Chapter 2

The demand to increase doctorates

- The early years of doctoral production in South Africa
- Post-apartheid policy on doctoral education
  - Differentiation
- Trends in doctoral enrolments since 1996
  - The postgraduate pipeline
  - Doctoral enrolments by field of study
  - Doctoral enrolments by institution type
  - Reasons for enrolment
  - Salient trends in doctoral enrolment since 1996
- Trends in doctoral graduations since 1996
  - Growth in doctoral graduates
  - The biggest producers of PhDs
  - Doctoral graduates by fields of study and institution type
  - Salient trends in doctoral graduations since 1996
- International comparison: How does South Africa fare?
- In conclusion

The early years of doctoral production in South Africa

As far as we could establish, one of the few long-term studies on trends in doctoral production in South Africa was undertaken by Johan Garbers (1960) who later became president of the Human Sciences Research Council (HSRC) (1979 to 1986) and director-general of the Department of National Education (1987 to 1993). As part of his doctoral study, Garbers provided the first systematic analysis of doctoral graduation trends in South Africa for the period 1920 to 1957. The goals of his thesis were to determine the percentage of students who pursued postgraduate studies through to doctoral level, and to determine whether the universities were graduating enough high-level skills for the needs of the economy. He measured the latter goal by comparing the participation of the white South African

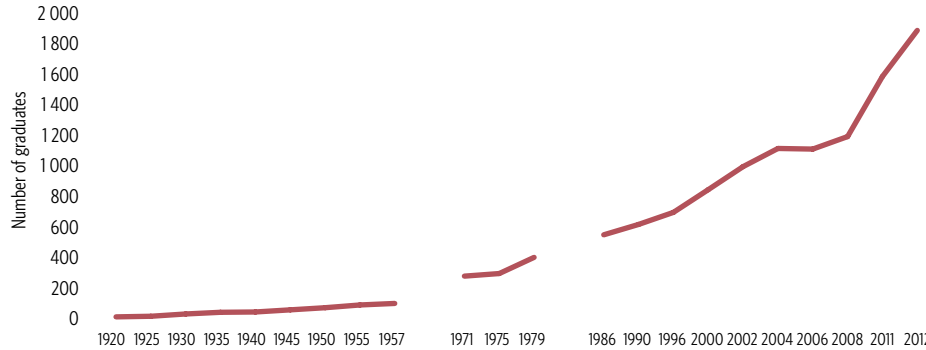
population in higher education with the participation of the populations of other countries. In the context of apartheid politics at the time, his study was only focused on whites in South Africa.

Garbers (1960) concluded that a very high proportion of white South Africans were studying (all students including doctoral) in 1957 compared to the populations of other countries. He showed that the student to population ratio for whites in South Africa was 1:99, compared to, for example, 1:71 for the USA, 1:611 for the UK and 1:305 for Australia.

Apart from the Garbers data, no single comprehensive data set is available on graduation trends before 1971. In order to get a comprehensive overview of trends since then, we consulted various data sources. The next available data set – on the qualifications awarded by the 11 historically white universities during the period 1971 to 1979 – was sourced from a statistical report compiled by the Department of National Education (1982). For the period 1980 to 1985, there is no comprehensive data set. The 21 universities and 15 technikons were controlled by eight different government departments that ceased to exist after 1994. Data for the decade 1986 to 1995 were obtained from the South African Post-Secondary Education (SAPSE) information system of the former Department of Education, which had incomplete data for the 'homeland' universities. The issue of recording stats for black students will be discussed in Chapter 4 on transformation.

Figure 2.1 is a graphical representation of the increase in PhD graduates for the period 1920 to 2013, including the two periods (1958 to 1970 and 1980 to 1985) for which no official data could be found.[1] It provides data for graduates since the data sources for the years prior to 1980 contain only graduation data.

Figure 2.1: Growth in PhD graduates in South Africa (1920–2012)



Sources: Garbers (1960), Departement van Nasionale Opvoeding (DNO) (1982), Department of Higher Education and Training (DHET) (2013a)

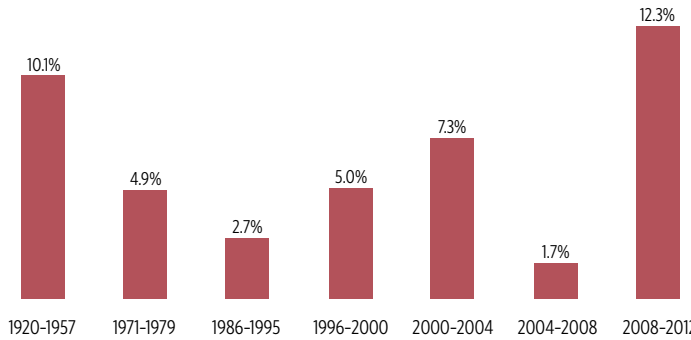
With regard to the average per annum growth of various degrees, Garbers (1960) established that during the period 1920 to 1957 the number of baccalaureus degrees awarded grew by 5.8%, first postgraduate degrees awarded by 5.5%, and doctoral degrees by 11.7%. Although the annual growth rates for doctoral graduates were the highest of the different degree levels, this growth came off very low base numbers.

Figure 2.2 presents the growth rates for doctoral degrees up to 2012. The annual average results show a steady 10% growth in PhD graduates during the 1920 to 1957 period. These growth rates would only be attained again during the post-2008 period. The periods of lowest growth in doctoral graduates, 2.7% from 1986 to 1995 and 1.7% from 2004 to 2008, occurred during periods of great uncertainty and instability in the education-political environment. During the last ten years of apartheid, with the focus on school and university anti-apartheid activism, the average tenure of a minister of education was well below two years, as the regime was occupied first with responding to mass protests and then to negotiations.

The 2004 to 2008 phase followed the uncertainty after the then Minister of Education, Kader Asmal, changed the apartheid landscape of higher education through the mergers of various institutions of higher education.[2]

The mergers had an impact on most of the comprehensive universities with the University of Johannesburg (UJ), the University of South Africa (UNISA), the University of Venda (Univen), Walter Sisulu University (WSU) and the University of Zululand (Unizulu) showing huge declines in graduates of between –16.4% and –19.5% on average per annum. The only exception was the Nelson Mandela Metropolitan University (NMMU), which had an average annual growth rate of 7.6% in graduates during the 2004 to 2008 period.

Figure 2.2: Average annual growth rate of PhD graduates (1920–2012)



Sources: Garbers (1960), DNO (1982), DoE (1999), DHET (2013a)

The picture regarding the universities that did not merge is not as clear. UCT grew at a high rate of 11.1% per annum over the 2004 to 2008 period, but Wits (3.3%) and Stellenbosch (1.1%) had very low growth rates. The low growth at Stellenbosch University was the result of a drop in doctoral graduates in engineering, philosophy, religion and theology, as well as in social sciences.

Overall, there has been a steady growth of between 5% and 12% from 1920 to 2012, except during two periods of major turmoil: in the course of the political and educational contestations from 1986 to 1995 when growth was only 2.7%, and immediately after the higher-education restructuring of 2000 to 2004 when growth was only 1.7% during the period of 2004 to 2008.

It is perhaps easier to explain the consistently high growth in doctoral graduates over the most recent period (since 2008). The revision of the DHET research subsidy framework in 2003, which came into effect in 2005, included subsidies for postgraduate students, research masters and doctoral students, for the first time. Most universities knew in 2003 already that these changes were imminent. If one keeps in mind that the average doctoral degree in South Africa takes five years to complete, it is not surprising that the first effects of the revised subsidy framework would only become clear by 2008.

It is a well-known fact that many South African universities incentivise doctoral production in the same way as they do for research publications. In some cases doctoral supervisors now receive ZAR 50 000 (approximately USD 3 800) in their research accounts for every doctoral graduate. In other cases, annual bonuses and merit awards are linked to increased doctoral production. The evidence at this point suggests that such incentives have started to have an impact on doctoral production in the country.

Post-apartheid policy on doctoral education

To get an overview of the policy and thinking around the doctorate for the period after 1994, the report of the National Commission on Higher Education (NCHE), *A Framework for Transformation* (1996), would be a good place to start, and the goals of the *National Development Plan 2030* (National Planning Commision 2012) an appropriate end-point.

The main task of the NCHE, appointed by then President Nelson Mandela early in 1995, was no less ambitious than to provide 'the government with policies to restructure fundamentally the higher-education sector' (NCHE 1996: i). The NCHE consisted of five task groups, and more than 20 technical groups and experts from the US, Europe, Africa and Australasia. Draft proposals were debated at numerous

consultative forums, some of which included up to a thousand participants (Cloete 2014b).

However, this wide range of experts was almost exclusively drawn from within the higher-education sector. The zeitgeist of the period immediately after 1994 was equity, redress and transformation. Mentions of the doctorate in the 400-page report are mainly in relation to differences in outputs and throughputs between historically white and historically black universities (NCHE 1996: 35–36). A number of the proposals dealt with how to strengthen research capacity in the historically black universities, but not with specific reference to the doctorate. The only recommendation on support for staff to improve their formal qualifications (masters and doctorates) was in relation to the incorporation of the nursing, agriculture and education colleges.

The NCHE argued for strengthening research, particularly at the historically black universities, but the focus was more on relevance than on increased output, and no connection was made between research and the doctorate. In short, producing more doctorates, more academic staff with doctorates and greater research output was not on the policy menu of the NCHE.

The importance of producing doctoral graduates to position South Africa as a significant knowledge economy was first articulated in the *Education White Paper 3* (Department of Education [DoE] 1997) and the *National Plan for Higher Education* (NPHE) (Ministry of Education [MoE] 2001). These policy documents emphasised that masters and doctoral enrolments in the system must grow because knowledge economies require increasing numbers of citizens with high-level qualifications. The *Education White Paper 3* also drew attention to the importance of increased access of black (African, coloured and Indian) and female students to masters, doctoral and postdoctoral programmes as a means of increasing the pool of researchers and improving the demographic representation of staff in higher education.

The NPHE concluded that the future sustainability of the national research system and of the higher-education system was threatened by low enrolment in postgraduate programmes (MoE 2001). Both the research and higher-education systems are dependent on the production of postgraduates for the replenishment of their academic and research ranks. To address this issue, the NPHE recommended the development of strategies at system and institution levels to make postgraduate study and academic careers more attractive options.

Skills in the fields of science, engineering and technology, and business, commerce and management are important drivers of economic development. The *Education White Paper 3* identified a key challenge facing

the South African higher-education system: enrolments and graduates in both these fields must grow, including at doctoral level (DoE 1997).

The Department of Science and Technology (DST) set initial targets for PhD production in its *Ten-Year Innovation Plan 2008–2018*: 'To build a knowledge-based economy positioned between developed and developing countries, South Africa will need to increase its PhD production rate by a factor of about five over the next 10–20 years' (DST 2008: 29).

But the real boost for linking higher education to the knowledge economy with a focus on the PhD came from South Africa's latest commission, the National Planning Commission (NPC). Located in the office of the Presidency, the commission started working on a development plan for the country called the *National Development Plan 2030: Our future, make it work* (NPC 2012). The NPC started by producing a *Diagnostic Report* (2011) and a subsequent first draft of the new *National Development Plan* (NPC 2011). From these documents it became clear that a radical shift in discourse had occurred – from equity to development. The NPC, consisting of 26 members including three vice-chancellors, focused on the country and the economy, not just the higher-education sector. The NPC embraced the new global knowledge-economy argument. In fact, it was so enthusiastic about knowledge production that it declared that 'knowledge production is the rationale of higher education' (NPC 2012: 271). While knowledge production was not even mentioned in the policy menu of the NCHE in 1996, by 2012 it had become the main rationale for universities in the *National Development Plan* (NDP).

Differentiation

Arguably the most contentious higher-education policy issue in the post-1994 period has been differentiation. Historically, apartheid is based on notions of differentiation, mainly of race, but race is linked to privilege, resulting in the complex and often obfuscating notions of historically white and black institutions, and overlaid with an even more entrenched notion of historically advantaged and historically disadvantaged universities. Badat argued that institutional restructuring was a key part of post-1994 policy discussions and the 1997 *White Paper*. Noting the shortcomings of the structure of the existing system, he was emphatic that the 'system has no alternative but to remake itself' (Badat 2004: 38).

In a 2005 review of *Transformation Tensions in Higher Education*, Cloete and Moja wrote:

> *Higher education in South Africa since 1994 is braided into the bargain struck by President F.W. De Klerk and prisoner Nelson Mandela – both in terms of the baggage it carried and the promises*

> *it offered. When the new government came to power in 1994 on the basis of the 'implicit bargain' (Gelb, 2001) reached between the National Party and the liberation movement led by the African National Congress (ANC), there was consensus in the government of national unity that higher education needed transformation. Not as clear was the nature of the tensions implicit in the compromises that had to be made and how the trade-offs would be negotiated.* (Cloete and Moja 2005: 693)

In this context there were legitimate concerns among historically black institutions that a policy of differentiation in post-1994 would perpetuate the historical patterns of disadvantaging them and benefiting the historically white institutions, especially if there were no strategies of institutional redress and developmental trajectories for historically black institutions to address the apartheid legacy, and to enable them to take on new social and educational roles.

Two different approaches that have obfuscated the debate are 'diversity' versus 'differentiation' and 'overt' versus 'covert differentiation'. 'Diversity' denotes horizontal variability, that is, variability across a 'less–more' continuum; 'differentiation' denotes vertical variability: that is, variability across a 'better–worse' continuum. The latter requires categories of vertical variability. The categories currently employed by the DHET include: undergraduate success rates; postgraduate (particularly doctorate) enrolments and throughput rates (time to completion); and research output (staff/publication ratios). 'Differentiation' is more associated with rankings and prestige than diversity.

According to Muller (2006), in Europe covert differentiation works in the following way: adopt a rhetoric of diversity, i.e. proclaim and advocate a rhetoric of horizontal variability, but practice, principally via instruments of funding, an incremental differentiation (weak to strong), moderate at the lower levels of the rank, getting steeper at the apex, where the criterion of research and innovation is the undisputed rewarded value. For example, although the Norwegian system prides itself on diversity and equality, and the policy focus is actually on strengthening the regional universities and colleges, the apex institution, the University of Oslo, was nevertheless ranked 67th by Shanghai Jiao Tong University's world academic rankings in 2012, and no other Norwegian university features in the top 500.

From the NCHE (1996) to the *Green Paper for Post-School Education and Training* (DHET 2012) and the NDP (2012), differentiation is accepted as principle and fudged in practice in terms of diversity/differentiation and covert/overt. The only policy proposal that put a clear, but stark, differentiation model on the table was the Council on Higher Education's (CHE 2000: 36) three types of institutions, with the most contentious

notion the category of a 'bedrock' university that would focus on quality undergraduate education while some comprehensive universities would have a full suite of masters and doctoral programmes with research.

The Minister of Education rejected the CHE's proposals. The 2001 *National Plan*, as a consequence, had to formulate different ways of determining institutional diversity, and of ultimately placing limits on the range of doctoral programmes that institutions could offer. In the *National Plan* the Ministry proposed that institutional diversity would be achieved through mission and programme differentiation based on the type and range of qualifications offered. As part of the merger process the *National Plan* suggested three categories of universities:

- *Universities* are mostly pre-merger universities, and are defined as institutions that offer primarily *university-type* academic programmes. These institutions are intended to be major producers of high-level knowledge, and are therefore expected to enrol substantial proportions of the doctoral students in South Africa, and to produce most of the doctoral graduates.
- *Comprehensive universities* are institutions that offer a mix of *technikon-type* and *university-type* academic programmes (four of the six institutions in this category were formed by mergers between universities and technikons, and the remaining two are universities that were given new mandates by government). Because of their programme mixes, these institutions are not expected to compete with universities as producers of high-level knowledge.
- *Universities of technology* are mostly pre-merger technikons, and are defined as institutions that offer primarily *technikon-type* academic programmes. As a consequence, they are supposed to enrol a small number of doctoral students and produce very few doctoral graduates (CHE 2002).

In terms of overt differentiation, a key moment was the March 2010 Higher Education Summit from which the *University World News* reported that:

> *Almost 16 years after 1994, at the Higher Education Summit of the Minister, a broad spectrum of the South African higher education community accepted differentiation as a strategy to bring greater diversity and mission for purpose into the system.* (MacGregor 2010)[3]

However, following the path dependency of previous debates on differentiation, the usual ambiguities appeared in the summit statements[4] and the implementation plan was deferred to the DHET's 2012 *Green Paper*.

The *Green Paper for Post-school Education and Training* (DHET 2012: 39–41) started off boldly by stating that 'the need for a differentiated system of university education has long been recognised. Not all institutions can or should fulfil the same role', and then went back to the past stating that:

> *A few relatively research intensive universities are responsible for most of the post graduates, and are engaged in cutting edge research and innovation. However, their needs must not be allowed to divert attention from the need of all universities – and particularly the poorer ones – to have sufficient resources.*

It concluded that:

> *The process through which these principles will be realised must include both the universities and the DHET, working together to define the mission and the role of each institution. In the near future the DHET will initiate such a process.*

At the beginning of 2014, no such process had appeared in print.

Following the *Green Paper*, the *White Paper for Post-school Education and Training*, approved by Parliament in November 2013 (DHET 2013c), stated that since the establishment of the DHET in 2010, the department recognised that the principle of differentiation must apply beyond the universities to the entire post-school system. The key recommendations were:

- A continuum of institutions is required in the post-school system, including universities with differentiated missions.
- Each institution must have a clearly defined mandate within the system and the level and type of research will be determined in relation to the overall mandate of the institution.
- Universities will become an integral part of the post-school system, interfacing with TVET and other vocational colleges.
- Better intergovernmental coordination will be required (DHET 2013c: 29–30).

While this formulation is indeed the strongest ever made by the national education department,[5] like the *Green Paper*, there is no implementation plan: 'The DHET will engage universities and other stakeholders to discuss higher-education differentiation in order to develop sufficient national consensus on a programme for purposeful differentiation' (DHET 2013c: 30).

The 2014 gazetted *Policy Framework on Differentiation in the South African Post-School System* (DHET 2014) does not make the necessary

distinctions between 'mandates', 'missions', 'performance goals' and 'targets', neither does it provide the programme for purposeful differentiation that was promised in the 2013 *White Paper*.

A more targeted development has been the NDP which, in Chapter 9 (Improving Education, Training and Innovation) started with an empirical, rather than an ideological, statement: 'South Africa has a differentiated system of university education, but the system does not have the capacity to meet the needs of the learners' (NPC 2012: 318). It then presented a muddled mixture of features of the system, but unlike any previous policy document, made a number of bold proposals for universities and the doctorate in particular:

- Improve the qualifications of higher-education academic staff from the current 39% to 75% (this is the number one recommendation).
- Produce more than 100 doctoral graduates per million by the year 2030. South Africa currently produces 28 per million, which is low by international standards.
- To achieve the target of 100 per million, the country needs more than 5 000 doctoral graduates per annum, as against the 2013 figure of 2 051.
- If South Africa is to be a leading innovator, most of these doctorates should be in science, engineering, technology and mathematics.
- Increase the number of masters and PhD students. By 2030, over 25% of university enrolments should be at a postgraduate level.
- Strengthen universities that have an embedded culture of research and development.
- Provide performance-based grants to develop centres or networks of excellence within and across institutions. International exchange partnerships should be encouraged (NPC 2012: 318–320).

It is clear from these statements that current government thinking on the imperative for growth in doctoral graduates can be understood to mean the following:

- It remains vital to increase the overall number of doctoral graduates but there is now an explicit target of reaching 5 000 doctorates by 2030.
- Growing doctoral output is now specifically linked to replenishing the pool of ageing academics and the need to achieve higher proportions of academic staff with PhDs (a target of 75% for all institutions by 2030). This expectation is evidently not simply about numbers, but also speaks to matters related to quality (of supervision) and hence will be addressed in Chapter 5 on quality.

- Increasing doctoral production does not seem to apply equally to all universities, but implies differentiated growth. This issue is addressed below where we present the latest data on institutional contributions to doctoral production.
- And finally, the imperative of producing more doctoral students in South Africa is further qualified by the requirement that there is an urgent need for considerably more doctorates in the fields of science and engineering.

Following this brief policy overview, the subsequent sections of this chapter will focus on the:

- Growth patterns in PhD enrolment and graduation;
- Growth in fields of study, with emphasis on enrolments and graduation in science, engineering and technology, which includes the sub-fields natural sciences, engineering and health sciences;
- Institutional differentiation in the production of PhDs; and
- International comparisons.

Periods for the trends analysis

The post-1994 period is divided into five data points of four-year intervals. The data periods are 1996, 2000, 2004, 2008 and 2012. Although somewhat arbitrary, these time periods have been selected as they followed or coincided with the release of important policies and changes in the higher-education system since the establishment of the new democratic state. The rationale for using these particular years is summarised below:

1996 The report of the National Commission on Higher Education, *A Framework for Transformation* (NCHE 1996) was published. This was also the year before the release of *Education White Paper 3: A Programme for the Transformation of Higher Education* (DoE 1997) and the promulgation of the Higher Education Act No. 101 of 1997. This forms the base year for comparative purposes, and provides data at the brink of the implementation of the huge reforms put forward in these policy documents, which were primarily aimed at achieving greater equity, efficiency and effectiveness within institutions and across the system.

2000 This was another benchmark year in which the Council on Higher Education's report, *Towards a New Higher Education Landscape: Meeting the equity, quality and social development imperatives of South Africa in the 21st century*, was released in June. The report to the

Minister of Education represented the considered proposals of the Size and Shape Task Team of the Council on Higher Education (CHE) on a new and more effective size and shape of South African higher education. In response to this report, the Ministry of Education published the *National Plan for Higher Education* in 2001 (MoE 2001). According to the Plan, the number of public higher-education institutions would be reduced from 36 to 23 through mergers. In addition to restructuring, the plan identified the need for increased access, equity of access and outcomes, diversity through mission and programme differentiation, and the need to sustain current research strength and build high-level research capacity. Since 2000 was the year before the release of the *National Plan for Higher Education* in 2001, it serves as a base year from which to track changes that have occurred since the *National Plan*.

2004 An important principle of the *National Plan for Higher Education* was that the 'effective use of funding as a steering lever requires the development of a new funding formula based on the funding principles and framework outlined in the *White Paper*' (MoE 2001: 12). The current framework was approved in the *Government Gazette* (Vol. 462, No. 25824) of 9 December 2003 (MoE 2003), and has been used for allocating grants since the 2004/05 funding year. A basic feature of the new funding framework, which came into effect in 2004/05, is that it links the awarding of government higher-education grants to national and institutional planning. Reforms of the higher-education system started mostly in 2004 through merging and incorporating smaller universities into larger institutions. The year 2004 was thus an important year because of the new funding framework and because it serves as a reference point for the mergers that came into effect on 1 January 2005.

2008 Although the current funding framework was introduced in 2003 and came into effect in 2004/05, it was only fully functional by the financial year 2007/08, as a result of a period of migration from the previous framework. The impact of the introduction of the new funding framework was smoothed by gradually implementing the new funding framework over a period of three years. This year (2008) can thus be considered as the period where the impact of the current funding framework became more evident. Following the release of the *National Plan,* the Minister appointed a National Working Group for the period 2001 to 2007 to investigate and report on programme offerings, growth of institutions, students' success rate, ratios of staff, etc. The year marked the end of the period of institutional Programme Qualification Mix (PQM) reviews by the Ministry, which impacted on the range of programmes that universities were allowed to offer. The conclusion of the PQM process removed some of the doctoral programmes from institutions that did not have the appropriate capacity to offer these programmes. The DST's *Ten-year Innovation Plan 2008–2018* (DST 2008) that

states that PhDs in science, engineering and technology must increase fivefold was also released in 2008.

2012 This year marks the latest available official Higher Education Management Information System (HEMIS) data at the time of writing. It is also benchmark information for the monitoring of trends following the publication of the *Green Paper for Post-school Education and Training* (DHET 2012) and the *National Development Plan 2030* (NPC 2012). The *White Paper for Post-School Education and Training: Building an Expanded, Effective and Integrated Post-School System* has since been released (DHET 2013c). These documents place a premium on the accelerated production of PhD graduates as a prerequisite for economic growth, innovation and a knowledge economy.

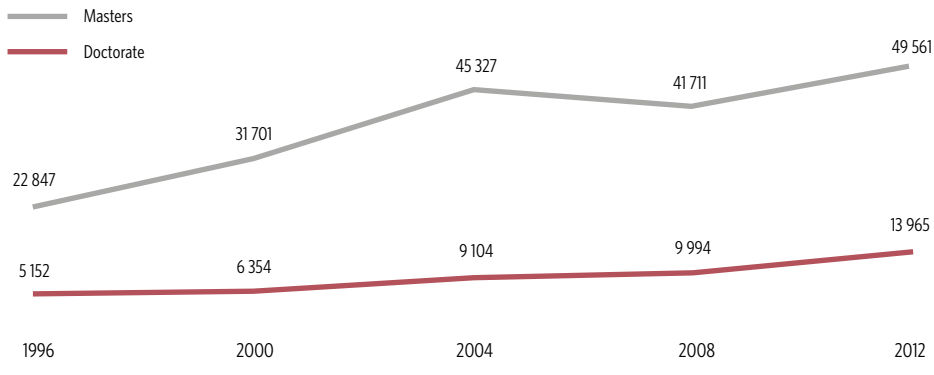
Trends in doctoral enrolments since 1996

The postgraduate pipeline

Before focusing on doctoral enrolments specifically, it is necessary to look at shifts in masters enrolments, which form the pipeline for doctoral enrolments. The general trends are evident in Figure 2.3. From 1996 to 2012 the number of masters enrolments more than doubled, while the number of doctoral enrolments increased nearly threefold.[6]

The trend for masters enrolment reveals interesting fluctuations with an increase between 2000 and 2004 followed by a subsequent, equally large, decrease. The two universities that recorded the biggest decrease in

Figure 2.3: Masters and doctoral headcount enrolments (1996–2012)



Sources: DoE (1999), DHET (2013a)

masters enrolments were UNISA (decreasing from 5 738 in 2004 to 4 153 in 2008, a reduction of 1 685) and Tshwane University of Technology (TUT) (1 567 in 2004 to 68 in 2008, a decrease of 1 499 enrolments). These decreases were mostly in the fields of education, and human and social sciences. The reason/s for the sharp reduction in the masters enrolments at UNISA could not be established, but in the case of TUT a managerial decision was made to reduce the numbers of enrolments for the masters programme in education, based on insufficient capacity to offer a quality programme, as well as the low throughput rate in the programme.

The growth in doctoral enrolments between 2004 and 2008 slowed down over this period. The total increase in doctoral enrolments in 2008 compared to 2004 was only 890 (or 10%).

The decrease in masters enrolments and the slowing down of doctoral growth could have been the result of the withdrawal of programmes from some institutions, as well as from the uncertainties generated by institutional mergers, which reduced the number of public higher-education institutions from 36 in 2000 to 23 in 2008.

The effects of the full introduction of government funding incentives that were designed to encourage postgraduate studies can be seen in the enrolment increases that occurred between 2008 and 2012. Masters enrolments increased by 7 850 (or 19%) from their 2008 low point. Doctoral enrolments increased by 3 971 (or 40%) over this same period.

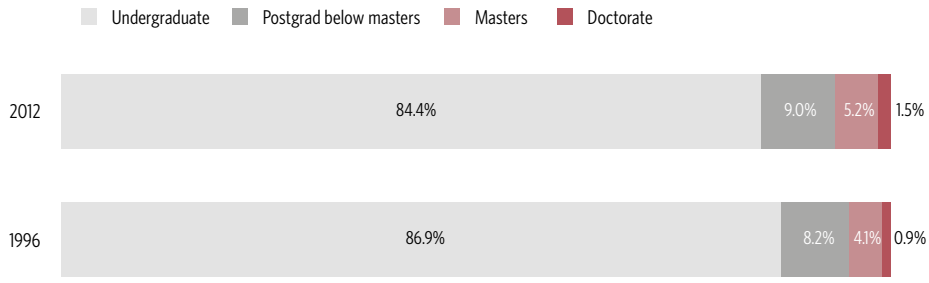
Doctoral enrolments increased from 5 152 in 1996 to 13 965 in 2012, an average annual growth rate of 6.4% over the sixteen-year period. Doctoral enrolments increased from 5 152 in 1996, which was the base year, to 6 354 in 2000, which was the year of the size-and-shape discussions. These changes account for a total increase in doctoral enrolments of 1 202 (or 23%). Masters enrolments grew by 39% over this same four-year period.

The overall picture that emerges from Figure 2.3 is that the public higher-education system has certainly responded to the 'policy imperative' to grow postgraduate numbers. One should also add that the past eight to ten years have witnessed huge increases in the number of masters and especially doctoral students from the rest of Africa, which have substantially added to these growth trajectories.

However, despite this increase in doctoral enrolments, the South African public higher-education system remained a dominantly undergraduate one. The predominance of undergraduates is shown in Figure 2.4, which compares the proportions of undergraduate and postgraduate students in the system in 1996 and 2012.

Although the proportion of postgraduate students increased from 13.1% to 15.6% between 1996 and 2012, the overall proportion of doctoral students in 2012 remains at 1.5%. This is despite the fact that the growth in doctoral

Figure 2.4: Student enrolments (1996 and 2012)



Sources: DoE (1999), DHET (2013a)

students was the highest of these categories: The growth in doctoral student enrolments was 6.4% over the period, masters 4.8% and postgraduate below masters at 3.8%. Undergraduate enrolments increased at 3.0% on average per annum.

The reality is that the South African public university system remains overwhelmingly focused on the production of undergraduate students and it is clear that the target of 25% postgraduates posited by the NDP for 2030 is unlikely to be achieved.

Doctoral enrolments by field of study

The policy imperative with regard to field of study is to increase enrolments and graduates at doctoral level, particularly in science, engineering and technology (which are analysed in terms of the sub-fields natural sciences, engineering and health sciences).

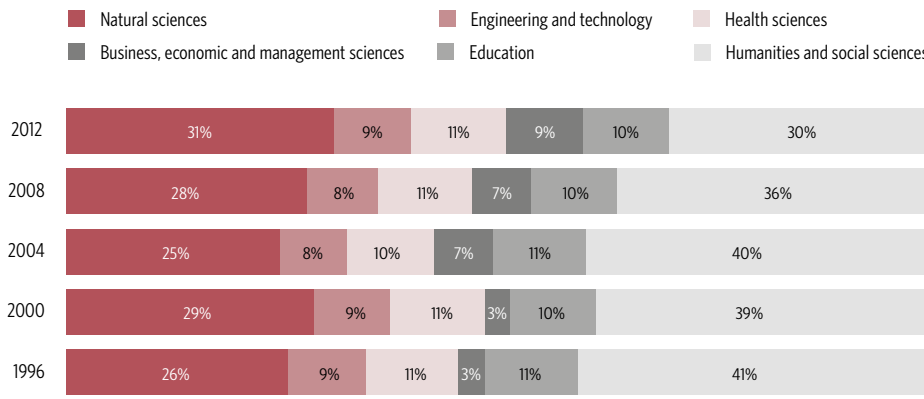
For the purpose of our analyses by field of study, we have grouped disciplines together as follows:

- *Natural sciences* include agriculture and agriculture operations, computer and information sciences, family ecology and consumer sciences, life sciences and physical sciences, mathematics and statistics.
- *Engineering and technology*, made up of engineering, architecture and the built environment.
- *Health sciences*, being health professions and related clinical sciences.
- *Business, economics and management* include accounting, auditing, economics, finance, business administration, and various management programmes.

- *Education*, made up of studies in pre-primary, primary, secondary and post-school education, and the training of teachers at all levels.
- *Humanities and social sciences*, being fine arts, music and drama, communication and journalism studies, languages and literature, law, public management and services, psychology, sociology and anthropology, history, political sciences, military sciences, philosophy and religious studies.

Figure 2.5 disaggregates the headcount doctoral-enrolment totals for the period 1996 to 2012 according to broad fields of study. The proportion of doctoral students in science, engineering and technology increased from 46% in 1996 to 51% in 2012, with a low point of 43% in 2004. In contrast, the share of doctoral enrolments in the humanities and social sciences doctoral enrolments fell from 41% in 1996, to 40% in 2004 and 30% in 2012. The higher-than-average growth rate of doctoral students in business, economics and management science (but from a small base) ensured that its share of enrolments tripled, albeit from a low base (from 3% in 1996 to 9% in 2012). The share of doctoral enrolments in education declined marginally (from 11% in 1996 to 10% in 2012).

Figure 2.5: Average shares of the doctoral enrolments in the various fields of study (1996–2012)



	Natural sciences	Engineering and technology	Health sciences	Business, economic and management sciences	Education	Humanities and social sciences	Total
2012	4 284	1 240	1 485	1 311	1 455	4 190	13 965
1996	1 352	445	541	158	563	2 093	5 152

Sources: DoE (1999), DHET (2013a)

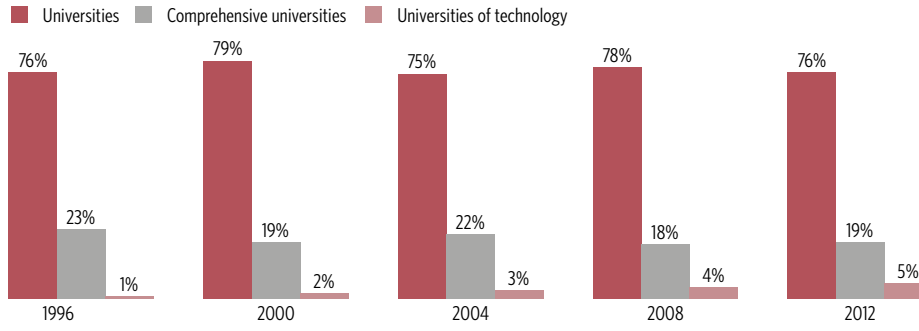
In policy terms it means that the intention of the *National Plan* (2001) and the NDP that the 'majority' of enrolments must be in SET has been achieved. The 'decline' of the humanities and social sciences (from 52% to 40%) could also be regarded as a 'correction' from over-enrolments in these fields during the 1980s and 1990s. A more detailed analysis of changes in subject fields is required for a better understanding of these shifts, and whether it points to a more permanent trend.

Doctoral enrolments by institution type

In 2005, the higher-education institutions merged to create the three types of university institutions that are currently in place. In line with this, and in order to determine trends, data were mapped from the former 36 universities and technikons for the years 1996 to 2004 to each of the eleven universities, six comprehensive universities and six universities of technology that were formed through the 2005 mergers.

Table 2.1 and Figure 2.6 present the doctoral enrolments per individual university and Figure 2.6 presents the same data by type of institution collectively for the three types of institutions for the period 1996 to 2012. Over this period, the eleven traditional universities enrolled the most doctoral students (10 621 or 76% in 2012). Far fewer doctoral students were enrolled at the six comprehensive universities (2 638 in 2012), with only a marginal number (706) enrolling at the six universities of technology in 2012. At universities of technology, however, doctoral enrolments grew at an average annual rate of 20.0% between 1996 and 2010 (but from a small base). This is considerably higher than the 5.1% growth of the comprehensives, and 6.4% of all the universities over the same period. Compared to 1996, enrolments in doctoral programmes at traditional universities in 2012 had

Figure 2.6: The distribution of doctoral enrolments by institution type (1996–2012)



Sources: DoE (1999), DHET (2013a)

Table 2.1: PhD enrolments per institution type (1996–2012)

	1996	2000	2004	2008	2012	Average annual growth rate (1996–2012)
Universities						
Fort Hare	1	27	30	216	284	42.3%
Limpopo	36	76	143	136	189	10.9%
Western Cape	132	170	304	386	603	10.0%
North West	247	327	615	758	1 048	9.5%
Rhodes	130	181	216	245	420	7.6%
KwaZulu-Natal	517	684	1 115	1 095	1 626	7.4%
Stellenbosch	529	708	780	880	1 308	5.8%
Witwatersrand	574	605	643	988	1 424	5.8%
Cape Town	571	698	898	1 030	1 328	5.4%
Pretoria	848	1 143	1 597	1 458	1 860	5.0%
Free State	339	429	520	580	531	2.8%
Subtotal: Universities	3 924	5 048	6 861	7 772	10 621	6.4%
Comprehensive universities						
Venda	3	12	39	50	140	27.1%
Walter Sisulu	2	4	1	15	34	19.4%
Zululand	22	89	151	153	179	14.0%
Nelson Mandela	138	140	263	337	452	7.7%
South Africa	593	533	908	778	1 173	4.4%
Johannesburg	432	417	611	502	660	2.7%
Subtotal: Comprehensives	1 190	1 195	1 973	1 835	2 638	5.1%
Universities of technology						
Tshwane	6	45	101	143	308	27.9%
Durban	2	25	30	51	99	27.6%
Central	2	19	70	58	85	26.4%
Vaal	1	5	19	29	17	19.4%
Cape Peninsula	27	17	50	106	197	13.2%
Mangosuthu	0	0	0	0	0	0.0%
Subtotal: U of technology	38	111	270	387	706	20.0%
Total	**5 152**	**6 354**	**9 104**	**9 994**	**13 965**	**6.4%**

Sources: DoE (1999), SAPSE, DHET (2013a), HEMIS data (2000–2012)

almost tripled and at comprehensive universities had more than doubled, while universities of technology were enrolling almost 19 times the number of doctoral students they had in 1996. However, whether these changes in enrolments resulted in commensurable increases in graduates in the three institution types will be analysed and discussed later in this chapter.

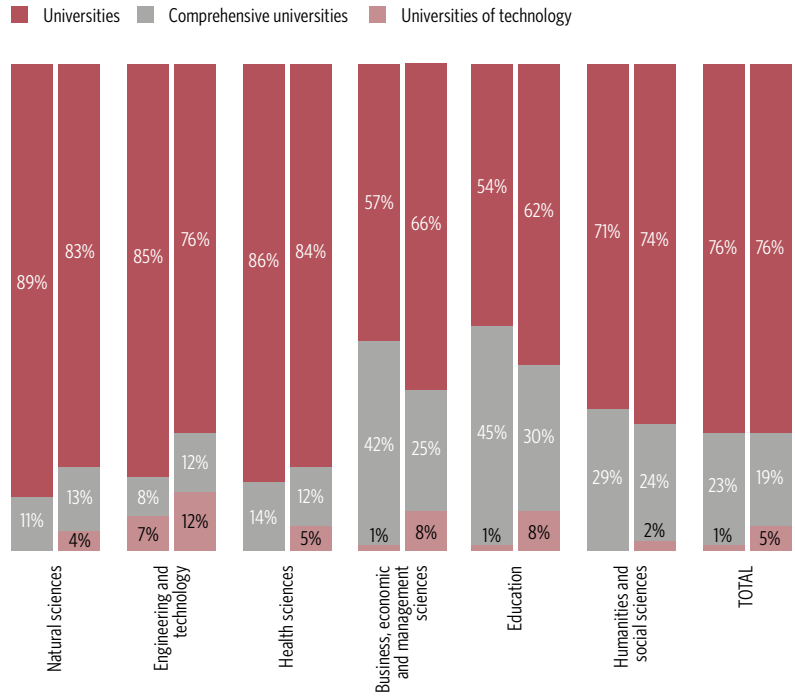
The differential growth rate of doctoral students within the three categories has had a small effect on the overall shares of doctoral students. The university category's share of doctoral enrolments increased from 76% in 1996 to 79% in 2000 and then decreased again to 76% in 2012. The share of universities of technology increased from 1% in 1996 to 5% in 2012, and that of comprehensive universities declined from 23% to 19%.

Figure 2.7 illustrates how the doctoral-enrolment proportions in the major fields of study changed between 1996 and 2012 for the three institution types (also see Table A1 in Appendix 5). It shows that the universities lost some of their share of doctoral students in the natural sciences, engineering and technology and health sciences to the comprehensive universities and universities of technology, which in turn show an increased share in these fields. But the traditional universities gained in business and management enrolments (from 57% to 66%), mainly at the expense of the comprehensive universities (42% to 25%). The biggest change in the universities of technology group was an increase from 1% to 8% in both the business, economics and management sciences, and in education doctoral enrolments between 1996 and 2012.

Reasons for enrolment

In a 2014 study conducted nationally (see Study 3 in Appendix 1), currently enrolled honours, masters and doctoral students were asked to respond to

Figure 2.7: Distribution of doctoral enrolments across major fields of study and institution categories (1996 compared to 2012)



Sources: DoE (1999) DHET (2013a)

24 statements about their choice of their current academic programme. Respondents were asked to rate the importance of each statement on a scale of (1) very important, (2) important, (3) neutral, (4) not important, to (5) not important at all. The results are presented in Table 2.2 for all doctoral, masters and honours students.

The five most important reasons affecting respondents' choice to enrol in their selected programmes are highlighted across the three groups of students. The results differ very slightly among the groups, with honours students deeming the encouragement from family etc. to be more important than that of lecturers, whereas the opposite was the case for masters and doctoral students. This might be due to the fact that the cohort of honours respondents is younger than that of masters and doctoral students. The sampled honours students were also more concerned with meeting the entry requirements of the study programme.

The most important finding for our purpose is the fact that doctoral students rated (1) the relationship with their academic supervisors and (2) the academic reputation of the university as the most important factors in making their decision on where to pursue their studies.

Table 2.2: 'Top 5' factors influencing students' choice of their current degree programmes

	Honours	Masters	Doctoral
Course content	95%	90%	#
Academic reputation of the university	90%	91%	88%
Employment prospects on completion of the programme	85%	81%	#
Meeting the entry requirements	83%	#	#
Encouragement from family (parents, guardians, spouse, etc.)	80%	#	#
Relationship with academic supervisor	#	83%	90%
Encouragement from lecturers/tutors	#	77%	81%
Scholarship/funding/bursary provided	#	#	82%
Availability of scholarships or bursaries	#	#	81%

 # = not part of 'top 5'
Source: Mouton 2014

Salient trends in doctoral enrolments since 1996

- Doctoral enrolments at South African universities increased faster than any other category of students over the 16-year period up until 2012.
- The increase in doctoral enrolments are more pronounced over recent years and may reflect the impact of the revised research output subsidy framework that came into effect in 2005.
- The traditional university sector remains the largest contributor to doctoral education in the country (75%).

- Doctoral enrolments in science and engineering fields increased more than in any other fields – most notably overtaking the social sciences and humanities.

Trends in doctoral graduations since 1996

Growth in doctoral graduates

As mentioned in the first section of the chapter, doctoral graduates increased by 174% between 1996 and 2012 (from 685 to 1 879). This represents an average annual growth rate of 6.5% over this period.

The politically uncertain pre-1994 period showed a low growth (2.7%), which may account for the immediate post-1994 growth rate, more than doubling to 7.3% during the uncertain 2000 to 2004 period. The post-merger period (after 2005) showed the lowest growth rate in the entire history of the doctorate from 1920 (1.7%). By 2008 the new landscape had stabilised, and the new post-2004 funding regime had become fully operational. This period saw the highest growth rate (12.3%) since 1996.

In terms of incentives from the national government, the South African Post-Secondary Education (SAPSE) funding framework, implemented between 1983 and 2003, provided no direct financial incentives for the enrolment and graduation of doctoral students (DoE 1999). Up until 2004, government funding of doctorates was based on 'effective subsidy students', which were projected numbers established on a mix of 50% enrolled full-time equivalents and 50% completed full-time equivalents. The current funding framework, which was introduced in 2003, came into effect in 2004/05 and was fully operational by 2008, links the awarding of government higher-education grants to national and institutional planning.

The funding–planning link makes the current framework essentially a goal-oriented mechanism for the distribution of government grants to individual institutions, in accordance with (a) national planning and policy priorities, (b) the quantum of funds made available in the national higher-education budget, and (c) the approved plans of individual institutions. The funding framework places doctoral enrolments and graduates into different funding categories, with a weight of four for level, which means that the enrolled full-time equivalents for doctoral students get four times the funding of the undergraduate enrolments in the same field of study. Doctoral research graduates are regarded as a research output unit with a weight of three, which means one doctoral graduate 'earns' three times the subsidy of an accredited journal article for a university (approximately ZAR 360 000 [USD 36 000] in 2012). In essence, doctoral enrolments and graduates are highly funded in the current funding framework. Depending on the average number of years that doctoral students take to graduate, and changes in the

rand values of the subsidy components from year to year, a university in 2012 could have received between ZAR 447 000 (USD 44 700) and ZAR 664 000 (USD 66 400) (depending on funding group) for a full-time doctoral graduate, of which 46% would have been teaching input and 54% research output subsidy. In addition, universities receive the annual fee income from the students for each year of registration (see Appendix 4 for more detail on how the production of doctoral graduates is steered through the funding framework, the programme approval process as well as the enrolment planning processes).

It could be argued that the combination of a more stable system and a goal-directed funding framework with substantial rewards for enrolling and graduating PhDs contributed to the sevenfold increase in growth rates of doctoral graduates from the preceding unstable period. However, we will also comment – in Chapter 4 – on the huge impact that doctoral students from other African countries have had on South Africa's enrolment and graduation statistics.

Table 2.3: Total number of doctoral graduates per institution (2012)

Universities		2012 doctorate graduates	Accumulative total	Accumulative percentage
Stellenbosch	TOP 7 68%	240	240	13%
Pretoria		200	440	23%
Cape Town		199	639	34%
KwaZulu-Natal		177	816	43%
North-West		154	970	52%
South Africa		152	1 122	60%
Witwatersrand		150	1 272	68%
Johannesburg	TOP 12 91%	109	1 381	73%
Free State		94	1 475	78%
Nelson Mandela		86	1 561	83%
Western Cape		75	1 636	87%
Rhodes		67	1 703	91%
Tshwane	BOTTOM 11 8%	44	1 747	93%
Fort Hare		43	1 790	95%
Zululand		28	1 818	97%
Cape Peninsula		24	1 842	98%
Limpopo		17	1 859	99%
Durban	BOTTOM 6 1%	6	1 865	99%
Central		5	1 870	100%
Venda		4	1 874	100%
Walter Sisulu		3	1 877	100%
Vaal		2	1 879	100%
Mangosuthu		0	1 879	100%

Source: DHET (2013a)

The biggest producers of PhDs

In terms of differentiation (see Table 2.3) seven of the 23 universities (all of which are traditional, historically disadvantaged institutions) produced 68%, while 12 of the 23 universities produced 91% of the doctoral graduates in 2012. Newly merged universities such as UKZN, North-West, UNISA and Johannesburg also did well. However, the previous technikons, now universities of technology, were small contributors to doctoral production in the country.

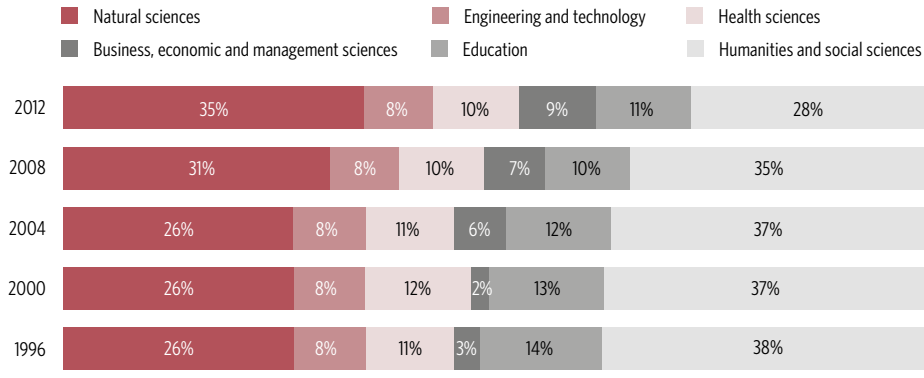
Doctoral graduates by fields of study and institution type

This section addresses the distribution of graduates across the institution types and the broad fields of study for the years 1996 to 2012.

Figure 2.8 illustrates a number of changes in the graduates according to field of study during the period 1996 to 2012:

- The percentage of graduates in natural sciences, engineering and technology (SET) increased from 45% in 1996 to 53% in 2012. The biggest contribution to the increase was in the field of natural sciences where the share of graduates gained nine percentage points, increasing from 26% in 1996 to 35% in 2012. The share of graduates in the SET subfield of engineering and technology remained constant at 8% from 1996 to 2012, while the health sciences showed a drop of 1% (from 11% to 10%) over this period.
- Doctoral graduates in business, economic and management sciences increased from 3% in 1996 to 9% in 2012.

Figure 2.8: Average shares of the doctoral graduates in the various fields of study (1996–2012)



Sources: DoE (1999), DHET (2013a)

- The share of doctoral graduates in education dropped from 14% to 11%.
- The largest decrease in the number of doctoral graduates was in the humanities and social sciences: from 38% in 1996 to 28% in 2012.

The *National Development Plan 2030* statement that 'if South Africa is to be a leading innovator most of the doctorates should be in science, engineering, technology and mathematics' (NPC 2012: 319) has almost been achieved. By 2012 53% of South Africa's doctoral graduates were in these fields. However, neither the NDP nor the ministries of higher education or science and technology have ever specified which percentage is considered 'most'.

In terms of institutional differentiation, it is important to look how doctoral graduate totals by fields of study were shared between the three institution types (see Table 2.4 below and Table A2 in Appendix 2):

- The group of traditional universities increased their total share of doctoral graduates from 74% in 1996 to 75% in 2012. The comprehensive universities as a group showed a decline from 25% in 1996 to 20% in 2012, while universities of technology increased their share from 1% in 1996 to 4% in 2012.

Table 2.4: Distribution of doctoral graduates per institution type and field of study (1996–2012)

1996							
	Natural sciences	Engineering and technology	Health sciences	Business, economic and management sciences	Education	Humanities and social sciences	Total
Universities	89%	98%	90%	55%	42%	67%	74%
Comprehensive universities	9%	2%	8%	45%	58%	33%	25%
Universities of technology	2%	0%	1%	0%	0%	0%	1%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
2012							
	Natural sciences	Engineering and technology	Health sciences	Business, economic and management sciences	Education	Humanities and social sciences	Total
Universities	85%	71%	84%	49%	63%	74%	75%
Comprehensive universities	12%	13%	10%	38%	35%	25%	20%
Universities of technology	3%	16%	5%	13%	3%	1%	4%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

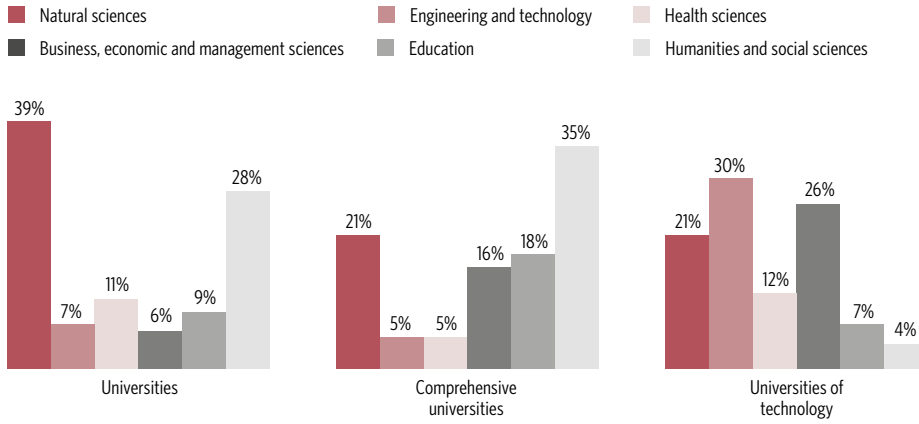
Note: Percentages may not add up to 100% due to rounding.
Sources: DoE (1999), DHET (2013a)

- There were considerable shifts in the shares of engineering and technology and health sciences (sub-sets of SET) graduates from 1996 to 2012. The share of universities in engineering and technology graduates decreased from 98% to 71%, while comprehensive universities showed an increase from 2% to 13%, and universities of technology expanded their graduates from 0% to 16%. Similar changes took place with health sciences graduates: at traditional universities this declined from 90% to 84%; comprehensive universities increased their share from 8% to 10%; and universities of technology improved their quota from 1% to 5% between 1996 and 2012.
- Universities and comprehensive universities showed substantial losses in their doctoral graduate shares in business, economic and management sciences (55% to 49% for universities, and 45% to 38% for comprehensive universities).
- Universities boosted their share in education doctoral graduates (from 42% to 63%) and in humanities and social sciences (from 67% to 74%) during the 1996 to 2012 period. Comprehensive universities experienced a major decrease in education (from 58% to 35%) and in humanities and social sciences (from 33% to 25%) doctoral graduates over the 1996 to 2012 period.
- Universities of technology produced 4% of all doctoral graduates in 2012. They improved their portion of doctoral graduates in the natural sciences slightly from 2% to 3%. Their number of doctoral graduates increased in all fields of study, with the highest growth in engineering and technology (from 0% to 16%) and in business, economic and management sciences (from 0% to 13%) between 1996 and 2012.

Salient trends in doctoral graduations since 1996

- The number of doctoral graduates more than doubled from 685 in 1996 to 1 878 in 2012 (and 2 051 in 2013). The annual growth rate (6.5%) compares favourably with the 6.4% average annual growth rate of in the number of enrolments. This – as we will argue in Chapter 3 – can be interpreted as a proxy measure of efficiency in the system. The simple fact that the consistent growth in doctoral enrolments has not come at the cost of a commensurable decline in growth of doctoral graduations suggests that the universities have mobilised additional resources and capacity to deal with the increasing burden of supervision (without a concomitant increase in their own supervisory capacity).
- The production of doctoral graduates is heavily skewed in the sector, with 12 universities producing nine out of every 10 graduates in 2012. This, we believe, is not unexpected, as doctoral students worldwide are attracted to the best universities (or at least the universities they believe

Figure 2.9: Percentage distribution of doctoral graduates per institution type and field of study with SET subdivided further (2012)



Source: DHET (2013a)

to be the best) and to doctoral supervisors with the best reputations. In a recent survey of doctoral (and other postgraduate) students in South Africa we were able to 'test' this claim.

International comparison: How does South Africa fare?

The NPC in 2011 had similar concerns to those of Johan Garbers in the late 1950s. Its *Diagnostic Report* (NPC 2011) raised concerns about how South Africa fares internationally in terms of doctorate production, and whether sufficient numbers of doctoral graduates are being produced to fuel the knowledge economy. The report compares South Africa (with a population of 51 million) to Norway (with a population of 5 million people). At the time, South Africa had 19 000 full-time researchers and 28 PhDs per million, as opposed to Norway's 25 000 full-time researchers and 151 PhDs per million (NPC 2011: 273). (The report does not provide a reason for the comparison with Norway.)

While it is evident that international comparisons and rankings are to be read with caution, the pressure to be globally competitive and, by implication, comparable is a worldwide phenomenon. The most systematic comparative data available to assess the performance of South Africa's graduation of PhDs against other countries is that of the Organisation for Economic Co-operation and Development (OECD) countries. Table 2.5 shows how South Africa's PhD graduation compares with a number of selected OECD countries for the years 2000 and 2011.[7]

Table 2.5: Comparison of PhD production in South Africa with a number of selected OECD countries (2000 and 2011)

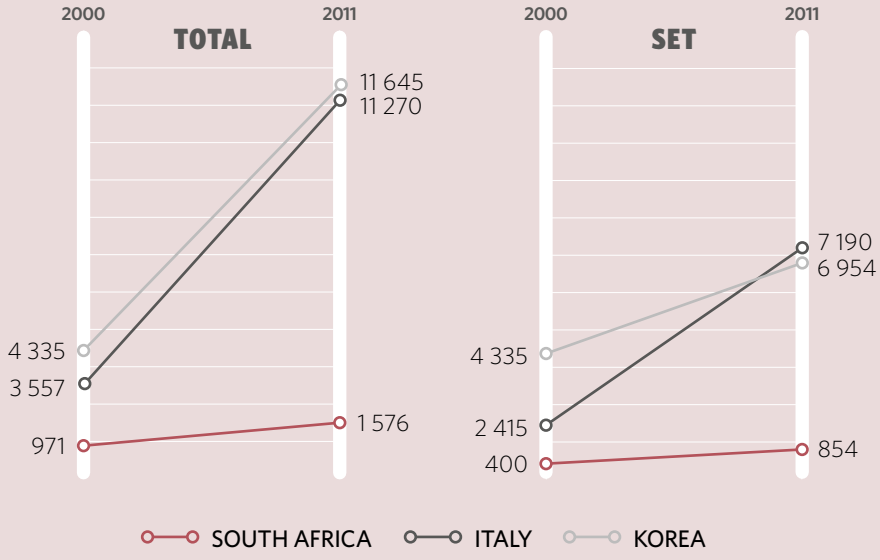
Country	PhD graduates in SET		Average annual growth rate in SET PhDs 2000–2011	2011 SET PhD graduates as % of all 2011 PhD graduates	Total PhD graduates		Average annual growth rate in total PhDs 2000–2011	Population	2011 SET PhD graduates per 100 000 of 2011 population	2011 total PhD graduates per 100 000 of 2011 population
	2000	2011			2000	2011		2011		
Australia	2 326	3 553	3.9%	58.4%	3 687	6 079	4.7%	22 324 000	15.9	27.2
Canada	2 156	3 563	4.7%	62.8%	3 978	5 673	3.3%	34 483 980	10.3	16.5
Germany	19 355	19 835	0.2%	72.5%	25 780	27 354	0.5%	81 797 670	24.2	33.4
Italy	2 415	7 190	10.4%	63.8%	3 557	11 270	11.1%	60 723 570	11.8	18.6
Korea	4 355	6 954	4.3%	59.7%	6 143	11 645	6.0%	49 779 440	14.0	23.4
Norway	274	829	10.6%	63.9%	658	1 297	6.4%	4 953 000	16.7	26.2
Portugal	747	1 205	4.4%	52.1%	1 586	2 314	3.5%	10 557 560	11.4	21.9
Switzerland	2 042	2 385	1.4%	68.5%	2 733	3 484	2.2%	7 912 398	30.1	44.0
United Kingdom	8 088	12 027	3.7%	59.9%	11 568	20 076	5.1%	61 761 000	19.5	32.5
United States	19 932	40 450	6.6%	55.4%	44 808	73 041	4.5%	311 591 900	13.0	23.4
South Africa	**400**	**854**	**7.1%**	**54.2%**	**971**	**1576**	**4.5%**	**51 770 560**	**1.6**	**3.0**

Source: OECD (2013) (data extracted on 4 July 2013)

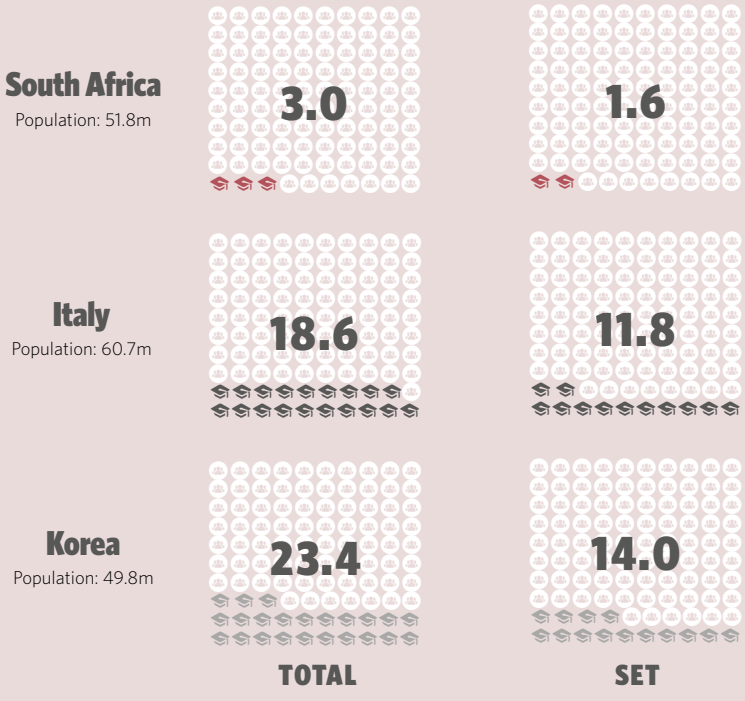
Note: SET (science, engineering and technology) has been defined for purposes of this analysis as all graduates in the fields of (a) agriculture, which includes agriculture, forestry and fishery, and veterinary, (b) engineering, manufacturing and construction, which includes engineering and engineering trades, manufacturing and processing, and architecture and building, and (c) science, which includes life sciences, physical sciences, mathematics and statistics, and computing.

DOCTORAL GRADUATES

INCREASE 2000–2011



PER 100 000 OF 2011 POPULATION



Source: Table 2.5: Comparison of PhD production in South Africa with a number of selected OECD countries (2000 and 2011)

If the factors of population size and GDP ranking are combined, Korea (50 million, 15 GDP), Italy (60 million, 9 GDP) and Turkey (74 million, 17 GDP) are closest to South Africa (51 million, 28 GDP) (World Bank 2012). In terms of total number of PhD graduates, Turkey (4 653) outperformed South Africa (1 576) by three times, and Korea (11 645) and Italy (11 270) each produced seven times more graduates than South Africa. The same applies to the proportion of doctorates in science, engineering and technology. When it comes to SET PhD graduates per 100 000 of the population, South Africa produced 3.0 per annum, Turkey 6.3, Italy 18.6 and Korea 23.4.

To compound this picture, when South Africa is compared to much smaller countries, with much lower GDP rankings, it also performs poorly. For example, the Slovak Republic, with a GDP ranking of 62 and a population of 5 million, produced around 100 more PhDs (1 672) per annum than South Africa, while the Czech Republic, with 10 million people and a GDP ranked 50, produced 1 000 more doctorates than South Africa in 2011.

The comparison becomes far worse when South Africa is compared to the top-ranked GDP country, the United States, where the population is six times greater (310 million) than South Africa: the US turned out 73 000 doctorates – 46 times more than South Africa – in 2011.

When compared to OECD countries, South Africa not only fares poorly against countries with a similar population size and GDP ranking, but even does so when compared to much smaller countries with lower GDP rankings, and fares considerably worse when compared to top-ranked GDP countries.

In conclusion

The public higher-education system in South Africa has evidently responded to the imperative for growth. Both doctoral enrolments and graduations increased significantly between 1996 and 2012/13 and at higher rates than any other degree level. The resultant growth in doctoral enrolments and graduations is clearly the result of a variety of demand-side factors (new demands from the labour market; the demand created by the increase in students from other African countries who choose South Africa as a destination for postgraduate students), as well as supply-side factors (new masters and PhD programme offerings, increased supervisory capacity at most universities, increased funding for doctoral studies, as well as the effect of the new incentive and reward strategies of universities).

Universities as a group have also been more successful in achieving the aim of increasing the number of doctoral graduates in specific fields. The proportions of doctoral graduates in science, engineering and technology, and in the business, economic and management sciences have improved

considerably over the 1996 to 2012 period, and clearly the system is making progress in delivering more graduates in these fields.

The explicit targets of the NDP and the DST's Ten-year Innovation Plan 2008–2018 for doctoral enrolments and graduates in science, engineering and technology, reinforced by financial incentives since the introduction of the current funding framework (for example, these doctoral enrolments are funded at 3.5 times the level of enrolments in education) could have played a role in stimulating the elevated growth in these fields.

There has been considerable progress towards achieving government expectations of increased enrolments in science, engineering and technology and business, economics and management, to the extent that science, engineering and technology candidates now constitute 51% of all doctoral enrolments. Enrolments and graduates in these fields expanded at higher average annual growth rates than in the fields of education and in humanities and social sciences.

The Global DBA Survey 2014 (Graf 2014: 1) found that the need for professional doctorates in management has increased worldwide and that the strongest demand comes from Asia, the Middle East and Africa, followed by Europe and Latin America. This trend contributed to the increased enrolments and graduates in business, economics and management. Kyvik and Olsen (2013: 5) referenced various studies that found that the completion rates across countries are lower in the humanities and social sciences than in the natural sciences and technology. This can mostly be attributed to the longer period often needed to undertake research for a thesis in the humanities and social sciences, because students mostly choose their own topic, unlike in the natural sciences and technology fields, where doctoral students are frequently part of a research team, with a closer supervisory relationship, and co-publishing with supervisors is more common.

When comparing South Africa's yield of PhDs to other countries worldwide, the data corroborates the finding of the ASSAf (2010) PhD study that the country's production of PhD graduates is too low, and that South Africa is near the bottom of the list of PhD-producing countries worldwide. For South Africa to be a serious competitor in the global knowledge economy and to achieve standards that are internationally comparable, the quantity of PhDs needs to be expanded dramatically. This is clearly recognised by government (in both the NDP and in a speech by DST Minister Naledi Pandor in 2014). The question is whether the target of 5 000 PhDs by 2030 is achievable. A projection of growth will be discussed in the concluding chapter.

Despite the generally positive picture that we have presented in this chapter on trends in growth, the question remains whether even higher growth rates could have been achieved. Our focus thus far has been on national policy imperatives (and targets) and the response to these (and other

demand factors) by the universities. But as our discussion in Chapter 1 argued, we should not lose sight of two other major actors: the doctoral student and the doctoral supervisor.

As far as the doctoral student is concerned we will present evidence in the following chapter that points to some of the socio-economic realities that currently constrain further growth in the postgraduate pipeline. We will show how the lack of financing for full-time doctoral studies has arguably become the single biggest constraint to increasing the progression, retention and completion rates of all students, but black students in particular. We will argue there (within the context of a discussion about efficiency gains) that any expectation of substantial growth must be tempered by these constraints.

Where the doctoral supervisor is concerned, we will devote a separate discussion to the realities faced by many supervisors in the country in Chapter 5 on quality. We will show – based on a survey of experienced supervisors – that there is an increasing burden (even stress) on doctoral supervisors that acts both as a barrier to further growth (the top supervisors are already supervising too many students) as well as a serious challenge to maintain current standards of quality (increasing numbers of supervisors are taking on students outside their main area of expertise and are expected to do more remedial and support work in ensuring that a quality doctoral thesis is produced).

In summary, it is our considered view that universities have responded admirably to the demands and imperatives to grow doctoral production. This growth has exceeded the growth for any other postgraduate degree and has also slowly shifted to those fields that are aligned with national science policy goals. We will also see in Chapter 4 that this growth has occurred alongside a significant transformation in student demographics.

Notes

1 Two comments about missing data are in order. Firstly, in theory it is possible to fill the gaps for the missing years through individual data-collection at South African universities that would (presumably) have kept records of all their doctoral students. We did not have the resources to undertake such a check. Secondly, the information presented here does not include any statistics on the number of South African students who went overseas for their doctoral studies. The graph is intended to show only doctoral graduates at South African universities, but it would be useful to have a comprehensive picture of all South African doctoral graduates for these periods. (Such a study is not available as far as we know, but see our discussion in Chapter 4 on black students who went to the USA during the apartheid years.)

2 Of course, the low growth rates between 1986 and 1995 can also be explained with reference to the political situation at the time. Two related trends – the 'white flight' of the early 1990s and the fact that many people went into exile to study abroad – would explain these low growth rates.

3 For further reading see Van Vught (2008) at www.chet.org.za/files/resources/UWN_Special_Edn_1_Jan_08.pdf and http://chet.org.za/research-areas/differentiation.

4 See www.chet.org.za/resources/higher-education-summit-march-2010-institutional-differentiation.

5 After saying that there is broad agreement that South Africa needs a diverse university sector that is purposefully differentiated in order to meet a range of social, economic and educational requirements, the *White Paper* stated emphatically: 'We consider differentiation in a positive light' (DHET 2013c: 29).

6 A the time of finalising this manuscript the 2013 statistics became available. The number of masters enrolments in 2013 reached 62 110 and the number of doctoral enrolments 16 039. The growth at both levels continues.

7 There are at least two limiting factors that underpin comparisons such as these. Any comparison of doctoral production across countries has to recognise the big differences in the structure of doctoral education in these countries. The South African system still reflects its Anglo-Saxon heritage with the inclusion of the honours degree and masters as intermediary degrees. In many countries, doctoral students can enrol for doctoral studies with an extended bachelors degree. Comparisons such as these also have to take into account the fact the differences between proportions of full-time (residential) and part-time (including distance) students. In the South African system we estimate that between 60% and 65% of all doctoral students study while they work. They are in fact part-time students. In many countries in Europe and North America, full-time, residential students make up the bulk of doctoral students. Taken together, these two facts mean that comparisons across countries have to focus on large patterns and trends rather than finer differences.