



**CHET**

CENTRE FOR HIGHER EDUCATION TRANSFORMATION

# High Level Knowledge Production: CHET Data Profiles of Four Universities

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# Introduction



CHET has followed the OECD in identifying these as higher education's key high level knowledge inputs and outputs:

**Inputs:** academic staff and doctoral enrolments

**Outputs:** research publications and doctoral graduates

This presentation will offer data analyses of these inputs and outputs of the 4 universities involved in the Carnegie project. The sources of the academic staff and student enrolment and graduate data are:

1. Universities of Ghana and Makerere: data collected by CHET as part of the Herana 2 project.
2. Universities of Cape Town and Witwatersrand: (a) SA higher education management information system (HEMIS) data and (b) Herana 2 data.

The data cover the academic years 2008/09 to 2010/11 for Ghana and Makerere and 2008–2010 for Cape Town and Witwatersrand. In the tables which follow these academic years are reported as 2008, 2009 and 2010.

## Introduction (cont.)



The sections which follow are these:

1. **Total head count student enrolments**: a background overview of total undergraduate plus postgraduate enrolments
2. **Academic staff**: total permanent academics by rank and highest qualification
3. **Programme and qualification mixes**: a brief account of the subject classification system employed by CHET in Herana 2
4. **Doctoral enrolments and graduates**: using the Herana 2 subject classifications, and linking graduates to academic staff
5. **Research publications**: using web of science data prepared by CREST, and linking publication outputs to academic staff
6. **Doctoral graduate efficiency**: using quantitative indicators to measure the output efficiency of the 4 universities

# Head count student enrolments



Tables 1 and 2 provide background information on the student enrolments of the 4 universities.

Table 1 shows that Ghana and Makerere are primarily undergraduate universities. More than 90% of their students are in undergraduate programmes, and only about 1% are in doctoral programmes. Ghana does however have increasing proportions of students in masters programmes: up from 7% in 2008 to 11% in 2010.

Cape Town and Wits have large undergraduate enrolments, but 30% of their enrolments are in postgraduate programmes. In 2010 15% of Cape Town's students were in masters and 5% in doctoral programmes. The proportions for Wits for 2010 were 18% masters and 4% doctoral programmes.

Table 2 shows that the programme emphasis in Ghana has been in humanities and social sciences. On average 65% of students have been following programmes in these fields.

# Head count student enrolments (cont.)



**Table 1:** Head count enrolments by qualification type

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Undergraduate degrees & diplomas	70%	69%	69%	93%	92%	88%	94%	94%	93%	67%	70%	69%
Postgraduate below masters	10%	11%	11%	0%	0%	0%	0%	0%	0%	9%	9%	9%
Masters	15%	15%	15%	7%	7%	11%	4%	4%	5%	20%	18%	18%
Doctors	5%	5%	5%	0%	1%	1%	1%	1%	2%	4%	3%	4%
<b>TOTAL ('000)</b>	<b>21.2</b>	<b>22.6</b>	<b>23.4</b>	<b>33.6</b>	<b>35.5</b>	<b>38.4</b>	<b>34.1</b>	<b>33.6</b>	<b>34.0</b>	<b>26.1</b>	<b>29.2</b>	<b>29.4</b>

**Table 2:** Head count enrolments by field of study

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Science and technology	44%	43%	43%	24%	26%	21%	35%	37%	37%	46%	45%	45%
Business & economics	26%	26%	25%	10%	9%	13%	21%	22%	23%	17%	16%	19%
Education	3%	4%	5%	1%	1%	1%	17%	14%	11%	9%	12%	14%
Humanities & social sciences	27%	26%	28%	65%	64%	66%	27%	28%	29%	27%	28%	23%
<b>TOTAL THOUSANDS</b>	<b>21.2</b>	<b>22.6</b>	<b>23.4</b>	<b>33.6</b>	<b>35.5</b>	<b>38.4</b>	<b>34.1</b>	<b>33.6</b>	<b>34.0</b>	<b>26.1</b>	<b>29.2</b>	<b>29.4</b>

# Academic staff



The academic staff of a university were listed as one of the two main inputs for its high level knowledge production.

Tables 3–5 give details of the ranks and highest formal qualifications of the permanent academics at the 4 universities. Permanent academics are defined as academics who contribute to an institutional retirement fund or who hold a full-time contract of at least 3 years.

Points to note about Tables 3–5 are these:

1. The possession of a doctoral degree is an important prerequisite for research delivery. In 2010 only Cape Town had, at 62%, a proportion of permanent academics with doctorates above 60%. The 2010 proportions of the others were: Wits 53%, Ghana 50%, Makerere 31%.
2. In 2010 large proportions of the permanent academic staff held masters degrees as their highest qualification: Ghana 53%, Makerere 44%, Wits 33%, Cape Town 29%.

## Academic staff (cont.)



4. Ghana had in 2010 only 62 full professors (6% of total), and had 486 associate professors (46% of academic staff total). So in 2010 52% of Ghana's permanent academics were in the two senior ranks which should be delivering leadership in teaching and research.
5. The comparable proportions of full plus associate professors in 2010 were: Cape Town 39%, Wits 33% and Makerere 15%.
6. Makerere had in 2010 the highest total of permanent academics: 1209. But 867 (or 72%) were in entry level posts of lecturer or below.
7. Makerere had in 2010 only 68 full professors (6%), compared to Cape Town's 190 (21% of total) and Wits' 149 (15%).

# Academic staff (cont.)

**Table 3: Permanent academic staff by rank**

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Professors	212	199	190	59	63	62	69	69	68	137	146	149
Associate professors	174	176	171	445	456	486	104	103	103	162	165	175
Senior lecturers	245	255	261	244	246	259	172	185	171	249	271	269
Lecturers & below	248	269	301	142	178	251	805	822	867	431	397	404
<b>TOTAL PERMANENT ACADEMICS</b>	<b>880</b>	<b>900</b>	<b>923</b>	<b>890</b>	<b>943</b>	<b>1058</b>	<b>1150</b>	<b>1179</b>	<b>1209</b>	<b>979</b>	<b>979</b>	<b>997</b>

**Table 4: Proportions of permanent academic staff in each rank category**

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Professors	24%	22%	21%	7%	7%	6%	6%	6%	6%	14%	15%	15%
Associate professors	20%	20%	18%	50%	48%	46%	9%	9%	9%	17%	17%	18%
Senior lecturers	28%	28%	28%	27%	26%	24%	15%	16%	14%	25%	28%	27%
Lecturers & below	27%	30%	33%	16%	18%	24%	70%	70%	72%	44%	41%	41%
<b>TOTAL PERMANENT ACADEMICS</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

**Table 5: Highest formal qualifications of permanent academic staff**

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Doctoral degree	59%	58%	62%	51%	50%	50%	30%	31%	31%	49%	53%	53%
Masters degree	30%	31%	29%	43%	44%	44%	50%	51%	53%	33%	33%	33%
Below masters degree	11%	11%	9%	6%	6%	6%	20%	18%	16%	18%	15%	14%
<b>TOTALS</b>	<b>880</b>	<b>900</b>	<b>923</b>	<b>890</b>	<b>943</b>	<b>1058</b>	<b>1150</b>	<b>1179</b>	<b>1209</b>	<b>979</b>	<b>979</b>	<b>997</b>



# Programme and qualifications mixes (PQM)



An important first step in CHET's Herana 2 data project was that of drawing up a PQM for each participating university.

These PQMs contain three important elements:

1. a listing of the qualifications (certificates, diplomas, degrees) offered
2. the major field of study linked to each qualification
3. the placing of these fields of study into a subject matter classification system

The subject matter classification system adopted by CHET is an adapted version of the subject matter classifications used in the South African higher education management information system (HEMIS).

CHET's adaptation uses the 20 first order categories of HEMIS, but (a) does not use this system's third order categories, and (b) employs a limited set of its second order categories.

## Programme and qualifications mixes (PQM) (cont.)



CHET has clustered the first and second order categories which it employs into four broad subject matter groupings. These are:

1. science & technology
2. business, economics and management sciences
3. education
4. humanities and social sciences.

Tables 6 and 7 use the four broad groupings and the 20 first order categories to show what the doctoral enrolments and graduates of the four universities were during 2008–2010.

# Doctoral enrolments



Table 6 uses the 20 fields of study to show what the patterns of doctoral enrolments were during 2008 to 2010. The highlighted rows point to fields in which the different universities have their highest levels of activity. As can be seen, these high activity levels differ across the 4 universities.

The final row in the table is an important indicator because it shows what share the doctoral enrolments listed have of the total enrolment of each university.

Linking the doctoral enrolment totals in Table 6 to the academic staff total in Table 3 produces indicators, which suggest that Ghana and Makerere may have ‘spare capacity’ as far as doctoral supervisors are concerned. Calculations show this:

1. Over the period 2008–2010, Cape Town and Wits had, on average, 2.0 and 2.1 doctoral enrolments per permanent academic with a doctorate. These are reasonable supervisory levels.
2. Makerere’s average doctoral enrolment per permanent academic with a doctorate was 1.3, and Ghana’s only 0.5, implying that they could have recruited and supervised more doctoral students.

## Table 6: Doctoral enrolments by field of study

	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
<b>SCIENCE &amp; TECHNOLOGY</b>												
Agriculture, Agricultural Operations	0	0	0	37	60	71	57	58	69	0	0	0
Architecture and the Built Environment	12	11	7	0	0	0	0	0	0	18	15	23
Computer and Information Sciences	37	39	40	0	0	0	65	65	72	0	2	3
Engineering	144	135	156	0	2	5	29	38	46	149	148	142
Health Professions and Clinical Sciences	193	215	113	10	28	39	54	66	96	221	256	183
Family Ecology and Consumer Sciences	0	0	0	2	3	3	0	0	0	0	0	0
Life Sciences	143	141	240	10	19	24	9	6	9	48	46	136
Physical Sciences	135	132	132	12	42	55	33	47	53	167	175	133
Mathematics and Statistics	30	29	36	3	2	3	9	13	16	34	33	39
Military Sciences	0	0	0	0	0	0	0	0	0	0	0	0
<b>BUSINESS &amp; MANAGEMENT</b>												
Business, Economics and Management	76	86	96	2	5	6	0	0	0	36	44	147
<b>EDUCATION</b>												
Education	27	24	25	2	3	5	51	55	55	63	68	91
<b>HUMANITIES &amp; SOCIAL SCIENCES</b>												
Visual and Performing Arts	12	16	24	2	2	2	4	6	8	12	14	17
Communication, Journalism	0	0	8	0	0	0	0	0	0	0	0	0
Languages, Linguistics and Literature	45	44	32	7	11	14	0	0	0	61	60	54
Law	35	43	47	1	1	1	3	3	3	15	20	15
Philosophy, Religion and Theology	27	29	24	9	9	11	0	0	0	2	3	4
Psychology	29	30	40	4	7	11	7	9	14	20	30	35
Public Management and Services	0	0	2	1	6	7	0	0	0	38	33	0
Social Sciences	85	84	91	30	41	59	44	47	56	105	99	111
Other humanities	0	0	0	0	0	0	55	58	66	0	0	0
<b>TOTALS</b>	<b>1030</b>	<b>1058</b>	<b>1110</b>	<b>132</b>	<b>241</b>	<b>316</b>	<b>420</b>	<b>471</b>	<b>563</b>	<b>988</b>	<b>1045</b>	<b>1133</b>
<b>DOCTORAL AS % OF TOTAL ENROLMENTS</b>	<b>4.6%</b>	<b>4.4%</b>	<b>4.5%</b>	<b>0.4%</b>	<b>0.7%</b>	<b>0.8%</b>	<b>1.2%</b>	<b>1.4%</b>	<b>1.7%</b>	<b>3.8%</b>	<b>3.6%</b>	<b>3.8%</b>

# Doctoral graduates



Table 7 shows, using the same format as Table 6, how many doctoral graduates were produced during 2008–2010. It should be noted that Makerere has not yet given CHET details of doctoral graduates for 2010; which is its 2010/11 academic year.

The striking aspect of the table is how low the doctoral graduate totals are relative to the enrolment totals reported in Table 7. This will be taken further in the later analyses of doctoral output efficiency.

Preliminary points to note are these:

1. Over the three years 2008–2010, Cape Town produced a total of 489 doctoral graduates. Wits' total was 336, Ghana's 69. Over the two years 2008 and 2009, Makerere produced 92 doctoral graduates.
2. Science and technology fields produced the most doctoral graduates: Makerere 75% of total, Cape Town 70%, Wits 64% and Ghana 58%

**Table 7: Doctoral graduates by field of study**



	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
<b>SCIENCE &amp; TECHNOLOGY</b>												
Agriculture, Agricultural Operations	0	0	0	3	3	7	9	7		0	0	0
Architecture and the Built Environment	1	3	0	0	0	0	0	0		0	2	1
Computer and Information Sciences	6	6	6	0	0	0	2	3		0	0	0
Engineering	19	18	22	0	0	0	3	5		16	19	19
Health Professions and Clinical Sciences	31	36	17	1	1	3	12	9		17	26	19
Family Ecology and Consumer Sciences	0	0	0	0	0	0	0	0		0	0	0
Life Sciences	19	31	41	1	1	4	6	5		7	8	14
Physical Sciences	23	23	24	2	3	9	1	7		23	20	13
Mathematics and Statistics	3	9	5	0	0	2	0	1		6	3	4
Military Sciences	0	0	0	0	0	0	0	0		0	0	0
<b>BUSINESS &amp; MANAGEMENT</b>												
Business, Economics and Management	11	13	17	1	2	0	0	0		3	0	7
<b>EDUCATION</b>												
Education	3	4	5	2	1	2	1	7		6	9	4
<b>HUMANITIES &amp; SOCIAL SCIENCES</b>												
Visual and Performing Arts	3	3	2	0	1	0	0	0		1	4	1
Communication, Journalism	0	0	1	0	0	0	0	0		0	0	0
Languages, Linguistics and Literature	9	8	3	2	0	3	0	0		8	11	8
Law	4	3	5	0	0	0	0	0		1	6	0
Philosophy, Religion and Theology	1	8	3	1	1	1	0	0		0	0	0
Psychology	4	2	3	0	0	0	0	2		4	0	1
Public Management and Services	0	0	0	0	0	0	0	0		3	2	0
Social Sciences	14	11	6	3	4	5	2	3		12	15	15
Other humanities	0	0	0	0	0	0	2	6		0	0	0
<b>TOTALS</b>	<b>151</b>	<b>178</b>	<b>160</b>	<b>16</b>	<b>17</b>	<b>36</b>	<b>38</b>	<b>55</b>		<b>106</b>	<b>124</b>	<b>106</b>

# Research publications



The source of the research publication data in Figure 1 is a report prepared for CHET for the Herana 2 project by CREST at Stellenbosch University. Publication data are for 2008–2010, from the Web of Science (WoS). This data base contains all research publications which appear in the citation indexes for arts and humanities, social science, and science–expanded.

The report includes as full units in a university's count all papers which gave it as the address of at least one of the authors. This implies that a multi–author publication was not sub–divided between the universities involved in its production.

Because research publications in the SA system (a) include research books, research journal articles and research conference proceedings, and (b) allocate fractions of units to universities involved in the publications, the totals reported for Cape Town and Wits will not match the research output totals which they report annually to the SA government. For example Cape Town's 2010 SA publication unit total, based on fractional counts, was 1253 compared to the Herana full unit count of 1517. Wits' comparable totals were: fractional count 936, Herana 1111.

## Research publications (cont.)



Figure 1 summarise CREST's totals of research journal publications for the years 2008–2010. Because the data do not divide publications between authors, they can be read as showing that over the 3-year period Cape Town's permanent academic staff were shown as full or joint authors in a total of 4207 web of science publications. The comparable 3-year totals were 3083 for Wits, 955 for Makerere and 424 for Ghana.

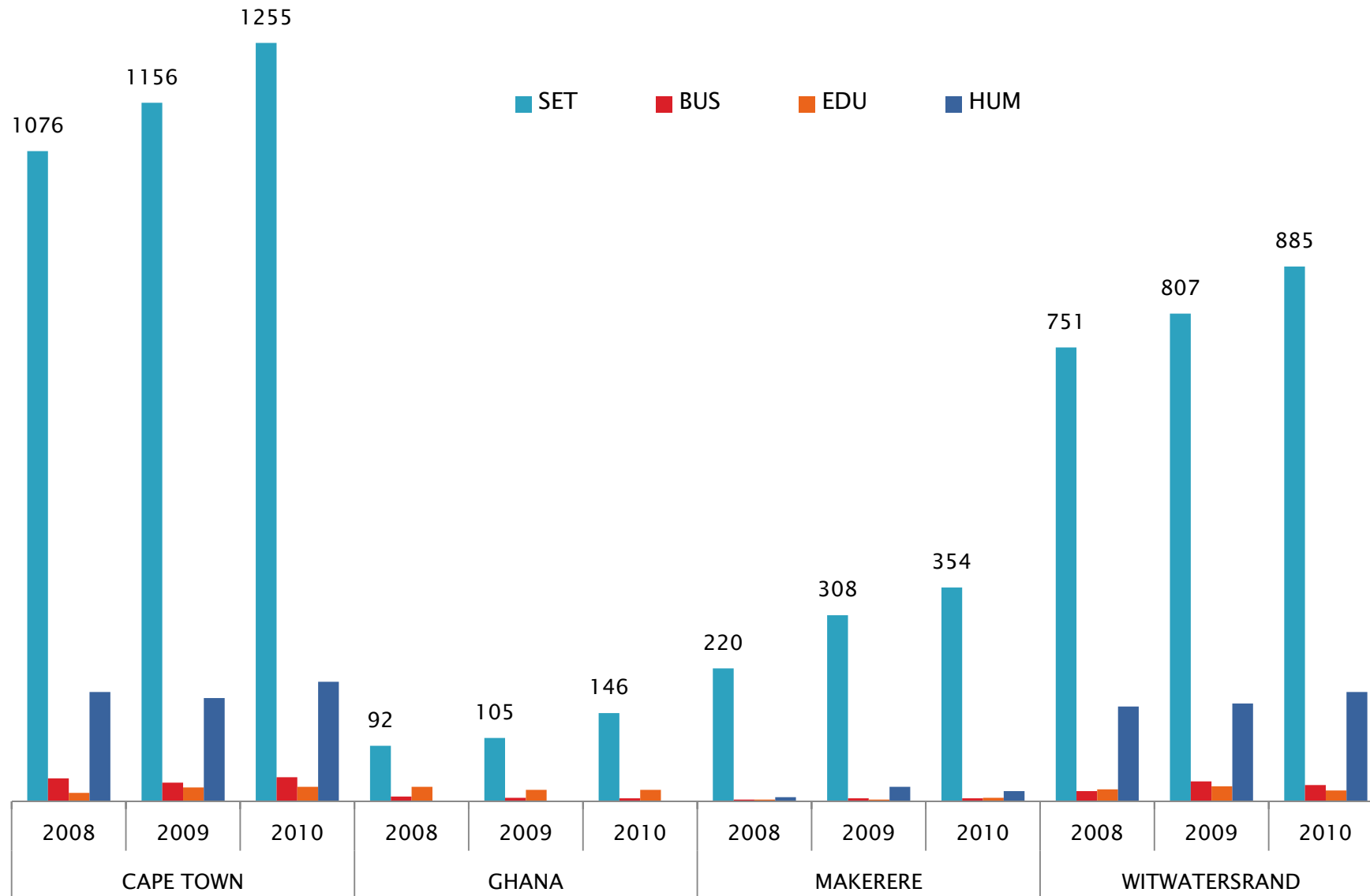
Figure 1 shows that most of these research publications have been in science and technology. Makerere's 3-year average was 93% of research publications in science and technology, Cape Town's 83%, Ghana 80% and Wits 79%.

Table 8 links the publication data in Figure 1 to the academic staff data in Table 5. The ratios in the first row are for total research publications per permanent academic. The target suggested for Herana 2 universities is a ratio of 1.0, which only Cape Town and Wits satisfy.

The second row in Table 8 shows how the ratios change if total research publications are divided by the totals of permanent academic with a doctorate as highest qualification.



**Figure 1: Research publications**



**Table 8:** Ratios of research publications to permanent academic staff by fields of study



	CAPE TOWN			GHANA			MAKERERE			WITWATERSRAND		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Research publications per total permanent academic	1.5	1.5	1.6	0.1	0.1	0.2	0.2	0.3	0.3	1.0	1.0	1.1
Research publications per permanent academics with doctorates	2.5	2.6	2.6	0.3	0.3	0.3	0.7	0.9	1.0	2.0	2.0	2.1

# Doctoral graduate efficiency



Graph 11 offers a picture of the doctoral output efficiency of the 4 universities. It is based on the output ratios of SA's 2001 National Plan for Higher Education. The National Plan set what in SA is described as a 'graduation rate' as an output norm:

The ratio between doctoral graduates in any given year and doctoral enrolments in that same year should = 20%. So if 10 000 doctoral students were enrolled in the HE system in year X, then there should have been at least 2000 doctoral graduates in year X.

The National Plan based the 20% graduation rate on the expectation that at least 75% of any cohort of students entering doctoral studies for the first time should eventually graduate.

CHET has used these National Plan ratios to link graduation rates to cohort output equivalents. Examples of these links are set out on the next slide. CHET's practice has been to calculate average graduation rates over a 3-year period rather than for a single year.

**Table 9: Graduate output efficiencies 2008–2010**

	CAPE TOWN		GHANA		MAKERERE		WITWATERSRAND	
	Graduation rate	Cohort output equivalent	Graduation rate	Cohort output equivalent	Graduation rate	Cohort output equivalent	Graduation rate	Cohort output equivalent
<b>SCIENCE &amp; TECHNOLOGY</b>								
Agriculture, Agricultural Operations			8%	30%	14%	53%		
Architecture and the Built Environment	13%	49%					5%	19%
Computer and Information Sciences	16%	60%			4%	15%	0%	0%
Engineering	14%	53%	0%	0%	12%	45%	12%	45%
Health Professions and Clinical Sciences	16%	60%	6%	23%	18%	68%	9%	34%
Family Ecology and Consumer Sciences			0%	0%				
Life Sciences	17%	64%	11%	41%	75%	100%	12%	45%
Physical Sciences	18%	68%	13%	49%	10%	38%	12%	45%
Mathematics and Statistics	18%	68%	25%	90%	5%	19%	12%	45%
Military Sciences								
<b>BUSINESS &amp; MANAGEMENT</b>								
Business, Economics and Management	16%	60%	23%	90%			4%	15%
<b>EDUCATION</b>								
Education	16%	60%	50%	100%	8%	30%	9%	34%
<b>HUMANITIES &amp; SOCIAL SCIENCES</b>								
Visual and Performing Arts	16%	60%	17%	64%	0%	0%	14%	53%
Communication, Journalism	13%	49%						
Languages, Linguistics and Literature	17%	64%	16%	60%			15%	56%
Law	10%	38%	0%	0%	0%	0%	14%	53%
Philosophy, Religion and Theology	15%	56%	10%	38%			0%	0%
Psychology	9%	34%	0%	0%	13%	49%	6%	23%
Public Management and Services	0%		0%	0%			7%	26%
Social Sciences	12%	45%	9%	34%	5%	19%	13%	49%
Other humanities					7%	26%		
<b>AVERAGES FOR ALL DOCTORATES</b>	<b>15%</b>	<b>56%</b>	<b>10%</b>	<b>38%</b>	<b>10%</b>	<b>38%</b>	<b>11%</b>	<b>41%</b>

## Doctoral graduate efficiency (cont.)




Efficiency assessments different to those used in Table 11 can be produced. These would be 'proper' cohort output calculations, which would involve tracking actual new doctoral entrants from the date of their first registration to a date (normally) 6 years after their first registration year. These are obviously calculations which depend crucially on universities and/or the national system having detailed and accurate electronic records of individual students.

CHET has undertaken detailed individual tracking analyses for cohorts of doctoral students entering the SA university system for the first time in 2001, 2002, 2003, 2004 and 2005.

Tables 12 and 13 summarise the results of tracking, across a 6-year period, new doctoral entrants in the 2004 and 2005 cohorts into (a) science and technology programmes, and (b) social science and humanities programmes.


These results are close to, and consistent with, CHET's calculations of graduation rates and the linking of these to cohort output equivalents.

**Table 10:** Efficiency ranking of 2004 & 2005 cohorts of new doctoral entrants in science and technology programmes  
Ranked in descending order by % of cohort graduating

	Cohort of new entrants in 2004 +2005	Total graduated after 6 years	 % of new entrants graduated	University's share of graduates
Rhodes	64	47	73%	5%
Stellenbosch	65	47	72%	5%
Cape Town	272	177	65%	19%
Witwatersrand	198	121	61%	13%
North West	97	58	60%	6%
Tshwane	31	16	52%	2%
Pretoria	287	146	51%	16%
Nelson Mandela Metropolitan	36	18	50%	2%
KwaZulu-Natal	226	106	47%	11%
Johannesburg	93	44	47%	5%
Venda	13	6	46%	1%
Western Cape	74	33	45%	4%
Fort Hare	27	12	44%	1%
Free State	119	51	43%	6%
Cape Peninsula	23	8	35%	1%
Durban	19	5	26%	1%
Limpopo	37	9	24%	1%
Central	19	4	21%	0%
Zululand	16	3	19%	0%
Unisa	60	10	17%	1%
Vaal	22	3	14%	0%
Walter Sisulu	0	0	0%	0%
Mangosuthu	0	0	0%	0%
<b>TOTALS</b>	<b>1669</b>	<b>924</b>	<b>55%</b>	<b>100%</b>

**Table 11:** Efficiency ranking of 2004 & 2005 cohorts of new doctoral entrants in humanities and social science programmes  
Ranked in descending order by % of cohort graduating



	Cohort of new entrants in 2004 +2005	Total graduated after 6 years	 % of new entrants graduated	University's share of graduates
Cape Peninsula	12	9	75%	1%
Tshwane	10	7	70%	1%
Witwatersrand	70	42	60%	7%
Cape Town	117	67	57%	10%
Rhodes	18	9	52%	1%
North West	180	90	50%	14%
Pretoria	218	98	45%	15%
Stellenbosch	40	18	45%	3%
Zululand	81	34	42%	5%
KwaZulu-Natal	229	76	33%	12%
Western Cape	70	23	33%	4%
Johannesburg	85	27	32%	4%
Free State	102	30	29%	5%
Limpopo	38	11	28%	2%
Unisa	344	89	26%	14%
Fort Hare	29	8	26%	1%
Nelson Mandela Metropolitan	19	3	16%	0%
Venda	5	0	0%	0%
Walter Sisulu	1	0	0%	0%
Central	2	0	0%	0%
Durban	1	0	0%	0%
Vaal	2	0	0%	0%
Mangosuthu	0	0	0%	0%
<b>TOTALS</b>	<b>1266</b>	<b>640</b>	<b>51%</b>	<b>100%</b>

