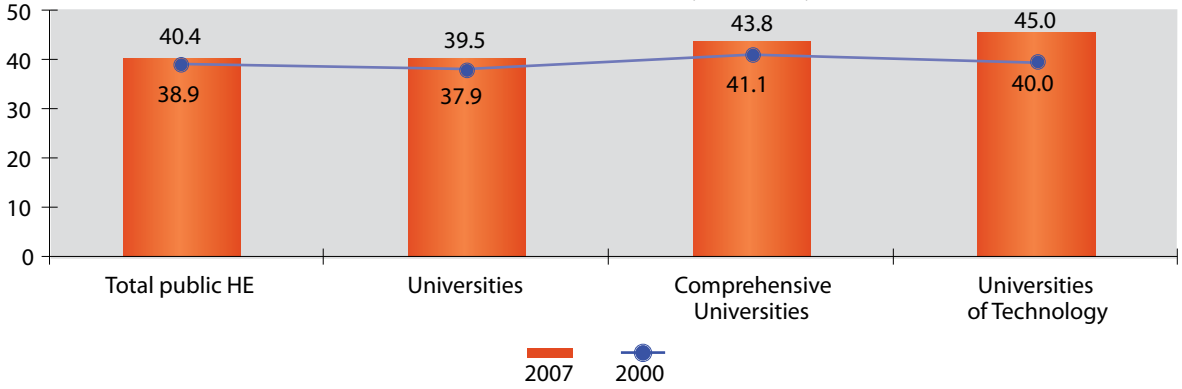
Figure 4: Share of doctoral graduates at public higher education institutions in South Africa in terms of age at graduation, 2000 and 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

The fact that doctoral students spend, on average, about five years completing their degrees, together with the fact that they are between 33 (natural and agricultural sciences) and 41 (social sciences and humanities) years of age when first enrolling for a doctoral degree, results in most South African doctoral graduates being relatively mature when eventually awarded a doctoral degree. In 2007, the average age of doctoral students at graduation was 40.4 years (compared with 38.9 years in 2000). This varied between 39.5 years (universities) and 45 years (universities of technology) in terms of university classification (see Figure 5, below).

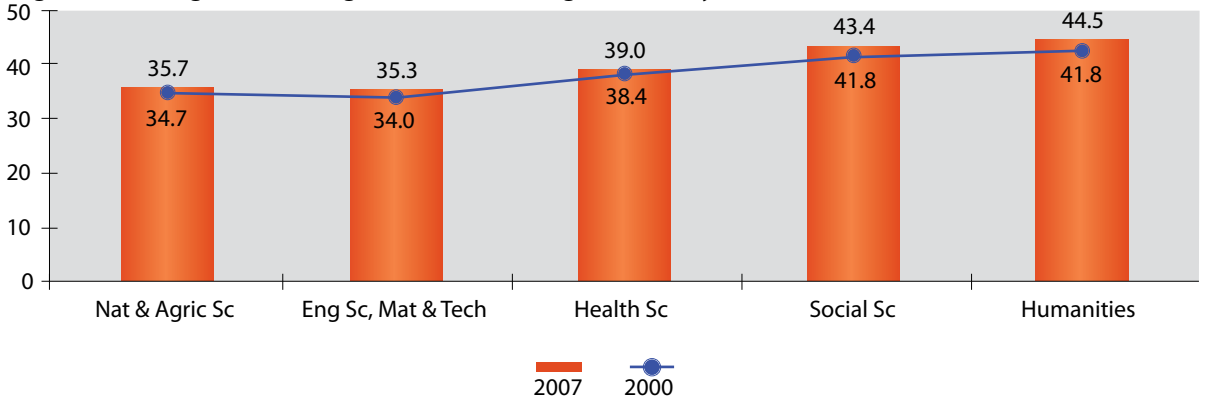
Figure 5: Mean age of doctoral graduates at time of graduation by university classification, 2000 and 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

In terms of broad field of study, the mean age of doctoral graduates in 2007 varied between 35.3 years (engineering sciences, materials and technologies) and 44.5 years (social sciences) – with all fields showing an increase in age compared with the 2000 graduate cohort (see Figure 6, below).

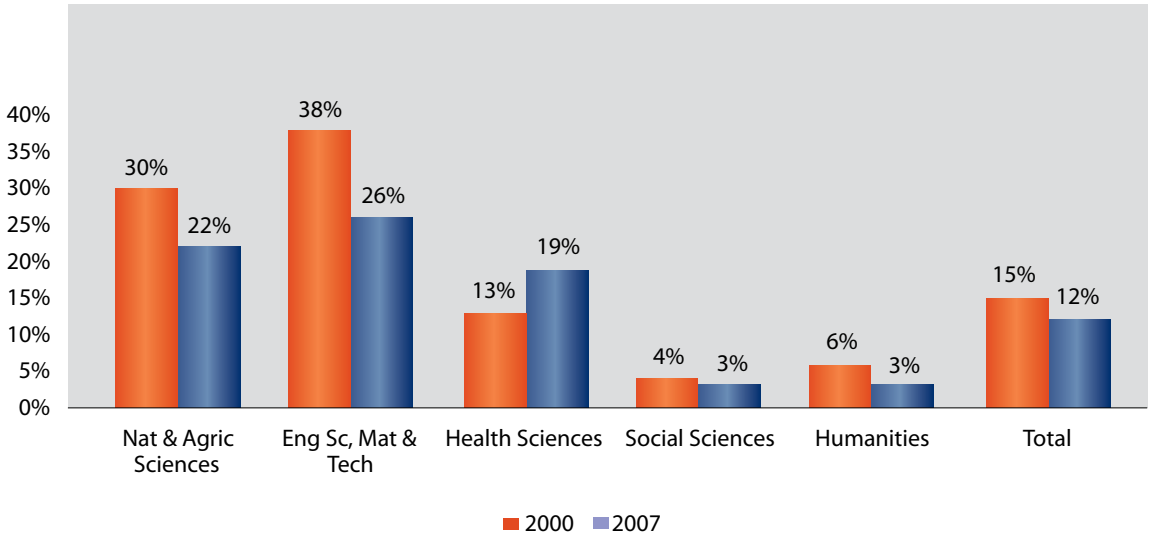
Figure 6: Mean age of doctoral graduates at time of graduation by broad field, 2000 and 2007



Source: *Doctoral students in South Africa: A statistical* profile (refer to Appendix 1)

We witness critically low shares of young graduates (i.e. younger than 30 years) for all races in the social sciences and humanities – the overall figures for 2000 of 4% and 6% respectively have declined even further to only 3% and 3% in 2007 (see Figure 7, below).

Figure 7: Profiles of doctoral graduates by broad field in terms of % graduates <30 years, 2000 & 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 11)

Compared to black graduates, a relatively larger proportion of white graduates in 2007 were under 30 years of age, with 16% of white graduates falling within this age group, compared to 7% of black graduates. Among the same cohort of graduates, the mean age of African doctoral graduates was 41.1 years, for Indian graduates 40.6 years, for white graduates 40 years, and for Coloured graduates 39.3 years.

With regard to gender, the graduating age for females and males was very similar – being 40 years and 40.6 years respectively.

Refer to Table 26 (Appendix 2) for more detailed demographic information from 2000 to 2007.

1.3 In what fields are doctorates being produced?

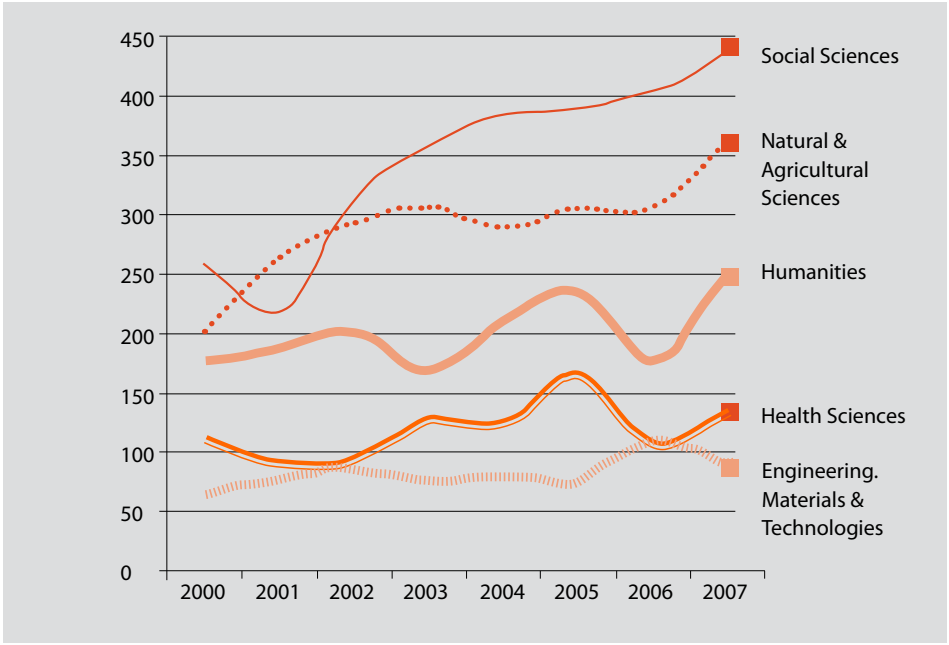
Finding 5: Most doctoral graduates are produced in the social sciences, with the headcount figure for these graduates being almost five times that for engineering sciences, materials and technologies.

Field-specific differences with regard to the number of doctoral graduates are evident as early as 2000. However, these differences had become even more pronounced by 2007 (see Figure 8).

Most PhDs are produced in the social sciences (34% in 2007) and together with humanities, social science doctorates constitute more than half (54%) of all doctoral graduates in 2007. Engineering, materials and technologies consistently produced the smallest share of graduates from 2000 to 2007. For 2007 the headcount figure for social sciences (437) was almost five times that for engineering, materials and technologies (92).

The social sciences also recorded the single highest annual average growth rate (11.9%) in terms of graduates during the period 2000-2007; during this period the graduates increased on average by about 34 a year (see Table 7). The natural and agricultural sciences displayed the second highest growth rate (5.8%) and also produced the second largest number of doctoral graduates for most years during the period 2000-2007 (see Figure 8, below).

Figure 8: Headcount of doctoral graduates by broad field of study, 2000-2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

The data indicates that humanities recorded the lowest average annual growth rate of doctoral graduates during the period 2000 to 2007 (see Table 7, below).

From the following data (Table 7, below) it is evident that the social sciences showed the most consistent growth in terms of graduates, as the difference between growth rates for 2000-2005 and 2000-2007 is smallest in this field (11.6% versus 11.9%). The field of health sciences showed the largest inconsistency (9.5% versus 4.5%).

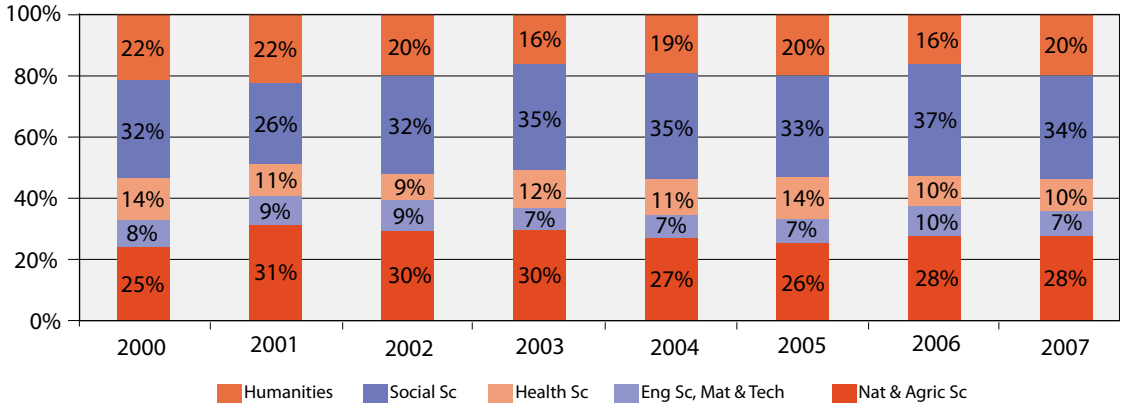
Table 7: Average annual growth rate and average headcount growth of doctoral graduates in public higher education institutions in South Africa by broad field of study, 2000-2005 and 2000-2007

	Social Sciences		Natural & Agricultural Sciences		Health Sciences		Humanities		Engineering Sciences, Materials & Technologies	
	2000-2005	2000-2007	2000-2005	2000-2007	2000-2005	2000-2007	2000-2005	2000-2007	2000-2005	2000-2007
Average annual growth rate	11.6%	11.9%	6.8%	5.8%	9.5%	4.5%	4.6%	3.4%	2.6%	4.6%
Average growth in headcount	34	34	17	16	11	5	9	7	2	4

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix1)

The share of doctoral graduates by broad field for the period 2000 to 2007 is illustrated in Figure 9. From this it is evident that the respective share of each broad field has stayed more or less constant during the period under review.

Figure 9: Share of doctoral graduates by broad field, 2000-2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Finding 6: Education, economic and management sciences, and religion produce the largest share of all doctoral graduates.

The breakdown of 2007 data by sub-field (see Table 8, below) shows that at least one quarter of doctoral graduates in each broad field can be accounted for by a single sub-field. The dominance of specific fields of study is further illustrated by the fact that, across all fields, nearly 30% of degrees are awarded in only three fields: education, economic and management sciences, and religion.

Table 8: Share of doctoral graduates in public higher education institutions in South Africa in terms of sub-fields of study with largest headcounts, 2000 and 2007

Sub-fields with largest number of headcounts in broad field	Headcount	As % of broad field total	Headcount as % of grand total (819)	Headcount	As % of broad field total	Headcount as % of grand total (1274)
	2000			2007		
Social Sciences	**251**		**32%**	**437**		**34%**
Education	115	46%	14%	142	32%	11%
Economic & Management Sciences	45	18%	5%	136	31%	11%
Humanities	**177**		**22%**	**252**		**20%**
Religion	75	42%	9%	106	42%	8%
Language & Linguistics	57	32%	7%	78	31%	6%
Health Sciences	**111**		**14%**	**132**		**10%**
Clinical & Public Health	69	62%	8%	88	67%	7%
Natural & Agricultural Sciences	**205**		**25%**	**362**		**28%**
Biological Sciences	71	35%	9%	89	25%	7%
Chemical Sciences	39	19%	5%	73	20%	6%
Engineering Sciences, Materials & Technologies	**65**		**8%**	**92**		**7%**
Electrical & Electronic Engineering	15	23%	2%	28	30%	2%
Mechanical Engineering	17	26%	2%	17	18%	1%

Note: The sub-fields are not necessarily mutually exclusive because any degree could be classified in more than one category. Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

When comparing the performance of the various sub-fields for 2000 and 2007, it emerges that most maintained a more or less constant level in terms of their contribution to the percentage of the grand total of doctoral graduates, with the exception of education (the contribution of which dropped from 14% in 2000 to 11% in 2007) and economic and management sciences, which increased its contribution from a lowly 5% in 2000 to 11% in 2007 (see Table 8, above).

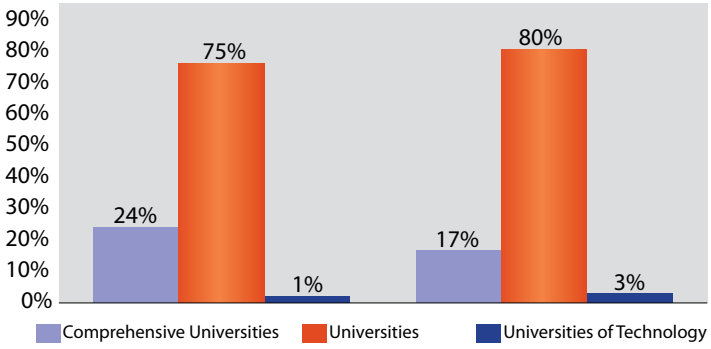
More information on graduates by broad field of study and sub-field is provided in Table 27 (Appendix 2).

1.4 Which institutions are producing the doctorates?

Finding 7: In 2007, 80% of all graduates were produced by Universities (as opposed to Universities of Technology and Comprehensive Universities[71]).

A detailed breakdown of South African public higher education institutions in terms of their share of doctoral graduates in all fields of study from 2000 to 2007 is included as Table 28 (Appendix 2). In 2007, 80% of all doctoral graduates were produced by the Universities, compared to 75% in 2000 (see Figure 10, below).

Figure 10: Share of doctoral graduates at public higher education institutions in South Africa in terms of institutional type, 2000 and 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

In considering the share of doctoral graduates by university classification it is also relevant to take into account the headcounts and growth rates in terms of first-enrolments. By far the majority of enrolments take place in Universities (78.5% in 2007) with an annual average growth rate for doctoral first-enrolments of 4.8% (see Table 9 and Table 10, below).

Table 9: Headcount of doctoral first-enrolments by university classification, 2000 to 2007

Classification	2000	2001	2002	2003	2004	2005	2006	2007
First-enrolments	1897	2122	2481	2519	2693	2692	2916	2684
Universities	1600	1672	1820	1902	2040	2072	2283	2106
Comprehensive Universities	231	362	553	514	530	508	507	460
Universities of Technology	54	68	92	70	123	112	126	118

Vista University not included in breakdown for the years 2000-2003.
Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

[71] The South African higher education landscape includes 22 public higher education institutions categorised as Universities (11), Comprehensive Universities (6) and Universities of Technology (5)

In terms of university classification, Universities of Technology recorded the largest average annual growth rate for doctoral graduates during the period 2000-2007 (27.5% growth). This is followed by Universities (6.8% growth) and Comprehensive Universities (2.8% growth). However, Universities of Technology started with a very small base in 2000 (five graduates) and subsequently increased this number by an average of four graduates a year, eventually to produce 38 graduates in 2007.

Table 10: Average annual growth and growth rate of doctoral graduates and first-enrolments by university classification, 2000 to 2007

Classification	Average annual growth (2000)		Average annual growth (2007)	
	Graduates	First-enrolments	Graduates	First-enrolments
Universities	52	89	6.8%	4.8%
Comprehensive Universities	6	26	2.8%	7.8%
Universities of Technology	4	10	27.5%	12.3%
Total	**61**	**122**	**6.1%**	**5.3%**

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Finding 8: The top nine South African public higher education institutions in terms of PhD production were responsible for 83% of the doctoral graduates in 2007.

In terms of doctoral production in 2007 the top nine South African public higher education institutions were the Universities of Pretoria, Stellenbosch, Cape Town, Witwatersrand, North-West, KwaZulu-Natal, UNISA, the Free State, and Johannesburg (see Table 11, below). Together they contributed 83% of the doctoral graduates produced in 2007.

These same universities also featured in the top nine doctoral graduate-producing universities in 2000 (though with different rankings); in that year however their share of the doctoral graduate production exceeded 88% (see Table 11).

Table 11: Top nine doctoral graduate-producing universities, 2007 and 2000

University	2007		2000	
	Rank	Share of doctoral graduates	Rank	Share of doctoral graduates
University of Pretoria	1	13.3%	1	14.0%
Stellenbosch University	2	12.0%	4	10.2%
University of Cape Town	3	11.1%	2	12.4%
University of the Witwatersrand	4	10.5%	5	10.0%
North-West University	5	9.7%	9	6.3%
University of KwaZulu-Natal	6	8.3%	7	8.2%
UNISA	7	6.1%	6	9.5%
University of the Free State	8	6.0%	8	7.3%
University of Johannesburg	9	5.9%	3	10.9%
Total		**82.9%**		**88.8%**

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

In terms of university classification, eight are classified as 'Universities', with UNISA and the University of Johannesburg being classified as 'Comprehensive Universities'.

The detailed breakdown of performance of all public higher education institutions is contained in Table 12 (below). Institutions are listed in order of performance in 2007.

Table 12: Universities in terms of their share of doctoral graduates in all fields, 2000 to 2007

Classification	University	2000		2001		2002		2003		2004		2005		2006		2007	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
UP	U	114	14.0%	134	16.0%	152	15.7%	146	14.2%	187	17.2%	192	16.3%	148	13.5%	170	13.3%
SU	U	83	10.2%	103	12.3%	111	11.5%	112	10.9%	115	10.6%	126	10.7%	102	9.3%	153	12.0%
UCT	U	101	12.4%	86	10.2%	108	11.2%	101	9.8%	97	8.9%	182	15.5%	133	12.1%	142	11.1%
WITS	U	81	10.0%	79	9.4%	97	10.0%	70	6.8%	90	8.3%	100	8.5%	98	8.9%	134	10.5%
NWU	U	51	6.3%	58	6.9%	59	6.1%	92	9.0%	87	8.0%	82	7.0%	110	10.0%	124	9.7%
UKZN	U	67	8.2%	89	10.6%	94	9.7%	127	12.4%	92	8.5%	90	7.7%	108	9.8%	106	8.3%
UNISA	Comp	77	9.5%	69	8.2%	71	7.3%	75	7.3%	95	8.7%	92	7.8%	81	7.4%	78	6.1%
UFS	U	59	7.3%	50	6.0%	77	8.0%	82	8.0%	56	5.2%	65	5.5%	60	5.5%	77	6.0%
UJ	Comp	89	10.9%	65	7.7%	70	7.2%	91	8.9%	95	8.7%	88	7.5%	73	6.6%	75	5.9%
RU	U	28	3.4%	24	2.9%	41	4.2%	27	2.6%	40	3.7%	31	2.6%	46	4.2%	48	3.8%
UWC	U	20	2.5%	22	2.6%	15	1.6%	27	2.6%	23	2.1%	35	3.0%	28	2.5%	41	3.2%
NMMU	Comp	11	1.4%	27	3.2%	23	2.4%	28	2.7%	35	3.2%	30	2.6%	25	2.3%	35	2.7%
UZ	Comp	17	2.1%	14	1.7%	21	2.2%	12	1.2%	29	2.7%	17	1.4%	31	2.8%	20	1.6%
UL	U	6	0.7%	4	0.5%	4	0.4%	10	1.0%	20	1.8%	15	1.3%	12	1.1%	17	1.3%
TUT	UoT	2	0.2%	8	1.0%	9	0.9%	5	0.5%	9	0.8%	12	1.0%	19	1.7%	12	0.9%
CUT	UoT	3	0.4%	1	0.1%	4	0.4%	7	0.7%	7	0.6%	6	0.5%	6	0.5%	11	0.9%
CPUT	UoT	0	0.0%	2	0.2%	5	0.5%	5	0.5%	2	0.2%	5	0.4%	6	0.5%	10	0.8%
UFH	U	3	0.4%	2	0.2%	2	0.2%	3	0.3%	2	0.2%	1	0.1%	9	0.8%	10	0.8%
UNIVEN	Comp	0	0.0%	1	0.1%	0	0.0%	1	0.1%	1	0.1%	2	0.2%	0	0.0%	6	0.5%
DUT	UoT		0.0%	2	0.2%	1	0.1%	2	0.2%	3	0.3%	4	0.3%	4	0.4%	5	0.4%
VUT	UoT	0	0.0%	0	0.0%	1	0.1%	2	0.2%	2	0.2%	1	0.1%	1	0.1%	0	0.0%
WSU	Comp	1	0.1%	0	0.0%	2	0.2%	1	0.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total		**813**		**840**		**967**		**1026**		**1087**		**1176**		**1100**		**1274**	

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

CPUT	Cape Peninsula University of Technology	SU	Stellenbosch University	UKZN	University of KwaZulu-Natal	UWC	University of the Western Cape
CUT	Central University of Technology, Free State	TUT	Tshwane University of Technology	UL	University of Limpopo	UZ	University of Zululand
DUT	Durban University of Technology	UCT	University of Cape Town	UNISA	University of South Africa	VUT	Vaal University of Technology
NMMU	Nelson Mandela Metropolitan University	UFH	University of Fort Hare	UNIVEN	University of Venda	WITS	University of the Witwatersrand
NWU	North-West University	UFS	University of the Free State	UP	University of Pretoria	WSU	Walter Sisulu University
RU	Rhodes University	UJ	University of Johannesburg				

Table 13 (below) demonstrates which institutions were the top five producers of doctoral graduates per broad field of study in both 2000 and 2007. From this it is clear that the production of doctoral graduates was dominated by the relatively larger and more prominent research-orientated universities, such as the Universities of Cape Town (UCT), Pretoria (UP), KwaZulu-Natal (UKZN), Stellenbosch (SU) and the Witwatersrand (Wits). However, North-West University (NWU) also recorded a significant increase in its share of doctoral graduates between 2000 and 2007, ranking in 4th place nationally in 2007 in terms of overall doctoral production and also featuring among the list of 'top five' institutions in four of the five broad fields of study.

Table 13: 'Top 5' institutions per broad field of study in terms of their share of doctoral graduates, 2000 and 2007

Rank Field of study		1	2	3	4	5
All fields	2000	UP : 14.0%	UCT : 12.4%	UJ : 10.9%	SU : 10.2%	WITS : 10.0%
	2007	UP : 13.3%	SU : 12.0%	UCT : 11.1%	WITS : 10.5%	NWU : 9.7%
Health Sciences	2000	UCT : 23.4%	WITS : 15.3%	UKZN : 10.8%	UP : 9.9%	UJ : 9.0%
	2007	UCT : 24.2%	WITS : 18.9%	SU : 12.9%	NWU : 11.4%	UKZN : 8.3%
Social Sciences	2000	UJ : 16.7%	UNISA : 16.3%	UP : 15.1%	NWU : 8.7%	UFS : 7.9%
	2007	UP : 15.3%	NWU : 11.7%	UJ : 10.5%	UKZN : 8.5%	SU : 7.6%
Humanities	2000	SU : 15.3%	UP : 14.2%	UNISA : 13.1%	UJ : 11.9%	NWU : 9.7%
	2007	UP : 18.3%	SU : 15.1%	UNISA : 14.7%	NWU : 11.9%	UCT : 7.9%
Natural & Agricultural Sciences	2000	WITS : 17.6%	UP : 15.1%	UCT : 14.1%	UFS : 11.2%	UKZN : 10.2%
	2007	SU : 14.1%	WITS : 13.5%	UCT : 13.0%	UKZN : 11.6%	RU & UP : 9.1%
Engineering Sciences, Materials & Technologies	2000	UCT : 30.8%	WITS : 21.5%	SU : 16.9%	UP : 13.8%	UKZN : 9.2%
	2007	WITS : 19.6%	UCT & UP : 18.5%		SU : 15.2%	NWU : 12.0%

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Finding 9: Half of doctoral students select a particular PhD programme or institution based on the research focus of a department or programme.

In the survey conducted by Herman[72], doctoral students were asked to indicate the reasons they had selected a specific programme or institution. The most prevalent reason (see Box 1) why doctoral candidates select a specific programme or institution to host their studies is a well-matched research focus. This is followed by a preferred supervisor, the quality of the programme, and financial support offered. Thus a high proportion of doctoral students indicated that issues related to the nature and quality of the programme and/or department (including the supervisor) contributed to their decision. However, this should also be seen in the context of other factors which influence the decisions made by potential doctoral candidates.

Box 1: Ten top reasons why doctoral students select a specific programme/institution, 2009

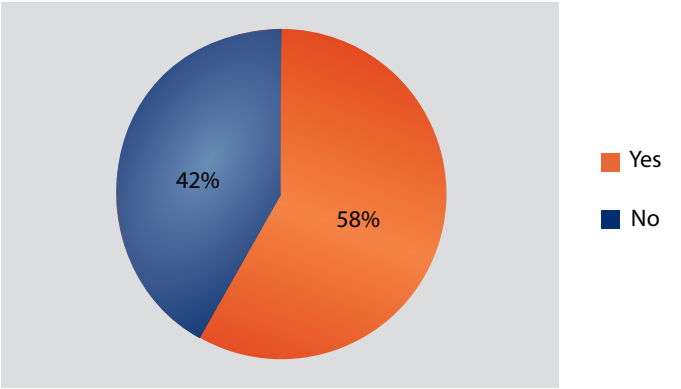
1. Research focus of the department/programme (50%)
2. I wanted to study with a particular supervisor at this institution (46%)
3. Quality of the department/programme (43%)
4. Financial support offered (42%)
5. I did my masters here (40%)
6. Prestige of the institution (30%)
7. Location (26%)
8. I am employed as a lecturer here (12%)
9. Recommendation of friends/family (8%)
10. Recommendation of faculty from my previous institution (3%)

Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

[72] A survey of current PhD students in South African universities (refer to Appendix 1)

Most doctoral students (58%) in South Africa continue their studies at the same institution at which they completed their masters degree (see Figure 11). These figures probably relate to discipline emphasis, location and nationality. The vast majority are confident that they made the right decision in choosing a specific department or programme for their studies (see Table 19, below).

Figure 11: Are the students pursuing their PhD at the same institution where they obtained their masters?



Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

There were some institutional differences. The numbers and percentages of the students obtaining their masters degrees at the same institutions were:

North-West University	(n=51)	78%
University of Cape Town	(n=135)	70%
Stellenbosch University	(n=209)	63%
University of KwaZulu-Natal	(n=80)	61%
Rhodes University	(n=70)	60%
University of the Witwatersrand	(n=64)	48%
University of Pretoria	(n=159)	47%
University of Johannesburg	(n=55)	47%

The vast majority are confident that they made the right decision in choosing a specific department or programme for their studies (see Table 19, below).

1.5 What is the capacity for doctoral supervision?

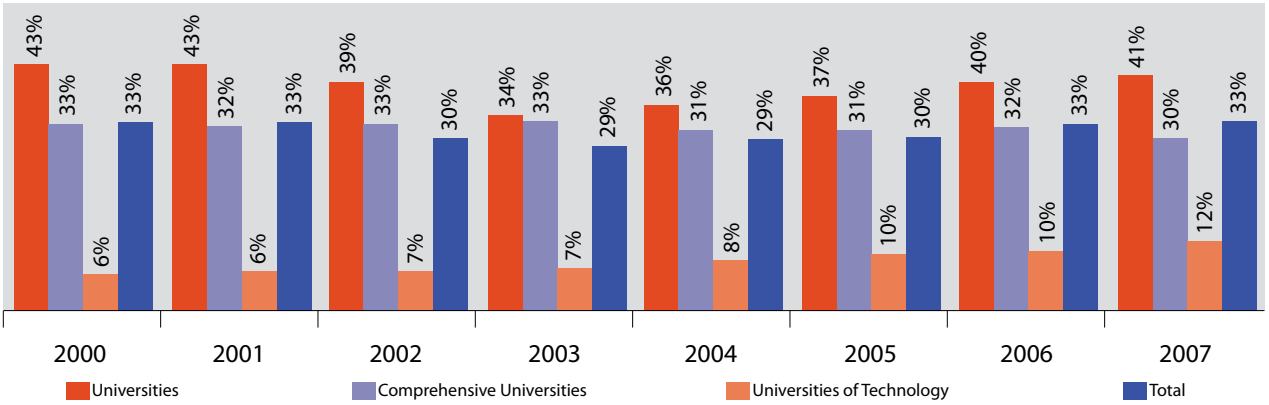
Finding 10: About a third of all permanent academic staff members at public higher education institutions in South Africa hold a doctoral qualification.

The minimum required qualification for doctoral supervision is a PhD or equivalent – preferably with some experience in supervision. The practical implication of this is that the pool of potential doctoral supervisors is determined by the number of academic staff with a PhD (or equivalent) qualification. The smaller the share of doctorate staff and the larger the ratio of doctoral students to such staff, the greater the burden of supervision tends to be.

In 2007, a total of 5 191 permanent academic staff members at South Africa's public higher education institutions held a doctorate. As a share of the total permanent academic staff complement, this figure has remained relatively constant since 2000 (32% in 2000 compared to 33% in 2007).

Figure 12 (below) clearly shows that doctoral supervisory capacity has always been highest in the University sector (41% in 2007) and lowest among Universities of Technology (12% in 2007 - although this is a significant improvement compared to the 6% in 2000).

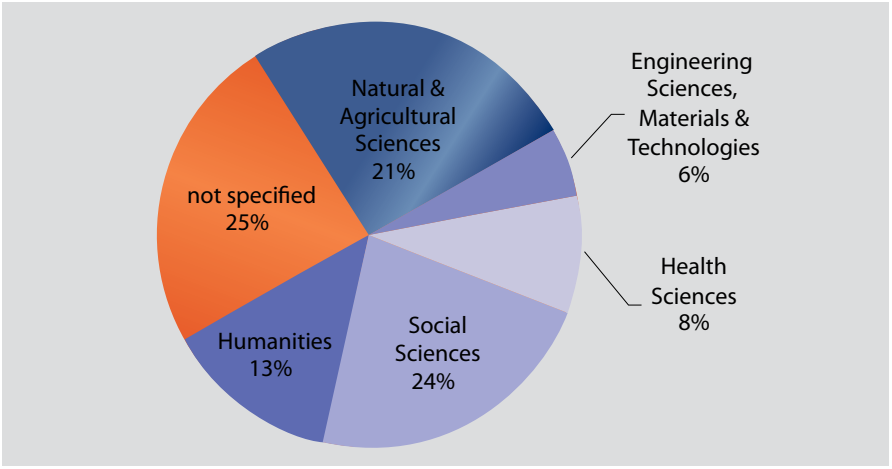
Figure 12: Share of permanent academic staff at public higher education institutions in South Africa with a doctoral qualification, by university classification, 2000-2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

When measured as a share of the total number of permanent academic staff with a doctoral qualification across all institutions, doctoral supervisory capacity is highest in the natural and agricultural sciences and the social sciences; engineering sciences, materials and technologies as well as health sciences have the lowest capacity for doctoral supervision (see Figure 13, below).

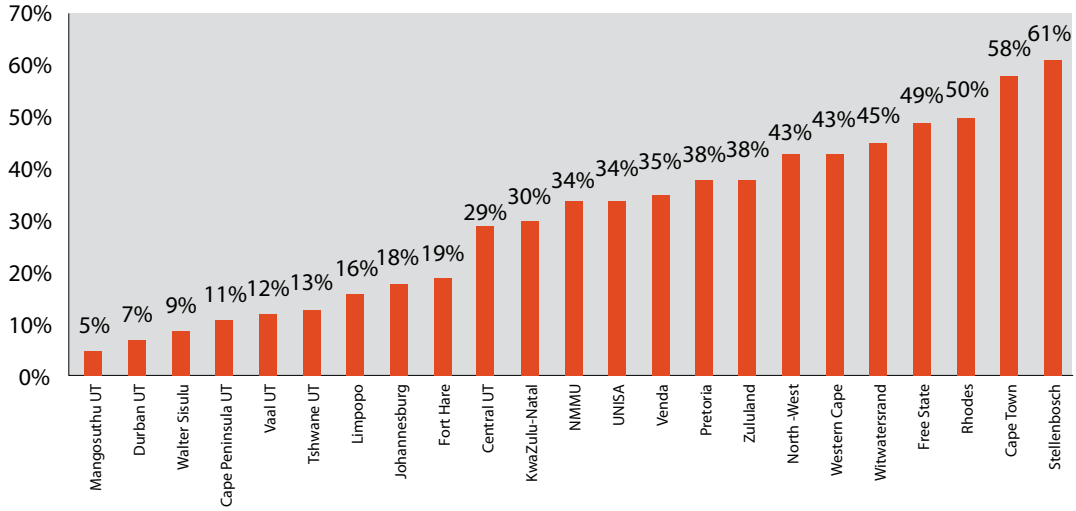
Figure 13: Share of permanent academic staff at public higher education institutions in South Africa with a doctoral qualification by broad field of study, 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Fairly significant individual differences are evident among the 23 public higher education institutions in terms of the percentage of permanent academic staff (PAS) with a doctoral qualification (see Figure 14 below).

Figure 14: % PAS with a doctoral qualification per institution, 2007



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

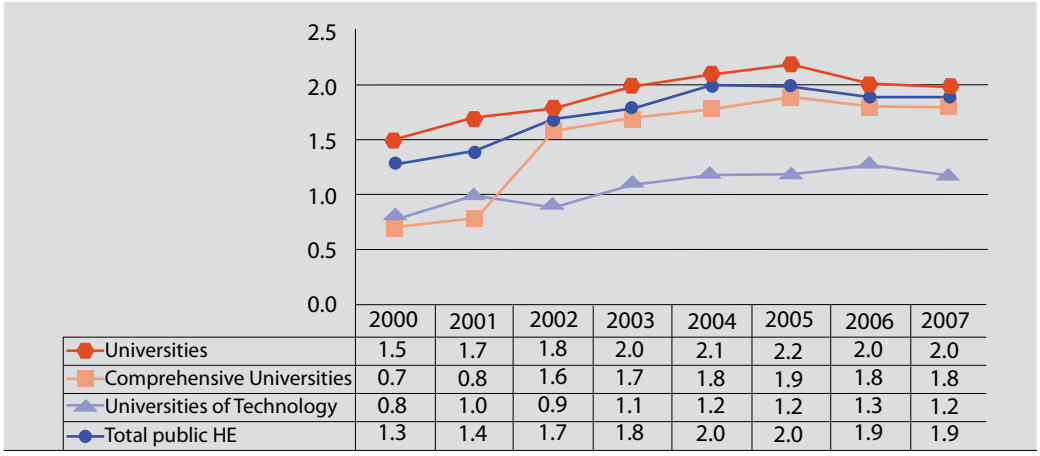
Full details of permanent academic staff members with a doctoral qualification per institution are provided in Table 29 (Appendix 2).

Finding 11: The average ratio of doctoral students to supervisors in 2007 was about 2:1 across all South African higher education institutions.

The average doctoral supervisory load of permanent academic staff is expressed in terms of the number of doctoral students per staff member. This was obtained by dividing the total number of doctoral enrolments by the number of permanent academic staff with doctoral degrees (i.e. those who are considered as meeting the minimum requirement for doctoral supervision). Even though this serves as one indicator of supervisory capacity, these ratios do not capture the full supervisory load of doctorate staff. Often these staff members are also responsible for the supervision of masters students. Co-supervisory arrangements are also common practice, meaning that each student will often have more than one supervisor.

This being said, approximately two doctoral students per supervisor appear to be the norm in the University sector, compared to a lower supervisory load of about 1.2 doctoral students per supervisor at the Universities of Technology (see Figure 15).

Figure 15: Average number of doctoral students per permanent academic staff member (with a doctoral qualification) by university classification, 2000-2007



	2000	2001	2002	2003	2004	2005	2006	2007
Universities	1.5	1.7	1.8	2.0	2.1	2.2	2.0	2.0
Comprehensive Universities	0.7	0.8	1.6	1.7	1.8	1.9	1.8	1.8
Universities of Technology	0.8	1.0	0.9	1.1	1.2	1.2	1.3	1.2
Total public HE	1.3	1.4	1.7	1.8	2.0	2.0	1.9	1.9

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Significant individual differences exist among the various institutions in terms of their student-to-supervisor ratios. Perhaps surprisingly, the highest ratios are not associated with the five strongest research-orientated universities (UCT, UKZN, UP, Wits and SU) but with the Universities of Johannesburg (UJ) and Fort Hare (UFH) – 3.4 and 2.8 doctoral students per doctorate staff member in 2007. Table 14 (below) shows the ratio of doctoral students enrolled at South African public higher education institutions to permanent academic staff members who hold a doctorate.

Table 14: Average number of doctoral students per permanent academic staff with a doctoral qualification (supervisors) by institutional type and individual university, 2000-2007

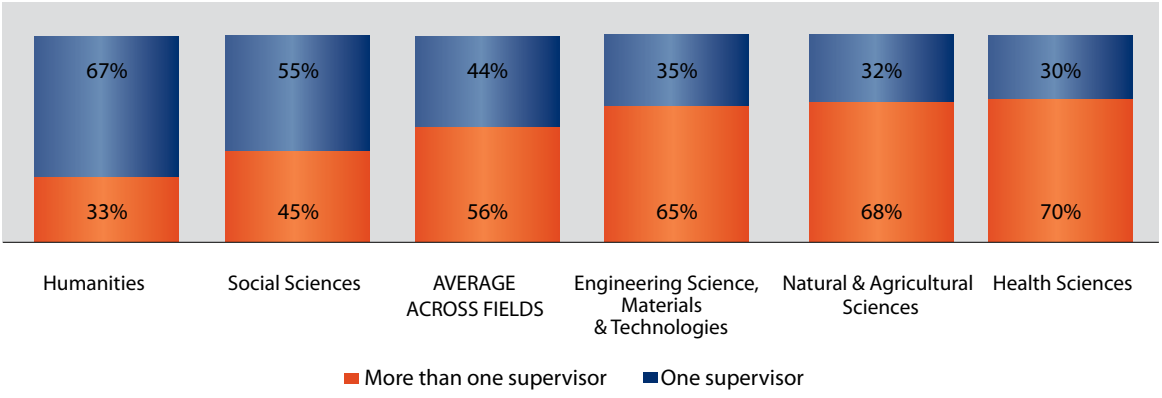
Institutional type/Institution	2000	2001	2002	2003	2004	2005	2006	2007
Comprehensive Universities	**0.7**	**0.8**	**1.6**	**1.7**	**1.8**	**1.9**	**1.8**	**1.8**
Nelson Mandela Metropolitan University	1.2	1.5	1.7	1.6	1.6	1.5	1.7	1.8
University of Johannesburg	2.1	2.3	2.7	3.3	3.1	2.8	2.7	3.4
University of South Africa	0.2	0.2	1.3	1.5	1.7	2.1	1.9	1.7
University of Venda	0.1	0.2	0.4	0.3	0.4	0.5	0.5	0.5
University of Zululand	1.2	1.6	1.8	1.9	2.2	1.7	1.4	1.8
Walter Sisulu University	0.1	0.1	0.1	0	0	0	0.4	0.3
Universities	**1.5**	**1.7**	**1.8**	**2**	**2.1**	**2.2**	**2**	**2**
North-West University	1.3	1.4	1.4	3.4	3.7	3.8	2.1	2.2
Rhodes University	1.3	1.2	1.3	1.3	1.6	1.5	1.6	1.5
Stellenbosch University	1.7	1.8	1.9	1.9	2.2	2.3	1.7	1.7
University of Cape Town	1.7	1.7	2.3	2.5	3	2.5	1.9	1.9
University of Fort Hare	0.6	0.7	0.7	0.9	1.2	3	1.7	2.8
University of the Free State	1.7	1.6	1.8	1.4	1.7	1.7	1.7	1.8
University of KwaZulu-Natal	1.2	1.5	1.7	1.8	2.3	2.3	2.3	2.4
University of Limpopo	0.4	1.4	0.9	1.1	1.2	1.4	1.4	1.3
University of Pretoria	2.1	2.4	2.9	2.7	2.5	2.3	2.4	2.4
University of the Western Cape	1	1.2	1.3	1.3	1.6	1.6	1.5	1.7
University of the Witwatersrand	1.5	1.5	1.4	1.7	1.3	1.7	2	2.2

Universities of Technology	**0.8**	**1**	**0.9**	**1.1**	**1.2**	**1.2**	**1.3**	**1.2**
Cape Peninsula University of Technology	0.6	0.5	0.8	0.8	0.9	1	1.4	1.2
Central University of Technology, Free State	1.1	1.6	2	1.9	1.9	2.2	1.9	1
Durban University of Technology	1.1	1.4	0.5	0.8	1.2	1.4	1.4	1.4
Tshwane University of Technology	0.8	1	1	1.1	1.2	1.2	1.3	1.3
Vaal University of Technology	0.7	0.6	0.6	1	0.8	0.9	0.8	0.9
Total	**1.3**	**1.4**	**1.7**	**1.8**	**2**	**2**	**1.9**	**1.9**

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Most doctoral students at South Africa's public higher education institutions have at least two supervisors (see Figure 16, below). About 64% of co-supervisors are from the same institution as the main supervisor – mostly from the same department (45%) – and only a small percentage are from industry (3%) or a science council or national research facility (6%). There is variation between broad fields of study, with students in the social sciences and humanities being significantly more likely to have only one supervisor than those in other fields.

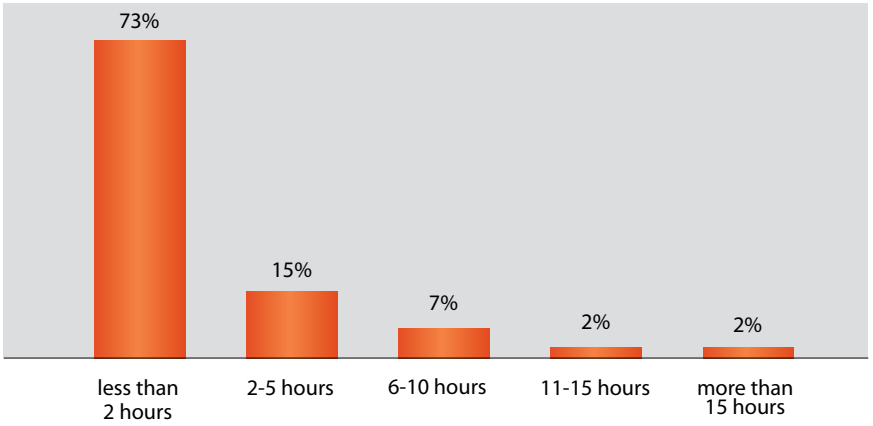
Figure 16: Supervisors per doctoral student at public higher education institutions in South Africa by broad field of study, 2007



Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

Social science and humanities students also receive significantly less supervision time. About 80% of students in these fields indicate that they spend less than two hours per month with their supervisor(s), as opposed to just over two-thirds of students in health sciences, natural and agricultural sciences and engineering science, materials and technologies. Across fields, only 26% of doctoral students indicate that they receive two or more hours of supervision per month (see Figure 17, below), with supervisors spending progressively less time with their students from the third year onwards – by the 6th year of enrolment, only 14% of students spend two or more hours per month with their supervisor(s). As can be expected, full-time students receive significantly more hours of supervision than their part-time counterparts.

Figure 17: Hours of supervision received per month by doctoral students at public higher education institutions in South Africa, 2009



Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

The fact that only about 40 to 50% of the academic staff at South Africa's more research-intensive universities have doctorates poses a serious constraint on any substantive growth in doctoral enrolments in the near future. Coupled with the continuing ageing of the same cohort, the 'burden of supervision' is possibly the single largest threat to any major initiative to increase doctoral output in the next decade.

At the time of writing this Report, the first Higher Education Quality Committee (HEQC) audit cycle (which commenced in 2005) was nearly complete. Inspection of the HEQC Audit Panel reports of nine universities indicates that quality assurance mechanisms in many cases were found wanting[73]. Universities are criticised, amongst other things, for:

- not providing adequate support for their postgraduate students;
- a lack of clarity on guidelines to postgraduate students on the doctoral process;
- a lack of formal training for supervisors;
- inconsistent application of rules regarding supervision and examination across faculties within the same university;
- inadequate monitoring and information systems to track postgraduate students.

Interestingly, many of these critical comments were directed at the established and strong research universities, and they were encouraged to improve their quality assurance and support structures for postgraduate education.

Finding 12: It is evident that the traditional apprenticeship model may not be an efficient approach for the purpose of rapidly increasing the production of doctoral graduates in South Africa.

Four main models of training doctoral students in South Africa were identified:

- The traditional model is the apprenticeship model of individual mentoring. This model is usually supplemented by informal and *ad hoc* support programmes.
- The course work approach, which comprises a more formalised curriculum in addition to apprenticeship.
- The cohort-based model provides a critical mass of students and supervisors and supposedly offers economies of scale.
- The PhD by publication.

The models are differentiated by whether or not (1) the student works with researchers or academics other than his/her immediate supervisor(s); (2) the student

> *"… it is really an old-fashioned apprenticeship; I think the strength of working like this is that it's a slow process, but it's a sure process. It's very time-consuming. And it cannot be mechanised."*
> (Interviewee: Exemplary PhD Programmes)

[73] Unpublished assignment conducted by Mouton for the HEQC.

works within a group with other students; (3) the doctoral studies include formal course work; and (4) the doctorate is examined on the basis of peer-reviewed academic papers. The models are not mutually exclusive but rather they often have shared characteristics, and doctoral programmes may adopt hybrid versions (Box 2, below).

In South African public higher education institutions there is a persistence of the apprenticeship model of individualised and personal relationship between the supervisor and the PhD student. However, new pathways to a PhD are emerging to fill the need for more diversified modes of delivery for the knowledge economy. There are three prevalent understandings among PhD programme leaders with regard to the purpose of the PhD: (1) as training for an academic career; (2) as training for industry; and (3) as training for a profession. While some of the programmes focus on only one goal, most try to achieve a hybrid of at least two purposes. It is evident that as the purposes of the doctorate are changing, so are the modes of delivery, provision, pedagogy, policy and funding.

The availability of appropriately qualified doctoral supervisors is particularly important within the South African context, where the traditional apprenticeship model remains the most prevalent approach to doctoral education. It is evident that the traditional approach – being based on the availability of suitably qualified supervisors – serves a relatively small number of students and may not be an efficient model for rapidly increasing PhD production, especially when it involves a one-on-one student-supervisor relationship. As indicated above, the shortage of suitably qualified academic staff and the continuing ageing of the same cohort pose a serious constraint on any substantive growth in doctoral enrolments in the near future.

Internationally, there is a growing trend towards abolishing the apprenticeship model in favour of more structured research education and training within disciplinary or interdisciplinary programmes or graduate schools[74]. The new types of programme that have been created are intended to reduce the duration of doctoral education, to reduce drop-out rates, and to provide more targeted research training. Typically they include course work.

The study found that there is an increasing trend to incorporate some kind of course-based programme, or an expressed wish to do so. A number of PhD programme leaders maintain that they would like to emulate the concept of a course work PhD in order to ensure the quality of the input. It is important to remember, however, that doctoral training is context-dependent. What may work well in one discipline, or at one university, or in one country, may not be directly transferable to other areas. The assumptions regarding the success of course-based doctorates need to be tested as they have various unintended consequences.

Furthermore, it should be noted that the proliferation of types and models for doctorate education have also triggered some criticism, and the full impact and consequences of these changes continue to unfold and become apparent in international research literature[75].

Recent innovative supervision practices, such as supervisory committees, joint supervision, virtual faculty and consortia, could potentially increase supervisory capacity and expose students to additional expert knowledge. These innovations also provide opportunities to make use of the large numbers of staff members with doctoral qualifications employed within South Africa's national science councils, which represent an underutilised source of doctoral supervisory capacity. Cohort-based and course-based models could also maximise the available supervisory capacity, but they remain resource-intensive (in terms of time and money), require institutional support and infrastructure, and may not be applicable across all contexts (i.e. different aims, fields of study and modes of research).

[74] Kehm, B.M. (2004)
[75] Park, C. (2005b)

Box 2: Four models of doctoral education within the South African context, 2009

Traditional apprenticeship

The main feature of the traditional apprenticeship model is the development of an informal, unstructured, *ad hoc* and individualised, one-on-one mentoring relationship between student and supervisor. It generally does not include any course work and is defined as a delivery model "whereby PhD students are expected to learn the necessary skills and competencies from their supervisors"[76].

Even though this is still the most prevalent approach to doctoral education at public higher education institutions in South Africa, there is an acknowledgment of the vulnerability of the model, especially when the student is relying on only one supervisor. In response, various mechanisms are being used to supplement the apprenticeship model to expose students to the experience of additional supervisors. These include forming various co-supervisory arrangements, establishing doctoral student groups and providing formal opportunities for regular scholarly exchanges and debate between students and academics other than the main supervisor. However, the exposure of the students to all these possibilities still depends on the individual supervisor.

Cohort-based

The cohort-based model represents a shift from doctoral education as a solitary experience defined by an individual student-supervisor relationship, to a shared (group) experience defined by a specified time cycle. A PhD cohort can be defined as "a year-group of self-minded doctoral candidates who study together in workshops, progress through doctoral studies together, are identified by others as a group and identify themselves as a group"[77] and generally include a strong course work component.

Some of the reported advantages of a PhD cohort in the South African context are that it provides a critical mass of students and supervisors and theoretically offers economies of scale. It also provides structure and clear achievement benchmarks for students within the training process, it ensures the development of a 'community of scholars', and it creates opportunities for students to network and learn from one another, thereby lessening the isolation of young researchers.

There are also disadvantages to the cohort model, such as dominant group members or lack of commitment to the cohort. The cohort may also create pressures, especially in the advanced stages when students tend to have different timeframes. There is a certain degree of competition (though this is not always a negative consequence).

There is also a view that cohort students are being segregated from colleagues outside the group, and that these students may be perceived as being more privileged than other PhD students. Finally, the cohort approach requires funding, infrastructure and compatibility with the existing tradition of research.

The project-based model is a type of cohort-based model in that students also study in a group. It does not, however, necessarily include collaboration with other students, course work or a specified time cycle. In this approach students are assigned to a research project upon admission and work in close collaboration with their supervisors and other junior and senior researchers as an integrated part of an ongoing project. It is said that working in a project enhances the students' research skills and their level of commitment. However, projects are usually pre-defined by the supervisor – who also provides the necessary funds and bursaries – and students therefore do not initiate their own research.

Course-based

In this model, the doctoral programme includes a structured curriculum in addition to individual supervision (i.e. apprenticeship model). Course work provides students with input from a variety of academics and usually focuses on epistemology, research methodology, critical thinking skills and discipline-specific theory. The course-based model is usually presented in a cohort format, but can also be utilised as a competency-based model, i.e. tailored to an individual student's previous academic qualifications, work experience and learning goals.

Some supervisors consider PhD-level course work to be a critical part in the development of the student. It is often noted that coursework is required at this level in the South African context to compensate for the lack of adequate research training at the undergraduate, honours and masters levels.

[76] Ulhøi, J P. (2005)
[77] Leshem, S. (2007)

There is, however, resistance to the course work model from students as well as institutions. Where course work is presented in a cohort format, students sometimes feel that some courses do not relate directly to their topics. The model is also a resource-intensive approach to doctoral education, it is far removed from the traditional model, and it is not accredited by the HEQF.

PhD by publication
PhD by publication is accredited in a number of faculties at South African public higher education institutions. This model is defined by Park[78] as a doctorate that is "... based largely on the supervised research project, but examined on the basis of a series of peer-reviewed academic papers which have been published or accepted for publication, and usually accompanied by an overarching paper that presents the overall introduction and conclusions." There are, however, different conceptions of what counts as a publication and how a dissertation is constructed and assessed.

Source: *Exemplary PhD programmes* (see Appendix 1)

1.6 What are the conversion rates from masters to doctoral degrees?

Finding 13: Major blockages along the educational route towards the doctorate severely limit the pool of potential PhD graduates.

In considering the systemic blockages which impact on the production of PhD graduates, both the normative and policy context which frame current actions and initiatives in doctoral education and the structural factors that constrain such actions need to be taken into account.

The review of the policy and strategic initiatives that have some relevance to postgraduate education and doctoral production clearly showed that high-level skills development has been a core demand and imperative of the new government since 1994. More recently, and as the evidence has mounted that our system was producing too few doctorates, these goals and objectives were further operationalised in the business plans of the NRF and DST and even targets specified. All of this culminated in the most concrete expression of government's intention to spur action in this field when the new funding framework was passed by the Department of Education in December 2003 and came into effect in 2004. Under this framework, the production of research masters and doctoral graduates would be rewarded to such an extent that it has prompted universities to respond more systematically and more proactively. The reward system has in fact become the most significant incentive scheme for increasing doctoral production. It is too early to tell what the systemic impact of the new funding formula has been. Thus, government has through various policy, strategic and funding frames sent a clear signal to higher education regarding the strategic importance of increasing high-level research output and its intention to reward those institutions which accept the challenge.

The regulatory instruments used by the Department of Education to steer and regulate the higher education sector were viewed in some areas as being quite interventionist. Although enrolments at the postgraduate level were therefore not at any stage capped by the Department, its policy of capping enrolments at the undergraduate level as well as decisions regarding limiting growth in distance education programmes would of necessity impact on the size and growth of the 'pipeline'. A review of the enrolment planning decisions by the Department and subsequent responses from the higher education sector illustrated quite vividly that institutional capacities (physical resources, lecture halls, laboratories, residences) are limited and were cited as major obstacles to any attempt to increase enrolments as part of the overall goal of increasing participation rates in higher education.

The policy and regulatory framework is thus largely encouraging of increased production of doctoral graduates, and it is thus obvious that the major blockages occur as a result of structural constraints. Four categories of 'structural' constraints were identified:

(1) Pipeline constraints
- o quality of students exiting a dysfunctional school system;
- o blockages in the graduate and postgraduate pipeline.

[78] Park, C. (2007)

(2) Institutional constraints: limited supervisory capacity at South African universities.
(3) Financial constraints: inadequate funding for doctoral studies.
(4) Administrative constraints: rules and procedures in government departments that have an impact on doctoral education.

Constraints associated with the pipeline of doctoral students constitute the most serious challenges to growth in doctoral production. These include a number of interrelated problems: students entering the higher education system who are increasingly less well-prepared for university studies (which points to the failure of our schooling system) (see Box 3), low conversion rates at the postgraduate level, a possible decline in first-enrolments at the masters and doctoral levels, and an interaction effect with age which means that the pile-up effects are even more pronounced for 'late' entrants into the doctoral system.

Box 3: Preparedness of students for university study

Various studies over the past number of years have expressed concern about the high drop-out rates (between 40% and 50%) for first-year students and subsequent low graduation rates, especially among black students. From a study commissioned by Higher Education South Africa (HESA) it is clear that the country's school system is continuing to fail its pupils and the country – with most first-year students being unable to adequately read, write or comprehend. Competency tests on first-year students indicate that:

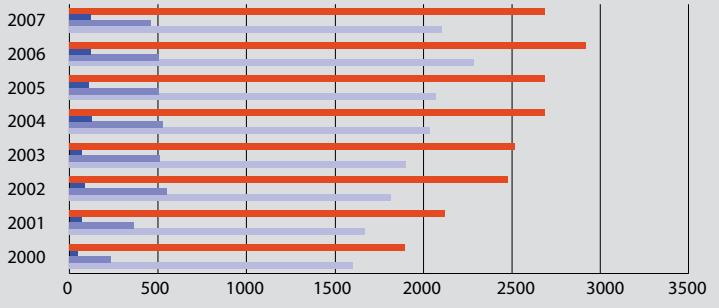
- In terms of academic literacy, 47% of students were proficient in English; 46% fell into the 'intermediate' category, and 7% had only 'basic' academic literacy.
- Only 25% of students were proficient in quantitative literacy, while 50% attained intermediate level, and 25% basic level.
- Only 7% of students were found to be proficient in skills needed to study first-year mathematics; 73% had intermediate skills, while 20% had basic skills and would need long-term support.

The implications are significant in that they clearly show the undergraduate pipeline challenges faced by universities. Unless the schooling system in the country produces better quality matriculants, universities will struggle to reverse current trends of low and even declining throughput and completion rates.

Source: *Systemic blockages in postgraduate education and training* (refer to Appendix 1)

The immediate source of potential doctoral graduates is new doctoral enrolments, and of concern is that first-enrolments declined steeply for the first time in 2007 – to be less than the number for 2004 (see Figure 18, below). It is too early to determine if this is the beginning stage of a new declining trend, but it does give cause for concern.

Figure 18: Headcount of doctoral first-enrolments, by university classification, 2000 to 2007



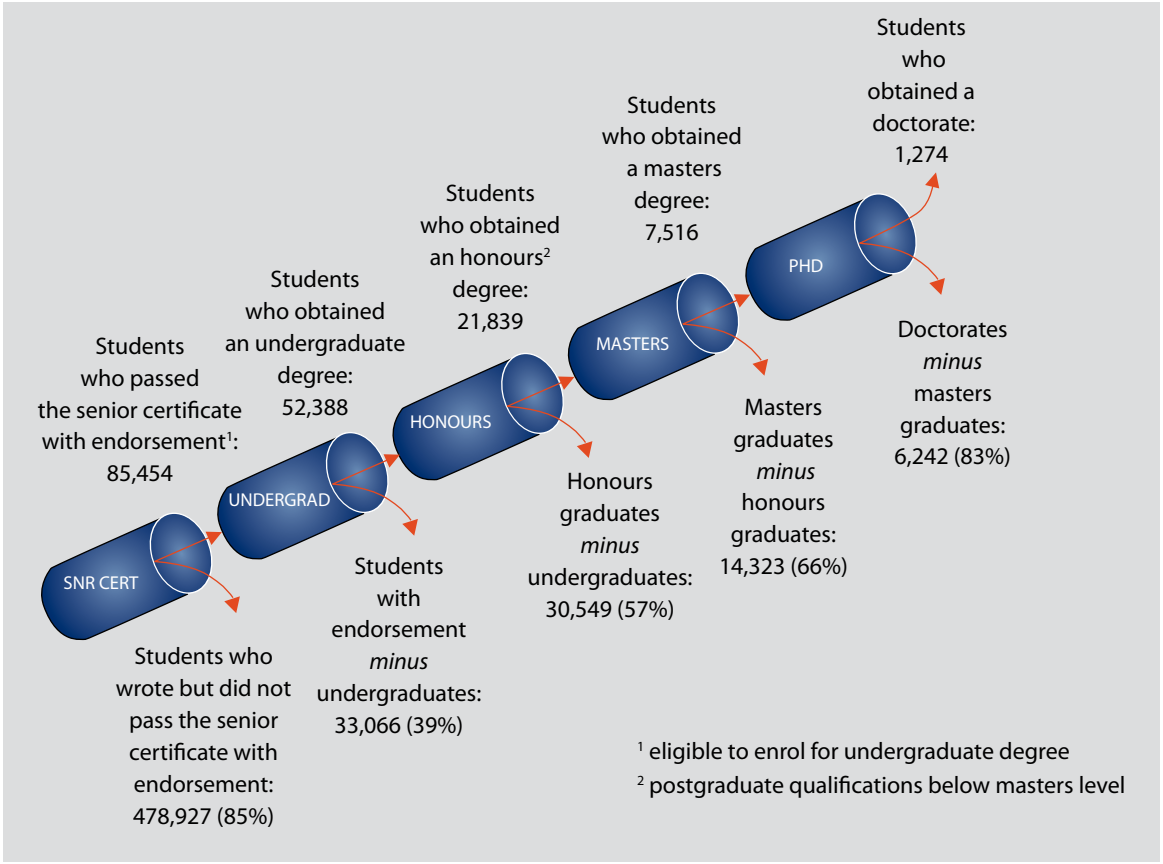
	2000	2001	2002	2003	2004	2005	2006	2007
Total first-enrolments	1897	2122	2481	2519	2693	2693	2916	2684
Universities of Technology	54	68	92	70	123	112	126	118
Comprehensive Universities	231	362	553	514	530	508	507	460
Universities	1600	1672	1820	1902	2040	2072	2283	2106

Source: *Systemic blockages in postgraduate education and training* (refer to Appendix 1)

Some clues as to the relatively low PhD production rate in South Africa may be garnered when investigating the route from the final year of secondary education towards the doctorate (that is the PhD pipeline). The ratio of learners writing the national senior certificate examination in 2007 to those who graduated with a PhD was 443:1. Put another way, only 0.2% of learners who attempt the final examination prior to the tertiary level of education eventually obtain a doctorate.

'Leaks' occur all along the pipeline, with increasingly smaller shares of students completing the subsequent level of education (see Figure 19). The most severe blockages are located at the senior certificate level (85% of 2007 senior certificate candidates did not attain the minimum level of achievement to enrol for an undergraduate degree) and at the postgraduate level. When doctorates are calculated as a share of all undergraduate degrees conferred in 2007, only 2% of undergraduates obtained a doctorate.

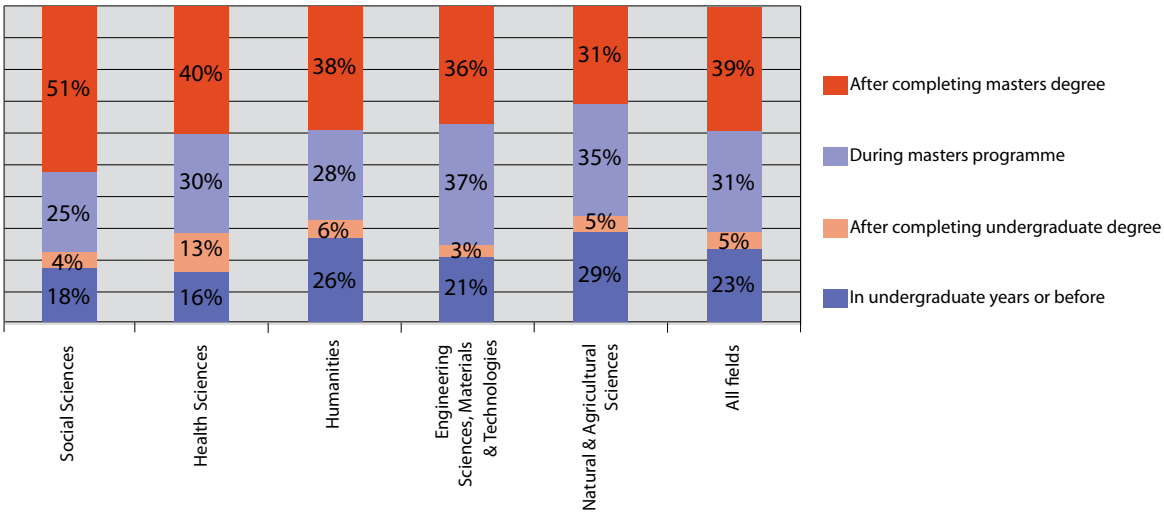
Figure 19: The South African PhD pipeline in 2007



Data source: Undergraduate and senior certificate data from South African Department of Education: *Education Statistics* (http://www.education.gov.za/emis/emisweb/statistics.htm); postgraduate data from *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

With this as background it is pertinent to ask at what point within the PhD pipeline students decide to pursue a doctoral degree. Figure 20 (below) indicates that less than a third of doctoral graduates decided to continue towards the doctorate during or after their undergraduate studies. Most students made this decision only after they had entered or completed their masters studies, suggesting that the masters programme serves as an important catalyst for continuation. There are, however, field-specific differences: students in the natural and agricultural sciences are most likely to make the decision during their masters studies, while those in social sciences postpone the decision until after completion of the masters degree.

Figure 20: Stage within PhD pipeline when doctoral students at public higher education institutions in South Africa decide to pursue a doctorate by broad field of study, 2009



Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

Finding 14: From 2000 to 2006, the average conversion rate from masters to doctoral degrees is estimated at 37%.

In South Africa, the successful completion of a relevant masters degree is the only entrance requirement for a doctoral degree. It was therefore considered worthwhile to establish what share of masters graduates enrol for a doctoral degree directly after completion of their masters degrees. Conversion rate refers to the share of masters graduates who enrol for a doctoral degree directly after completion of their masters degrees. When doctoral first-enrolments in year X+1 (e.g. 2006) are calculated as a share of masters graduates in year X (which refers to the previous year, 2005), the average conversion rate from masters to doctoral degrees is only 37% (see Table 15, below).

It must be remembered though that some doctoral students might have first moved into employment or have taken a 'grace' period after completion of their masters. Also, not all doctoral students have completed their masters at a South African university. This means that not all students who first enrol for a doctoral degree in year X+1 (e.g. 2007) are to be found among the group of masters graduates in year X (which refers to the previous year, 2006). This method of calculation serves as a rough indicator of the share of masters students who continue with doctoral studies.

Table 15: Masters-to-doctorate conversion rates for public higher education institutions in South Africa, 2000-2006

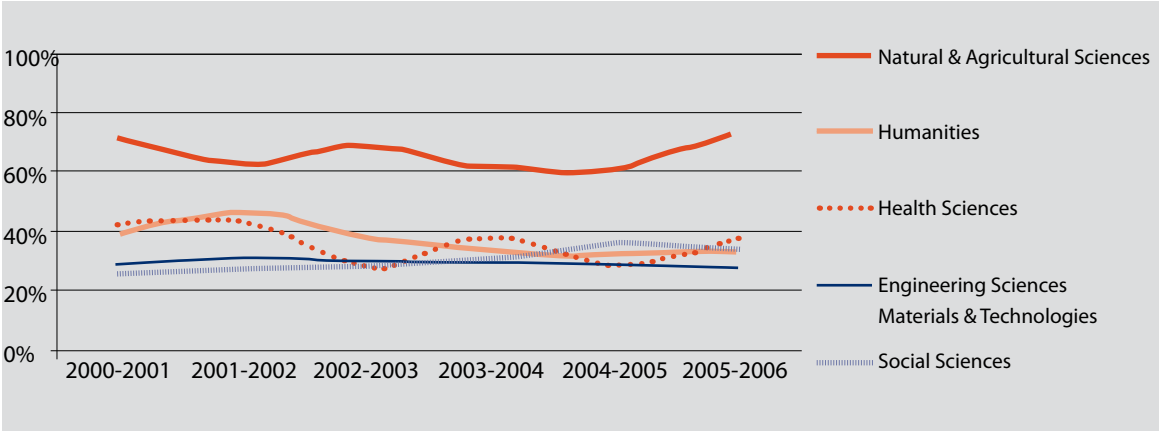
[A] Masters graduates in Year X		[B] Doctoral first-enrolments in Year X+1		[B]/[A]
Year	Headcount	Year	Headcount	
2000	5795	2001	2122	37%
2001	6426	2002	2481	39%
2002	6871	2003	2519	37%
2003	7396	2004	2693	36%
2004	7536	2005	2692	36%
2005	7881	2006	2916	37%

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

In comparing trends in the graduation rates of masters and honours students, these reveal that the conversion rate between honours and masters students averages around 2.9 (it 'takes' approximately 2.9 honours graduates to produce one masters graduate); whilst the conversion from masters to doctorate averages around 6.9 (every seven masters graduates convert into one doctoral graduate). While, compared to international standards, this is by no means satisfactory, possibly a larger challenge is to understand how to translate more bachelors graduates into masters graduates. On the one hand this is partly tied in with the structure of the degree system, while, on the other, it relates to the way in which the bachelors degrees are prosecuted.

As Figure 21 (below) indicates, students in the natural and agricultural sciences are more likely to continue with doctoral studies directly after completing a masters degree than their counterparts in other fields of study (61-73%, compared to the system average of 37%). However, in the social sciences, where the corresponding shares vary between 29-30%, the transition from masters to doctoral studies appears to be more interrupted. This observation is in line with the finding that social science students tend to postpone the decision to continue with the doctorate until after they have completed their masters degree, and also supported by the fact that doctoral first-enrolments in the social sciences are significantly older than those in the natural and agricultural sciences when starting their degree (41 years versus 33 years, based on figures for 2007). Corresponding mean ages for the other three broad fields are as follows: engineering sciences, materials and technologies (34 years), health sciences (38 years), and humanities (41 years).

Figure 21: Masters-to-doctorate conversion rates for public higher education institutions in South Africa by broad field of study, 2000-2006



Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

The decision to pursue a doctoral degree is of a personal nature, and one that needs to match one's ultimate career and life goals[79]. The most prevalent reasons why students in South Africa decide to pursue doctoral studies are that they enjoy academic work or research; personal fulfilment, achievement and satisfaction; or because it was a natural continuation of their studies or career (see Box 4, below). Other common reasons include a particular interest in a specific subject area and preparation for a career.

"The doctorate enables me to interact at the highest level in the scientific community, to improve my creative abilities and to make me a more independent person."
(Respondent: A survey of current PhD students in South African Universities)

The latter observation is also supported by another study, which found that the employer plays a role in the decision to pursue a doctoral qualification for the majority (52%) of doctoral graduates who worked while studying, particularly those students employed in the higher education sector, at science councils and in government. It would therefore not be unreasonable to assume that an employed person pursuing a doctoral degree would have some level of expectation that such a qualification would have an impact on their working environment. Interestingly, though, these same graduates claim that while their titles and status at their place of work changed after graduation, and to a lesser degree their responsibilities, their income, key tasks and position did not necessarily change accordingly.

Box 4: Most prevalent reasons why students at South Africa's public higher education institutions pursue doctoral studies, 2009

1. It is a natural continuation of my studies/ career
2. I wanted to prepare myself for a career in teaching or research at a higher education institution
3. I wanted to pursue personal interests
4. I wanted to prepare myself for some other professional career
5. I was encouraged by someone
6. I wanted to earn more money, and expected that earning will increase with a doctorate
7. I wanted to change my field of study
8. I wanted to change my field of work
9. I could not find a job so I decided to go back to study

Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

1. I enjoyed academic work/research
2. I was particularly interested in the subject area
3. Mainly for personal fulfilment, achievement and satisfaction
4. I thought it would lead to enhanced career opportunities
5. I had a particular career in mind for which a PhD was important
6. To achieve a better long-term income
7. I wanted to postpone job hunting/career decisions
8. I could not find employment so I decided to go back to studying

Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

1. Personal reasons and fulfilment
2. Required by employer
3. Supervisor involvement and encouragement

Source: *Doctoral attrition study* (refer to Appendix 1)

1.7 What is the time-to-degree for doctoral students?

Finding 15: The average time-to-degree completion for doctoral students was 4.8 years in 2007, up from 4.6 years in 2000.

In accordance with the HEQF, 2007, the research dissertation/thesis is at the centre of each PhD programme, which corresponds to the concept of the PhD as training for academia. According to the HEQF, the graduate is required to "demonstrate high-level research capability and make a significant and original academic contribution at the frontiers of a discipline or

[79] Kamas, L.; Paxson, C. Wang, A., & Blau, R. (1995)

field" and "must be able to supervise and evaluate the research of others in the area of specialisation concerned"[80]. The HEQF assumes that these outcomes can be achieved in only two years of full-time study – which is the minimum duration of a PhD. However, doctoral students at South African public higher education institutions spend (on average) almost five years on completing their degrees (see Table 16 and Figure 22, below).

Figure 22: Average time-to-degree completion, 2000-2007

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Males generally (in 2007) took less time (4.1 years) to complete their degrees than their female counterparts (4.9 years); whites took longer than the other races to complete their degrees (5 years on average, compared to 4.5 years for African and Coloured graduates). In addition, we see that the older the student at the time of graduation, the longer the time taken to degree completion (in 2007 graduates younger than 30 took 3.6 years on average, compared to 5.7 years in the case of graduates in the 50+ age group). Similarly, South African nationals also spent more time on completing their degrees (4.9 years), compared to students from other countries (4.5 to 4.6 years).

In terms of broad field of study, those in the health sciences tended to take less time (4.5 years) to graduate than their counterparts in other disciplines. Those in the humanities took the most time to complete (5.3 years).

[80] Republic of South Africa. Ministry of Education (2007)

Table 16: Average time (in years) to degree completion for doctoral students at public higher education institutions in South Africa by selected demographic variables, 2000-2007

Demographic variables	2000	2001	2002	2003	2004	2005	2006	2007
University classification								
Universities	4.7	4.5	4.6	4.6	4.6	4.9	4.7	4.8
Comprehensive Universities	4.3	4.3	4.2	4.1	3.9	4.5	4.4	4.9
Universities of Technology	4.8	3.9	3.7	4.0	3.6	3.2	4.0	4.0
Broad field of study								
Natural & Agricultural Sciences	4.8	4.6	4.7	4.6	5.0	4.9	4.7	4.8
Engineering Sciences, Materials & Technologies	5.0	5.0	4.3	4.3	4.8	4.5	4.7	4.6
Health Sciences	4.8	4.2	4.2	4.5	4.5	4.5	4.7	4.5
Social Sciences	4.4	4.3	4.3	4.3	3.7	4.6	4.4	4.6
Humanities	4.2	4.5	4.6	4.6	4.8	5.0	5.2	5.3
Gender								
Female	4.4	4.3	4.5	4.3	4.3	4.7	4.7	4.9
Male	4.7	4.6	4.5	4.6	4.5	4.7	4.7	4.7
Race								
African	4.2	4.2	4.3	4.2	4.3	4.7	4.4	4.5
Coloured	4.5	4.6	4.3	4.2	4.1	4.6	5.7	4.5
Indian	4.6	4.2	4.4	4.4	4.2	4.5	4.4	4.7
White	4.7	4.6	4.6	4.6	4.6	4.8	4.8	5.0
Age at graduation								
<30 years	3.7	3.5	3.4	3.6	3.3	3.5	3.6	3.6
30-39 years	4.5	4.6	4.5	4.5	4.6	4.7	4.7	4.7
40-49 years	5.0	5.0	5.0	4.8	4.3	4.9	4.9	4.9
50+ years	5.6	5.0	5.3	5.4	4.9	5.4	5.1	5.7
Nationality								
South Africans	4.7	4.6	4.6	4.6	4.4	4.8	4.8	4.9
Other SADC* nationals	4.5	4.3	4.3	4.4	4.8	5.0	4.4	4.5
Nationals from other African countries	3.9	3.6	4.0	3.8	4.4	4.4	4.1	4.5
Nationals from rest of world	3.9	3.7	4.3	4.1	4.7	4.5	4.8	4.6
TOTAL	**4.6**	**4.5**	**4.5**	**4.5**	**4.4**	**4.7**	**4.7**	**4.8**

* Southern African Development Community

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

The term 'pile-up' refers to the state of affairs where students remain enrolled for their degree much longer than expected. One indicator to measure this pile-up effect is the number of ongoing doctoral enrolments as a percentage of total doctoral enrolments. Ongoing enrolments are neither first-enrolments (i.e. students who are enrolled for a doctoral degree for the first time) nor graduates (i.e. students who have fulfilled the requirements of a doctoral programme and can be awarded the qualification). Total enrolments represent the sum of these three categories (i.e. first-enrolments, ongoing enrolments and graduates). An increase in the value of the indicator shows that more students are remaining or 'piling up' in the system. As can be seen in Table 17 below, the share of graduates is more or less constant across years whereas the share of first-enrolments shows a decline and the share of ongoing enrolments an increase. About 55% of all doctoral students in 2000 were recurring students and in 2007 this figure had increased to 61%, indicating a pile-up effect (see Table 17, below).

Table 17: 'Pile-up' of doctoral students in public higher education institutions in South Africa (2000-2007)

	2000	2001	2002	2003	2004	2005	2006	2007
Headcounts								
First-enrolments (X)	1897	2122	2481	2519	2693	2692	2916	2684
Graduates (Y)	719	733	910	956	1008	1093	994	1163
Ongoing enrolments (Z) (Neither first-enrolment nor graduate)	3236	3495	4307	4830	5324	5566	5826	6125
Total enrolments (X+Y+Z)	5852	6350	7698	8305	9025	9351	9736	9972
Indicators								
First enrolments as % of total enrolments [X/(X+Y+Z)]*100	32%	33%	32%	30%	30%	29%	30%	27%
Ongoing enrolments as % of total enrolments [Z/(X+Y+Z)]*100	55%	55%	56%	58%	59%	60%	60%	61%
Graduates as % of total enrolments [Y/(X+Y+Z)]*100	12%	12%	12%	12%	11%	12%	10%	12%

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Similar pile-up effects are also visible in the broad fields of study (see Table 18, below). The exception is natural and agricultural sciences, where piling-up appears to be reversed as the share of recurring students decreased between 2000 and 2007. The share of recurring students is highest among white students and South African nationals. Pile-up effects are linearly related to the age of doctoral students – the older the group of students, the more pronounced the pile-up effect appears to be.

Table 18: Pile-up of doctoral students in public higher education institutions in South Africa by selected demographic variables, 2000-2007

Demographic variables	2000	2001	2002	2003	2004	2005	2006	2007	Trend
University classification									
Universities	57%	58%	57%	58%	59%	58%	59%	61%	↑
Comprehensive Universities	45%	36%	55%	60%	61%	64%	65%	64%	↑
Universities of Technology	47%	46%	42%	55%	47%	58%	56%	59%	↑
Broad field of study									
Natural & Agricultural Sciences	60%	60%	58%	58%	59%	55%	57%	57%	↓
Engineering Sciences, Materials & Technologies	58%	55%	54%	64%	58%	66%	56%	62%	↑
Health Sciences	53%	59%	60%	58%	56%	58%	57%	63%	↑
Social Sciences	49%	49%	51%	54%	56%	59%	60%	62%	↑
Humanities	58%	56%	60%	63%	65%	64%	66%	66%	↑
Gender									
Female	53%	54%	55%	58%	59%	60%	59%	62%	↑
Male	57%	55%	56%	58%	59%	60%	60%	61%	↑
Race									
African	51%	53%	52%	57%	57%	57%	58%	59%	↑
Coloured	45%	48%	46%	53%	45%	50%	54%	55%	↑
Indian	52%	56%	54%	55%	54%	57%	57%	62%	↑
White	58%	57%	59%	60%	62%	63%	63%	65%	↑
Current age									
<30 years	51%	50%	50%	51%	51%	51%	48%	54%	↑
30-39 years	56%	56%	56%	59%	62%	59%	58%	60%	↑
40-49 years	57%	55%	57%	58%	59%	60%	64%	64%	↑
50+ years	61%	58%	62%	66%	65%	66%	67%	68%	↑
Nationality									
South Africans	56%	55%	56%	58%	59%	61%	61%	64%	↑
Other SADC* nationals	49%	52%	56%	60%	57%	56%	58%	59%	↑
Nationals from other African countries	47%	48%	53%	52%	55%	52%	51%	52%	↑
Nationals from rest of world	55%	56%	62%	62%	63%	61%	64%	60%	↑
TOTAL	55%	55%	56%	58%	59%	60%	60%	61%	↑

* Southern African Development Community

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Obviously, one would expect an association between larger shares of recurring students and longer time periods spent on degree completion (see Table 18, above). The only instance where the findings of the pile-up effect and time-to-degree analyses appear to be incongruent relates to the broad field: doctoral graduates in natural and agricultural sciences do not spend the least time (of all fields) on degree completion, as is expected on the basis of the results of the pile-up analysis. In fact, in 2007, doctoral graduates in natural and agricultural sciences recorded the second longest period of time-to-degree, after graduates in the humanities[81].

Doctoral students experience work commitments, problems with access to facilities and resources, financial or funding problems and issues with supervision as the four main obstacles to on-time completion of their studies. However, the more personal obstacles (such as academic or financial challenges, and family or work commitments) seem to weigh more heavily than institutional obstacles (such as supervision, access to facilities and interaction with academic or other students).

Work commitment was slightly different for those who work full time and study part time compared to those who study full time and work part time. Time conflicts (as well as those of energy) are the greatest concerns for both groups.

The other common problem was constant interruption to studies and the difficulty of re-starting after being involved in other things. It often meant repeating work already done and moving backwards in terms of progress.

For those who worked full time while studying part-time, it was easier when the PhD topic was related to their work. Academics who studied full time while tutoring and lecturing part-time indicated that while they gained valuable experience in academia, they lost their own research time for their PhD studies.

Balancing work, study and family was often viewed as a priority issue. Yet when choices had to be made, the PhD studies often took last place.

Problems with access to facilities and resources included faulty equipment, unavailability of library materials or publications, internet time, computer time or access, working space and telephones. These were clearly of more concern to the students who did not live on campus. The problems seemed often to be compounded by lack of funding. At the institutional level, lack of funding for facilities seemed to have prevented certain universities or departments from buying or repairing equipment, books and journals or from employing technical support personnel. At the personal level, insufficient funding seemed to have contributed to some students' inability to afford laptops, use of libraries, purchase of materials and internet access. Many problems in this category seemed to be beyond the control of the individual students. These problems seemed to be more applicable to certain fields, especially the natural sciences.

Respondents claimed that inadequate funding had caused delay in completing their PhDs, either because there were insufficient funds for fieldwork or data analysis, or because the students had to seek employment (either part time or full time). Some students indicated that lack of funding made them consider dropping out. By analysing the students' comments about funding, five main themes emerged:

- There is an insufficient level of funding.
- The funding criteria are perceived to be unfair.
- There are also reported differences in the level of funding between universities.
- The administrative procedures for accessing funding are not always friendly.
- The hidden costs of doing a PhD are not covered.

Four major themes concerning supervision as an obstacle to on-time completion of the PhD were identified:

- Availability of supervisors to students in terms of time and access or communication: Some students observed that their supervisors seemed to be overloaded with teaching or with the numbers of students they supervised. This has meant less availability than the students would like. Quite a number of respondents claimed that the time it took to get feedback from supervisors had severely delayed their progress.
- Attention or interest expressed by supervisors in the development of the students: Here, 'develop-

[81] It must be remembered though that the figures in the time-to-degree analysis are produced for graduates, whereas the figures in the pile-up analysis consider ongoing enrolments in relation to the total pool of doctoral enrolments (i.e. graduates, ongoing enrolments and first-enrolments). In natural and agricultural sciences first-enrolments are growing at a faster rate than in any other field. Hence, one could argue that doctoral graduates in natural and agricultural sciences also take relatively long to complete their degrees, but that their piling-up is masked by a strong influx of first-enrolments

ment' included the students' research, their possible academic careers and skills such as writing and publishing. Another concern was that supervisors could show such a lack of interest that students' feelings of loneliness were exacerbated, especially when there was little interaction with peers or other academics, and this could also lead to a lack of motivation. Some students related lack of attention or interest to insensitivity to cultural differences.
- Concern over possible lack of competence demonstrated by supervisors. Some students felt that there was a mismatch between the expertise and interest of their supervisors and their research topics (an administrative issue), and that "supervisors have little idea about scope and completion of projects. And some even supervise work in areas in which they are not knowledgeable". Supervisors' computer literacy was also mentioned by some students as having caused unnecessary delays.
- Concern about having access to only one supervisor.

1.8 Why do students drop out of doctoral programmes?

Finding 16: Risk factors for non-completion (attrition) of doctoral candidates in South Africa are reported as:

(i) the age of the student at time of enrolment, coupled with professional and family commitments;
(ii) inadequate socialisation experiences;
(iii) poor student-supervisor relationships;
(iv) insufficient funding.

The most academically capable, most academically successful, most stringently evaluated and most carefully selected students in the entire higher education system – the doctoral students – are the least likely to complete their chosen academic goals[82]. Investigating doctoral attrition is important for at least three reasons. One, attrition is motivated by the economic and psychosocial costs of attrition[83]. Involvement with a PhD involves both real and opportunity costs for individuals, supervisors, departments and even the taxpayer. Second, attrition at doctoral level is poorly understood.

This is not surprising as there are currently no measures in place (in South Africa) that can even accurately determine attrition rates let alone explain its prevalence. Finally, consistently high levels of attrition may be indicative of underlying problems in a department, university or discipline.

Internationally, it has been shown that attrition rates for postgraduate students in various countries are high – with 17 % in the UK study of Christie, Munro and Fisher (2004) and 40–50% noted in the American studies of Golde (2005) and Lovitts (2005)[84].

Different studies, initiatives and programmes have found that there is no single reason why doctoral students discontinue their studies[85]. Existing literature that examines the causes and consequences of doctoral student attrition fall into several categories, including the relationships between:

- attrition and funding;
- attrition and advisor relationship;
- attrition and gender;
- attrition and race;
- attrition within particular disciplines;
- attrition and quantitative measures such as test scores;
- attrition and socialisation experiences.

> *" The time of our life, you set about doing your PhD, is going to be critical to creating the conditions for seeing it through to the end, and it really is a difficult thing, when you're busy setting up a family at the same time."*
> (Interviewee: Doctoral attrition study)

Through all the research that has been conducted in the USA in the recent decades, a number of trends have come to the fore:

- Women drop out at a higher rate than men do. The results of a survey conducted by Workman and Bodner[86] confirm this trend; it was found that women were more than twice as likely to 'drop down' than men (18.5% vs. 7.5%, respectively).
- Minority students leave at a higher rate than white students do.
- American students drop out more than international students do.

[82] Gilliam, J.C. & Kritsonis, W.A. (2006)
[83] Golde, C.M. (2005)
[84] Albertyn, R. M.; Kapp, C. A. & Bitzer, E. M. (2008)
[85] Gardner, S.K. (2009) Workman, M. & Bodner, G. (1996)
[86] Workman, M. & Bodner, G. (1996)

- Students leave humanities and social science programmes at a higher rate than those in the sciences[87]. According to Groen, Jakubson, Ehrenberg, Condieb and Liu[88], it is common for more than half the students who start a PhD programme to leave without earning their doctorate.

Students may abandon their programmes of study for many reasons, however the majority of all students do not leave due to a lack of competence or failed admissions processes. As Barbara Lovitts' (2001) research reveals, there are virtually no academic differences between completers and non-completers among the participants in the study they conducted[89].

In the case of this study it too was found that the factors which contributed to students' discontinuation vary greatly. Interviews with a sample of doctoral candidates in South Africa who did not complete their degrees reveal that students who are older (i.e. over 30 years of age) at time of enrolment seem to be at higher risk for non-completion. This is in line with a study done by Park in which it was found that there was a significant association between age and non-completion of students; non-completion was lower than expected among the 20-29 year olds but higher than expected amongst students aged over 40[90]. The South African cases confirm this hypothesis.

"Working in an academic environment with full-time teaching and learning responsibilities make completing a PhD in the expected time virtually impossible!"
(Respondent: A survey of current PhD students in South African universities)

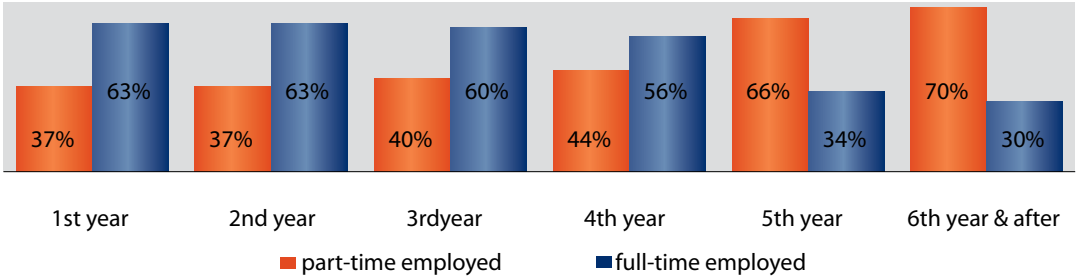
The primary reason given for increasing difficulty of completion with advanced age is the pressure to balance professional, family and academic responsibilities. Professional and familial commitments are cited as major factors limiting the quality and quantity of time that may be devoted to studies. Various respondents described the financial and relational sacrifices that had to be made and that eventually could no longer be sustained.

"… the difficulty we had was to change the attitude of the full-time students because full time used to be regarded as what the rich did. Even if they come here once a week, they would consider themselves full time. But we say no, we want you here, we want to integrate you with the staff and into academia."
(Interviewee: Exemplary PhD programme)

Work commitments seem to be one of the major reasons for doctoral attrition. One study[91] found that most doctoral students in South Africa are already employed at the time of enrolment (almost 70% of respondents) and a third of students who are not employed at time of enrolment start working during the course of their studies. Another study[92] indicates that, on average, 41% of doctoral students are employed full time during their studies, with a further 23% working part time.

As Figure 23 (below) shows, more students maintain full-time employment during the earlier years of their studies, with part-time employment becoming more prevalent from the 5th year onwards. The study also

Figure 23: Full-time *versus* part-time employment of doctoral students at higher education institutions in South Africa by year of study, 2009



Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

[87] Gilliam, J.C. & Kritsonis, W.A. (2006)
[88] Groen, J.A.; Jakubson, G.H.; Ehrenberg, R.G.; Condieb, S. & Liu, A.Y. (2008) [89] Gilliam, J.C. & Kritsonis, W.A. (2006)
[90] Park, C. (2005a)
[91] Destination study: A survey of doctoral graduates across a sample of fields and institutions (refer to Appendix 1)
[92] A survey of current PhD students in South African universities (refer to Appendix 1)

found that black South African nationals are far more likely to maintain full-time employment (51%) while studying towards a doctorate than their counterparts from elsewhere on the continent (17%); and that natural and agricultural science students are more likely to study full time with no employment (58%) than any other field of study.

"You're not in a group where you can sort of speak to other people and you get a feeling that they're also drifting on an island. Because you get ideas via talking to people, and if there was more of an interaction between the students themselves it would have probably given me a better idea of where I was going…"
(Interviewee: Doctoral attrition study)

These students also report a sense of isolation and loneliness, and a desire for better social and academic integration within the context of their studies. Orientation programmes and structured opportunities for peer interaction could alleviate this sense of isolation.

Problems emanating from the student-supervisor relationship also emerged as one factor directly affecting doctoral students' decision to discontinue their studies. In certain instances, an unsatisfactory advisory relationship is strongly implicated in many students' decisions to leave doctoral study.

"I experienced a total lack of structured supervision, i.e. setting of definite targets and intervention when a given strategy did not work. This caused a situation where the alternatives were sinking or learning to swim on your own".
(Respondent: A survey of current PhD students in South African universities)

Various students describe problems emanating from their relationship with their supervisor as directly affecting their decision to discontinue their studies. The respondents called for prompt, regular, positive verbal and written communications indicating their progress and giving insightful suggestions. Tensions arose where supervisors were too close (colleagues) or lacked expertise.

Finally, insufficient funding emerged as one of the major factors contributing to attrition. Interviews with the leaders of a number of exemplary South African PhD programmes reveal that even these prestigious, well-funded and input-intensive programmes are not immune from attrition. The main reason for non-completion in these programmes is reported as insufficient bursary funding, which often leads to students' premature entry into the job market.

Other notable explanations for attrition include personal reasons (such as family responsibilities and health issues); students not being academically prepared to or capable of accomplishing a PhD; students being unable to sustain the required financial, emotional and intellectual commitment; conflicting agendas (e.g. students enrol in a PhD programme in order to further their careers and are not prepared for the academic and theoretical requirements); students realising that academia is 'not for them'; lack of an appropriate supervisory and support system at institutional level; and black students' experiences of racism at South African public higher education institutions.

"We are at a stage in our lives when many of our peers who chose to work are buying houses and cars, while those of us who chose to continue with our studies are constantly anxious about our funding and the fact that we continue to be a financial burden on our parents. This anxiety will continue for those who stay in academia, as postdoctoral funding is equally precarious … many people who have the potential cannot afford to pursue an academic career, aside from the difficulties of raising a family and saving for retirement."
(Respondent: A survey of current PhD students in South African universities)

To summarise the findings:

- From the literature it is clear that doctoral attrition is a universal problem.
- Academic integration within a doctoral programme stands out as one of the key determinants for doctoral success; thus improved institutional support structures need to be created for the benefit of students.
- Rates of doctoral attrition are different between disciplines and the implementation of retention initiatives needs to acknowledge this.

- Further research is required to determine how the gap between the opposing perspectives of faculty staff and doctoral students may be minimised.
- It should be remembered that doctoral students are individuals from different social backgrounds and life experiences, yet all wishing to achieve the same end goal – attaining their PhD.

1.9 How do doctoral students experience doctoral education?

Finding 17: There seems to be a balance between those students who portray their experience of doctoral education as positive and those who portray it as negative.

When a sample of 445 doctoral students currently studying at public higher education institutions in South Africa were asked to "tell us about any specific positive or negative experiences of your doctorate", 39% of them described only negative experiences, 32% only positive, and the remainder (29%) described both. The most common positive themes emerging from students' descriptions are knowledge gain, personal growth and achievement, while the most common negative theme is inadequate funding (see Box 5). Interestingly, supervisory experience and institutional support appear as common themes in both positive and negative categories.

Box 5: Four most prevalent positive and negative themes reported by doctoral students at public higher education institutions in South Africa in terms of their doctoral experience, 2009

Positive
1. Knowledge gain, personal growth and achievement
2. Positive supervisory experience
3. Overall positive experience
4. Institutional support

Negative
1. Inadequate funding
2. Negative supervisory experience
3. Difficulty in balancing work, family, study and social activities
4. Lack of institutional support

Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

There is a close correlation between the negative themes and those issues which relate to the main obstacles to on-time completion of the doctoral studies (already reported under Finding 15). This section therefore concentrates on the positive experiences that supported and sustained the students through their doctoral journeys.

"The gap between masters and doctorate is huge and a big jump to reach the standard expected".
(Respondent: A survey of current PhD students in South African Universities)

A number of respondents described their doctoral experiences as "overall positive". Although many of them did not elaborate, the excitement of their PhD journeys was articulated in words such as: "fulfilling", "life-changing", "enriching", "enlightening" and "thrilling". Those who provided more detailed descriptions indicated that they had gained knowledge or experienced personal growth.

In particular, some respondents described the importance of having opportunities to network and interact with peers and other academics.

Students discussed the details of the supervisor's(s') supportive role. These included demonstrating interest and understanding in research; offering encouragement; facilitating funding opportunities, conference attendance, networking and publication opportunities; offering other structured support (such as workshops, seminars, courses, coaching, programmes); cultivating a conducive research environment; and helping with other practical issues, such as accommodation and study leave.

"I have been very fortunate with the support from (my university). They have provided workshops, courses, coaching programmes and financial aid to encourage students to complete their PhDs; I think they have carefully planned what is required for their students and have encouraged us to make use of their facilities."
(Respondent: A survey of current PhD students in South African Universities)

In some instances, the need for support is seen as linked to a perceived gap between masters and PhD degrees which has resulted in some students' lack of preparedness for PhD studies, both emotionally and academically. Since most of the students worked closely with

their supervisors, most of the support mentioned above was expected from their supervisors.

Institutional support, on the other hand, usually provided a supplementary role in terms of support. However, in institutions where well-planned support systems or structures existed, this support could to a certain extent 'replace' the need for supervisory support.

Students were also asked to rate their level of satisfaction with specific aspects of their doctoral education experience. These reports indicate a mostly positive experience (see Table 19, below). However, only 54% of students experience a 'sense of community' with other doctoral students, indicating that the PhD was still a lonely journey for many.

Table 19: The responses of doctoral students at public higher education institutions in South Africa to specific statements describing their doctoral experience, 2009

Statement	Response	
	No	Yes
I am confident that I made the right decision in choosing to pursue my doctoral studies	6%	94%
I am confident that I made the right decision in choosing my doctoral studies in this specific department	12%	88%
I am satisfied with the availability of the department/faculty members to meet with students	21%	79%
I am satisfied with the quality of academic advice/feedback by my department/faculty	22%	78%
I am satisfied with the quality of overall department/faculty member-student relationship	23%	77%
It is easy to develop personal relationships with faculty members in my department	25%	75%
I am satisfied with the collegial atmosphere between the department/faculty members and students	26%	74%
I am satisfied with the communication between the department/faculty members and students	29%	71%
I am satisfied with the department/faculty interest in my personal development/ future plan	39%	61%
I am satisfied with my financial support	41%	59%
There is a strong sense of community, a feeling of shared interest and purpose among the doctoral students in my department	46%	54%

Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

In response to questions about their supervisory experience, students also report a positive or satisfactory supervision experience overall. Most students report that their supervisors displayed interest in their personal welfare (64%) and professional development (76%), provided them with as much supervision as they wanted (68%), had general discussions with them about their subject area (76%), were available for consultation (78%), provided constructive criticism of their research (80%) and allowed them to work as independently as they wanted to (96%). Very few students found themselves in a situation where the supervisor or supervision provided made them feel uncomfortable (12%) and fewer seriously considered or actually succeeded in switching supervisors (10%).

The only exception to this positive trend is the 58% of current students who reported that their supervisor spent little or no time discussing the student's plans for

"She was definitely one of the most professional one could have – you could send her some work and within a week she would comment – also even at one stage she was overseas on sabbatical and she still sent comments".

"I could go eight to twelve months until you get an e-mail. I don't think an e-mail is good enough for a doctoral student. Rather have your one-hour scheduled teleconference regularly ...

(Interviewees: Doctoral Attrition study)

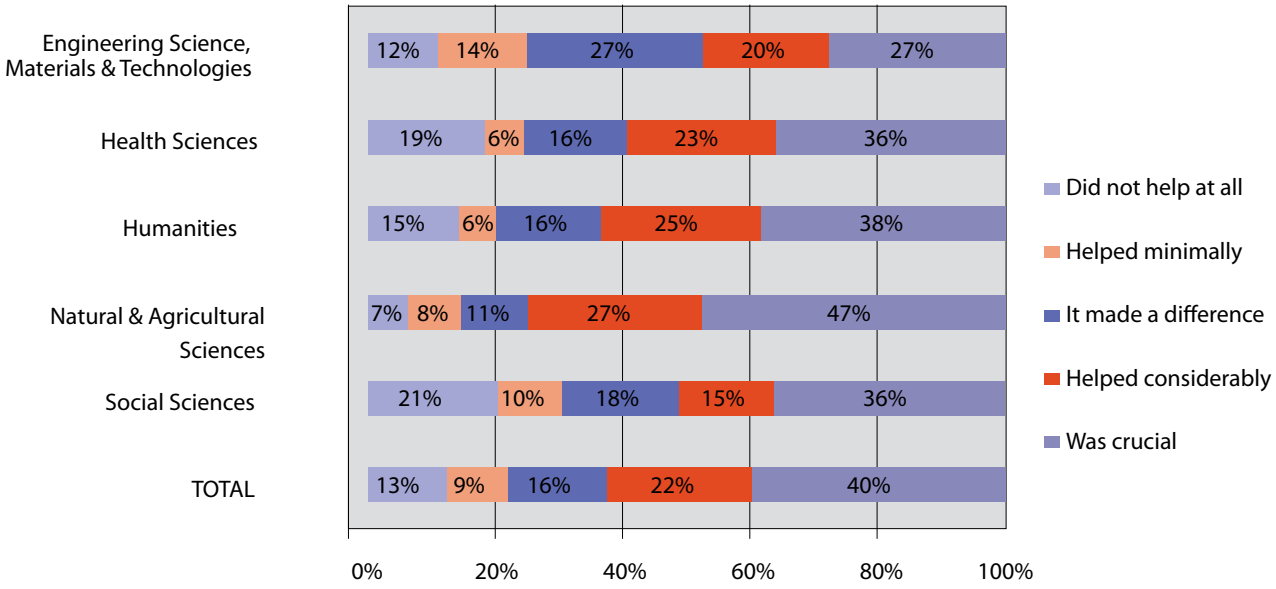
the future. To exacerbate this shortcoming, the vast majority of graduates who progressed directly into employment after graduation report that neither had they received satisfactory career planning support from their academic institution – 54% received none whatsoever and 22% received only a very small amount.

1.10 What do employers expect from PhDs?

Finding 18: Employers note as the salient weaknesses in the skills and abilities of doctoral graduates from public higher education institutions in South Africa a lack of (i) exposure to international expertise, theories and debates; (ii) methodological competence; and (iii) 'real world' relevance.

Does doctoral education at public higher education institutions in South Africa indeed contribute to the graduates' career success and to the knowledge economy as a whole? From the employed graduates' point of view, their doctorates prepared them well or very well for employment. In response to the question as to whether their qualification helped to obtain their current job, they consider the benefits of a PhD in terms of its value in securing employment favourably (see Figure 24, below). Overall 40% feel that their doctorate was crucial in obtaining their current employment and a further 22% feel that the degree helped considerably. Respondents from natural and agricultural sciences were most positive about the contribution their doctoral qualification had made in terms of securing employment, with 47% considering it to have been crucial.

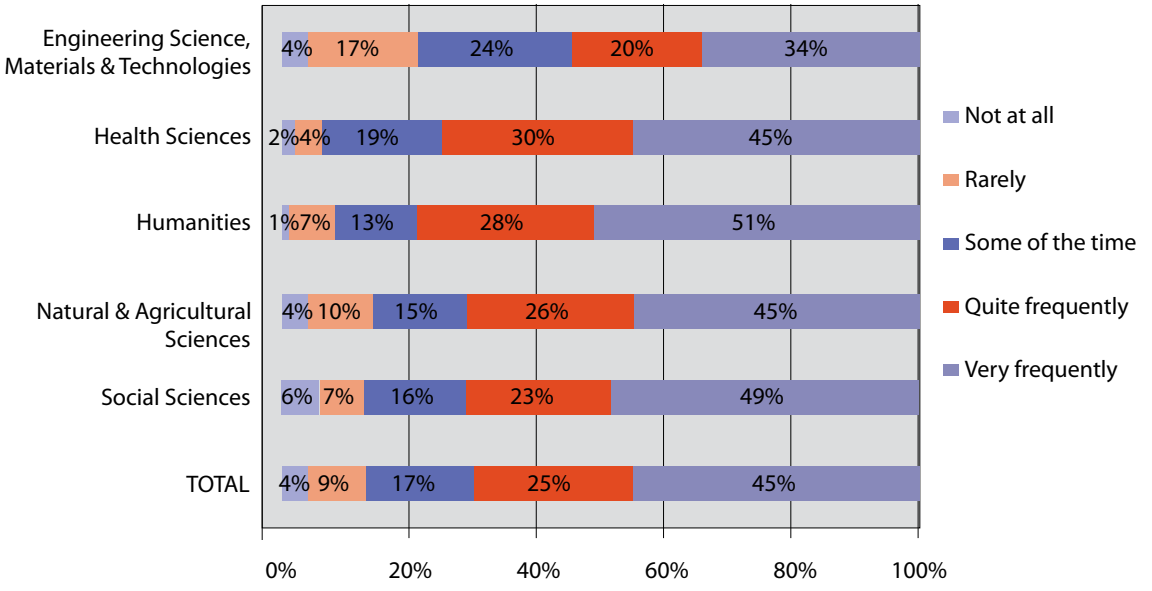
Figure 24: Contribution of doctoral qualification to obtaining current job by broad field of study, 2009



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

In terms of the skills that the doctoral qualification brings to such employment, even though the vast majority of employed graduates (70%) also indicate that they frequently apply the technical skills obtained during their studies in their current positions, this opinion varies across fields, with graduates in humanities being most likely to apply doctorate skills in the workplace and those in engineering science, materials and technologies the least likely (see Figure 25, below).

Figure 25: Utilisation of skills obtained in doctoral qualification in current position by broad field of study, 2009



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

It must be noted that more than half of the respondents were employed within the higher education sector. However, increasing numbers of doctoral graduates are entering non-academic sectors of employment, compelling higher education to reconsider the relevance of its doctoral education in line with the needs of other graduate employers. In addition, it seems that doctoral graduates' perceptions of the benefits of the doctorate in the workplace are far removed from those of the doctoral graduate employer outside higher education.

"(PhD graduates are) better equipped, better trained, more self confident; they think for themselves".
(Non-profit NGO employer: Employer study report)

"Let me put it this way, people who haven't done a PhD tend to trivialise the amount of work involved, so sometimes the approach to research can be a little bit superficial. Whereas people who have done a PhD kind of have an understanding of the depth of what we are after, they are just generally better able to manage research."
(Science council employer: Employer study report)

Those being the views of the graduates themselves, how do they compare with the views of the employers? One study[93] constituting in-depth interviews conducted with a number of employees representing different sectors of employment found that PhD graduates are sought as they lend internationally recognised credibility to organisations and have superior researching skills. Employers seek PhD graduates who can run a research project in its entirety. In order to fulfil this ideal, PhD employers express the desire for a PhD graduate who has extensive knowledge of the relevant field, extensive training in methodology, well-developed report-writing skills, relevant managements skills (finance- and project-related), and networking capabilities. They are considered the future leaders of their organisations and are expected to mentor the junior staff. This is, however, not the reality that employers describe. Various problems perceived range from insufficient exposure to international expertise to weaknesses in the conceptualisation and management of research reports and projects. Employers describe sub-standard research and report-writing skills.

[93] Employer study report (refer to Appendix 1)

An area of pronounced concern was in statistics. Measures that may be implemented to rectify these include multidisciplinary training and the introduction of taught components and formalised presentations and seminars.

The study revealed that South African employers have the following expectations of their doctorate employees:

- PhD graduates must be independent future leaders who will assume various roles of responsibility, from mentoring junior researchers to eventually managing research projects in their entirety.
- Graduates must be well-prepared for work, to 'hit the ground running', and to "bring rigour into the organisation".
- They must have, at the very least, good conceptual thinking skills and mastery of research methodology.
- Doctoral graduates should have additional skills, including diverse networking skills, project proposal (tender) and fundraising skills and financial management skills.
- They should have the ability to cooperate, compete and eventually be recognised in international settings.

Unfortunately, virtually all areas of desired strength are also depicted as areas of weakness. Employers lament that South African doctoral graduates are severely isolated and lack exposure to international expertise and debates. There is concern that theoretical models are outdated and that students are unaware of international developments.

A recurring concern across all sectors is the lack of quantitative and statistical grounding and expertise in many doctoral graduates. Social science employers in particular consistently emphasise the key importance (and lack of) a thorough grounding in methodology. This speaks to substandard training in many fields and the fact that most fields now require a fairly advanced knowledge of quantitative methods to be able to function and compete effectively. Weaknesses are also identified in the conceptualisation and management of research reports and projects. Lacking methodological competence, it follows that these individuals need assistance in completing research tasks and are unable to lead research projects.

Various employers report problems in contracting graduates with relevant expertise. This is most notable amongst scarce-skill positions and regarding management level positions. Employers from the natural sciences, for example, want a greater integration of theory and practice – i.e. PhD topics should be more closely related to industry and more relevant to the specific field of employment – while many private sector employers feel that the PhD is an unnecessary qualification, requiring more practical business administration, financial administration and other business-related skills.

A number of sector-specific findings indicate that natural science employers desire a greater combination between practice and theory. These employers also reported significantly greater difficulties contracting PhD graduates with relevant expertise. Less emphasis was placed upon the relevance of studies by social science employers, with more emphasis on thorough training in methodology.

Undertaking a PhD while at work was severely hampered by intellectual property rights issues. Exciting projects for doctoral studies need to be kept confidential to ensure competitive advantages. Considerable concern was expressed regarding the perceived drop in standards at universities.

In the private sector, a call for business administration, financial administration and other business related skills was made. University leaders, heads of departments and deans were encouraged to interact more closely with business so as to propose thesis topics that have greater applicability. In general, private sector employers felt that the PhD was an unnecessary qualification.

These sentiments expressed by employers are supported (to some extent) by student perceptions. For example, current doctoral students report that the skills they develop least are in elaborating innovative solutions, networking, teamwork, leadership and managerial skills, and international cooperation. However, contrary to the employers' opinions, the same students found that the skills they developed most were those concerned with strategic thinking, logical writing and mastering the scientific approach.

Currently-employed graduates considered the ability to design and manage a research project as the most important preparation for employment. This is closely linked to the ability to think and work independently. Having specialised subject knowledge also opened and eased the entry into employment for a number of PhD graduates. It would also seem that a doctoral qualification provided confidence and acceptance into the scientific world for some of the respondents (see Figure 26, below).

Figure 26: How the PhD prepared graduates for employment (N=285)

Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

Nevertheless, the same graduates suggest that their doctoral education could have prepared them better by providing more project and business management skills training, more interaction with industry, more course work and more experience in the commercial application of knowledge gained (see Box 6, below).

Box 6: 'Top 10' suggestions from employed graduates for improving public doctoral education in South Africa, 2009

We need more …

1. project and business management skills training
2. interaction with industry
3. courses on related subjects/broader discipline focus
4. opportunity for short courses focused on specific skills
5. commercial application of knowledge
6. opportunities to develop teaching skills
7. training on budgeting/applying for grants, etc
8. realistic picture of what to expect in the workplace
9. opportunities to develop writing and presentation skills
10. practical application opportunities

Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

These discrepancies in perceptions highlight a number of notable tensions that policy-makers and academia must consider with regard to the future of the South African doctorate:

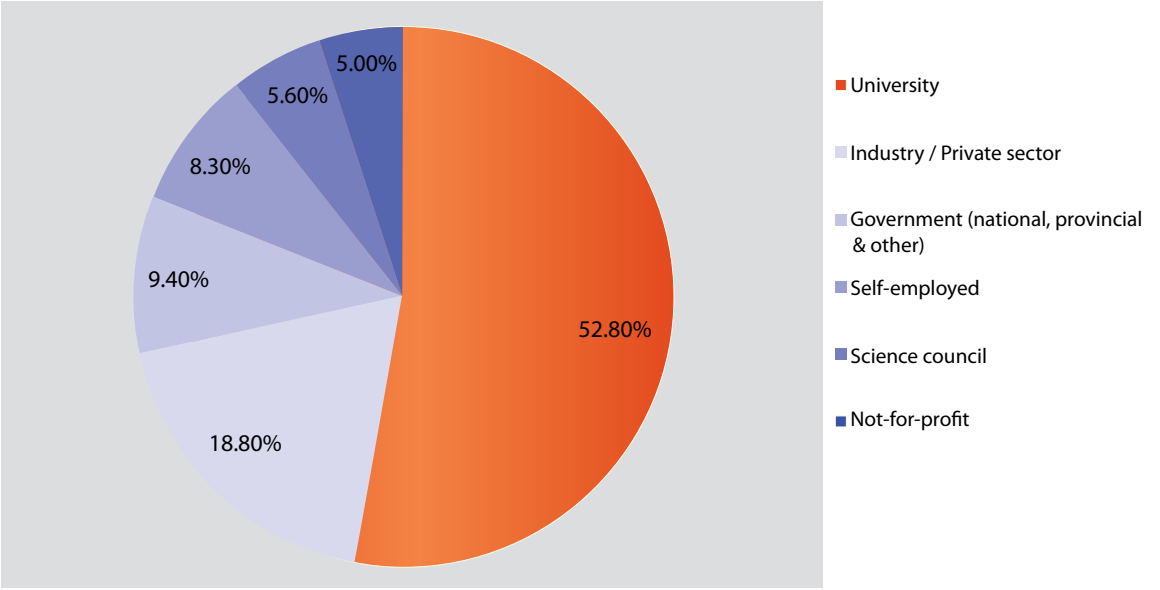
- Business *vs*. academia. What is the responsibility of business and what is the responsibility of academia with regard to skills development?
- Taught *vs*. inherent. Which skills and abilities can be taught and which are inherent?
- Applied *vs*. basic and theoretical research. To what extent can applied research be incorporated into doctoral studies?
- Well-rounded *vs*. refined expertise. With the growth of trans-disciplinary research and increasing emphasis being placed upon the need for greater exposure of graduate students to a range of theories and methodologies, to what extent can rigour be maintained?

1.11 Where do doctoral graduates go?

Finding 19: More than half of doctoral graduates in South Africa are employed in the higher education sector.

According to the findings of a survey of current doctoral students at public higher education institutions in South Africa, more than half of the respondents are currently employed in the higher education sector. The second largest employer of PhDs is industry (18.8%), followed by government (9.4%). Slightly more than 8% of PhD graduates are self-employed and the remaining 10% are working for the science councils or not-for-profit sector (see Figure 27, below).

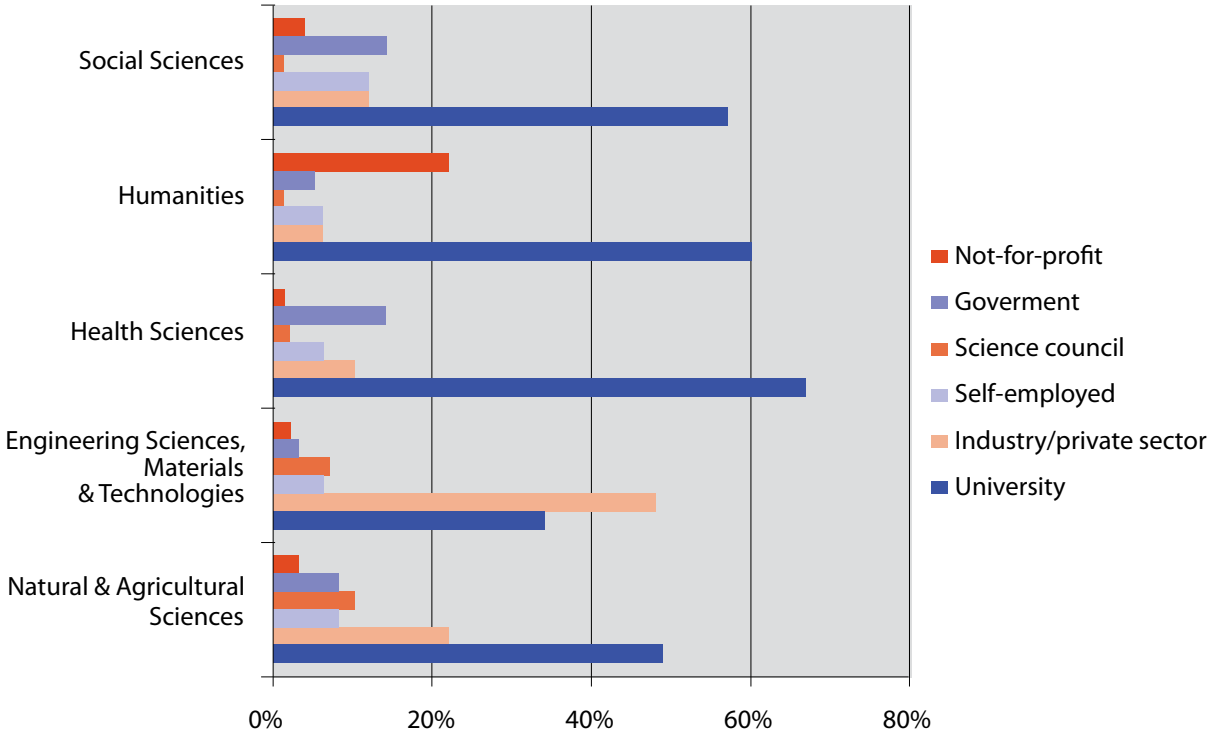
Figure 27: Employers of doctoral graduates in South Africa, 2009



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

However, the distribution changes by scientific field as illustrated in Figure 28 (below). Nearly half (48%) of PhD graduates in the engineering sciences, materials and technologies and 22% of PhD graduates in the natural and agricultural sciences are employed by industry. The higher education sector is currently the main employer of PhD graduates across fields, with the exception of the engineering sciences and applied technologies. More than 10% of PhD graduates in the health sciences and social sciences are employed by government. A quarter of all PhD graduates in the humanities are working for the not-for-profit sector. PhD graduates in the social sciences have the highest portion of self-employed individuals per field (12%).

Figure 28: Current employers of PhD graduates per field of study



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

The same study revealed that:

- Around three in five students plan to take up academic and/or research positions after completing their doctoral studies, mostly within a higher education institution or as postdoctoral fellows.
- Around three in five students who work during their studies are unlikely to change their career as a result of their studies.

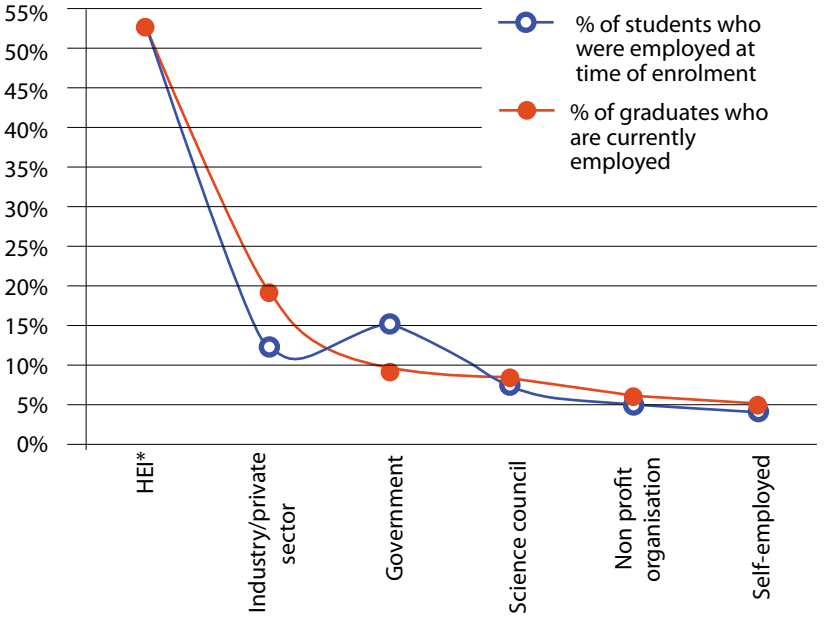
A survey of doctoral graduates who completed their degrees at the same institutions shows that:

- 67% of doctoral graduates stay with their employer after graduation;
- more than half of doctoral graduates who were already working when they enrolled were employed at a higher education institution;
- 45% of those who were not working during their studies and accepted offers of employment before graduation, took up employment within higher education.

It is therefore not surprising that more than half of currently employed doctoral graduates are working within the higher education sector, while three in five reported have worked in higher education at some point in their career. Only 17% of graduates who take up employment in a higher education institution eventually migrate to other employment sectors.

As Figure 29 (below) clearly shows, the higher education sector remains the largest employer both of doctoral students who work while studying and of doctoral graduates after completion. In terms of those who employ doctoral candidates before completion, the second largest employer is government (15%), closely followed by industry (12%). These employer roles are reversed after graduation – industry employs 19% of all doctoral graduates, while government employs only 9%, indicating that doctoral students tend to move away from government employment towards the private sector after graduation.

Figure 29: Employers' share of doctoral students and graduates before and after graduation from public higher education institutions in South Africa, 2009



* Higher Education Institution
Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

This distribution changes when viewed by field of study (see Table 20, below). For graduates in engineering sciences, materials and technology, the employer trend remains relatively comparable before and after graduation, with the exception of employment in higher education versus industry – before graduation most students are employed in higher education, while nearly half of graduates in this field are employed by industry after graduation. These graduates also tend to migrate away from employment in government or at science councils towards self-employment and the not-for-profit sector after graduation.

Table 20:Employers' share of doctoral students and graduates before and after graduation from public higher education institutions in South Africa by broad field, 2009

Employment sector Field of study	Higher Education	Industry/ private	Self-employed	Science council	Government	Not-for profit
% of total number of students in specified field who were employed at time of enrolment						
Engineering Sciences, Materials & Technologies	49%	31%	1%	10%	9%	0%
Health Sciences	56%	4%	4%	7%	24%	2%
Humanities	52%	10%	2%	0%	11%	17%
Natural & Agricultural Sciences	53%	13%	2%	14%	15%	1%
Social Sciences	54%	11%	8%	2%	16%	5%
All Fields	53%	12%	4%	7%	15%	5%
% of total number of graduates in specified field who are currently employed						
Engineering Sciences, Materials & Technologies	34%	48%	6%	7%	3%	2%
Health Sciences	67%	10%	6%	2%	14%	1%
Humanities	60%	6%	6%	1%	5%	22%
Natural & Agricultural Sciences	49%	22%	8%	10%	8%	3%
Social Sciences	57%	12%	12%	1%	14%	4%
All Fields	53%	19%	5%	8%	9%	6%

Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

For doctoral graduates in all other fields of study, higher education remains the main employer both before and after graduation. The migration away from science councils and government is also observed for health science and natural and agricultural science students; students in health sciences tend to take up employment in higher education and industry after graduation, while natural and agricultural science students move towards industry and self-employment. Both groups are also less likely to work in the not-for-profit sector both before and after graduation when compared to the average across fields. Health science students are more likely to work in government before graduation than any other field of study.

The employer trend for social science students is very stable before and after graduation, with the only noticeable migration after graduation being towards self-employment. When compared to the average across fields, these students are generally more likely to be self-employed or to work in government, while almost none work at science councils.

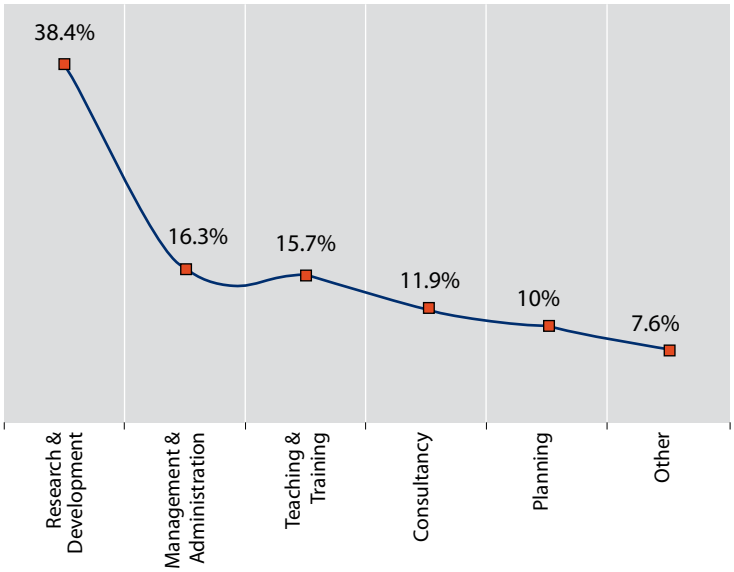
Similarly, almost no doctoral students in the humanities work at science councils both before and after graduation. Humanities students also tend to migrate away from government towards the not-for-profit and higher education sectors after graduation, and much larger shares of these students work in the not-for-profit sector both before and after graduation than any other field of study.

The two most important reasons why so many graduates go into higher education are a keen interest in research, and the unique opportunity provided by higher education to combine this interest with a passion for teaching. Others indicate that a career in academia had always seemed an attractive option and that higher education offers a challenging and rewarding work environment. The following are the 'top ten' reasons why doctoral graduates at South African HEIs consider employment in the higher education sector:

1. Research interest.
2. Can combine passion for teaching and research.
3. Enjoy teaching.
4. Was interested in an academic career.
5. Rewarding and challenging working environment.
6. Was offered an attractive position.
7. Only opportunity at the time.
8. Enjoy learning and disseminating knowledge.
9. Flexibility, able to combine with other interests and responsibilities.
10. Personal interest and development.

Of the small number of graduates who migrate away from higher education, the biggest shift (73%) is to the private sector. The single most important reason stated for leaving higher education is 'better remuneration', even though most of those who had moved to another sector felt that their doctoral qualification was still better suited to a career in higher education (63%).

Figure 30: Share of doctoral graduates from South African higher education institutions by nature of current employment, 2009



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

The nature of current employment for doctoral graduates is predominantly research and development (R&D), followed by management/administration and teaching/training (see Figure 30 above). Consulting and planning are lowest on the list of employment activities.

Graduates employed in higher education are typically engaged in R&D and teaching activities, with many also engaging in management and administrative functions (see Table 21, below). Those working in the private sector spend almost an equal amount of time on R&D, management and consulting activities. Interestingly, about two in three graduates working in the not-for-profit sector spend time on teaching/training, implying that they are involved in capacity building within the sector, or cascading their research expertise to colleagues through training.

Table 21: Share of doctoral graduates from South African higher education institutions by employer and nature of current employment, 2009

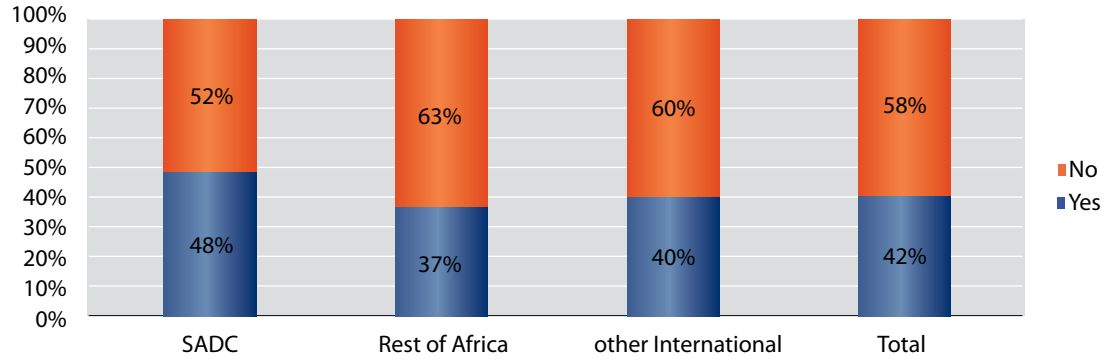
Employment sector Nature of employment	Higher Education	Industry/ private	Government	Self-employed	Science council	Not-for-profit
Teaching/training	84%	23%	41%	30%	36%	65%
Research and development	82%	52%	65%	33%	96%	49%
Management/administration	45%	52%	58%	19%	43%	53%
Consultancy	27%	45%	20%	62%	29%	35%
Planning	26%	30%	44%	17%	38%	33%
Other	8%	23%	22%	36%	13%	25%

Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

Finding 20: A third of non-South African doctoral students studying in South Africa intend to stay in the country after graduation, while a relatively small number of South African-born graduates migrate to other countries.

Half of the non-South African doctoral students studying in South Africa indicated that they intend to return to their country of origin after completing their doctoral studies, and a third intend to stay in South Africa; the remainder are undecided. A greater percentage of SADC students than students from the rest of Africa or the rest of the world intended to stay in South Africa (see Figure 31, below).

Figure 31: International students intending to stay in South Africa, 2009

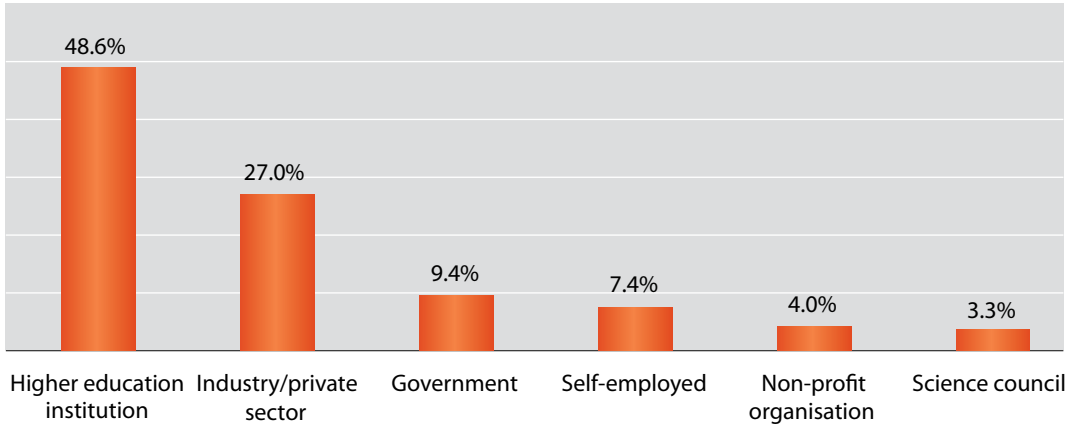


Source: *A survey of current PhD students in South African universities* (refer to Appendix 1)

Although the numbers are too small to draw firm conclusions, an analysis of the international students' intention to stay in South Africa after their doctoral studies by fields of study suggests that the highest percentage of the students intending to return to their home countries was for the students in religion, followed by the students in education and agricultural studies. Of the other students in other fields, about half intended to stay and half to go home. Influences may have been career opportunities and skills shortages in South Africa.

A survey of doctoral graduates from South African public higher education institutions (Destination study: a survey of doctoral graduates across a sample of fields and institutions (refer to Appendix 1) –1060 respondents) found that only 14% of South African-born respondents are no longer living in the country, and they are mostly employed in the higher education sector (see Figure 32, below).

Figure 32: South African PhD migrants by employment sector, 2009



Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

Most of these PhD migrants are white males between 36 and 55 years old (see Table 22, below), in Australia, the USA and the UK (see Tables 22 and 23, below). If one compares the percentage per field as taken from all survey respondents, 19% of engineering science, materials and technology graduates and 15% of both health science and natural and agricultural science graduates are currently living and working in countries outside of South Africa.

Table 22: Gender, race and age distribution of South African PhD migrants, 2009

Demographics	%
Gender	
Female	22%
Male	78%
Race	
Black African	1%
Coloured	4%
Indian	1%
White	78%
Unknown	4%
Age	
26-35	10%
36-45	28%
46-55	29%
59-65	19%
≥ 66	13%

Table 23: South African PhD migrants by destination country and field of study, 2009

Field of study	Australia	Canada	UK	USA	SADC*	Other	Total
Natural & Agricultural Sciences	11	7	10	17	4	12	61
Engineering Sciences, Materials & Technologies	7	3	1	6	1	6	24
Health Sciences	7	2	3	5	0	3	20
Humanities	3	4	2	2	1	1	13
Social Sciences	7	1	8	3	2	7	29
Total	35	17	24	33	8	29	146

* Southern African Development Community
Source: *Destination study: a survey of doctoral graduates across a sample of fields and institutions* (refer to Appendix 1)

These graduates give a variety of reasons for pursuing employment outside of the country. The three most prevalent reasons are: more opportunities for career advancement, personal safety and international exposure and experience.

More than half of the PhD migrants also indicate that they would consider returning to South Africa, particularly if they received an attractive career offer with similar or better working conditions and remuneration.

1.12 What are the features of highly productive PhD programmes?

Finding 21: The most salient feature of a productive doctoral programme in South Africa is the level and diversity of funding.

A review of 16 exemplary doctoral programmes at public higher education institutions in South Africa identified the common practices which sustain both the quality and quantity of PhD production within these programmes. These practices were examined in order to develop a better understanding of the programme strengths, as well as the weaknesses which threaten their continued existence.

Resource-intensiveness is the most significant common characteristic of all exemplary doctoral programmes. These programmes utilise high levels of funding from diverse sources in order to provide excellent doctoral training and to sustain high student throughput rates. In addition to university funds, the lion's share of the money, especially in the natural sciences, comes from government and statutory bodies (such as the NRF). The rest of the funds are raised from international foundations, industry, local organisations, non-governmental organisations, projects and miscellaneous sources. Funds are often dependent on supervisors' initiative, collaboration and personal connections.

In most of the programmes, the students are fully funded during their studies, allowing them to maintain a reasonable lifestyle, to dedicate their time to their studies, to participate in local and international conferences and to benefit from extended periods of study abroad. Funding for value addition to the programme is also essential – whether for postdoctoral positions, equipment

and running costs of students' research, or to buy in expertise to present coursework.

The NRF remains the main funding source for most of these programmes. Even though the NRF is considered a 'comfortable' funding source (it is relatively easy to access, there is a clear application process and it does not require unsolicited petitioning of industry or donor agencies) the funds provided remain insufficient. Supervisors of large programmes therefore spend a great deal of their time pursuing alternative funding sources such as the DST, international foundations, industry, local organisations and non-governmental organisations to supplement NRF funding.

However, the utilisation of ample and varied funding is not the only common practice among highly productive PhD programmes in South Africa. Other typical features include:

• **Different types of programmes**
Different understandings of the purpose of the PhD lead to different types of programmes. There are three prevalent understandings among PhD programme leaders regarding the purpose of the PhD, i.e. (i) as training for an academic career; (ii) as training for industry; and (iii) as training for a profession. In line with the HEQF, most PhD programme leaders consider the main purpose of the doctorate in South Africa as being to prepare the next generation of scholars for academia. However, there is an increased demand on the PhD programmes to produce knowledge that is applicable to the needs of the workplace or industry. Most programmes try to achieve a hybrid of at least two purposes.

The doctoral programmes that serve as training for an academic career (to produce the next generation of scholars) tend to emphasise both teaching and research, which are perceived to be at the heart of academic work. The PhD programme leaders emphasise the following as essential ingredients of a PhD programme that prepares students for academic citizenship: (i) intellectual debate and the creation of knowledge; (ii) reading extensively beyond the scope of the individual research topic; and (iii) broad exposure to international and local experts in the field.

There is a growing tendency to introduce cohort-based course work organised around epistemology, research methodology, critical thinking skills or discipline-specific theory into PhD programmes (see Box 2, above). Many supervisors note that course work is required at this level in the South African context to compensate for the lack of adequate research training at the undergraduate, honours and masters levels. The move towards cohort-based programmes also satisfies the need to achieve a critical mass of students and to create an academic environment.

• **Availability of students**
Another factor described by PhD programme leaders as essential for a successful PhD programme is having full-time students on site. Full-time students can focus on their studies, participate in all the activities of the centre, department or laboratory and be integrated into the intellectual life of the organisation. Describing full-time students as the ideal type relates to the dominant discourse of the PhD as training for an academic career. One PhD programme leader maintains that there is a need to change our attitude towards full-time study in South Africa from the perception that this is a luxury for the rich.

There is an increasing tendency for PhD programme leaders to begin their recruitment efforts at undergraduate or honours levels and to 'grow their own timber'. The two main reasons for this practice are to ensure solid background knowledge for a PhD and to ensure that PhD students are capable of managing higher learning. In some institutions this practice is encouraged by allowing a direct route from honours to doctorate, thus fast-tracking the process. It is important, however, to realise that this also limits the pool and the diversity of potential students. Stringent selection criteria are also applied in some programmes.

• **Increased mentoring capacity through various supervisory arrangements**
There are different approaches to doctoral supervision, ranging from the traditional apprenticeship model (or individual mentoring) to joint supervision or a supervisory committee. However, most PhD programme leaders see themselves as providing students with much more than research skills and an amount of subject knowledge; there is a strong emphasis on developing students as independent academics and peers.

Students are often placed in a research group or work together with more than one supervisor, especially in the natural sciences. Some programmes have a formalised system of supervisory committees. Supervising by committee is particularly suitable in an area where unique expertise has been sought, or when a study is located in an interdisciplinary organisation.

It is perceived that since higher education in South Africa has become teaching intensive, the 'burden of undergraduate teaching' is high. Selected programmes increase their capacity to supervise PhD students by releasing the supervisors from undergraduate teaching

and allowing them to focus on postgraduate (masters and doctoral) students. A number of PhD programme leaders in senior positions only supervise PhD students.

The practice of sharing expertise and resources between academic institutions is growing, especially in innovative, interdisciplinary and multidisciplinary fields of study. This trend is particularly relevant within exemplary doctoral programmes where various collaborative supervisory arrangements – such as supervisory committees, joint supervision and virtual faculty – increase the supervision capacity of the programme and help to build a critical mass of supervisors.

• Appropriate support structures

There are great structural diversities among the exemplary PhD programmes surveyed. Some programmes have a formalised structure with a set of clear deadlines, while others offer *ad hoc* interventions and a relaxed atmosphere. It is evident that cohort-based and course-based PhD are more formally structured than other PhD programmes; many provide students with clear guidelines, deadlines and expected outcomes. Structured programmes facilitate high throughput rates by means of 'carrots and sticks', i.e. rules and regulations linked to rewards and penalties.

A second type of support structure is established through the creation of 'learning communities'. Cohort-based PhD programmes or those that include a course work component provide a natural community of scholars around the PhD student. The same applies to research laboratories. In other PhD programmes an academic community has been created by scheduling regular group meetings at which students present their work-in-progress to supervisors and colleagues. Community is also achieved by encouraging students to participate in conferences and seminars, by inviting international and national scholars to give seminars to students, by linking with other research centres, and by providing various ways for the students to network and support one another.

Finally, to compensate for the erosion of time available to academics for research and mentoring and the huge burden of undergraduate teaching, exemplary doctoral programmes have established dedicated posts for mentoring of students. Postdoctoral positions in particular greatly increase the supervisory capacity of these programmes and also improve the quality of supervision.

• Highly charismatic, energetic and committed leadership

It is evident that one of the essential attributes of an effective PhD programme is its committed and energetic leadership. None of the exemplary PhD programmes which formed part of the study could have achieved their level of success without the commitment, energy, goal-orientation, connections and enthusiasm of their leaders. Students and supervisors, both local and international, are drawn towards programmes by the reputation, academic accolades and charisma of the programme leaders.

At the same time, the leaders of effective PhD programmes are also at the height of their careers. They are in demand for international conventions, committees, advisory bodies and so on. They have very little time to supervise students or to chase after funding. They need access to adequate resources, especially dedicated administrative and research support.

1.13 What are the systemic barriers to increasing the productivity of PhD programmes?

Finding 22: The primary barriers to increasing the productivity of PhD programmes at South African higher education institutions are (i) financial constraints; (ii) the quality of incoming students and blockages in the graduate and postgraduate pipeline; (iii) limited supervisory capacity; and (iv) certain government rules and procedures.

Many of the constraints and barriers which hinder increased productivity of PhD programmes have been discussed in previous sections (in particular refer to section 1.6, 1.7 and 1.9); however they are consolidated and discussed in more detail in this section, which draws significantly from the following reports: (i) Systemic blockages in postgraduate education and training (Prof Johann Mouton, Stellenbosch University, and Ms Lise Kriel, University of the Free State, September 2009); and (ii) Exemplary PhD programmes (Dr Chaya Herman, University of Pretoria, July 2009) (refer to Appendix 1).

From these reports, four main systemic barriers are identified:

i. financial constraints;
ii. pipeline constraints related to the quality of incoming students and blockages in the graduate and postgraduate pipeline;

iii. institutional constraints related to limited supervisory capacity;
iv. administrative constraints related to government rules and procedures.

• Inadequate funding for PhD programmes and doctoral studies

The salient feature across all the successful PhD programmes is their high level of funding. Funding comes from various sources. In addition to university funds, most funding, particularly within the natural sciences comes from the government (including DST) and statutory bodies (such as the NRF). The rest of the funds are raised from international foundations, industry, local organisations, non-governmental organisations (NGOs), projects and miscellaneous sources. Funds are often dependent on the supervisors' initiative, collaboration and personal connections.

Some programme leaders, especially in the natural sciences, rely almost entirely on NRF and DST funds, which could be quite adequate if the programme is run by or includes a number of rated researchers, has a Research Chair, or is able to access a specific grant to secure funds for a number of years. Some programmes use funds from multiple sources.

"It is more straightforward to apply for grants from statutory organisations because there is a system, there is a website, there are calls for funding – it's tedious to put the grant proposal together but you know what to do. Getting money form industry is often about cold calling, phoning somebody that you don't know, and getting together with them and selling them on the idea of a student training for a PhD … so I think I am more comfortable currently, and also because what the grant money is there for is academic research and I am an academic, so I think that's a plus."
(Interviewee: Exemplary PhD programmes)

Funding is often perceived as the main threat to the continuation of the programmes and as an obstacle for their expansion. The main argument is that the funding is just not enough: "Nothing is funded properly; everything is funded partially".

Other concerns are the availability of funds, the bureaucratic process of accessing and managing funds and the continuous change in the strategic thinking of the funding agents.

Some PhD programmes in the humanities and social sciences have been established with external funds (usually from philanthropic and other foundations abroad) or reserve funds of the faculty. The continuation of these programmes supported by external sources is in constant threat. In some cases they ceased to exist when funds became unavailable. This also applies to programmes which are funded by the NRF, where the threat of NRF programmes being phased out, is a concern.

While the NRF has been the main funding source of most of the programmes, it is not able to support PhD production adequately. The NRF, as the official national funding agency of the state, has the primary responsibility for postgraduate and research support in the country. But recent developments in the Treasury's allocations to the NRF points to increasing resource constraint. "Trajectories of NRF Research Support" outlines "the new facts and realities that confront the NRF and the research community"[94] in terms of the current funding climate in South Africa. According to the NRF document entitled "Trajectories of NRF Research Support", despite increased funding received, the freedom of the NRF to invest these funds at its own discretion has been significantly restricted. However, there is a renewed strategic focus on doctoral education that proposes three specific areas for intervention:

- Increasing direct funding for students: The NRF proposes to change this ratio to 1:1 by 2013, by decreasing grantholder-linked student support in favour of freestanding bursaries and fellowships, which it predicts will encourage more students to complete their PhDs. It also states that this strategy will empower students to seek out the most suitable supervisors instead of requiring researchers to find appropriate students.
- Increasing the value of bursaries and fellowships: Current NRF postgraduate bursary and fellowship values are widely acknowledged as being too low and insufficient for students to complete their PhDs. Even though the NRF is committed to raising bursary values whenever possible, it is concerned that such changes will significantly reduce the number of students who can be supported within the budget.
- Increasing throughput rates via a '4 by 4 graduate experience': Under the current HEQF structure students regularly exit the route towards the doctoral degree (i.e. the PhD pipeline) at three points,

[94] National Research Foundation. (2009)

namely post-undergraduate (exit level 7), post-honours (exit level 8) and post-masters (exit level 9). The '4 by 4 graduate experience' encourages universities to avoid these losses by advocating only one exit point after the first four years of study (i.e. exit level 8) and offering an integrated masters-doctoral experience, effectively circumnavigating exit level 9.

In addition to the freestanding and grantholder-linked funding of doctoral students, three other programmes of the NRF allow for PhD support. These are Technology and Human Resources for Industry Programme (THRiP), the South African Research Chairs Initiative (SARChI) and Centres of Excellence (CoE).

Despite the availability of funding support for doctoral students in all of these categories, and despite the NRF's best efforts to secure more state funding in order to increase scholarship values, the reality is still that current scholarship values do not allow prospective doctoral students to study full time. This means – as we have discussed elsewhere – that the majority of doctoral students in South Africa undertake their doctoral studies whilst they work, and full-time residential doctoral studies are the exception rather than the rule. This impacts on completion rates as well as age at completion and has a knock-on effect on the potential contribution that such graduates can make to the scientific and higher education systems.

In a related survey of PhD students, respondents tended to concur with these sentiments, indicating that there is an insufficient level of funding, the funding criteria are unfair, the administrative procedures for accessing funding are not always friendly, and the hidden costs of doing a PhD are not covered.

It is evident that unless the financial needs of PhD programmes are met, expanding PhD numbers will not be achieved.

• Pipeline constraints relating to the quality of students exiting a dysfunctional school system and blockages in the graduate and postgraduate pipeline

The South African higher education system witnessed its highest growth rates towards the end of the 1990s and early 2000s. Undergraduate enrolments grew by about 5% a year during this period and redress targets were increasingly being met with black students comprising 63% of enrolment. However, various studies over the past few years (including one by the Department of Education in 2004) expressed concern about the high drop-out rates (between 40% and 50%) for first-year students and subsequent low graduation rates, especially among black students. Only a third of students obtain their degrees within five years.

According to a study recently commissioned by HESA, most first-year students could not adequately read, write or comprehend, and universities that conduct regular competency tests have reported a decline in standards. From this benchmark project it is clear that South Africa's school system is "continuing to fail its pupils and the country, and that universities will need to do a lot more to tackle what appear to be growing proficiency gaps". Some extracts from the main findings of the report are:

- In terms of academic literacy, the tests showed that 47% of the students were proficient in English, the dominant language of higher education. But almost the same proportion - 46% - fell into the 'intermediate' category, while 7% had only 'basic' academic literacy.
- The challenges facing students were even greater in quantitative literacy and mathematics. Only a quarter of students were proficient in quantitative literacy, while half attained intermediate and 25% basic levels. This low achievement suggested that the new school curriculum "has a long way to go".
- Most frightening of all were the mathematics results. Only 7% of students were found to be proficient in the tests, which measured the skills needed to study first-year mathematics. Some 73% had intermediate skills and would need assistance to pass, while 20% had basic skills and would need long-term support.

The implications of results such as these are significant as they clearly show the undergraduate pipeline challenges faced by the university sector. As studies such as these and overwhelming feedback from academics in the system suggest, unless the schooling system in the country produces better quality matriculants, universities will struggle to reverse current trends of low and even declining throughput and completion rates.

Interrelated problems are the low conversion rates at postgraduate level, a possible decline in first-enrolments at masters and doctoral levels and an interaction effect with age, resulting in increasing pile-up effects. The latter refers to the fact that increasing numbers of doctoral students remain in the system without completing their studies. The results show that the proportions of ongoing (or 'recurring') students have increased, while the number of doctoral graduates as proportion of total enrolment has decreased. This is strongly correlated

with the mean age of the student, and so is even more pronounced with 'late' entrants into the doctoral system (see Tables 17 and 18).

It is evident that in order to escalate the number of PhDs it is essential to increase the pool of suitable candidates and this calls for a system-wide effort that starts at school level.

• Limited supervisory capacity at South African public higher education institutions

One of the 'golden rules' of doctoral education is that doctoral students may only be supervised by someone who has a doctoral degree. In fact, most guidelines for doctoral supervision would add to this 'rule' that the doctoral supervisor has some experience in supervision and is also himself/herself a relatively experienced scholar and scientist. The practical implication of these rules is that the pool of potential doctoral supervisors is determined by the number of academic staff who have PhDs. Currently only 40% of staff at the Universities (which produce most of the doctoral students) have doctorates. The situation is worse for the Comprehensive Universities (only 27% with doctorates) and the Universities of Technology (12% in 2007) (see Figure 12, above). Due to the shortage of suitably qualified supervisors, their workloads are an area of great concern. The number of students per supervisor varies from only one to ten or more, though the average doctoral supervisory load of permanent academic staff (calculated by dividing the total number of doctoral enrolments by the number of permanent academic staff with doctoral degrees) is 2.1 (see Figure 15, above).

A major concern is the quality of supervision and the perception that not enough is being done to ensure that inexperienced supervisors, such as recent PhD graduates or unsuitable supervisors, should not supervise doctoral students, nor are they being assisted to become better supervisors.

If one adds to this picture the general ageing of the academic workforce (or at least of the most active components thereof), as well as the 'pile-up effect' currently evident in the system (discussed above), this situation points to a significant structural constraint to growth in the number of doctoral graduates. Anecdotal evidence is increasingly showing that many academics who retire are immediately re-appointed on contract appointments to assist specifically with doctoral supervision.

• Government rules and procedures that have an impact on doctoral education

While the government has put in place very enabling plans and frameworks to encourage and reward doctoral production, there are certain elements that can have a constraining effect on the increased production of PhD graduates.

Although enrolments at the postgraduate level were not at any stage capped by the Department of Education, its policy of capping enrolments at the undergraduate level, as well as decisions regarding limiting growth in distance education programmes, would of necessity impact on the size and growth of the pipeline. The enrolment planning decisions by the Department, and subsequent responses from the higher education sector, also illustrate that institutional capacities are limited and were cited as major obstacles in any attempt to increase enrolments as part of the overall goal of increasing participation rates in higher education.

The final constraint in this category is one which affects foreign students. Under current immigration regulations the Department of Home Affairs does not restrict admission of foreign students to South African educational institutions, allowing foreign doctoral students to study in the country (or to participate in learning programmes) for a period exceeding three months through temporary residence status acquired with a study or exchange permit. Permit holders are, however, restricted in terms of the paid work that they are allowed to engage in while in the country and must provide proof that they will be self-sufficient in terms of all costs associated with their stay prior to entry into the country. Application costs are minimal and African students are exempt from paying a deposit covering their return travel to their country of origin, given that their government submits a written undertaking to cover costs relating to the deportation of the student, should this become necessary. This does not necessarily point to any major blockages, but rather constitutes bureaucratic hindrances with some irritation value.

In conclusion therefore, the findings of these studies point to a number of systemic constraints that will impede any escalation in doctoral production in the near future. However, it is contended that the two main constraints are the pipeline constraints and the limited supervisory capacity at South African higher education institutions. Unless these two constraints are urgently addressed, it is unlikely that other initiatives (such as new funding opportunities and other reward incentives offered by the DHET) will lead to any significant improvement in doctoral output.

1.14 What can we learn from other countries with respect to escalating the production of PhDs?

Finding 23: Other countries have attained success with respect to escalating the production of doctoral graduates through six 'promising practices'. These include[95]:

(i) developing a strategic increase in postgraduate education that addresses multiple needs;
(ii) embracing 'brain circulation';
(iii) differentiating the higher education system;
(iv) ensuring international exposure for doctoral students through national initiatives;
(v) building cooperation and collaboration in doctoral training across different types of organisations;
(vi) introducing graduate or research schools to coordinate postgraduate training.

Since the 1990s, nations around the world have been increasing doctoral degree production and introducing initiatives to reform their postgraduate programmes. Examples of such initiatives in a selection of countries are summarised in Table 30 (Appendix 2). A number of 'converging practices' in doctoral education have emerged around the world. These practices are related to specific areas within the doctoral education process, as follows[96]:

- ***The future careers for which doctoral students are being prepared***
  Doctorates are increasingly seen in non-academic careers and students are being prepared not just for becoming a professor but also for doing research and teaching in industry, business, governments and not-for-profit organisations.

- ***Access and funding for doctoral students***
  An increasing number of countries are allowing access to doctoral programmes after a bachelors degree, as opposed to only after first earning a masters degree. The admission procedure has also become a defined, formalised and competitive process. In order to attract the best, students are now being offered several years of funding. In some countries funding comes directly from the government. In others, such as the USA, students are funded indirectly by the government through research grants or by the states through teaching assistantships. Students increasingly are offered a three-to-four year funding package.

- ***Coordination of the activities within doctoral programmes***
  Where not already existing, graduate schools or research schools are being established to coordinate and develop overall guidelines for the doctoral education process. These schools develop codes of practice and offer training for supervisors, administer evaluation surveys assessing what doctoral students think about programmes and supervision, and offer incentives for good mentoring through special awards.

- ***The range of expertise and experience available to doctoral students***
  Students benefit from having more than one supervisor or advisor, professional skills training, and international experience. In many cases a dissertation or supervisory committee – a panel of several people – guides the doctoral student throughout the doctoral education process. Training in professional skills is offered through graduate or research schools and is usually focused on conducting ethical research, working effectively in teams, knowing how to teach, how to publish, how to present, how to communicate complex information, how to write group grants, and how to manage time and projects. Doctoral programmes also increasingly endeavour to provide international experiences for their postgraduate students.

- ***The way in which doctoral students are being assessed***
  Countries that traditionally have not had examinations during doctoral study are introducing oral examinations. Students (specifically in the natural sciences and economics) increasingly have the possibility of choosing between a traditional dissertation or a compilation of several peer-reviewed articles based on their research. Higher education institutions are beginning to adopt policies that recognise such articles as well as dissertation chapters with multiple authors.

- ***The language of doctoral education***
  In many countries English has become the language of doctoral education.

[95] Nerad, M. (2009a)
[96] Nerad, M. (2009a)

- ***Quality assurance of doctoral programmes***
  National funding agencies and higher education institutions are creating templates for the review of doctoral programmes that synthesise international standards on PhD programmes. They are reaching out to international review teams for programme review. Funding and regulatory agencies are also asking doctoral programmes to undertake formative and summative evaluations for ongoing programme improvements.

Leading scholar in doctoral education, Prof Maresi Nerad, recommends six 'promising practices' which she gathered from experiences that have resulted in the planned outcomes. Because it is a given that sufficient resources need to be provided, and doctoral education needs to be aligned with national goals and included in a country's spending on research and development, she does not include funding in her list of recommendations. The six promising practices are listed below, along with the countries that have successfully used them.

• Development of a strategic increase in postgraduate education that addresses multiple needs
Strategies vary between countries. Ireland and Brazil, for example, have developed ten-year plans for doubling the number of academic staff in all fields who hold doctoral degrees. Ireland, Brazil, the European Union and Malaysia target a proportion of the increase in PhD production in fields that directly impact economic growth and Brazil plans for a regionally balanced increase. Brazil, Ireland, Iceland and Malaysia have created novel world-class doctoral programmes that are unique in the world and many countries create more professional masters programmes.

• Embrace 'brain circulation'
A 'brain-drain' was experienced by many resource-poor nations or countries with few world-class universities, but now these countries are turning past loss of excellent minds into a positive situation by bringing back expatriates who have become outstanding researchers. South Korea, Australia, Ireland, Germany, China, and now India have all developed systems to bring back to their universities (permanently or for a few years at a time) eminent scholars in areas of national and institutional need. These countries allocate a considerable amount of funding to make such a move attractive. One country even provides funds to support employment of spouses in cases of scholars in dual-career couples (e.g. the German Alexander von Humboldt distinguished professorship). In countries with such initiatives, the returning scholars are paid well, have excellent working conditions, state-of-the-art laboratory equipment, and an exciting mission to conduct high-quality research and train postgraduate students in the process.

• Differentiate the higher education system
Different higher education institutions could offer different doctoral degrees. In the USA, centres for excellence based on different fields of study are being established at different institutions. In other countries research specialisation is being combined with a sufficient critical mass to make quantity and quality of PhD production more feasible in only selected fields. In Brazil and the USA not all higher education institutions offer doctoral degrees. The California Master Plan for Higher Education, for example, differentiates by functions and degrees among its three types of higher education institutions and has a strong system of articulation between the different institutions.

• Ensure international exposure for doctoral students through national initiatives
Create a national prestigious fellowship which includes a maximum two years of study at a foreign higher education institution to ensure international exposure, as is the case in Brazil, China and Thailand.

• Build cooperation and collaboration in doctoral training across different types of organisation
Doctoral education programmes in Australia, Ireland and the USA are establishing Round Tables with higher education institutions, research councils, government, not-for-profit organisations and industry that include mentoring and career planning and development for current doctoral students with alumni from industry and other non-academic sectors.

• Introduce graduate or research schools to coordinate postgraduate training
Many higher education institutions have successfully introduced a single graduate or research school to control, design and assure quality and quantity of masters and doctoral programmes. Recent European implementation of various forms of graduate schools finds the American model of a single graduate school superior to several decentralised research schools (see Box 7, below).

Box 7: The American Graduate School Model

The Graduate School is closely linked to the research agenda of the institution. A graduate dean heading the Graduate School belongs to the inner circle of a university's governance. A Graduate School is both an administrative and an academic unit. It has five basic functions:

1. It is the executive policy body of an academic senate committee that assures the quality of masters and doctoral education across the entire university.
2. It is an administrative unit for all matters of postgraduate and postdoctoral affairs. As such, it oversees the basic requirements of admissions and degrees.
3. It is a service unit for postgraduate programmes and postgraduate students. In this function, it provides additional professional skills training that allow doctoral students to be successful in a variety of employment settings.
4. It is an institutional research unit for postgraduate matters and it collects and analyses data on postgraduate education at its university. Institutional research serves as a base for policy-setting.
5. It is an initiator and catalyst for innovation in postgraduate and postdoctoral matters.

Source: Nerad, M., 2009. *The context for increasing the quantity and assuring the quality of doctoral education in South Africa: what we know about the increase in PhD production and reform of doctoral education worldwide.* Commissioned paper for the ASSAf Consensus Study on PhD production (refer to Appendix 1)

In the current context of higher education, and given increasing global competition and rapid technological change, many government initiatives worldwide are supporting collaborative ventures between universities and users of knowledge in doctoral programmes as a means of building human capital and innovative capacity, as well as enhancing wealth-creation. Emergent economies are now looking closely at benefits that might accrue from such ventures.

Innovative responses in doctoral programmes have evolved in the UK, Europe, the United States and Australia that support integrated learning in collaborative industry settings.

In her ASSAf-commissioned paper[97], Prof Kay Harman elaborates on the establishment and successes of these initiatives, in particular the response of the Australian government in setting up the Australian Cooperative Research Centres (CRCs). Conceived in 1990 as a government-inspired initiative, Australian CRCs were set up with their educative aim to produce 'industry-ready' graduates via an integrated industry-based work-study programme. The programme is geared to enhancing student attractiveness to industry and developing more favourable attitudes to university-industry collaboration and more positive orientations towards careers in industry. The Centres comprise multi-site collaborative research and development ventures and act as key linkage mechanisms between universities and users of knowledge and technical know-how from private industry and public agencies. The main driver for this development is furthering national innovation goals by linking major players in the innovation chain – research organisations, industry and a range of research users. This model of knowledge production and transfer or 'triple helix' (government-industry-university links) as it is known, is where the university plays an enhanced role in innovation and knowledge exploitation[98].

The type of research training in CRCs has necessitated a more integrated approach to the production of knowledge, as illustrated in Table 24 (below).

[97] Harman, K. (2009)
[98] Etzkowitz, H. & Leydesdorff, L. (eds). (2000)

Table 24: Comparisons between the traditional and CRC doctoral training models in science-based fields

Indicator	Traditional model	CRC model
Knowledge production	Fragmented Linear (decontextualised) Discipline-based Tight boundaries Mode 1	Integrated & holistic Contextualised Multi/transdisciplinary Boundary spanning Mode 2
Emphasis on knowledge transfer/ commercialisation	Minimal	Strong
Alignment with industry/user needs	Weak link	Strong link
Mode of research	Investigator-driven Bottom up	User-driven Combined bottom up/top down
Research management	Loose arrangements with less direction	Managed research with timelines, milestones and more direction
Supervision mode	Master/apprentice	Shared between university-industry-research producers
Professional development	Weak emphasis	Strong emphasis with formal PD course and yearly CRC Association conferences
Emphasis on collaborative research	Weak	Very strong
Career emphasis	Largely for academe	Industry, research leadership
Reward systems	Individual performance measures	Performance rewarded on a project or team basis

Source: Harman, K., 2009. *The interface between the doctorate and industry: Reconceptualising doctoral education from an international perspective.* Commissioned paper for the ASSAf Consensus Study on PhD production (refer to Appendix 1)[99]

Another scheme of interest that Harman[100] identifies which views industrial links as an important element of doctoral programmes is the DOC-CAREERS project generated by the European University Association (EUA). Without establishing specially designed cooperative research centres such as the Australian CRCs, the project aims to produce doctoral graduates with a high level of awareness of the business environment, market regulation and intellectual property rights, and to provide industry with access to a highly skilled workforce and up-to-the-minute research. A significant outcome has been a noticeable increase in collaborative doctoral programmes between universities and industry and most of the universities report completion rates of over 90%.

A new initiative of the University of Melbourne is the Graduate Certificate in Advanced Learning and Leadership (GCALL). Begun in March 2009, it aims to develop and refine future career skills, to integrate academic and non-academic knowledge, energise the PhD experience, help determine future career directions and stimulate community engagement and knowledge exchange. Courses are run with input from academics, industry, business personnel and government experts[101].

In responding to concerns expressed by critics of American doctoral programmes, Nerad[102] notes one particular initiative offering integrated programmes at the doctoral level – the National Science Foundation (NSF) Integrative Graduate Education Research and Traineeship Program (IGERT). This programme, a theme-based initiative similar in its aims to the German Research Council funded *Graduiertenkollegs*, seeks to provide programme funding support for students; build interdisciplinary programmes; operate on a problem-theme-based orientation; provide opportunities for students to work with professionals outside academia; offer transferable

[99] Adapted from Harman, K.M. (2008a)
[100] Harman, K.M. (2009)
[101] Harman, K.M. (2009)
[102] Nerad, M. (2004)

skills development; and bring diversity to doctoral programmes[103].

Collaborative PhD programmes established to produce graduates with high level skills suitable for employment in public and private spheres, and to address the brain drain by retaining African scholars, are not new on the African continent. One that set out to address the variable quality in PhD offerings is the Collaborative PhD Programme (CPP) in Economics instigated by the African Economic Research Consortium (AERC) in league with universities and other stakeholders within and outside Africa. This programme, which had its first intake of students in 2003, has the advantage of being more directly relevant to the needs of Africa in terms of research direction, policy orientation, theories, literature and other information such as data sets and local examples and applications[104].

These types of initiatives are responding to the new demands of their respective country's rapidly growing knowledge economy with their emphasis on the importance of integrated work and learning and producing knowledge that is contextualised and transferable. This is not to say that the CRC or any other model would be recommended as a 'one size fits all' model of education. While aspects of the integrated CRC doctoral programme approach may well be a model worth emulating by universities in emerging economies, where a new mindset geared to the rapidly changing needs of the knowledge economy of the 21st century and beyond must be developed, the resource implications (human and financial) would pose significant challenges[105].

Harman[106] contends that if South Africa is to become globally competitive in its nominated fields of research and scholarship, an urgent need is to increase the diversity and number of doctoral graduates and link research training more closely with local, regional and national needs. As explained by the NRF[107], a key objective of the South African PhD Project, in addition to building strength and diversity in the public and private sectors, is to foster private-public partnerships for human capacity development.

In the light of the wide variety of programmes currently available to many doctoral candidates in the countries included in the Harman report, and not ignoring the need for a core emphasis on the research component in the PhD award, it would appear that doctoral programmes of the future would do well to include aspects outlined below (see Box 8, below):

Box 8: Aspects to include in future doctoral programmes

- Preparation for a variety of different work contexts including academia, research institutes, industry, government, private and not-for profit organisations
- Programmes to develop generic or transferable skills in areas such as problem solving, planning, project management, communication and leadership
- Engagement in interdisciplinary and multidisciplinary research
- A supervisory/advisory approach with a panel of mentors/advisors
- Opportunities to study with a cohort of peers
- Opportunities for teamwork
- Work on projects that demand collaboration with other universities, research centres, industry and research groups at national and international levels
- Experience working in other countries
- Teaching and presentation skills

Source: Harman, K., 2009. *The interface between the doctorate and industry: Reconceptualising doctoral education from an international perspective.* Commissioned paper for the ASSAf Consensus Study on PhD production (refer to Appendix 1) [108 & 109]

[103] Harman, K.M. (2009)
[104] Harman, K.M. (2009)
[105] Harman, K.M. (2009)
[106] Harman, K.M. (2009).
[107] National Research Foundation (NRF) (2009a)
[108] Harman, K.M. (2004)
[109] Nerad, M. (2005)

Developing a strategic increase in the production of postgraduates that (i) is linked to the national innovation agenda; (ii) is paired with changes in doctoral education; and (iii) includes collaborations between South African higher education institutions, government, business and industry, and the not-for-profit sector, as well as among individual departments of South African universities, has a high promise of bringing desirable changes in a period of 10-20 years. If these changes include the creation of graduate schools in South African universities and attraction back of some outstanding South African researchers and scholars who are committed to rebuilding the country, charged with an exciting mission and provided with good working conditions, the quantitative increase and qualitative changes in doctoral education will be well supported and may come to fruition as it has done elsewhere in the world.

1.15 How much do we know about doctoral education in South Africa?

Finding 24: More research is required to develop a comprehensive understanding of the dynamics of doctoral education in South Africa.

The ASSAf-commissioned studies investigated various facets of doctoral education at public higher education institutions in South Africa. The researchers examined the statistical profiles and qualitative experiences of the country's PhD students and supervisors; they considered employment and other postgraduation activities, as well as attrition or the 'drop-out' phenomenon; they explored the factors that make an exemplary PhD programme, and those that contribute to blockages within the PhD production system; and they related their findings to the international academic literature on the subject. Thus, the short answer to the question posed is that we know a great deal more about doctoral education in South Africa than before the commencement of these studies.

However, even though, as stated above, this body of work represents a groundbreaking advancement in our knowledge of doctoral education in South Africa, without exception each researcher noted that we still have much to learn. The two major needs identified are further and continuous research and improved record-keeping. Both of these issues require commitment at national and institutional level. New and regular research should preferably be institutionalised throughout the higher education sector, while data on doctoral education processes should not only be accurate and accessible but also tailored to elucidating the critical questions.

In particular, the researchers point to the following areas that need further research and/or intervention:

- **Attrition rates:**
Attrition rates are rarely computed or publicised. Departments and schools rarely keep track of students who leave and departments seldom tout the accomplishments of non-graduates. This attribution relieves the faculty and university of responsibility for attrition by locating it principally with the student[110]. Nor is there evidence that students who were dropping out routinely received exit interviews or that those departments are interested in learning from these students' experiences[111]. This situation needs to change, so that better information on students who have 'dropped out' can be obtained and their voices heard.

- **Skilling of postgraduates:**
A better understanding of the links between skills, attributes and employability is required in order to optimise the supply of graduates with the appropriate training, skills, knowledge and abilities.

- **Careers of PhD graduates:**
More studies are required on the careers of PhD graduates in specific fields and across the various sectors of employment. These studies should aim to determine who are employing PhD graduates, why they favour certain sectors and, most importantly, capture the graduates' views on the role their doctoral degree has played in career development. In order to determine national trend data and benchmarking across individual universities, such studies will need to become part of, first, institutional, and, second, higher education policy and practice.

[110] Albertyn, R. M.; Kapp, C. A. & Bitzer, E. M. (2008)
[111] Golde, C.M. (2000)

• **Destination studies:**
Destination studies should be institutionalised and routinely administered to determine where PhD graduates are located. Awareness of their location will help determine which 'kinds' of skills are required.

• **Advocacy:**
In order to escalate the number of PhDs there is a strong need for advocacy at all levels – individual, institutional and national. The country does not yet fully appreciate the importance of higher education, and the PhD in South Africa is perceived as a luxury rather than as a necessity among some policy-makers and society at large.






CHAPTER 5

Main Recommendations

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Main Recommendations

After due consideration of the findings of the Consensus Study on the status and place of the South African doctorate in a global knowledge economy, the Study Panel makes the following recommendations with regard to the ten key actions to escalate the production of high-quality doctoral graduates in South African public higher education institutions:

Recommendation 1:

Escalate the numbers of doctoral graduates through external intervention programmes, for which there is successful precedent in recent South African history.

The PhD data shows clearly that the production of doctorates in South Africa is and has remained stable for several years. It is equally clear that working only within existing systems, and taking into account available capacity, there is simply no way that a rapid growth in high-level qualifications at the level of the doctorate will materialise in the foreseeable future.

Indisputably, constraints on doctoral production lie deep within the school system, where only 16% of graduating matriculants qualify for university entrance (the exemption pass). So, from the very start of undergraduate entry the pool of available students from whom postgraduate entries will be determined, is very small.

However, problems also reside within the structure and design of undergraduate programmes themselves, with high drop-out and repetition rates ensuring a small percentage of baccalaureate graduates. The problem is compounded by the so-called honours degree, an anachronism in higher education elsewhere but yet another structural anomaly that prevents students from entering a masters degree directly. The masters degree, in turn, provided for some time an exit option with a lesser certificate for those who do not intend to, or do not have the time or capacity to complete the full degree. This means that the pool of qualifying masters students for potential doctoral studies remains slim.

In addition, the problem of supervision capacity remains a very real constraint on what is possible within the existing higher education system. There are simply not enough supervisors, even assuming all those available were qualified and that the supervisor/student ratio was equally spread. This means that any attempt to rapidly increase the number of doctoral graduates will have to happen outside of universities.

Private-public partnerships will make some difference, but short of turning engineering firms or science councils into fully-fledged doctoral training sites – which is impossible – significantly higher numbers of doctoral graduates will not emerge. In any event, since only universities award qualifications the onus will remain on these institutions to lead the production of higher degrees.

Fortunately there is a precedent for turning to international universities with massive external funding for escalating the number of doctorates in South Africa. During the terminal years of apartheid, with access limited to black students in the former white universities a large number of black students – mainly masters and PhDs – went to study in the USA. The return records were very positive, with more than 90% of graduates returning home. Administered locally by the Educational Opportunities Council, funded by the US government, as well as US foundations and corporations, the International Institute of Education led the administration and placement of South African students in participating universities in that country. Today, graduates of this massive international programme can be found throughout government and in the private sector in South Africa.

The injection of large numbers of externally trained PhDs across all disciplinary fields over the next decade will impact the South African knowledge system in a number of ways. First, it will help to address the dire shortage that has emerged in a number of key academic areas such as engineering. Second, it will inject enormous intellectual diversity into that knowledge system – new blood, as it were. Third, it will help to build new, dynamic and organic bridges between the local knowledge system and others across the world. Fourth, it will introduce into the local system new cultures of and approaches to graduate education. Fifth, within a decade this will reshape the issue of supervisory capacity.

If one considers the cost at the top end, one may perform a back-of-the-envelop calculation that indicates a cost of approximately R2 billion for producing one thousand externally trained PhDs in ten years.

It would take leadership by the South African government and its major departments, such as DST and DHET, working with the NRF, to re-establish a similar programme targeting doctoral students.

At the same time, it should be possible to expand to some degree the smaller programmes for international placement of doctoral students, such as the Fulbright Programme, the Nelson Mandela/Rhodes Scholarship, and the Harvard South Africa Programme. However, these initiatives were not designed for large intakes of postgraduate students.

In a resource-constrained environment the relationship between this recommendation and others (in particular Recommendations 2 and 4) and their phasing will need to be carefully managed.

Recommendation 2:

Expand significantly the levels of funding for doctoral studies in South Africa, with a particular focus on shifting the balance of students towards full-time study.

The data underlines the fact that South Africa has an older doctoral student population than most countries, especially in the social sciences and humanities. This means that students come into doctoral studies at a stage in the life-cycle when there are families to support. This is especially the case with students from disadvantaged backgrounds who are already approaching mid-career status in their fields of employment. For such students to study on the rather limited bursary funds available from the main source of funding (the NRF) means very real hardships have to be faced and choices made.

Clearly, students who are able to study full time are able to finish more quickly, and it is a reasonable assumption that such students are also able to engage learning much more deeply because of the time available. Such students can attend seminars, produce papers, take on research assignments, work with their professors and mentors in an engaged way, and attend conferences more readily than part-time students who need to work. The ideal, therefore, is to have more full-time doctoral students.

For this to happen, scholarship agencies such as the NRF have choices to make: use the limited funding available to support many more students with minimal grants or deploy the funding in ways that support fewer students but favour full-time doctoral studies. The only other option, of course, is for government to increase significantly the scholarship funding available to the NRF, and other agencies, through the parliamentary grant.

Whatever the mechanism for sourcing funds that enable full-time study through generous doctoral grants, it is clear to the Panel that attracting and retaining larger numbers of doctoral students is simply not possible without very significant increases in the volume of funding available for advanced study. Innovative measures, such as mixed-mode study could also offer good possibilities in this regard.

There are some innovative programmes underway in the higher education system. Some universities offer bursaries in excess of R150 000 per annum; others take on the most promising students as junior lecturer equivalents, even though in such cases there are regulatory tensions between paying students and paying faculty members. The tax sometimes levied on such payments cancels out the value of the funding in the lives of mature or married doctoral and indeed postdoctoral students.

Providing scholarships for mixed-mode study (i.e. full time and part time during different periods within the course of doctoral studies) could also be effective. Instead of offering substantial bursaries for full-time study only, students could be offered 12 to 18 months of full-time scholarship support during the preparatory phase and in writing-up, with the rest of their candidature being part time.

Another approach would be to emulate the system in the USA where graduate students are able to support

themselves and their families through employment as teaching assistants by the institutions in which they study. This will require the emergence of a systemic approach which deals with the issues of taxation and benefits – an approach which includes the emergence of national policy that will facilitate and enhance this. This will have the added advantage of increasing undergraduate teaching capacity and thereby allowing high levels of access or else more significant time for research.

Nevertheless, the Panel advises that major and new refinancing models for doctoral studies be designed if the task of increasing the number and quality of senior postgraduate students is to become a reality.

Recommendation 3:

Create an overarching and interconnected national planning strategy for dealing with high-level skills production, such as the doctorate, so that all parts of the system work in the same direction.

It is clear from the evidence available to the Panel that there is a very limited sense of coherence in terms of training for advanced skills across the various sectors of government. There is no sense of a national strategy that integrates the strategic plans of units like DHET, DST, the Department of Labour, the South African Qualifications Authority (SAQA), the Council on Higher Education (CHE), the NRF, the National Advisory Council on Innovation, the Department of Home Affairs (DHA), and Higher Education South Africa (HESA) – to name but a few. This is particularly the case when it comes to the doctorate.

The new National Planning Commission appears to be an ideal vehicle for bringing together such variant elements of planning for advance skills, and for monitoring progress towards such goals as increasing the pool of doctorates available for national economic and social development.

For example, to recruit large numbers of top scholars as researchers and supervisors for doctoral students requires that the DHA revisits its policies and procedures for international scholars in ways that facilitate the flow of knowledge workers into the country; it requires the South African Revenue Services to join the effort and revise the tax implications for paying such scholars; it requires that the Treasury increases the pool of institutional funds available to DHET or DST in order to fund doctorates at much higher levels; it requires the smaller government departments to develop a joint strategic initiative that pools their resources for maximum impact with respect to the attraction and retention of postgraduate and especially doctoral students.

In other words, a fractured and disparate set of initiatives for human capital development at the level of the doctorate will have a muted effect on the kinds of radical changes proposed by the Panel.

Recommendation 4:

Address the pipeline issues as a matter of urgency, for in the long term it will not be possible to sustain high levels of doctoral entrants into advanced training without a sharp increase in the numbers of students coming into undergraduate education, early postgraduate education, and eventually into PhD programmes.

In this respect the Panel makes a series of bold recommendations for immediate action:

- strengthen the quality of the school system at its foundations, ensuring that literate and numerate students with greater confidence in their own learning proceed to high school;
- increase sharply the number of high-school matriculants with high-quality university-entrance passes, especially in science and mathematics;
- build on existing awareness among high-school graduates about careers requiring doctoral qualifications for the highest levels of performance;
- build stronger incentives into early post-graduate programmes for students to continue studies towards masters and doctoral qualifications;
- target at an early stage the most promising honours and masters students to enter doctoral programmes;
- create innovative programmes that attract and retain larger numbers of post-baccalaureate students in masters and doctoral studies.

In other words, the links between the school system and the university system need to be strengthened with purpose in order to ensure larger numbers of quality students pass from one level or phase of the education and training system into the next. At the same time, the links between bachelors, masters and doctoral studies need to be more strongly articulated so that it becomes increasingly meaningful and acceptable for ever-larger numbers of students to pass through university with a doctoral qualification in mind.

Low throughput from the undergraduate level onwards may be addressed through a different approach to the higher education phase of the pipeline, for example, the four-by-four approach, whereby the undergraduate and honours degrees are offered as an integrated course, and the masters and PhD are similarly combined. Dropping out at the higher level may also be combated through a mixed-mode approach for doctoral candidature, with the first year mandatory full time and subsequent years more flexible, taking advantage of state-of-the-art technology. It would be wise to consider regular, compulsory progress reporting, as well as a formal 'confirmation of candidature' process. This assesses the extent to which students are 'on track' during the probationary period (first six to 12 months full time) of their candidature (and thereafter), and ensures their readiness to attempt the next phase of their research. Confirmation and subsequent progress reporting provides an important educational component as well as an integral part of universities' quality assurance processes. It also helps to achieve more timely and successful completions.

Recommendation 5:

Eliminate the multiple barriers – bureaucratic, administrative, political, legal and structural – that stand in the way of increasing the pool of doctoral candidates in the system and the pool of competent supervisors for doctoral students in South African universities.

There are multiple barriers to increasing the pool of available doctoral candidates in South African universities, and these must receive decisive attention if the growth of doctoral graduates is to meet the need for high-level skills in the country.

The first set of barriers comprises ***organisational arrangements***, that is, existing within the ways universities manage and organise postgraduate studies in general and doctoral studies in particular. One organisational constraint is the lack of well-organised capacity for managing postgraduate studies. Typically, a 'Dean of Students' is in reality a dean of undergraduate students. There are few, if any, university-wide structures that account for and manage masters and doctoral studies.

In this respect, the trend among a few universities towards '(post) graduate schools' must be applauded. Run well, the literature suggests that graduate schools could greatly enhance the efficiency problems in the throughput and success rates of doctoral students. Graduate schools could become the centre for marketing, recruiting and retaining the most promising masters and doctoral students in the university. Graduate schools could coordinate organisational interventions that increase the conversion rates from bachelors to honours to masters and to doctoral programmes. Graduate schools could become institutional centres for predicting and managing the multifaceted problems encountered by so many senior postgraduate students, and that lead to high drop-out rates.

Graduate schools could become intellectual centres that deepen the quality of doctoral studies and create communities of learning and support across the university and among postgraduate students. Graduate schools as administrative centres could not only lessen the burden of doctoral studies for students but also monitor performance based on the routine collection of data for all students, in ways that enable the university to better respond to potential crises. Graduate schools could plan and coordinate professional training that makes the transition from university to business, industry and academia much smoother and placements more successful.

Finally, graduate schools could serve as institutional centres for the development of innovation in graduate education. Much international study indicates that doctoral education is undergoing enormous change all over the world – a change which requires serious discussion and contemplation at institutional level.

The second set of barriers is the ***available supervisory capacity***. Both the existing supervisor-student ratio and the fact that only 40-50% of academics in research-intensive universities hold doctorates, suggests a coming crisis in advisory capacity – made worse by another reality, the ageing professoriate.

Clearly the Research Chairs and the Centres of Excellence bring in some capacity outside of the normal university appointments process, but this is miniscule in relation to the demand for supervisors to meet projected capacity needs. It should also be noted that this projection does not even take into account the troubling question as to whether simply holding a PhD qualifies an academic to be able to supervise competently or at all.

There are multiple ways of redressing this problem. One, through the mass training of new PhDs to enable them to supervise at the level of the doctorate. Two, it should be possible to bring back into universities large numbers of senior academics, not only from science councils and industry, but also retired university professors and targeted recruits from other countries. Collaborative supervisory arrangements with targeted overseas

universities could also supplement limited supervision capacity through the recruitment of honorary adjunct supervisors from abroad on a part-time basis. Three, to enable the attraction of such additional supervision capacity, special institutional and perhaps even national government plans could be devised to arrange for special subventions in the remuneration of senior professors, many of whom would simply not come, or stay, against existing salary scales. Four, adopting a cohort model with shared supervision arrangements could not only distribute the supervisory load, but could also enhance the quality of the doctoral experience through active engagement with larger numbers of mentors and fellow students.

The third set of barriers is ***structural***, meaning the three-tier structure of universities (traditional, comprehensive and universities of technology). There are clear policy signals about the universities of technology (former technikons) not becoming major producers of doctoral degrees for reasons of capacity and, in some cases, high drop-out rates in the undergraduate programmes. This is understandable in some such institutions, however an increasing number of the universities of technology are absorbing senior academics from traditional universities into their management and academic bodies, such that there is latent capacity to launch, in selected institutions, strong doctoral programmes.

The fourth set of barriers comprises ***bureaucratic barriers,*** which affect the capacity of the South African science system to attract foreign scholars as supervisors and foreign students to enter doctoral programmes.

The Consensus Study findings could not identify major barriers in this regard but there are countless anecdotes about how difficult it is for visiting scholars to enter the country, especially when payment has to be made. The incredibly complex maze of regulations stands in the way of an efficient processing of knowledge workers to assist in dealing with the supervisory capacity problems.

It is recommended that a special international scholar visa be introduced for a period of ten years, in which the travel and remuneration of international scholars would be expedited to enable universities to more quickly appoint and pay expert university teachers and supervisors from other countries.

The data shows a steady growth in, and graduation of, international doctoral students so that it does not appear (outside of taxes on salaries) that such students experience major barriers to access or progress within the South African higher education system.

Recommendation 6:

Apply strong quality assurance measures to the doctorate, on one hand to prevent irresponsible massification of the degree in the light of the substantial funding incentives for graduating PhDs; and, on the other hand, to deepen the quality of this final qualification across universities.

The single most important policy initiative affecting the PhD is the new funding framework which significantly rewards the production of masters and doctoral students. This is one of a series of important shifts in the reward system that could potentially increase the number of doctorates.

However, if recent evidence on how funding incentives boosted journal publication is anything to go by, then there are clear warning signals ahead. Any mechanical increase in the production of PhDs in response to monetary incentives could jeopardise an already fragile quality spread across postgraduate qualifications, something brought to light in the work of the CHE. While massification itself is not necessarily considered to be irresponsible, it becomes irresponsible if there is a lack of proper quality assurance.

This is a trade-off that must constantly be monitored: the quest for greater numbers of outputs (be they doctoral students or publication units) against the concern for greater quality embedded in such outputs. Institutional behaviour often follows the money, especially when universities are under stress to meet their financial obligations, and this requires countervailing actions in the policy regime to ensure that quality and quantity grow without either one being jeopardised by the other.

The Study Panel recommends, accordingly, that the CHE finds the funding to undertake the planned quality assurance of PhD programmes even as the quest for expansion of doctoral enrolments and graduates continues.

Recommendation 7:

Advocate public support for, and understanding about, the PhD so that there is greater awareness and acceptance of its significance in social and economic development, beyond personal gains for the successful student. Developing this shared meaning about the value of the doctorate is vital for garnering public support for it.

South African students fall into PhD studies rather late in their educational experiences. Our data shows that the decision to study for the doctorate is not a long-term ambition but something that comes, for most, during their masters studies.

The Study Panel spent some time deliberating on the national culture with respect to education. In a place where so many are illiterate and unschooled, the emphasis of government policy has understandably been at the other end of the education and training spectrum. Few South Africans spend time thinking about the doctorate or its significance for social or economic development, but school education is understood differently.

It is also true that most doctoral students think of the degree in personal development terms, or more narrowly in making them better prepared for a particular job. There is no tradition of thinking – outside of the major policy agencies such as DST or the NRF – that links the attainment of the doctorate to national development needs.

It is the view of the Study Panel that in order to build a broader awareness of the importance of the PhD in national development terms, a concerted and focused effort should be made as part of public understanding of science initiatives of government. Universities themselves should begin marketing the PhD among their senior undergraduate students, and certainly among the top masters students in their programmes.

In other words, the doctorate – its meaning and significance – should become a part of public discourses in a more open and consistent way than at present, where these deliberations and announcements happen largely within the realm of small policy circles or academic administrative and planning groups. When proceeding to a doctorate becomes much more commonplace and not exceptional in the public mind, then an important hurdle is crossed in gaining broader support for the expansion of numbers in this ultimate degree.

Recommendation 8:

Target specific institutions with existing capacity and established track records for scaling up the production of PhDs even as selected programmes are funded within universities that are not strong overall in producing doctorates.

Political considerations (that is, the ways in which legacies of the past determine political decisions about the ways in which decisions on allocation are made), could be an additional barrier to postgraduate expansion. Of course, all governments make decisions based on political legacy factors, and South Africa is no exception. However, when such decisions act to undermine long-term correction of capacity problems, such as in the case of the doctorate, then the political actions could be considered a barrier.

What does this mean? South Africa is reluctant to make a distinction among universities on the basis of their racial legacies. So, for example, all universities can, in theory, offer PhDs. Such thinking flies in the face of some unpleasant realities, and that is that only a small number of universities generate more than 90% of all the PhDs in the country.

One strategy could be to follow models such as in the California higher education system, where there are dedicated doctorate-granting universities. This might be too hard a pill to swallow in South Africa since the top six PhD awarding universities, where much of the capacity lies, are former white universities. Another way of dealing with this is to recognise that these universities are producing increasing numbers of black graduates and that government investment for this task should be directed where the capacity lies. The importance of critical mass in doctoral programmes should not be underestimated: generally PhD students perform better when they are members of larger groups which can afford a variety of supplementary courses as well as input from external scholars.

Another strategy would be to make PhD investment decisions based on high-quality doctoral programmes in areas of national need, so that funding is less institution-focused and more programme-focused. So, for example, a programme producing doctorates in agricultural economics at the University of the Free State would receive preferred funding alongside a programme in the physical sciences at the University of Limpopo.

Recommendation 9:

Recognise and reward the diversity of doctoral programmes in practice, and adapt national policy to these realities rather than impose a one-size-fits-all model of the traditional PhD on a system that has long moved in the direction of multiple models of training for the doctorate in traditional academic as well as professional degrees.

Existing policy recognises only one kind of doctorate, the research PhD that comes with the standard require-

ment of a contribution to original knowledge and in which course work does not count in the credit value of the qualification.

The reality on the ground is vastly different. While the conventional PhD still dominates the higher education landscape, there are a myriad of other models of the PhD that now exist in practice. These include various kinds of professional doctorates such as in business, education and engineering, and a growing number of course-based PhDs that co-exist alongside more or less stringent research theses requirements.

One policy approach of course would be to force compliance with the requirements for a doctoral degree such as described in the 2007 Higher Education Qualifications Framework. Another policy approach would be to argue that formal policy lags behind professional practice, and that official positions need to adapt to these changes in the real world of doctoral education.

It is the view of the Study Panel that the insistence on a single model of the PhD will slow down the production of doctorates and frustrate practitioners responding to real needs in business, industry and academia for more relevant and more powerful training locked-up in a single model.

Policy signals are important, and not recognising, in credit value, the enormous time and significant resources that go into course-based teaching is sending the wrong message.

This does not mean that any and all existing practices should be sanctioned in policy or rewarded in practice, but it does mean revisiting the single-model approach of current policy to take account of high-quality, diverse approaches to doctoral training in South Africa.

Recommendation 10:

Strengthen and elaborate the relationship between universities and industry, as well as science councils, so that larger numbers of doctoral students are trained and supported through learning in practice while at the same time supplementing academic advisorships on campus with those working in the field.

Even without external intervention, universities alone cannot meet the high demands for highly-skilled labour through increases in doctoral output. It is critical that existing synergies between universities and industry be significantly enhanced to increase quality and quantity in doctoral graduates.

There are powerful examples of existing collaborations, such as the productive model of the Medical Research Council (MRC) in the health sciences, or the intense in-service training support of Africon (now Aurecon) in engineering, or the high absorption rates of doctorate personnel in chemistry at SASOL. The Study Panel found that these existing relationships could be strengthened through more effective use of university-based supervisors and industry-based mentors in training doctoral students.

Another important area for collaboration is between the universities and the human science councils, such as the Human Sciences Research Council (HSRC). In recent years, leading social scientists have gravitated towards the HSRC, leaving many universities with smaller numbers of senior and experienced personnel to train and supervise masters and doctoral students. Rather than bemoan this loss of skilled academics, another approach would be to structure internships for doctoral students within projects of the HSRC, which, for example, allow students to benefit from joint supervision and, in the process, earn money for their science council work. The student also learns hard skills in project management and research practice not as readily available in university environments alone.

While universities are the only degree-granting institutions, there is no reason that adjunct professors, for example, could not be appointed from within the personnel of the Council for Scientific and Industrial Research or the HSRC as full university appointments. Conversely, major research projects funded by these and other science councils could also include funding for PhD projects. These are the kinds of productive partnerships that must be expanded if, within South Africa, doctoral graduate numbers are to increase.

CHAPTER 6

Conclusion

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Being the first study of its kind in South Africa, this body of work represents a groundbreaking advancement in our knowledge of doctoral education in South Africa. However, precisely because it is the first of its kind, there are inevitably shortcomings and gaps that were identified in the course of the study and in the subsequent consultation regarding the outcomes. In some respects these possibly relate to methodological shortcomings, but in the main they are concerned with the need to debate and research many of the matters arising, further.

The Report on this Study should contribute to the discourse of the nature and form of PhD study and production in South Africa, and will undoubtedly stimulate much debate. Over and above the issues identified in Finding 24, it is anticipated that much debate will take place around four most pertinent topics:

i. What constitutes a quality PhD?
ii. The relationship between the production of doctoral graduates and economic growth.
iii. The methodological, theoretical and contextual contributions that each PhD offers.
iv. The interpretation of the Higher Education Qualification Framework.

- **What constitutes a quality PhD?**

With regard to the former, doctoral degrees are the highest academic qualifications students and scholars of a subject area can earn and are generally awarded only for a significant and original contribution to a field, outstanding scholarly or professional work and a high level of mastery in a particularly subject. However, there are varying views on what constitutes a 'quality' doctoral degree.

According to the HEQF, a "doctoral degree requires a candidate to undertake research at the most advanced academic levels culminating in the submission, assessment and acceptance of a thesis. Course work may be required as preparation or value addition to the research, but does not contribute to the credit value of the qualification. The defining characteristic of this qualification is that the candidate is required to demonstrate high-level research capability and make a significant and original academic contribution at the frontiers of a discipline or field. The work must be of a quality to satisfy peer review and merit publication. The degree may be earned through pure discipline-based or multidisciplinary research or applied research. This degree requires a minimum of two years' full-time study, usually after completing a masters degree. A graduate must be able to supervise and evaluate the research of others in the area of specialisation concerned"[112].

By way of comparison the doctoral degree in the European context of the Bologna framework is considered the 'third cycle' in the European Higher Education Area (EHEA), and the final cycle in the framework. In order for the 46 countries participating in the Bologna Process to be able to create doctoral programmes that allow for a greater uniformity and thus mobility, the so-called 'Dublin Descriptors' have been established which outline that a doctoral degree shall be awarded to students who:

- have demonstrated a systematic understanding of a field of study and mastery of research associated with that field;
- have demonstrated the ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;

[112] Department of Education (2007)

- have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication;
- are capable of critical analysis, evaluation and synthesis of new and complex ideas;
- can communicate with their peers, the larger scholarly community, and with society in general about their areas of expertise;
- can be expected to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge based society[113].

The Higher Education Act of 1997 assigns responsibility for quality assurance in higher education in South Africa to the CHE. The HEQC (the sub-committee of the CHE which carries out this responsibility) sets the following as its criterion for monitoring the quality of postgraduate programmes it sets as its criterion: "Efficient arrangements are in place for the quality assurance, development and monitoring of postgraduate education"[114]. In order to meet this criterion, they expect that there should be (i) clear policies, regulations and criteria in relation to the quality of postgraduate education; (ii) effective structures and processes that quality assure and monitor postgraduate education; (iii) an effective research information system which supports the monitoring of postgraduate education; (iv) clear and effective policies and strategies which facilitate the development, support and improvement of postgraduate education; and (v) regular review of the effectiveness of arrangements for the quality assurance, development and monitoring of postgraduate education[115].

However, it would seem that the monitoring of quality is concerned primarily with inputs to the process. More attention could be given to other aspects regarding quality of the proposal, supervision provided, the examination process, and, as universities increasingly become enterprises and must compete in an international education market, it will be essential to review doctoral programmes based on international standards.

• Relationship between the production of doctoral graduates and economic growth

Chapter 3 of this Report largely supports the contention that there is a strong relationship between the production of doctoral graduates and economic growth. This is in line with the view taken by higher education systems worldwide and is indeed the motivating factor behind most envisaged reforms in doctoral studies in Europe and the US who contend that frontier research is recognised as a key factor for advanced knowledge-based economies[116]. This view is to a large extent grounded in endogenous growth theory (or new growth theory) which contends that the enhancement of a nation's human capital will lead to economic growth by means of the development of new forms of technology and efficient and effective means of production. Doctoral education prepares researchers with the skills to be innovative, creative, critical and independent; these skills are not only related to the research process itself, but to a broader personal and professional training and development, thus providing highly talented human resources that are necessary for such growth.

According to the Sapir Report[117], as an economy gets closer to the educational frontier, higher education becomes increasingly important; thus while the basic requirement for the post-war economy was secondary education, that of an innovation-driven economy is higher education. Along with skills, the key intangible impact on innovation clearly comes from research and development – the turf of the PhD. Productivity growth can be generated either by imitation or by frontier innovation, with innovation becoming increasingly important for growth as countries get closer to the world technology frontier[118].

Thus there has been a growing recognition that in a knowledge-based world, no society can develop effectively without a serious capacity to generate, transmit, and consume new knowledge. In the view of Szanton and Manyika[119] "every complex modern society requires numerous technically trained people in a wide range of fields, a citizenry and leaders with a liberal education capable of critical analyses of local and national problems, policies, and opportunities, and an ability to train the next generations".

Thus it is clear that the contribution of highly qualified citizens (i.e. those with PhD) extends to societal and cultural development as well. Mala Singh[120] has argued

[113] Bologna Working Group on Qualifications Frameworks (2005)
[114] Council on Higher Education (2004)
[115] Council on Higher Education (2004)
[116] League of European Research Universities (LERU) (2010)
[117] Sapir, A. (2003)
[118] Aghion, P., Dewatripont, M., Hoxby, C., Mas-Collell, A. & Sapir, A. (2008)
[119] Szanton, D.L. & Manyika, S. (2001)
[120] Singh, M. (2001)

that higher education must go beyond a concern for labour market issues or individual or national economic competitiveness, and engage in, and stimulate others to engage in, broader social and philosophical issues and debates concerning the "public good".

As Szanton and Manyika compellingly argue, "with increasingly complex societies integrating into an increasingly complex and competitive world – and as elitist as it may sound – it is essential for every country to have a large and growing cadre of highly skilled professionals; thinkers, actors, writers, teachers, male and female, in a wide range of fields who are capable of producing critical analyses, local and national policies, and programmes to deal with the internal and external social and cultural issues facing their nation. Every country needs to continually replenish and expand its supply of people who can think critically and creatively about processes of globalisation, democratisation, development, human rights, etc."[121].

So what are the implications for South Africa? And do certain kinds of PhD contribute to certain kinds (or parts) of the economy? We possibly need to critique which economy the PhD contributes to the knowledge economy, the first world economy, the third world economy, the formal economy, the informal, and/or non-formal economy? What are the indicators of the link between PhD production and/or the development of the economy? As Amarta Sen[122] argues – possibly we need new definitions (or indices) for development (or growth) when we assess what productivity means.

- **Methodological, theoretical and contextual contributions that each PhD offers**

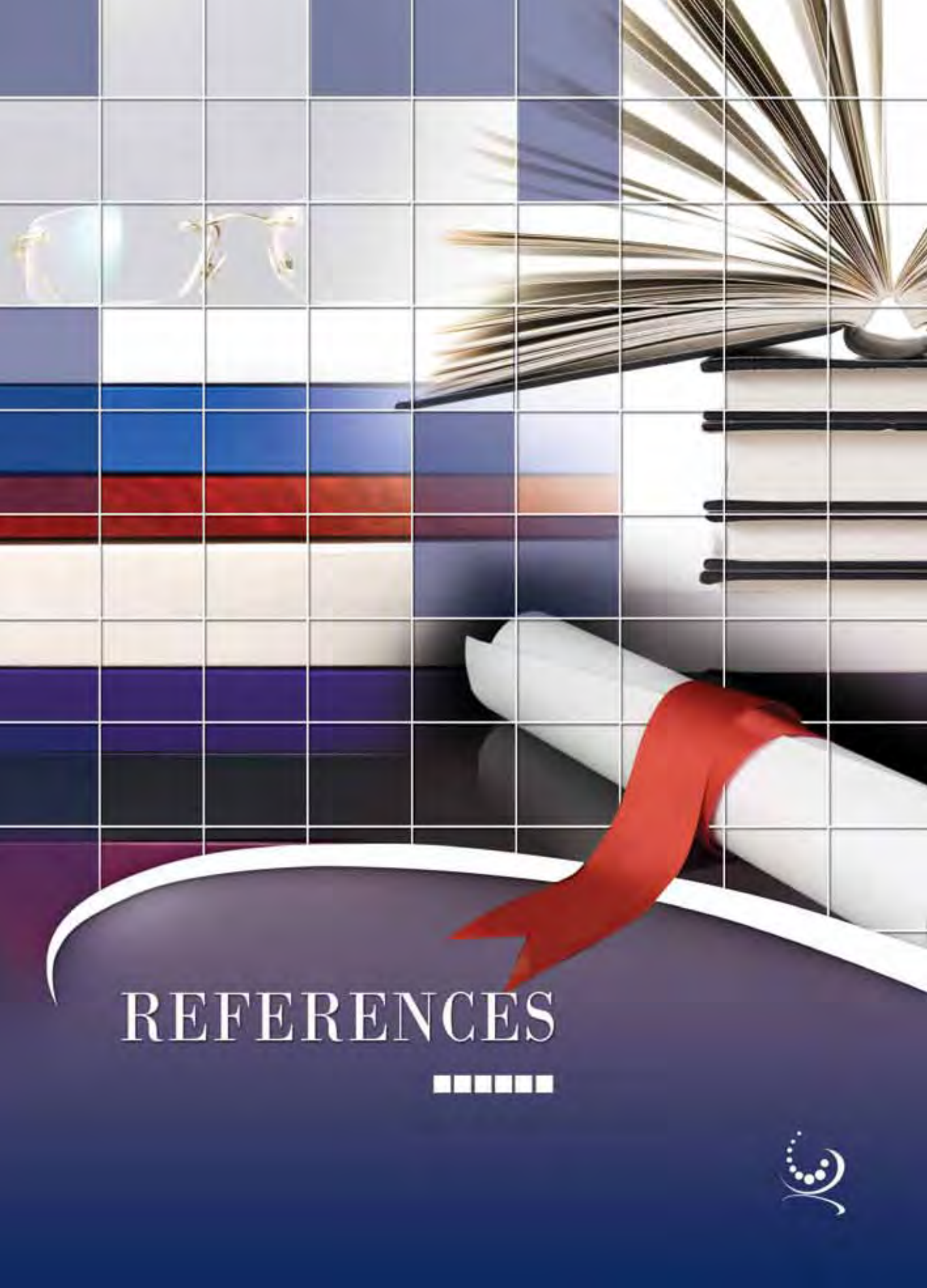
Allied to this, further study is required as to how/whether we can draw automatic linkages between the disciplinary bases of the PhDs and the potential contribution it makes, without a detailed breakdown of what the topic, focus, question and repositioning is in the specific PhD study. How do we interrogate the methodological, theoretical and contextual contributions that each PhD thesis offers? A purely disciplinary analysis is not likely to reveal this, but this has been the proxy used in this Study (perhaps unconsciously). Such an analysis would entail a fundamentally different kind of PhD production analysis.

- **Interpretation of the Higher Education Qualification Framework**

As a fourth point, the findings of this Report need to feed into the debates around the interpretation of the Higher Education Qualification Framework that is presently being undertaken by the DHET in relation to the qualifications structure for "Teacher Education Qualifications and Career Paths" – which is a revision of the well-established "Norms and Standards in Education" (2002) which has guided the construction of qualifications in the field of teacher education. The discussion concerning the possibility of professional doctorates should feature in these discourses since the prominence of parallel 'professional track' alongside the 'academic track' in the postgraduate band features in the draft proposal of the "Teacher Qualifications and Career Paths" document. This will help clarify for teacher education as a field the purpose of the PhD. Can there potentially be many purposes for the PhD? Are different fields of study (e.g. engineering, architecture, medical health, teacher education) likely to prefer certain options?

These debates are essential, and to be encouraged and welcomed.

[121] Szanton, D.L. & Manyika, S. (2001)
[122] Sen, A. (1999).



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APPENDICES

Appendices

Appendix 1: Research Method and Sample of Source Reports

(Commissioned reports and papers listed in alphabetical order by title).

1. The context for increasing the quantity and assuring the quality of doctoral education in South Africa: *What we know about the increase in PhD production and reform of doctoral education worldwide*
Prof Maresi Nerad, Centre for Innovation and Research in Graduate Education (CIRGE), University of Washington

- The paper, commissioned by ASSAf, begins by introducing the concept of the knowledge economy and doctoral education from an international perspective.
- Trends in the expansion of doctoral education from an international perspective are then considered.
- Issues relating to reform efforts to improve the quality and efficiency of doctoral education are then addressed.
- This is followed by a description of new models of knowledge production – in particular those linking universities with industry, and models used in various countries to develop world-class universities.
- Worldwide changes in postgraduate education systems are provided, with pertinent examples from Europe, Ireland, Iceland, Brazil, India and Malaysia.
- In spite of differences in doctoral education systems and practices, a number of converging practices are then identified.
- Finally, recommendations are made based on international experience.

2. Destination study: a survey of doctoral graduates across a sample of fields and institutions
Centre for Research on Science and Technology, Stellenbosch University, 2009

- The report is based on qualitative and quantitative analyses of a web-based survey conducted during 2009 of doctoral graduates who graduated from 15 South African higher education institutions.
- A total of 1 076 completed questionnaires were received.
- Comparison of the sample against the population of doctoral graduates for the period 2000 to 2007 indicates that:
  - the sample is representative for field of study (with natural science graduates slightly overrepresented) and nationality (South African students slightly underrepresented);
  - male students are overrepresented (60% versus 42%);
  - the majority of respondents are between 36 and 45 years of age (30%) and between 46 and 55 years of age (29%);
  - 65% of respondents indicated that they are white, 8% black, 4% Coloured and 3% Indian (20% of respondents did not provide details about their race);
  - the majority of respondents (64%) graduated after 2000, a further 12% between 1994 and 1999 and about 25% before 1994;
  - the average time-to-degree of the survey respondents (four years) was significantly shorter than the average for the population;
  - the average age at completion for the sample is 36 and the majority of respondents were 29 at the time of graduating.

3. Doctoral attrition study
Centre for Research on Science and Technology, Stellenbosch University, 28 July 2009

- The report is based on a thematic analysis of in-depth interviews conducted with 20 doctoral candidates who studied at six South African higher education institutions, but did not complete their studies or graduate.
- More than half of the 13 men and eight women interviewed were white.

4. Doctoral students in South Africa: a statistical profile
Centre for Research on Science and Technology, Stellenbosch University, 16 July 2009

- The profile presented in the report is based on the 2000 to 2007 records of the Higher Education Management and Information System (HEMIS) of the South African Department of Education.
- HEMIS was introduced in 1999/2000 and requires all state-subsidised higher education institutions to submit annual data returns on their students and staff members.

5. Employer study report
Centre for Research on Science and Technology, Stellenbosch University, 2009

- The report is based on a qualitative analysis of semi-structured interviews conducted with 20 staff members at 16 organisations that employ doctoral graduates outside of the higher education sector in South Africa.

- The interviewees represented national science councils and research facilities; non-profit, non-governmental and charitable organisations; the private sector; and government.
- The sample was selected from employers who advertise positions in two national newspapers.

6. Exemplary PhD programmes
Dr Chaya Herman, University of Pretoria, July 2009

- The report is based on computer-assisted qualitative analysis of in-depth interviews conducted during 2009 with 16 leaders of doctoral programmes from nine different South African higher education institutions.
- Programmes were selected from Department of Science and Technology (DST)-National Research Foundation (NRF) Centres of Excellence, recipients of National Science and Technology Forum (NSTF) awards specifically commended for graduating doctoral students, and Research Chairs with an exemplary doctoral graduate track record.
- Relevant documents (such as audit reports, promotional literature and websites) were also consulted for each programme.

7. The capacity to fund doctoral students
Dr Carlton McLellan, University of Fort Hare, 2009

- In this segment of the Study the goal was to determine what funding sources outside of government and its research agencies, such as the NRF, were available to fund doctoral studies in an expanded programme as proposed in the recommendations.
- In-depth interviews were conducted with lead-persons in agencies such as the Ford Foundation, the Volkswagen Foundation, the German Embassy, the US (American) Embassy, the British Council, the Royal Netherlands Embassy, the French Embassy, the Bank- and AgriSETA, and three selected universities - the University of Fort Hare, the University of Cape Town, and Rhodes University.

8. The interface between the doctorate and industry: Reconceptualising doctoral education from an international perspective
Prof Kay Harman, Centre for Higher Education Management & Policy, University of New England, 2009

- The paper, commissioned by ASSAf, begins by identifying pressures that have influenced a number of governments to support strategies aimed at reinforcing the interface between doctoral education and users of research.
- Cases of innovative responses in doctoral programmes that have evolved in the UK, Europe, the United States and Australia that support integrated learning in collaborative industry settings are provided.
- Programmes that are geared to producing enterprising graduates who can enhance the transferability of the skills they have developed and their marketability as 'industry ready' to a range of users on graduating, are a particular focus.
- Finally, focusing on the potential for South African PhD researchers to collaborate in a more structured way with industrial partners during their candidature, some suggestions stemming from ideas gleaned from international experience are offered.

9 The purposes of the doctorate—policy analysis
Prof Jonathan Jansen, University of the Free State, 2009

- This segment examined a range of higher education and training policy documents from the Department of Education (now reconstituted in part as the Department of Higher Education and Training), SAQA, the CHE and DST, among others.
- The goal was to determine what could be extracted about the purposes of the doctorate over time and in the current period, and how such goals and conceptions of the doctorate could impact on a recommended growth and escalation in the number of doctoral graduates in South Africa.

10. A survey of current PhD students in South African universities
Dr Chaya Herman, University of Pretoria, September 2009

- The report is based on qualitative and quantitative analyses of a web-based survey of doctoral students enrolled during 2009 at 12 South African higher education institutions. The 12 institutions produce approximately 90% of all doctorates in the country.
- A total of 936 responses was received.
- As a result of a technical fault, the responses to six of the survey questions were only captured for the last 438 respondents, which included only four institutions. These are referred to as sample 2.
- Comparison of the main sample (N = 936) against

the population of 2007 doctoral enrolments across all 12 institutions indicate that:
  - social sciences are under-represented and natural and agricultural sciences are over-represented in this sample;
  - women, white students and younger students are also over-represented;
  - the sample is fairly representative for nationality;
  - 57% of the respondents were married or in permanent relationship, and 45% had children.
- Comparison of sample 2 (N = 438) against the main sample indicates that sample 2:
  - is slightly biased towards the natural sciences and social sciences are under-represented;
  - is representative of the main sample in terms of respondents' gender, but white students are slightly over-represented and respondents are slightly younger;
  - includes more full-time students than the main sample.

11. Systemic blockages in postgraduate education and training
Prof Johann Mouton, Stellenbosch University, and Ms Lise Kriel, University of the Free State, 28 September 2009

- The report is based on a desktop study of literature and debates relevant to the aim of the study, i.e. to "identify the structural, legal, policy and organisational blockages in postgraduate education and training that might impede the escalation in the number of PhDs in South Africa".

12. The capacity to train doctoral students
Dr Chaya Herman, University of Pretoria, June 2009

- The aim of this segment of the Study was to establish the capacity of the national system for training more doctoral students outside of the universities.
- This study involved in-depth interviews with leaders in science councils knowledgeable about and responsible for doctoral training or the supervision of doctoral students/graduates.
- The target groups included the Human Sciences Research Council (HSRC), the Council for Geosciences, the Agricultural Research Council (ARC), the Council for Mineral Technology (MINTEK), the Council for Scientific and Industrial Research (CSIR), the Medical Research Council (MRC), and the South African Nuclear Energy Corporation (NECSA).

Table 25: Doctoral production worldwide, 2000-2007

Graduates Country	Headcount of ISCED 6* graduates								% increase in ISCED 6* graduates			
	2000	2001	2002	2003	2004	2005	2006	2007	2000-2007	2001-2007	2004-2007	2005-2007
Australia	3687	3802	3910	4315	4763	4886	5276	5559	50.8%	46.2%	16.7%	13.8%
Austria	1790	1871	2125	2197	2443	2228	2158	2085	16.5%	11.4%	-14.7%	-6.4%
Belgium	1147	1317	1413	1432	1479	1601	1718	1716	49.6%	30.3%	16.0%	7.2%
Brazil	-	-	-	-	35742	36042	-	9919			-72.2%	-72.5%
Canada	3978	-	-	-	3709	4116	4200	4608	15.8%		24.2%	12.0%
Chile	-	-	-	-	188	85	290	217			15.4%	155.3%
Czech Republic	895	1066	1327	1546	1732	1908	2023	2272	153.9%	113.1%	31.2%	19.1%
Denmark	913	900	732	859	788	955	910	973	6.6%	8.1%	23.5%	1.9%
Estonia	-	-	-	-	-	131	143	153				16.8%
Finland	1891	1797	1797	1751	1863	1957	1898	1986	5.0%	10.5%	6.6%	1.5%
France	9903	10404	10404	8420	8420	9578	9818	10650	7.5%	2.4%	26.5%	11.2%
Germany	25780	24796	23838	23043	23138	25952	24946	24439	-5.2%	-1.4%	5.6%	-5.8%
Greece	-	-	-	-	1295	1248	-	2436			88.1%	95.2%
Hungary	717	793	983	1067	893	1069	1012	1059	47.7%	33.5%	18.6%	-0.9%
Iceland	2	3	5	6	10	14	15	10	400.0%	233.3%	0.0%	-28.6%
Ireland	501	572	520	668	683	810	979	1035	106.6%	80.9%	51.5%	27.8%
Israel	688	859	863	999	1135	1206	1210	1288	87.2%	49.9%	13.5%	6.8%
Italy	3557	4044	3977	4456	6351	8466	9604	10188	186.4%	151.9%	60.4%	20.3%
Japan	12192	13179	13642	14512	15160	15286	15979	16810	37.9%	27.6%	10.9%	10.0%
Korea	6143	6208	6690	7172	7946	8449	8657	9082	47.8%	46.3%	14.3%	7.5%
Mexico	1036	1496	1801	1230	2325	2432	2800	2950	184.7%	97.2%	26.9%	21.3%
Netherlands	-	2533	2556	2584	2679	2879	2993	3160		24.8%	18.0%	9.8%
New Zealand	464	487	510	529	623	643	638	756	62.9%	55.2%	21.3%	17.6%
Norway	658	768	740	714	756	838	882	980	48.9%	27.6%	29.6%	16.9%
Poland	-	4400	4400	5450	5460	5722	5917	6072		38.0%	11.2%	6.1%
Portugal	1586	-	-	3723	3963	4150	5342	6038	280.7%		52.4%	45.5%
Slovak Republic	446	532	734	2126	854	1022	1218	1371	207.4%	157.7%	60.5%	34.1%
Slovenia	-	-	-	-	-	369	395	415				12.5%
South Africa#	823	843	981	1031	1087	1176	1100	1274	54.8%	51.1%	17.2%	8.3%
Spain	6007	6453	6905	7479	8168	6902	7159	7150	19.0%	10.8%	-12.5%	3.6%
Sweden	3049	3388	3517	3558	3834	2778	3781	3904	28.0%	15.2%	1.8%	40.5%
Switzerland	2733	2745	2800	2742	2952	3303	3381	3428	25.4%	24.9%	16.1%	3.8%
Turkey	2124	1985	2472	2815	2680	2838	2594	3357	58.1%	69.1%	25.3%	18.3%
United Kingdom	11568	14147	14232	14935	15257	15778	16466	17545	51.7%	24.0%	15.0%	11.2%
United States of America	44808	44904	44160	45994	48378	52631	56067	60616	35.3%	35.0%	25.3%	15.2%

* International Standard Classification of Education Level 6 (ISCED 6) refers to tertiary education programmes that lead directly to the award of an advanced research qualification, e.g. PhD. For a detailed description of the ISCED, refer to http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf

Data source for South Africa: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)
Data source for other countries: OECD.StatExtracts (http://stats.oecd.org)

Table 26: Gender, race, age at graduation and nationality of doctoral graduates, 2000 to 2007

Demographics	2000		2001		2002		2003		2004		2005		2006		2007	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Gender																
Female	337	41%	310	37%	380	39%	400	39%	416	38%	516	44%	475	43%	530	42%
Male	486	59%	533	63%	601	61%	631	61%	671	62%	660	56%	625	57%	744	58%
Race																
Black African	160	19%	185	22%	227	23%	237	23%	290	27%	335	28%	331	30%	405	32%
Coloured	38	5%	29	3%	50	5%	50	5%	50	5%	68	6%	57	5%	71	6%
Indian	48	6%	49	6%	70	7%	90	9%	100	9%	78	7%	91	8%	104	8%
White	577	70%	577	68%	633	65%	653	63%	646	59%	693	59%	618	56%	691	54%
unknown	0	0%	3	0%	1	0%	1	0%	1	0%	2	0%	3	0%	3	0%
Age at graduation																
<30	89	11%	91	11%	122	12%	138	13%	116	11%	139	12%	157	14%	151	12%
30-39	251	30%	199	24%	283	29%	276	27%	302	28%	443	38%	416	38%	501	39%
40-49	171	21%	168	20%	219	22%	231	22%	239	22%	321	27%	328	30%	383	30%
50+	77	9%	86	10%	114	12%	127	12%	143	13%	190	16%	199	18%	239	19%
unknown	235	29%	299	35%	243	25%	259	25%	287	26%	83	7%	0	0%	0	0%
Nationality																
South African	689	84%	679	81%	784	80%	806	78%	845	78%	870	74%	793	72%	900	71%
Other SADC* countries	37	4%	34	4%	41	4%	38	4%	61	6%	90	8%	93	8%	109	9%
Other African countries	14	2%	29	3%	66	7%	75	7%	76	7%	104	9%	100	9%	116	9%
Rest of world	35	4%	48	6%	66	7%	88	9%	85	8%	90	8%	92	8%	113	9%
unknown	48	6%	53	6%	24	2%	24	2%	20	2%	22	2%	22	2%	36	3%
Total	823	100%	843	100%	981	100%	1031	100%	1087	100%	1176	100%	1100	100%	1274	100%

* Southern African Development Community

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Table 27: Headcount of doctoral graduates at public higher education institutions in South Africa by field of study, 2000-2007

Field of study	2000		2001		2002		2003		2004		2005		2006		2007	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Natural & Agricultural Sciences	205	25%	265	31%	293	30%	307	30%	289	27%	306	26%	306	28%	362	28%
Plant Sciences	3	0%	11	1%	8	1%	29	3%	10	1%	16	1%	16	1%	15	1%
Veterinary Sciences	0	0%	0	0%	3	0%	1	0%	2	0%	6	1%	6	1%	7	1%
Other Agricultural Sciences	17	2%	22	3%	30	3%	34	3%	33	3%	35	3%	36	3%	42	3%
Biological Sciences	71	9%	84	10%	106	11%	96	9%	91	8%	102	9%	89	8%	89	7%
Chemical Sciences	39	5%	64	8%	74	7%	67	6%	67	6%	60	5%	61	6%	73	6%
Earth Sciences	13	2%	14	2%	18	2%	23	2%	18	2%	26	2%	20	2%	32	3%
Mathematical Sciences	25	3%	30	4%	36	4%	22	2%	27	2%	29	2%	28	3%	46	4%
ICCTs*	10	1%	13	2%	6	1%	15	1%	12	1%	9	1%	12	1%	17	1%
Physical Sciences	29	4%	28	3%	30	3%	20	2%	31	3%	26	2%	38	3%	41	3%
Engineering Science, Materials & Technologies	65	8%	78	9%	87	9%	77	7%	81	7%	78	7%	108	10%	92	7%
Electrical & Electronic Engineering	15	2%	20	2%	19	2%	21	2%	19	2%	18	2%	25	2%	28	2%
Mechanical Engineering	17	2%	15	2%	31	3%	16	2%	22	2%	18	2%	22	2%	17	1%
Mining Engineering	5	1%	5	1%	3	0%	4	0%	9	1%	9	1%	7	1%	6	0%
Materials Sciences	0	0%	1	0%	0	0%	0	0%	0	0%	0	0%	1	0%	0	0%
Other Engineering Sciences & Technologies	28	3%	37	4%	36	4%	36	3%	31	3%	33	3%	53	5%	41	3%
Health Sciences	111	14%	92	11%	94	9%	124	12%	123	11%	166	14%	107	10%	132	10%
Basic Health Sciences	42	5%	28	3%	43	4%	36	3%	48	4%	44	4%	37	3%	55	4%
Clinical & Public Health	69	8%	65	8%	51	5%	88	9%	75	7%	122	10%	70	6%	88	7%
Social Sciences	261	32%	220	26%	315	32%	360	35%	385	35%	391	33%	404	37%	437	34%
Economic & Management Sciences	45	5%	45	5%	82	8%	108	10%	118	11%	110	9%	87	8%	136	11%
Education	115	14%	84	10%	99	10%	112	11%	125	11%	112	10%	127	12%	142	11%
Psychology	40	5%	33	4%	43	4%	59	6%	55	5%	67	6%	74	7%	62	5%
Sociology & Related Studies	22	3%	20	2%	28	3%	28	3%	36	3%	35	3%	33	3%	38	3%
Other Social Sciences	42	5%	38	5%	66	7%	55	5%	53	5%	67	6%	83	8%	59	5%
Humanities	177	22%	187	22%	202	20%	167	16%	211	19%	235	20%	174	16%	252	20%
Language & Linguistics	57	7%	54	6%	60	6%	45	4%	57	5%	78	7%	60	5%	78	6%
Law	24	3%	21	2%	20	2%	16	2%	15	1%	24	2%	25	2%	33	3%
Religion	75	9%	74	9%	85	9%	82	8%	103	9%	98	8%	65	6%	106	8%
Other Humanities & Arts	21	3%	38	5%	38	4%	24	2%	36	3%	51	4%	24	2%	35	3%
TOTAL	819	100%	842	100%	991	100%	1035	100%	1089	100%	1176	100%	1099	100%	1275	100%

* Information, Computer & Communication Technologies

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

Table 28: South African public higher education institutions in terms of their share of doctoral graduates in all fields, 2000 to 2007

Institution/ Institution type	2000		2001		2002		2003		2004		2005		2006		2007	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Comprehensive Universities	195	24%	176	21%	187	19%	208	20%	255	23%	229	19%	210	19%	214	17%
NMMU	11	1%	27	3%	23	2%	28	3%	35	3%	30	3%	25	2%	35	3%
UJ	89	11%	65	8%	70	7%	91	9%	95	9%	88	7%	73	7%	75	6%
UNISA	77	9%	69	8%	71	7%	75	7%	95	9%	92	8%	81	7%	78	6%
UNIVEN	0	0%	1	0%	0	0%	1	0%	1	0%	2	0%	0	0%	6	0%
UZ	17	2%	14	2%	21	2%	12	1%	29	3%	17	1%	31	3%	20	2%
WSU	1	0%	0	0%	2	0%	1	0%	0	0%	0	0%	0	0%	0	0%
Universities	613	75%	651	78%	760	79%	797	78%	809	74%	919	78%	854	78%	1022	80%
NWU	51	6%	58	7%	59	6%	92	9%	87	8%	82	7%	110	10%	124	10%
RHODES	28	3%	24	3%	41	4%	27	3%	40	4%	31	3%	46	4%	48	4%
SU	83	10%	103	12%	111	11%	112	11%	115	11%	126	11%	102	9%	153	12%
UCT	101	12%	86	10%	108	11%	101	10%	97	9%	182	15%	133	12%	142	11%
UFH	3	0%	2	0%	2	0%	3	0%	2	0%	1	0%	9	1%	10	1%
UFS	59	7%	50	6%	77	8%	82	8%	56	5%	65	6%	60	5%	77	6%
UKZN	67	8%	89	11%	94	10%	127	12%	92	8%	90	8%	108	10%	106	8%
UL	6	1%	4	0%	4	0%	10	1%	20	2%	15	1%	12	1%	17	1%
UP	114	14%	134	16%	152	16%	146	14%	187	17%	192	16%	148	13%	170	13%
UWC	20	2%	22	3%	15	2%	27	3%	23	2%	35	3%	28	3%	41	3%
WITS	81	10%	79	9%	97	10%	70	7%	90	8%	100	9%	98	9%	134	11%
Universities of Technology	5	1%	13	2%	20	2%	21	2%	23	2%	28	2%	36	3%	38	3%
CPUT	0	0%	2	0%	5	1%	5	0%	2	0%	5	0%	6	1%	10	1%
CUT	3	0%	1	0%	4	0%	7	1%	7	1%	6	1%	6	1%	11	1%
DUT	0	0%	2	0%	1	0%	2	0%	3	0%	4	0%	4	0%	5	0%
TUT	2	0%	8	1%	9	1%	5	0%	9	1%	12	1%	19	2%	12	1%
VUT	0	0%	0	0%	1	0%	2	0%	2	0%	1	0%	1	0%	0	0%
TOTAL	813	100%	840	100%	967	100%	1026	100%	1087	100%	1176	100%	1100	100%	1274	100%

Source: *Doctoral students in South Africa: A statistical profile* (refer to Appendix 1)

CPUT	Cape Peninsula University of Technology	UJ	University of Johannesburg
CUT	Central University of Technology, Free State	UKZN	University of KwaZulu-Natal
DUT	Durban University of Technology	UL	University of Limpopo
NMMU	Nelson Mandela Metropolitan University	UNISA	University of South Africa
NWU	North-West University	UNIVEN	University of Venda
RHODES	Rhodes University	UP	University of Pretoria
SU	Stellenbosch University	UWC	University of Western Cape
TUT	Tshwane University of Technology	UZ	University of Zululand
UCT	University of Cape Town	VUT	Vaal University of Technology
UFH	University of Fort Hare	WITS	University of Witwatersrand
UFS	University of the Free State	WSU	Walter Sisulu University

Table 29: Permanent academic staff members with a doctoral qualification at public higher education institutions in South Africa, 2000 to 2007

Institutional type / Institution		2000	2001	2002	2003	2004	2005	2006	2007
Comprehensive Universities	% of PAS with a doctoral qualification	33%	32%	33%	33%	31%	31%	32%	30%
	Number of PAS with a doctoral qualification	992	982	1008	1019	1049	1029	1051	975
	Total number of permanent academic staff (PAS)	3040	3051	3084	3106	3331	3269	3314	3243
Nelson Mandela Metropolitan University	% of PAS with a doctoral qualification	23%	23%	24%	28%	29%	31%	34%	34%
	Number of PAS with a doctoral qualification	114	116	121	144	168	174	173	182
	Total number of permanent academic staff (PAS)	500	509	506	515	576	557	514	528
University of Johannesburg	% of PAS with a doctoral qualification	27%	26%	25%	22%	21%	22%	20%	18%
	Number of PAS with a doctoral qualification	200	193	197	181	197	203	201	157
	Total number of permanent academic staff (PAS)	731	744	795	815	944	917	982	871
University of South Africa	% of PAS with a doctoral qualification	41%	41%	43%	42%	39%	37%	38%	34%
	Number of PAS with a doctoral qualification	525	525	534	535	522	481	498	451
	Total number of permanent academic staff (PAS)	1277	1277	1244	1266	1330	1308	1319	1335
University of Venda	% of PAS with a doctoral qualification	30%	31%	32%	34%	34%	32%	34%	35%
	Number of PAS with a doctoral qualification	81	84	88	92	93	87	94	97
	Total number of permanent academic staff (PAS)	269	269	275	268	271	268	273	278
University of Zululand	% of PAS with a doctoral qualification	27%	25%	26%	28%	33%	38%	38%	38%
	Number of PAS with a doctoral qualification	72	64	68	67	69	84	85	88
	Total number of permanent academic staff (PAS)	263	252	264	242	210	219	226	231
Universities	% of PAS with a doctoral qualification	43%	43%	39%	34%	36%	37%	40%	41%
	Number of PAS with a doctoral qualification	3369	3292	3244	3199	3199	3285	3821	3847
	Total number of permanent academic staff (PAS)	7838	7640	8338	9412	8918	8816	9509	9350
North-West University	% of PAS with a doctoral qualification	55%	46%	45%	23%	22%	23%	43%	43%
	Number of PAS with a doctoral qualification	254	295	331	165	166	178	386	383
	Total number of permanent academic staff (PAS)	462	641	736	715	772	769	905	889
Rhodes University	% of PAS with a doctoral qualification	50%	44%	43%	46%	47%	48%	48%	50%
	Number of PAS with a doctoral qualification	142	146	147	153	139	147	152	159
	Total number of permanent academic staff (PAS)	282	330	343	334	298	306	316	320

Institutional type / Institution		2000	2001	2002	2003	2004	2005	2006	2007
Stellenbosch University	% of PAS with a doctoral qualification	53%	53%	50%	48%	46%	43%	58%	61%
	Number of PAS with a doctoral qualification	406	408	398	392	355	350	480	513
	Total number of permanent academic staff (PAS)	768	774	789	809	778	818	822	840
University of Cape Town	% of PAS with a doctoral qualification	60%	56%	43%	40%	36%	46%	59%	58%
	Number of PAS with a doctoral qualification	403	426	326	312	295	385	506	518
	Total number of permanent academic staff (PAS)	673	762	755	779	812	829	851	889
University of Fort Hare	% of PAS with a doctoral qualification	24%	21%	17%	14%	11%	12%	21%	19%
	Number of PAS with a doctoral qualification	43	27	31	26	26	28	54	55
	Total number of permanent academic staff (PAS)	179	129	183	190	239	230	261	292
University of the Free State	% of PAS with a doctoral qualification	45%	49%	48%	24%	51%	51%	50%	49%
	Number of PAS with a doctoral qualification	259	286	280	378	303	317	331	344
	Total number of permanent academic staff (PAS)	576	578	587	1565	596	620	659	708
University of KwaZulu-Natal	% of PAS with a doctoral qualification	41%	40%	37%	38%	35%	33%	31%	30%
	Number of PAS with a doctoral qualification	548	519	500	527	491	479	490	466
	Total number of permanent academic staff (PAS)	1329	1292	1369	1403	1391	1448	1583	1531
University of Limpopo	% of PAS with a doctoral qualification	25%	18%	18%	16%	15%	15%	14%	16%
	Number of PAS with a doctoral qualification	190	50	135	121	121	118	112	120
	Total number of permanent academic staff (PAS)	763	276	757	755	785	804	798	757
University of Pretoria	% of PAS with a doctoral qualification	37%	38%	36%	37%	40%	43%	38%	38%
	Number of PAS with a doctoral qualification	543	546	479	567	634	677	605	621
	Total number of permanent academic staff (PAS)	1449	1452	1321	1524	1578	1575	1574	1619
University of the Western Cape	% of PAS with a doctoral qualification	41%	41%	39%	43%	39%	43%	44%	43%
	Number of PAS with a doctoral qualification	168	168	171	192	185	199	210	222
	Total number of permanent academic staff (PAS)	406	406	444	448	480	465	476	516
University of the Witwatersrand	% of PAS with a doctoral qualification	43%	42%	42%	41%	41%	43%	39%	45%
	Number of PAS with a doctoral qualification	413	421	446	366	484	407	495	446
	Total number of permanent academic staff (PAS)	951	1000	1054	890	1189	952	1264	989
Universities of Technology	% of PAS with a doctoral qualification	6%	6%	7%	7%	8%	10%	10%	12%
	Number of PAS with a doctoral qualification	172	186	238	209	258	294	306	363
	Total number of permanent academic staff (PAS)	2952	2865	3593	2929	3052	3084	3101	3087

Institutional type / Institution		2000	2001	2002	2003	2004	2005	2006	2007
Cape Peninsula University of Technology	% of PAS with a doctoral qualification	6%	7%	8%	9%	10%	11%	11%	11%
	Number of PAS with a doctoral qualification	29	35	44	48	57	66	70	73
	Total number of permanent academic staff (PAS)	515	520	535	559	589	621	648	657
Central University of Technology	% of PAS with a doctoral qualification	9%	13%	17%	17%	18%	18%	17%	29%
	Number of PAS with a doctoral qualification	18	19	23	25	37	36	38	65
	Total number of permanent academic staff (PAS)	193	142	138	145	202	203	218	224
Durban University of Technology	% of PAS with a doctoral qualification	4%	3%	4%	4%	5%	5%	5%	7%
	Number of PAS with a doctoral qualification	22	19	54	22	25	29	30	40
	Total number of permanent academic staff (PAS)	602	572	1238	544	538	537	563	574
Tshwane University of Technology	% of PAS with a doctoral qualification	7%	8%	9%	9%	9%	11%	12%	13%
	Number of PAS with a doctoral qualification	59	67	76	76	84	101	101	106
	Total number of permanent academic staff (PAS)	816	798	853	884	895	880	855	819
Vaal University of Technology	% of PAS with a doctoral qualification	2%	4%	4%	5%	7%	10%	10%	12%
	Number of PAS with a doctoral qualification	7	12	14	14	23	31	30	34
	Total number of permanent academic staff (PAS)	291	309	312	308	313	312	296	287
Walter Sisulu University	% of PAS with a doctoral qualification	7%	6%	5%	5%	6%	6%	7%	9%
	Number of PAS with a doctoral qualification	37	34	27	24	32	31	37	45
	Total number of permanent academic staff (PAS)	535	524	517	489	515	531	521	526
TOTAL	% of PAS with a doctoral qualification	33%	33%	30%	29%	29%	30%	33%	33%
	Number of PAS with a doctoral qualification	4533	4460	4490	4427	4506	4608	5178	5185
	Total number of permanent academic staff (PAS)	13830	13556	15015	15447	15301	15169	15924	15680

Table 30: Examples of changes in postgraduate education worldwide

Country	headcount and % change in ISCED 6 graduates*		Examples of changes in postgraduate education#
Australia	5,559 in 2007	51% increase 2000-2007	• Australia is aiming to link postgraduate education at higher education institutions more closely to industry, introduce interdisciplinarity and problem solving into doctoral programmes, equip their graduates for participation in international networks, and assure doctoral programmes are completed in a timely manner. • It is recruiting heavily from overseas, most notably from Asian or Caribbean countries. • The Australian Cooperative Research Centres (CRCs), conceived by the Australian government in 1990, are examples of industry-higher education institution links and new modes of knowledge production. The goal of the CRC is to produce "end-user driven" or "employment-ready" graduates not only for industry but also the public sector. These centres emphasise collaborative, multidisciplinary and commercially-oriented research.
Brazil	9,919 in 2007	72% decrease 2004-2007	• Brazil's National Plan for Postgraduate Studies 2005-2010 is part of the government's plan for self-sufficiency in the principal sectors of society. It calls for the creation of high-quality professionals for the productive sector in order to increase the competitiveness of Brazilian companies in the global marketplace. The specific strategies of this plan are to: - increase the production of advanced degrees, masters and doctoral degrees, double the number of faculties with doctoral degrees within a ten-year period, and increase doctorates awarded in areas of relevant economic development - change the national fellowship system, align doctoral education with the national goals of self-sufficiency in principal sectors of the economy - create links between the academic world and the world of production - invest in research and development in the academic sector as well as in industry and business with an investment of $660 million for these goals - implement a clear, transparent national quality evaluation system coordinated by a Council for the Improvement of Higher Education Personnel and the National Research Council - enlist active participation of the academic community in these changes.
Canada	4,608 in 2007	16% increase 2000-2007	• Canada has expressed the intention of becoming a world centre of excellence and moving into the top 100 world-class higher education institutions league. • More recently, Canadian higher education institutions are also recruiting heavily from overseas.
Europe	-	-	• In the Bologna Declaration, Europe proclaimed its goal of becoming the leading knowledge-based economy in the world by 2010. • European Union leaders vowed to allocate 3% of the Gross National Product (GNP) by 2010 to research and development in their countries. • Doctoral education was included in the process of implementing this goal and the necessity of an increase in the number of doctoral candidates was spelled out. • During the 2007 presidency of the European Union, German Chancellor Angela Merkel made science and research one of the highest priorities. • While the introduction of a uniform degree system and the allocation of 3% of GNP to research and development in each of the member countries has not been uniformly reached, increases in PhD production and changes in doctoral education can be witnessed in many of the European Union member countries.

Country	headcount and % change in ISCED 6 graduates*		Examples of changes in postgraduate education#
Germany	24,439 in 2007	5% decrease 2000-2007	• Germany has expressed its intention to become a world centre of excellence and to move into the top 100 world-class higher education institutions league. • It is aiming to link postgraduate education at higher education institutions more closely with industry, introduce interdisciplinarity and problem solving into doctoral programmes, equip graduates for participation in international networks, and assure doctoral programmes are completed in a timely manner. • It has launched massive overseas recruitment efforts, particularly for its science, engineering, mathematics, and agricultural doctoral programmes. • In 1990, Germany introduced structured, interdisciplinary doctoral programmes, the *Graduiertenkollegs*. They are theme-oriented, involving professors from several higher education institutions, and often have an international orientation. • In 2005, it created an Excellence Initiative that aims to make Germany a more attractive research location and more internationally competitive. Between 2006 and 2011 the German government will have provided €1.9 billion in additional funding to create more graduate schools to promote young scientists, and to develop institutional strategies for and implement clusters of excellence to promote top-level research.
Iceland	10 in 2007	400% increase 2000-2007	• Iceland, a very small country where traditionally the annual home grown number of doctorates is 10, increased their PhD enrolment to 335 within a period of 13 years, with the support of governmental grants, fellowships, or special loans. • Icelandic scholars who studied elsewhere were enticed to return and became a small respected research community, capturing the entrepreneurial development that focused on Iceland's natural resources: geophysics and geothermal energy forces, fishing and fish-processing technology. This research capacity and the newly developed industrial research environments in these fields produced a research learning context that allowed for expansion of PhD production. • In addition, Iceland's higher education institutions set up cooperative agreements with higher education institutions around the world for student research exchanges and joint programmes and degrees.
India	-	-	• In 2005 the Indian National Knowledge Commission, an advisory body to India's Prime Minister, stated that India needed a knowledge-oriented paradigm of development to give the country a competitive advantage in all fields of knowledge. In 2007, the Department of Science and Technology, among others, allocated funding to increase PhDs in nano-science. • India's expansion of doctoral production is not only a response to intra-national needs, but also a response to the establishment of research and development centres of multinational-national companies and emerging collaborations between these research and development centres, Indian higher education institutions and research institutes and Indian companies. • These developments are concentrated in the areas of biotechnology, computer software development, and nanotechnology.
Ireland	1,035 in 2007	107% increase 2000-2007	• In 2005 Ireland developed a comprehensive plan to become a leading knowledge economy by 2013. The government's strategy for Science, Technology and Innovation included a tripling of their research and development investment in the higher education and business sector. • The country's strategy is five-fold: - Building a world-class research system by increasing the numbers of researchers trained in Ireland and by attracting highly skilled, research active individuals to Ireland. This is coupled with a change in doctoral education to structured programmes. - Capturing, protecting and commercialising ideas and know-how. - Driving growth through research and innovation by taking the outputs of research with commercial potentials and bringing them to a point where they can be transferred to industry. - Providing a solid foundation in primary and secondary education through improved teachers' education, creating professional development and networks for teachers and emphasising methods of science teaching. - Ensuring that all parts of the research and education system work well together. • By focusing on growth in research capacity and by increasing the reputation of its higher education institutions, coupled with an enhanced research and development tax credit arrangement, Ireland set up significant industrial and academic research collaborations. • In the expansion of advanced degrees, Ireland focused on areas in health, agriculture, marine, energy and environment sectors.

Country	headcount and % change in ISCED 6 graduates*		Examples of changes in postgraduate education#
Japan	16,810 in 2007	38% increase 2000-2007	• Japan is aiming to link postgraduate education at higher education institutions more closely with industry, introduce interdisciplinarity and problem solving into doctoral programmes, equip their graduates for participation in international networks, and assure doctoral programmes are completed in a timely manner. • It has launched massive overseas recruitment efforts, e.g. an initiative to attract more international students to their higher education institutions called "100,000 students from overseas". • In 2002 Japan began funding centres of excellence under the 21st Century Centre of Excellence (CoE) programme to strengthen and enhance the education and research functions of graduate schools in order to perform at a level of global excellence and elevate the international competitiveness of the Japanese higher education institutions.
Malaysia	-	-	• Malaysia has expressed the intention of becoming a world centre of excellence and moving into the top 100 world-class higher education institutions league. • The Malaysian government's goal is to become the higher education hub for the Asia Pacific region. It has been recognised that the cost of education in countries such as the UK, the USA and Australia has increased and that because of Malaysia's geographic location and religious diversity, it is in a good position to welcome international students. Initiatives to attract international postgraduate students are often linked to a nation's immigration policies. • Its 2007 National Higher Education Strategic Plan focuses on: - increasing the proportion of academic staff who hold doctoral degrees from 30% to 75% - implementing quality assurance indicators that include quality of academic staff, the quality of the infrastructure, and the quality of the learning and teaching content - adopting an excellence initiative – the APEX University – to create excellent, world-class higher education institutions (centres of excellence are being established at a small number of higher education institutions through competitive applications; to become an APEX University, a higher education institution has to demonstrate a willingness to look for innovative ideas, preparedness for change, and a readiness to implement the changes with a detailed plan).
United Kingdom	17,545 in 2007	52% increase 2000-2007	• The UK has launched massive recruitment efforts, particularly for their science, engineering, mathematics, and agricultural doctoral programmes. For example, an international student market analysis agency assesses foreign countries for their potential students who can be recruited to UK higher education institutions, and private firms advertise for and recruit students overseas.
United States of America	60,616 in 2007	35% increase 2000-2007	• The USA is aiming to link postgraduate education at higher education institutions more closely with industry, introduce interdisciplinarity and problem solving into doctoral programmes, equip their graduates for participation in international networks, and assure doctoral programmes are completed in a timely manner. • In 1997, it introduced programmes that aim to train doctoral students by working within multidisciplinary teams on topic-driven research in addition to acquiring traditional disciplinary research training. • Even though it is the country that has attracted the largest number of international doctoral students without recruitment, the USA began participating in an international recruitment fair in China in 2005 and it introduced international research and training programmes - the Partnership in International Research and Education. These programmes focus on providing strong international research experiences for USA students and postdoctoral researchers.

* Data source: OECD.StatExtracts (http://stats.oecd.org) International Standard Classification of Education Level 6 (ISCED 6) refers to tertiary education programmes that lead directly to the award of an advanced research qualification, e.g. PhD. For a detailed description of the ISCED, refer to http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf

Source: Nerad, M., 2009. *The context for increasing the quantity and assuring the quality of doctoral education in South Africa: what we know about the increase in PhD production and reform of doctoral education worldwide*. Commissioned paper for the ASSAf Consensus Study on PhD production

Appendix 3:

Survey of Doctoral Students Experiences in South Africa

The Academy of Science of South Africa (ASSAf) has commissioned this Study on the doctoral experience in order to inform policy, planning and practice on ways to improve support for doctoral students and to escalate the production of quality PhDs in South Africa. The Study was designed by a team of researchers from the University of Pretoria and is administered by the Centre for Research on Science and Technology (CREST) at Stellenbosch University.

We would like to invite you to participate in this Study by answering this short survey.

The main purpose of the Study is to learn more about the various aspects of the doctoral students' experiences such as the motivation to undertake the studies, the structure of the doctoral programmes, the available funding and the time spent studying for a doctorate. You will also be asked about your level of satisfaction with your doctoral studies as well as plans beyond the doctorate.

We expect that this web-based questionaire will take less than 20 minutes to complete.

Your participation is voluntary and the survey is anonymous. When you submit this web-based questionnaire, it will not be possible for anyone, including the research team, to establish your identity. Your responses will be combined with those of other participants and will be reported by institution as well as in the form of a national profile on doctoral student experiences. None of the reported data will capture individual student responses.

If you would like to discuss any aspect of the research and/or you contribution to it after completing the survey questionnaire, you can contact the research leader, Dr Chaya Herman, Faculty of Education, University of Pretoria on 012 420 5665 or via email: chaya.herman@up.ac.za.

Thank you for participating in this Study; your inputs are critical for the success of this inquiry.

Consent form

I hereby agree to participate in this national research project on the experiences of doctoral students in South Africa. I understand that I am participating freely and without being coerced in any way to do so. I also understand that I can stop completing the questionnaire at any time and withdraw as a participant in the research.

I have received the details of a person to contact should I need to speak about any issues which may arise from this survey.

I understand that my answers will be anonymous and will remain entirely confidential.

If you agree with al the above, please select 'Yes' and proceed.

1. At which University are you currently enrolled as a doctoral student?
    1. Nelson Mandela Metropolitan University (NMMU)
    2. North-West University (NWU)
    3. Rhodes University (RU)
    4. Stellenbosch University (SU)
    5. Tshwane University of Technology (TUT)
    6. University of Cape Town (UCT)
    7. University of the Free State (UFS)
    8. University of Johannesburg (UJ)
    9. University of KwaZulu-Natal (UKZN)
    10. University of Limpopo (UL)
    11. University of Pretoria (UP)
    12. University of South Africa (UNISA)
    13. University of the Western Cape (UWC)
    14. University of Zululand (UZ)
    15. University of the Witwatersrand (WITS)

2. Please indicate the primary field of your dissertation/thesis:

Natural and Agricultural Sciences	Engineering and Applied Technologies	Health Sciences	Humanities	Social Sciences
Plant sciences	Mechanical engineering	Basic health care sciences	Law	Economic & management sciences
Veterinary sciences	Mining engineering	Clinical health sciences	Religion	Sociology & related studies
Biological sciences	Electrical & electronic engineering	Rehabilitation & therapy	Language & linguistics	Education
Chemical sciences	Materials sciences	Pharmaceutical science	Arts	Psychology
Earth sciences	Other engineering sciences & applied technologies (please specify)	Emergency services	History	Communication
Mathematical sciences		Food & nutrition	Philosophy	National security & defence
Information, computer & communication technologies		Kinesiology	Other humanities (please specify)	Sport & recreation
Physical sciences		Hospital & health care administration		Social work
Other natural & agricultural sciences (please specify)		Public health		Libraries & museums
		Other health sciences (please specify)		Geography
				Political science
				Home economics & consumer sciences
				Other social sciences (please specify)

SECTION A:
Biographical information

1. What is your gender?
   A. Male
   B. Female

2. Which of the following best describes your racial or ethnic background?
   A. African
   B. Coloured
   C. Indian
   D. White
   E. None of the above groups

3. In what year where you born?

4. What is your current marital status?
   A. Married/permanent relationship
   B. Single
   C. Divorced
   D. Widowed

5. Do you have any children?
   A. Yes
   B. No

6. Are you South African citizen or a permanent resident?
   A. Yes (please go to question 9)
   B. No

7. What is your nationality? (drop down list of countries)

8. Do you intend to stay in South Africa after you finish your degree?
   A. Yes
   B. No

9. What language do you speak MOST OFTEN in your home?
   A. English
   B. Afrikaans
   C. IsiZulu
   D. IsiNdebele
   E. IsiXhosa
   F. Sepedi
   G. Sesotho
   H. Setswana
   I. SiSwati
   J. TshiVenda
   K. XiTsonga
   L. Other(pleasespecify)_____

10. What is your mother's highest qualification?
    A. Did not complete schooling
    B. Grade 12 certificate
    C. Diploma
    D. Degree

E. Postgraduate qualification
F. Doctoral degree
G. Other (please specify)_____

11. What is your father's highest qualification?
A. Did not complete schooling
B. Grade 12 certificate
C. Diploma
D. Degree
E. Postgraduate qualification
F. Doctoral degree
G. Other (please specify)_____

SECTION B:
Motivation

12. When did you decide that you wanted to pursue a doctoral degree?
A. In undergraduate years or before
B. After completing my undergraduate degree and while working
C. During my masters programme
D. After completing my masters degree and while working
E. None of the above (please elaborate)_____

13. In which field did you study for your masters (e.g. sociology, mathematics)?

14. Did you obtain your masters degree at the same institution where you are studying for your doctoral degree?
A. Yes
B. No

15. What did you do prior to your enrolment as a doctoral student?
A. I was a student (please go to question 18)
B. I was working
C. I was studying while working
D. I took care of my child/children at home (please go to question 18)
E. I was unemployed (please go to question 18)
F. I did something else (please specify)_____
(please go to question 18)

16. In which sector were you employed prior to your enrolment for doctoral studies?
A. Academia
B. Industry/business/self-employed
C. Government/parastatales
D. Social service sectors (e.g. Education or health)
E. Other (please specify)_____

17. What position did you hold in that sector?

18. What were your three main reasons for undertaking doctoral studies?
A. I wanted to prepare myself for a career in teaching or research at a higher education institution
B. I wanted to prepare myself for some other professional career
C. I wanted to change my field of study
D. I wanted to change my field of work
E. I was encouraged by someone
F. It is a natural continuation of my studies/career
G. I could not find a job so I decided to go back to study

H. I wanted to earn more money, and expected that earning will increase with a doctorate
I. I wanted to pursue personal interests
J. Other (please specify)_____

19. Why did you choose to do your doctoral studies in the specific department/programme? (You may choose more than one answer)
A. I did my masters here
B. I am employed as a lecturer here
C. Quality of the department/programme
D. Research focus of the department/programme
E. Prestige of the institution
F. I wanted to study with a particular supervisor at this institution
G. Financial support offered
H. Other tuition/fees assistance received
I. Recommendation of faculty from your previous institutions
J. It was the only programme that accepted me
K. Recommendations of family
L. Recommendations of friends
M. Location
N. Other (please specify)_____

20. In which year did you start your doctoral studies? (drop down list from 1995)

21. In which year do you expect to complete your doctoral studies? (drop down list from 2009 to 2020)

22. Have you ever interrupted/terminated your doctoral studies for any period of time since you first started?
A. Yes, once
B. Yes, more than once
C. No (please go to question 24)

23. Why were your doctoral studies interrupted?
A. Academic reasons
B. Financial reasons
C. Family needs
D. Health reasons
E. Job demand
F. Changed occupational priorities
G. Travel
H. Got married/started a family
I. Other (please specify)_____

Nature of the doctoral studies

24. Which of the following statement best describes your current status in your doctoral studies:
A. I need to defend my proposal
B. I need to defend my thesis/dissertation
C. I need to complete the course work before I can submit my proposal
D. I need to submit an article(s) based on my thesis /dissertation
E. I am working on my dissertation
F. I need to complete practical training
G. I completed all the requirements for my doctoral degree, but my doctoral degree has not yet been awarded

25. Do you need to complete any course work for your doctoral studies?
    A. Yes
    B. No (please go to question 28)

26. How long does the course work last?
    A. One semester
    B. Two semesters
    C. Three semesters
    D. Four semesters

27. How well do the following statements describe the course work?

		Very little/ not at all	Not much	A great deal	To a very great extent
A	The quality of the courses is high				
B	The balance between the course work and thesis is a good one				
C	The courses are relevant to the work I am doing on my thesis				
D	The courses offered fit in with my wishes and needs				

28. How did you select the topic of your thesis?
    A. Mainly by myself
    B. A recommendation from my department head or supervisor
    C. My topic was determined by my funding arrangement
    D. A recommendation from outside the university (please specify)_____
    E. A joint proposal by myself and my department or supervisor
    F. A joint proposal by myself and someone outside university (please specify)_____
    G. I have not yet selected a subject
    H. Other (please specify)_____

29. On average, how many hours per week do you dedicate to your doctoral studies?
    A. Less than 10
    B. 10-19
    C. 20-29
    D. 30-39
    E. More than 40
    F. I don't know

fINANCES

30. What best describes your overall student/work status since your started your doctoral programme?
    A. Full-time student with no employment (Please go to question 32)
    B. Full-time student with part time employment (Please go to question 32)
    C. Part-time student with part time employment
    D. Part-time student with full time employment

31. Why did you choose to do your doctoral studies part time? (You may choose more than one answer)?
    A. Financial reasons
    B. Family needs
    C. Health reasons

D. Maintain professional/occupational involvement
E. Other(pleasespecify)_____

32. Are your doctoral studies financially funded in any way?
A. Yes
B. No (please go to question 36)

33. Who are your funder(s)/sponsor(s)? (your may choose more than one answer)
A. The university
a. Bursary
b. Research assistantship
c. Teaching assistantship
d. Tuition/fess waiver
B. Research facility/research council
C. Foundation(s) within South Africa
D. Foundation(s) outside South Africa
A. Industry or business programme(s)
B. Government-sponsored programme(s)
C. Embassy-sponsored programme(s)
D. Employer tuition assistance plan
E. Other(pleasespecify)_____

34. Where did you learn about these sponsor(s)?_____

35. What does the funding cover? (your may choose more than one answer)
A. Anything that I want to use it for
B. Tuition
C. Books
D. Living expenses
E. Accommodation
F. Research costs
G. National and/or international conferences
H. Other than the above (please specify)_____

Supervision

36. Do you have any co- or assistant supervisor(s)?
A. Yes
B. No (please go to question 39)

37. How many co- or assistant supervisors do you have?_____

38. Do your co-supervisor(s) (other than your main supervisor) come from
A. Your own department
B. Another department at my university
C. Another university in South Africa
D. Science council/national research facilities in South Africa
E. Another university abroad
F. Other(pleasespecify)_____

39. Have you switched your supervisor (s) at any point?
A. Yes, at my own request
B. Yes, for some other reason
C. No

40. Please give an estimate of the average number of hours of supervision per MONTH you have been given
   A. Less than 2
   B. 2–5
   C. 6–10
   D. 11–15
   E. More than 15

41. To what extent has your supervisor(s):

	Very little/ not at all	Not much	A great deal	To a very great extent
A Displayed interest in my professional development				
B Displayed interest in my personal welfare				
C Had general discussions about my subject area with me				
D Discussed my plans for the future with me				
E Been available for consultation				
F Provided constructive criticism of my research				

42. To what extent in the course of your doctoral studies have you

	Very little/ not at all	Not much	A great deal	To a very great extent
A Worked as independently as I wanted to				
B Been provided with as much supervision as I wanted				
C Found myself in a situation where the supervisor/supervision provided made me feel uncomfortable				
D Seriously considered/succeeded in switching supervisors				

Research environment and development

43. Have you had access to any of the following (you may choose more than one answer)?

	Campus-based		Not campus-based	Not available
	Individuals	Shared		
Workspace/office				
Computer				
Internet/Web				
Phone				
Printing, fax and copying facilities				
Mentor (other than my supervisors) for advice, to review a paper, or for general support and encouragement				

44. Did you participate in any kind of research support programmes?
    A. Yes
    B. No (please go to question 46)

45. Who arranged the support programme?
    A. My supervisor
    B. My department
    C. My faculty
    D. My university
    E. Other (please specify)_____

46. Have you done any of the following during your doctoral studies? (you may choose more than one answer)
    A. Participated in any research project(s)
    B. Participated/ presented in national conference(s)
    C. Participated/ presented international conference(s)
    D. Presented in some form of seminar(s) at my department
    E. Published my research
    F. Networked with researchers in South Africa
    G. Networked with researchers abroad
    H. None of the above

47. To what extent do you think that you have acquired skills/competences in the following areas in the course of your doctoral studies?

	Very little/ not at all	Not much	A great deal	To a very great extent
A An increased ability to write in a clear and comprehensible way				
B Greater ability to present material orally in a clear and comprehensible way				
C Ability to approach scientific questions systematically				
D Ability to develop strategies by combining various perspectives				
E International cooperation				
F Networking				
G Language skills				
H Teamwork				
I Project work				
J Leadership and managerial skills				
K Administration				
L Elaborating innovative solutions				
M Entrepreneurship				

Future plans

48. Are you likely to change your job/career as a result of your doctoral studies?
    - A. Yes
    - B. No

49. Where do you see yourself working immediately after you complete your doctoral studies?
    - A. Faculty at a university or university of technology
        - a. An academic position
        - b. A managerial or administrative position
    - B. Research council
        - a. An academic position
        - b. A managerial or administrative position
    - C. Government
        - a. A research position
        - b. A managerial position
    - D. Industry/business/private sector
        - a. A research position
        - b. A managerial or administrative position
        - c. A consultancy position
    - E. Independent consultancy
    - F. An entrepreneur
    - G. Other professional positions
    - H. A postdoctoral fellow
    - I. Other (please specify)_____
    - J. I don't know

Satisfaction

50. Please choose the best option that reflects your agreement or disagreement with the following statements

		Very little/ not at all	Not much	A great deal	To a very great extent
A	I am confident that I made the right decision in choosing to pursue my doctoral studies				
B	I am confident that I made the right decision in choosing my doctoral studies in this specific department/ programme				
C	It is easy to develop personal relationship with faculty members in my department/programme				
D	There is a strong sense of community, a feeling of shared interest and purpose among the doctoral students in my department/programme				

51. Please rate your satisfaction level with the following aspects of your doctoral studies.

	Very little/ not at all	Not much	A great deal	To a very great extent
A Financial support				
B Collegial atmosphere between the department/faculty members and students				
C Communication between the department/faculty members and students				
D Availability of the department/faculty members to meet with students				
E Quality of overall department/faculty member-student relationship				
F Quality of academic advice/feedback by my department/faculty				
G Department/faculty interest in my personal development/ future plan				

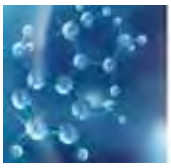
52. Please rate the following as the main obstacles to on time completion of your doctoral studies?

	Very little/ not at all	Not much	A great deal	To a very great extent
The academic challenge				
Financial problems				
Lack of administrative support				
Lack of collegial atmosphere /communication with other academics				
The quality of the supervision				
Lack of facilities (access to Internet, computer, space, library)				
Language difficulties				
Work commitments				
Family/other obligations				
Interaction with other doctoral students				
Boredom/lack of interest				
Health challenge				
Other (please go to question 53)				

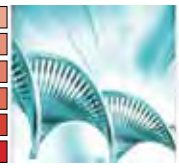
53. Please specify_____

54. Please use the space below to tell us about any specific positive or negative experiences of your doctorate.

_____
_____
_____








ASSAf

ACADEMY OF SCIENCE OF SOUTH AFRICA

ABOUT ASSAF

ABOUT the Academy of Science of South Africa

The Academy of Science of South Africa Act (2001): A statutory body placed strategically in the National System of Innovation

The Academy of Science of South Africa (ASSAf) was inaugurated in May 1996 in the presence of **then President Nelson Mandela, the patron of the launch of the Academy.** It was formed in response to the need for an academy of science consonant with the dawn of democracy in South Africa: activist in its mission of using science for the benefit of society, with a mandate encompassing all fields of scientific enquiry in a seamless way, and including in its ranks the full diversity of South Africa's distinguished scientists. The Parliament of South Africa subsequently passed the **Academy of Science of South Africa Act, *Act 67 of 2001*,** which came into operation on 15 May 2002. ASSAf is thus the official national Academy of Science of South Africa, recognised by government and representing South Africa in the international community of science academies.

Internationally recognised science academies are similar in that they are:

- **self-perpetuating,** with a merit-based membership that creates an upward aspiration for quality and excellence in scientific endeavours;
- **multidisciplinary,** striving to represent science as a consilient continuum of knowledge, insight and practical solutions;
- **independent of government,** but can be funded by government for performing certain tasks;
- a **credible voice of science** to be heard on topics of national concern, independent of institutional or commercial linkages, obligations and agendas;
- linked together in an **independent global community** that can mobilise scientific thinking, skills and knowledge across the world.

ASSAf places particular emphasis on **excellence in the application of scientific thinking to the problems and challenges facing South African society.** It draws its membership from all population groups and from all scientific disciplines.

OBJECTIVES

Scientific thinking for the good of society

According to the Act the **objectives of the Academy** are:

- to promote common ground in scientific thinking across all disciplines, for example the physical, mathematical, life, human, social and economic sciences;
- to encourage and promote innovative and independent scientific thinking;
- to promote the optimum development of the intellectual capacity of all people;
- to provide effective advice and facilitate appropriate action in relation to the collective needs opportunities and challenges of all South Africans;
- to link South Africa with scientific communities at the highest levels, in particular within Africa, and further afield.

VISION

An engine of excellence in scholarship and intellectual cooperation

ASSAf aspires to be the apex organisation for science and scholarship in South Africa, internationally respected and connected, its membership simultaneously the aspiration of the country's most active scholars in all fields of scientific enquiry, and the collective resource making possible the professionally managed generation of evidence-based solutions to national problems.

MISSION STATEMENT

Clarifying the niche of the Academy

Like democratic South Africa in general, ASSAf aspires to play both a national and an international role, particularly with respect to the African continent. We see the Academy as usefully at arm's length from government and other organised sections of the state, comprising an assembly of excellent scholars from many disciplines who are well-networked both nationally and internationally, and have shown their interest in and capacity for promoting the development of a prosperous and a fully enabled society. Membership of the Academy (by election) is both an honour and an obligation to work individually and collectively (as the Academy) to ensure that decision-making requiring scholarly scrutiny and analysis is based on the best and most integrated understandings and insights available to the country. The academicians thus represent an organised, independent but responsive scholarly voice to help guide the development of the country and its people.

The mission of ASSAf is thus to

- become increasingly associated in the mind of the nation with the highest levels of scholarly achievement and excellence in the application of scientific thinking for the benefit of society;
- consolidate its infrastructure and capacity, and to expand and mobilise the membership to ensure that scholars from a full disciplinary spectrum are available for its work, and that these are indeed both thinkers and doers, willing to put significant effort into the Academy's activities;
- embark on a programme of systematic studies of evidence-based issues of national importance, some proposed by government or other sectors, and some identified by the Academy itself;
- develop a sound and robust methodology for constituting consensus study panels, organising their work, including conferences and workshops, and producing authoritative reports that are well-disseminated and have significant impact;
- alternatively, constitute committees to oversee the Academy's work in broad areas of focus, usually expressed by the holding of national forums on particular key issues, leading to forum reports that have a significant impact on policy and practise;
- publish science-focused periodicals, especially a multidisciplinary journal of high quality (the *South African Journal of Science*) and a science magazine that will showcase the best of South African research to a wide national (and international) audience (*Quest – Science for South Africa*); and to promote the development in South Africa of an indigenous system of research journals of internationally recognised quality and usefulness;
- develop productive partnerships with other organisations, especially (but not only) the National Departments of Science and Technology, Education, Health and Agriculture; the National Advisory Council on Innovation; science councils; higher education institutions, etc., with a view to the building of capacity in science and its applications within the National System of Innovation (NSI);
- create new and diversified sources of funding for the sustainable functioning of an independent Academy;
- communicate effectively with the general and specific publics, as well as with partners and sponsors;
- develop a plan for the expansion of the activities of ASSAf in partnership with the national science academies of other countries, including contracted partnership with the US National Academies; and
- play a significant role in the international science system, particularly in Africa, through organisations such as the InterAcademy Panel (IAP) and the InterAcademy Council (IAC), the Academy of Sciences of the Developing World (TWAS), the International Council on Science (ICSU), as well as the Network of African Science Academies (NASAC), all in the context of the New Partnership for Africa's Development (NEPAD).

MEMBERS

Core asset of the Academy (each styled "MASSAf")

After nomination by four existing Members (at least two of whom do so from personal knowledge of the candidate), new Members of the Academy are elected in a secret ballot. The normal criterion for election is significant achievement in the advancement or application of science, and, in addition, Members should be persons who can be expected significantly to assist the Academy in achieving its objectives. By October 2009, ASSAf had 338 Members drawn by self-categorisation from the earth, economic, life, mathematical, physical, social, technological, education, and agricultural sciences as well as the humanities.

COUNCIL

Steering Academy activities and taking responsibility

The affairs of the Academy are governed by a Council comprising 12 Members, each of whom holds office for four years. This Council is elected by the Members every two years. For the sake of continuity, six Members continue to serve a further term, while six new members are elected once they have been nominated according to the constitutional mechanism. To provide a better balance of race, gender or disciplinary area, the Council can co-opt additional Members from persons who were nominated for election to the Council.

The office-bearers are, respectively, the President, two Vice-Presidents, a General Secretary and a Treasurer. Committees can be formed in order to carry out specific functions but each must be chaired by a Member of the Academy or, preferably, of its Council. Reports drawn up by its committees or *ad hoc* task groups are approved by the Council before entering the public domain.

INTERNATIONAL CONNECTIONS

Crucial catalyst for Academy-type activities

ASSAf is an active member of the IAP, a growing organisation that embraces the national science academies of over 90 countries. The Academy of Sciences for the

Developing World now has an office in Africa based in Nairobi, and the Network of African Science Academies, of which the President of ASSAf is a Vice-President, is also located in that city. ASSAf became an 'intense partner' of the US National Academies (together with the Nigerian and Ugandan Academies of Science) as part of the African Science Academy Development Initiative (ASADI), receiving a substantial 5-year grant to build its capacity for generating evidence-based advice for the government and the nation in general.

STRATEGIC PLAN AND POLICY DEVELOPMENT

The way to go

ASSAf has developed a comprehensive strategic plan following a thorough process for identification of its strengths, weaknesses, opportunities and threats. Through its governing Council, the Academy has developed policies and guidelines for its activities. The initiation of the ASADI partnership with the US National Academies prompted the generation, proposal and adoption of the following items:

- Guidelines for proposals of science-based topics in terms of the ASSAf Act;
- Guidelines for proposals of science-based topics (project proposals);
- Guidelines for the appointment of consensus study panels and forum steering committees
- Policy on conferences;
- Formation of a forum steering Committee on Science for Poverty Alleviation (first example of an ASSAf "Board");
- Panel for the Consensus Study on Nutritional Influences on Human Immunity, with special reference to clinical tuberculosis and HIV infection (first ASSAf consensus study).

ASSAf's strategic plan and the Academy's policies and guidelines are publicly featured on the ASSAf website at http://www.assaf.org.za.

RESEARCH PUBLISHING

The core of the quality assurance system for the dissemination of research findings

The Academy of Science of South Africa signed a contract in 2001 with the Department of Science and Technology (DST) for various activities in connection with the 'strategic management' of research journals published in South Africa. The first component was a comprehensive study of the present and best-possible future role of research journals published in South Africa, now completed through the release of a full report in March 2006, with evidence-based recommendations, and a range of follow-up project integration and implementation strategies.

SAJS

Publishing the *South African Journal of Science*

The *South African Journal of Science* is the leading multidisciplinary research journal in Africa, and features a great diversity of original work by researchers throughout the country and abroad, concentrating on articles that have an appeal that is wider than that of single disciplines. The SAJS was also the pilot journal on the SciELO open access platform and successfully transferred to the Open Journal System with online submission and tracking of manuscripts.

QUEST

Publishing *Quest*: A quarterly magazine of high quality, presenting science for South Africa

The Academy publishes the national science magazine *Quest: Science for South Africa* that was launched in 2004. *Quest* serves as a platform for communication about scientific research conducted in South Africa. It strives to showcase South African science in action, and is aimed at the broad scientific community, decision-makers, the public, students, and especially the senior grades at secondary schools.