

AN ESTIMATE OF THE NUMBER OF ENGINEERING PRACTITIONERS IN SOUTH AFRICA

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TOC

Background	2
Supply - engineers.....	3
Graduation statistics	3
Registration statistics.....	4
Supply - technicians and technologists.....	5
Graduation statistics	5
Registration statistics.....	5
Demand.....	7
Building a capable state	7
Infrastructure projects - work studies	7
Vacancies per discipline	8
Controlling the flow of spending	8
Possible actions.....	8
References	9

Background

There has been a request from the Dept of Economic Development to provide a best estimate of the number of engineering practitioners in South Africa. The Engineering Council of South Africa (ECSA) is the statutory body mandated to register engineering professionals working in environments where issues of public safety and health need to be protected, and possibly have the most comprehensive database of engineering practitioners in the country. Sadly, the data only covers those who are professionally registered, or are registered as candidates, who are working towards professional registration. ECSA registers under nine disciplines as follows:

1. Aeronautical
2. Agricultural
3. Chemical
4. Civil
5. Electrical
6. Industrial
7. Mechanical
8. Metallurgy
9. Mining

The categories of registration are as follows:

- Professional Engineer (Pr Eng)
- Professional Engineering Technologist (Pr Tech Eng)
- Professional Engineering Technician (Pr Techni)
- Certificated - Engineers (Pr Cert Eng)

Since there is no requirement for engineers working in many sub-sectors of the above disciplines to be professionally registered, it is difficult to determine the number of engineering practitioners active in South Africa as a whole.

This challenge is not unique to South Africa but is lamented in engineering supply and demand studies published in the UK, USA, Canada, Australia and New Zealand. In each, the difficulty in determining the actual number working in engineering, versus those in other sectors of the economy is highlighted, though it is recognised that graduates working beyond engineering, nevertheless continue to use their problem-solving skills to contribute to the economy.

Estimates have been calculated using two approaches:

1. Determining graduation figures and estimating the attrition over the years
2. Using current registration figures and using indicative ratios of registered to non-registered per discipline to determine the numbers in the industry. These are based on the ratios determined whilst carrying out the research for Numbers and Needs (Lawless, 2005) as shown in Table 1 and more recent registration research carried out for ECSA (yet to be published).

Table 1 : Ratio of registered to total numbers of engineers, technologists and technicians (Lawless, 2005)

Category/age	<25	25-34	35-49	50+
Engineer	2%	28%	71%	86%
Technologist	7%	33%	60%	70%
Technician	1%	5%	13%	11%

Supply - engineers

Graduation statistics

The statistics pertaining to the graduation of engineers have been determined from reports prepared by the National Bureau of Educational and Social Research, the Strassacker Commission, the Dept of Labour Supply and Demand studies, the Dept of Education DBase database and more recently the Dept of Higher Education HEMIS system.

Graduations since 1918 are shown in Figure 1 below. Peaks of graduations are to be seen after the First and Second World Wars, and after Apartheid development peaks. The number of engineers graduating topped 2000 for the first time in 2010. There had, however, been a dramatic decline in graduations from the mid nineties for a ten year period. This together with significant emigrations in the early nineties have impacted on the number of mid-career professionals available today. (See Borthwick & Murphy for an indication of the quantum of English speaking engineers entering Australia during that period, who would have been largely from South Africa.)

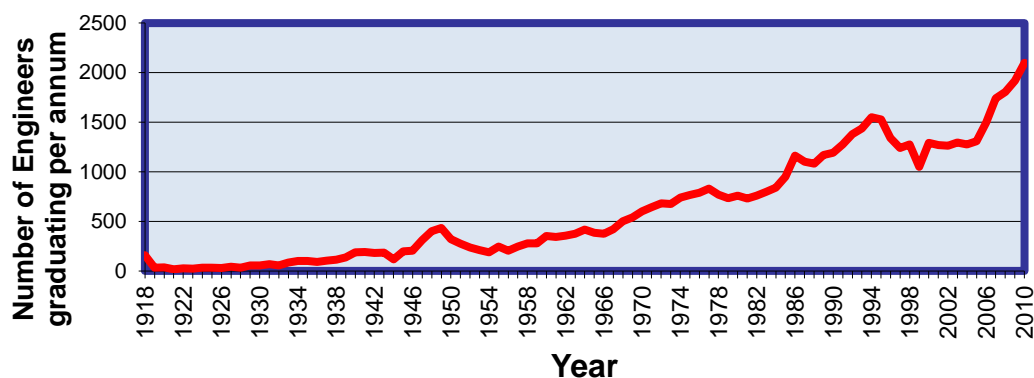


Figure 1: Graduation of engineers from South African Universities since 1918

Figure 2 shows the possible trend line had graduations continued at the pace shown prior to 1994. Extrapolating the data suggests that at least another 400 engineers a year should have been graduating, which today would equate to an additional 7200 graduate engineers.

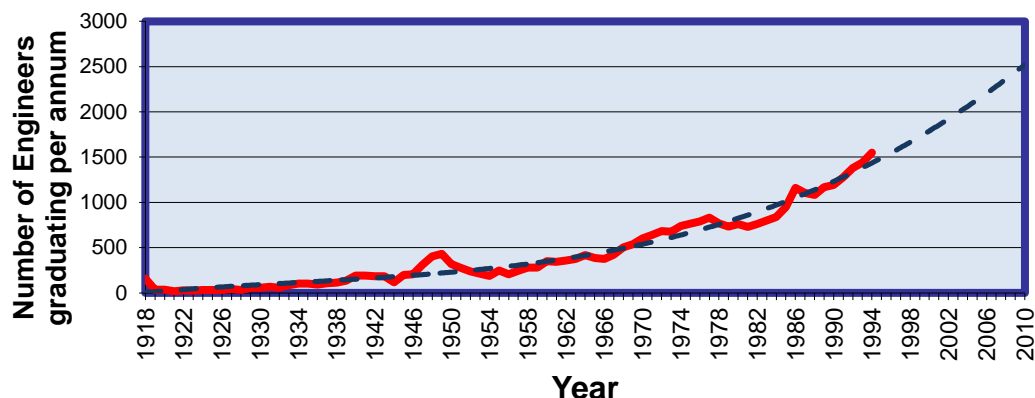


Figure 2 : Possible graduation projections for engineers post 1994

In carrying out the analysis of current numbers still active, it is assumed that few engineers over the age of 75 are active. Assuming a graduation age of 22 years old, graduations from 1959 onwards will be considered. Table 1 below offers an estimate of the attrition percentage per decade since

graduation and suggests that the total number of engineers currently in the system is of the order of 32 800.

Table 2 : Total number of engineers in South Africa in 2011, based on the attrition of graduate numbers plus effect of immigration

Years	Total Graduations	% Attrition	Rationale	Plus Immigration	Rationale	Nett
1959-1968	3808	80%	Past retirement age	76		838
1969-1978	7036	60%	Reaching retirement age and early retirements	563	Moss Gas, Power Station projects, Mining boom etc	3377
1979-1988	8919	50%	Large numbers of emigrations	892		5351
1989-1998	13393	50%	Large numbers of emigrations	670		7366
1999-2008	13796	25%	Research carried out in 2004 and 2005	1552	SWC, other major projects, plus brain gain from Africa	11899
2009-2010	4018	10%	Input from tertiary institutions	362		3978
TOTAL	50970			4114		32809

Registration statistics

The current registration statistics are shown in row 2 in Table 3 below. The total number of engineers under 75 who are still registered with ECSA is 12820. Research has shown that on the whole older engineers registered with the then South African Council for Professional Engineers. In the past 20 years, there has not been pressure on engineers to be registered and it has been found that in the past 10 years, low numbers of engineers have registered in relation to the number who have graduated as shown in row 4 of Table 3. Using the ratios shown for each age group, the total number of engineers in South Africa is estimated at 32300. This compares well with the model determined using graduation figures, and immigration and attrition estimates.

Table 3 : Estimate of the total number of engineers in South Africa in 2011 using ECSA registration data and estimates of ratios of those registered to those not registered

Estimated numbers to age 75	TOTAL	Aeronautical	Agriculture	Chemical	Civil	Electrical	Industrial	Mechanical	Metallurgy	Mining
Registered Professional Engineers	12820	48	170	732	5400	3163	164	2465	282	398
Engineers - older group - generally 2/3rds registered		66%	66%	66%	66%	66%	66%	66%	66%	66%
Younger Engineers registered in past 10 years, determined by recent research		10%	24%	11%	33%	13%	4%	16%	19%	28%
Total engineers in industry	32300	175	369	2494	10227	9677	1208	6653	690	808

It can therefore be assumed that the total number of engineers is of the order of 32000 to 35000. More time is required to carry out more detailed research if a more accurate figure is required.

Supply - technicians and technologists

Graduation statistics

Graduation statistics are only available for the past 25 years. Using the rate of graduation of engineers, the graduation statistics for the prior 25 years are estimated.

Table 4: Total number of technicians and technologists in South Africa in 2011, based on assumptions with respect to the attrition of graduates in industry

Years	Agriculture	Chemical	Civil	Electrical	Industrial	Mechanical	Mining	Total
Graduations 1986-2010	115	5218	11523	24082	3016	11349	1218	56521
Estimate of graduations 1959 to 1985	55	2480	5475	11443	1433	5393	579	26857
Total graduations	169	7698	16999	35525	4449	16742	1797	83378
Technicians in industry from 1986-2010 graduates, assume 70% entered industry and 40% attrition over time	48	2192	4840	10114	1267	4767	512	23739
Technicians in industry from 1959-1985 graduates, assume 60% attrition over time	33	1488	3285	6866	860	3236	347	16114
Total in industry	81	3679	8125	16980	2126	8002	859	39853

A full set of data for aeronautical and metallurgical engineering was not to hand. These two categories possibly represent some 2% to 3% of the total, which means that the total number of technician graduates still active will be of the order of 41 000.

Registration statistics

Registration for technicians and technologists was only implemented from the mid eighties to early nineties. As a result the percentage of technicians registered with respect to the total is significantly lower than for engineers. The civil engineering ratios shown in Table 1 are used to estimate the numbers of technicians and technologists as a whole which is possibly too broad a generalisation, but gives indicative figures of the possible number of technicians and technologists in practice in South Africa.

Table 5 : Estimate of the total number of technicians in South Africa based on registration statistics

Registered	TOTAL	Aeronautical	Agriculture	Chemical	Civil	Electrical	Industrial	Mechanical	Metallurgy	Mining
26-30 years	311	0	0	4	54	225	1	25	1	1
31-35 years	668	0	0	7	138	458	2	57	1	5
36-50 years	1761	0	5	5	301	1081	6	262	12	89
51-65 years	1494	0	6	2	284	727	10	370	7	88
> 65 years	703	1	0	0	117	276	13	279	0	17
Total registered	4937	1	11	18	894	2767	32	993	21	200
Total in industry from 1986-2010, assuming 10% registered	27400	0	50	160	4930	17640	90	3440	140	950
Total in industry from 1959-1985, assuming 11% registered	16777	5	55	18	3114	7864	150	4632	64	877
Estimate of total technicians in industry	44177	5	105	178	8044	25504	240	8072	204	1827

Table 6 : Estimate of the total number of technologists in South Africa based on registration statistics

Registered	TOTAL	Aeronautical	Agriculture	Chemical	Civil	Electrical	Industrial	Mechanical	Metallurgy	Mining
26-30 years	86	0	0	7	28	34	1	10	3	3
31-35 years	461	0	0	25	204	142	0	79	8	3
36-50 years	1656	0	7	27	787	506	13	274	29	13
51-65 years	1292	0	4	4	596	457	5	208	11	7
> 65 years	496	0	0	0	185	168	4	136	0	3
Total registered	3991	0	11	63	1800	1307	23	707	51	29
Total in industry from 1986-2010, assuming 33% registered	6676	0	21	179	3088	2067	42	1100	121	58
Total in industry from 1959-1985, assuming 66% registered	2333	0	6	6	1043	820	11	418	17	13
Total technologists	9009	0	27	185	4131	2886	53	1518	138	70

Combining the total number of technicians and technologists gives a total of 46 800. This is 12% higher than the estimate calculated from graduations, but suggests that ball park figures for the number of engineering technicians and technologists in South Africa ranges between 40 000 and 55 000.

Total number of engineering professionals

The above figures represent a best estimate of the numbers of engineers, engineering technologists and technicians currently active in the South African economy. More detailed research is required to refine these estimates and better understand the sectors in which they are employed.

Demand

At this stage, demand is difficult to determine. Most international supply and demand studies also express difficulty in addressing supply and demand due to the volatility of world economics, the impact of political events etc. Demand is not only indicated by vacancies, but also by the work that should be done, but is not being attended to. This is particularly prevalent in the engineering sector in South Africa where limited attention is being paid to operations and maintenance, which is evident from the visible degradation of much infrastructure and related services. The following considerations need to be factored into a demand study.

Building a capable state

South Africa, like many countries, has dramatically reduced the numbers employed in the public sector, to the detriment of service delivery.

It is recognised that many more engineering professionals are required in the state, but until such time as structures are redeveloped and an enabling environment is created to ensure that the state once again becomes an employer of choice, training additional engineering personnel for state positions will simply result in more unemployed graduates .

Infrastructure projects - work studies

The large infrastructure projects soon to commence, will require experienced engineering personnel, who , as in the case of the SWC, Gautrain and other major developments, need to be sourced from the private sector, internationally and from the ranks of retired engineers. Work studies per project type need to be undertaken to determine the numbers of engineering practitioners required, in order to determine the numbers to be sourced. These projects will also offer excellent training opportunities for young graduates, and all projects need to be issued with strict criteria associated with the methods of training and support required in terms of mentoring and coaching to ensure that the next generation is well trained. Structured training and comprehensive mentoring were in place in the days of Mossgas, the power station delivery of the late seventies and early eighties, and today's experienced engineers are the product of this training.

ECSA can report considerable success in transformation statistics over recent years, as can be seen in Figure 3. The training of many of these young people was achieved on the major projects of the past few years.

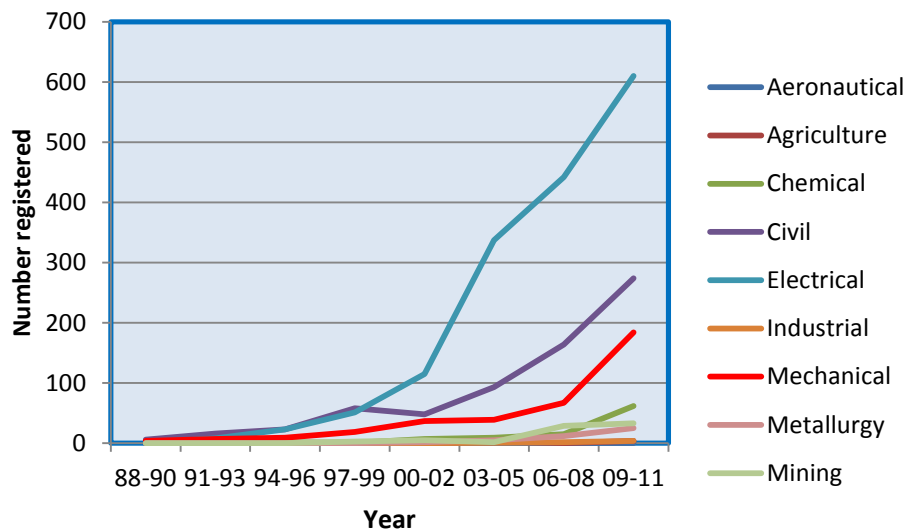


Figure 3 : Registration of African professionals since 1988

A similar trend is evident in the registration of females over recent years.

Vacancies per discipline

There is still the need for each engineering discipline to carry out vacancy and demand analyses within their constituents to give a more accurate assessment of current demand within each discipline and sub-discipline to determine the long-term need for engineering personnel. It is suggested that Voluntary Associations linked to each of the engineering disciplines be tasked to carry out such research, possibly funded through research grants.

Controlling the flow of spending

With the large infrastructure spending planned for the next 20 years, it is essential that the patterns of spending are reviewed to ensure that there is a relatively constant flow of spending rather than the boom and bust cycles we have seen in the past. This will have the effect of reducing short-term high peak demands for engineering personnel and will offer long-term job security for those who enter the field. In this way we will preserve the engineering workforce which has been costly to train. This will also address the challenges which we currently face with insufficient mid-career staff available to train the younger generation entering the industry

Possible actions

The actions required to build the skills base are multi-faceted and need to be phased as shown below.



Long term : 2012 -2022

Start training towards fully populating the structures designed in the medium-term. This will require the issuing of bursaries and major training programmes in all public sectors structures, workplace training, mentoring and coaching etc. Consider career paths, succession planning etc. Also consider other members of the engineering team such as artisans, operators, semi-skilled etc and other professions such as planners, surveyors, building inspectors, laboratory technicians, valuers, development economists etc.

Medium term : 2012 -2017

Re-develop the technical structures and systems required in public sector organisations and start populating them with available skills. This will include planning and design departments, project management units, teams responsible for infrastructure asset management, operations, maintenance, compliance and enforcement, and train existing in-house mostly junior technical staff to perform all these functions

Short term : 2012 -2014

Harness the private sector, retired engineers, overseas capacity etc as we did in the case of the Soccer World Cup to get the major projects off the ground, and set training conditions to all projects to ensure current graduates adequately trained

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