

National Education's Research Benchmarks: Realistic Targets or Pie in the Sky?

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Introduction

In a wide-ranging review of successful drivers for socio-economic development, the World Bank (1999) concluded that knowledge is central. In the new knowledge economy, information and its use are primary commodities (Castells 2001). Generation of new knowledge, its application, storage and manipulation are therefore important to socio-economic development (Muller *et al.* 2001). New knowledge and the skills to manipulate and process this new knowledge are acquired when undertaking research (Mouton *et al.* 2001). Thus, having a sustainable research capacity and capability is important, at both systems and institutional levels.

In South Africa, as in any other developing country, higher education is an important sector that produces new knowledge through research. In addition, appropriately designed postgraduate programs are the chief trainers of a new generation of researchers (Lundall *et al.* 1997; Naidoo & Lange 1999). The approach to, and quality of, research and research training at higher education institutions will be crucial for sustainable production of new knowledge (Mouton *et al.* 2001).

International research findings suggest that one way to assure sustainable production of new knowledge is to encourage regular measurement of research performance so as to enable targeted development of the underperforming parts of the research system (Stanley *et al.* 1995; Geuna *et al.* 2001). Some institutions in the United Kingdom and Australia report that development of a monitoring system plays a crucial role in identifying problems associated with research performance, while others report that it helps to improve research performance (Kemp 1999; Tognolini *et al.* 1994; Kingsley 1993).

Research performance at higher education institutions in South Africa has been erratic. There have been notable decreases in some cases and increases in others. There are several reasons for these trends. We argue that they partly emanate

from a lack of proactive monitoring and improvement of research performance at the institutional level, and ill-designed postgraduate programmes. The new proposal by the Department of Education's National Working Group of a benchmark of 1 and 0.5 SAPSE publication units per full-time academic for universities and technikons, respectively, will help to stimulate proactive monitoring of research performance.

In this article we examine whether the proposed benchmarks are realistic and appropriate for measuring and monitoring research performance. This we do based on the information and data from the SAPSE system, which we also examine critically. Research evaluation systems from other countries are also examined with a view to proposing a more appropriate system for South Africa. Lastly, we propose a new research evaluation system and some research performance indicators. We hope that the proposed performance indicators will help institutions to improve their own research evaluation systems, and thereby make advances towards attaining the proposed DoE's research output benchmark.

SAPSE Targets: Realistic or Pie in the Sky?

In 1985 the then Department of Education (DoE) introduced the South African Post-secondary Education (SAPSE) system, a new funding system and formula to stimulate research output at universities. At that time technikons were not expected to undertake research as a core function. Research outputs were encouraged through financially rewarding institutions for the number of scientific articles published. Only articles in refereed journals accredited by the DoE qualified for this reward (subsidy). At a later stage, books (excluding textbooks), chapters in refereed anthologies, refereed conference papers and patents were included for subsidy purposes. Only in 1992 were technikons included in the system and allowed to receive subsidy for SAPSE research outputs. Below is a table of the total SAPSE output for all higher education institutions for 1986 - 2000.

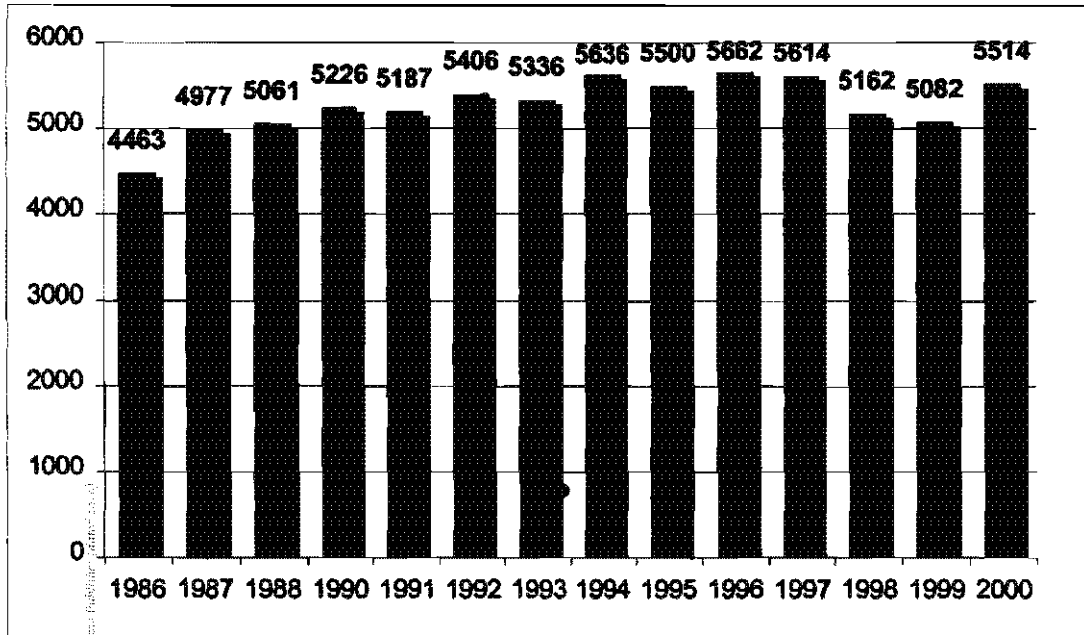


Figure 1

Higher education accounts for 85% of the published research output in South Africa (Mouton *et al.* 2001). A single SAPSE journal article is allocated one SAPSE unit while a book is allocated a maximum of five units (1 unit for every sixty pages) and a patent is allocated two units. Of the total SAPSE output, less than one percent is accounted for by patent outputs, with journal articles accounting for 87%. Since 1986 the SAPSE output grew by 25% and seems to have levelled off in 1994. Output dropped from its 1994 peak, picked up again in 1996, and dropped again by about 10% in 1998. But, as of 2000, it has increased to its former levels of the mid-1990s. Mouton *et al.* (2001) argue that the decline was not an indication of decreased research activity, but that researchers were more involved in contract research where scientific publications are not a priority, and where contracts embargoed journal publications. In addition, since the advent of the South African Qualifications Authority (SAQA) Act and White Paper 3 on Higher Education, many researchers have been busy with institutional restructuring, and not with research (Mignnone 2001). Only those researchers with well-established research teams and supporting postgraduate programmes have been able to keep pace.

Research performance and output, as indicated above, have been variable, but display a disturbing tendency towards remaining constant or decreasing. In 1985 South Africa accounted for 0.7% of the world's research output and this figure has declined to 0.4% by the mid-1990s (Pouris 1995). The data suggests that the higher education sector has reached its optimal research output as the SAPSE output seems to stabilise around 5500 SAPSE units. In the long term such a trend could have disastrous consequences for technological and socio-economic development and the sustainability of the research system in South Africa. According to the World Competitiveness Report (1999), there is a strong correlation of research and development expenditure with economic development. Yet there is a steady decline in Research and Development (R&D) expenditure in South Africa from 1.04% in 1987 to 0.68% in 1995. In terms of global competitiveness this R&D investment has failed to inspire confidence in South Africa's future performance. We need to attend to this problem immediately, before we reach crisis levels in research performance and output.

On the other hand, five out of the thirty-seven higher education institutions in South Africa account for sixty percent (60%) of the SAPSE output and have remained relatively stable over the last 10 years. These are the University of Cape Town (UCT), the University of Natal (UN), the University of Stellenbosch (US), the University of Pretoria (UP), and the University of the Witwatersrand (WITS). This output is not self-evidently optimal, especially since these are the institutions that industry prefers for contract research. This notwithstanding, the level of their collective output suggests that the other institutions are under-performing and that

they need to increase their output. Their improvement will impact on an increase in the general research output of the country.

The historical legacies of underfunding of Historically Black Universities (HBUs) and technikons—which were mainly seen as teaching and training institutions—did not allow much time and space for research. The potential to increase research output from these sectors is enormous, provided there is strategic financial redress. The National Research Foundation (NRF), through its Institutional Research Development Programme (IRDP) earmarked funding, has stimulated increased outputs in these sectors.

Given the history of higher education in South Africa, institutions were loosely grouped into Historically White Afrikaans medium Universities—the US, UP, Rand Afrikaans University (RAU), the University of Port Elizabeth (UPE), and the Potchefstroom University for Christian Higher Education (PUCHE); Historically White English medium Universities—UN, WITS, UCT, Rhodes University (RU); HBUs—the University of Durban-Westville (UDW), the University of the Western Cape (UWC); the University of Fort Hare (UFH), the University of Zululand (UZ), the University of Venda (UV); the University of Transkei (Unitra); the University of the North (Unin), the University of North-West (UNW); Historically Advantaged Technikons—the Cape, Free State, Pretoria, Wits, and Natal Technikons; and Historically Disadvantaged Technikons—Mangosuthu, M.L. Sultan, Peninsula Technikon, Technikon Northern Gauteng, Border, Eastern Cape, North-West, and the Vaal Technikon; and Distance Education—the University of South Africa (UNISA), Vista University and Technikon S.A. Below is a graph that illustrates the SAPSE output per institutional grouping for the period 1991–1999.

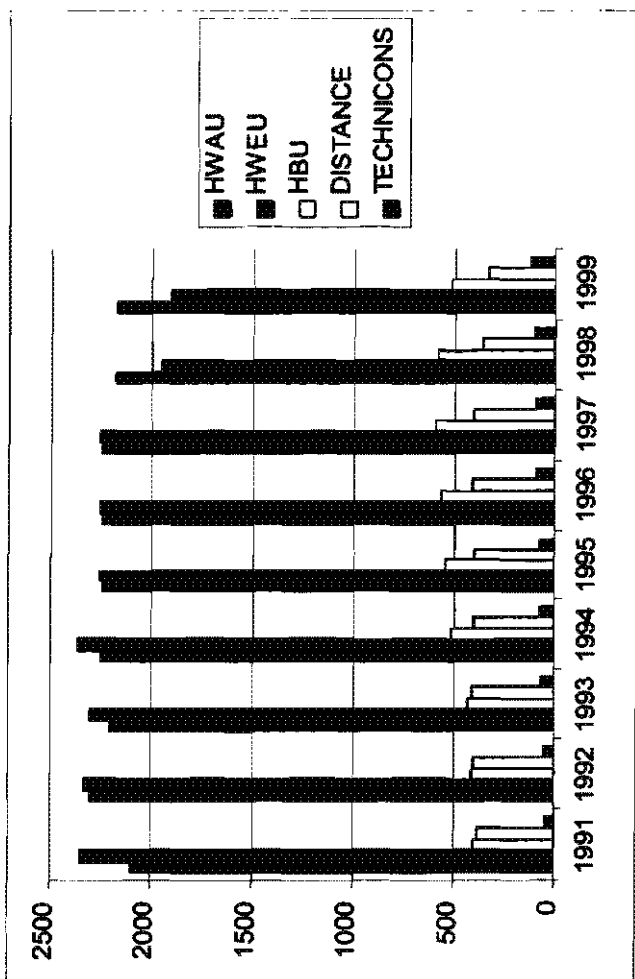


Figure 2

Figure 2 shows that the relative contribution by the Afrikaans universities has increased moderately from 37.2 % in 1986 to 41.5% in 1999. The proportion of the outputs from English medium universities has declined substantially from 53.5% in 1986 to 37.9% in 1999. The overall output from the HBU sector doubled from a low base of 5.1% in 1986 to 10.7% in 1999. The output in the technikon sector increased substantially from 23.52 units in 1991 (0.4% of the total) to 174 units in 1999 (3.1% of the total). Over eighty percent (80%) of the technikon output is produced by the historically advantaged sector of technikons. The distance education institutions decreased their output from 2.57% in 1986 to 2.2% in 1999. Over 95% of the output from this sector is produced by UNISA.

With the exception of Natal and Rhodes Universities, research outputs of most English medium universities have decreased dramatically. In the case of UCT, considered one of the best universities in the country, outputs have declined by as much as 20%. Within the historically Afrikaans universities, research outputs have increased, notably at RAU and UP. To some extent, HBUs and technikons have also increased their research output. Among the HBUs, UDW and UWC account for approximately 45% of the research output with UDW being the top performer among them. On the other hand, the overall increase of research output from these institutions does not balance out the overall decrease within the larger universities such as UCT and WITS.

SA Knowledge Base is a database being constructed by the Centre for Interdisciplinary Studies under the leadership of Professor Mouton at the University of Stellenbosch. Its aim is to produce a comprehensive, accurate and effective database of South African scientific production. A study by Mouton *et al.* (2001) of the database revealed the following:

- The biggest proportion of scientific articles from 1990 - 1998 was authored by white academics (93.5%), followed by Indian (3.2%), African (2.1%) and Coloured (1.0%) authors.
- Males dominated the scientific production—87% were produced by males and 17% were produced by females.
- In 1990, 36% of all the articles were produced by the 30 - 39 age group and the comparable proportion for 1998 has dropped to 17%. At this date, the majority of the articles were produced by the 45 years and older group. This trend is disturbing as it indicates that our current knowledge production is dependent on an ageing group of academics and that we are not producing young researchers or encouraging them into being active researchers.

We should read race- and gender-based research statistics above, in the context of the number of academics in each race and gender group, and the total number of equally qualified and experienced academics in the country. Given this context the race and gender groups that appear to be under-performing might actually have a reasonable per-capita performance. Nevertheless, there is an acute need to create a sustainable critical mass of women and black researchers. Hence, the training of these groups is crucial to the improvement of our total research outputs as a country.

The low total SAPSE output from the HBU and Technikon sector is unsurprising. As alluded to above, these institutions were mainly established as teaching and training institutions, and in the main, offered undergraduate degrees and three year diploma courses (Lundall *et al.* 1997). There were hardly any dedicated facilities and equipment for research, with poor infrastructure and staff capacities to undertake research. Technikons were not expected to perform research whilst HBUs were, despite their appalling circumstances. For these reasons, these institutions lacked a research culture and capacity. It is therefore unfair to compare these institutions, particularly technikons, with other higher education institutions. The majority of staff in technikons still have first degree qualifications and there are only a few with postgraduate training. It would seem, therefore, that the DoE's attempt to differentiate between the technikons and universities by setting different research benchmarks is justified. But are these benchmarks realistic?

Although not all technikons were encouraged to undertake research, they were resourced according to apartheid policies. The Historically White technikons were better resourced than the Historically Black Technikons, hence the differential research performance—i.e. advantaged white technikons accounting for 80% of SAPSE output within the technikon sector. Therefore, having a single SAPSE output benchmark for both these sectors is unfair and discriminatory given the privileged resourcing of one over the other. But is the 0.5 SAPSE output per full-time academic attainable—even within the historically advantaged technikons? The table below suggests that this target is almost impossible in the short-to-medium term.

Top Performing Technikons	Average SAPSE Output per Full-time Academic for 1998 - 2000
Cape Technikon	0.08
Free State Technikon	0.1
Natal Technikon	0.07

The SAPSE output must increase between 5 to 8 times in order to attain the DoE's benchmark. In the short-term, this is an impossible task for these technikons and a dream for the disadvantaged technikons which average 0.02. Research cultures and

performance develop over long periods of time and can take decades. As an example, UCT is 83 years old (formally established as a university in 1918) and produces a 0.65 SAPSE output per full-time academic. Makerere University, once a premier research institution on the continent developed a strong research culture over a 40 year period but was destroyed overnight by the Amin regime and has not regained its former research performance levels twenty-five years later (Naidoo 1998).

Is the benchmark of 1 unit per full-time academic at universities justified? As at the technikons, there was severe discrimination among the universities by the apartheid government. Moreover, since 1994 these institutions find themselves in a situation which is much worse. As their financial resources continue to decline, good academics have left for government, private sector and advantaged universities. They cater almost exclusively for students that are financially needy and academically under-prepared (Breier 2001; Mthembu *et al.* 2001). Catering for such students is labour- and cost-intensive. And yet, government agencies and industry would follow historically advantaged white institutions for contract research that could generate third-stream funding. We advance this argument fully aware that it has become unfashionable. Yet, the historically white institutions that have swelled their black student ranks cannot claim not to be taking the better academically prepared and performing ones, because of their more stringent admissions criteria.

As an example of the challenges of admitting the poorest of the poor, at UDW, full-time academic staff posts dropped from 452 to 335 as of 2001, and students that cannot pay fees readily increased from 15% to 60%. Obviously, more time has to be spent on these students by fewer academics, alas, with debilitating effects on research output. Hence, it is unjustified to set the same benchmarks for HBUs and HWUs. A differentiated benchmark should have been set for these two sectors, with the benchmark of 1 unit per full-time academic only realisable incrementally from whatever sectoral base. The table below suggests that most universities, even the historically advantaged, will not make this target in the short-term.

Top Performing Universities	Average SAPSE Output per Full-time Academic for 1998 - 2000
Pretoria	0.5
Wits	0.58
Stellenbosch	0.55
UCT	0.65
Rhodes	0.85

On average, all need to double their SAPSE output to make the benchmark. The data over the fourteen year period for these institutions show changes and in the case of

increases, it took time, while for UCT, it seems to have stabilised, having reached its maximum SAPSE output. Remarkably, the larger universities like US, UP and UCT have shifted their focus to the commercialising of their research findings and the undertaking of commissioned research. Approximately 70% of the research undertaken by these universities is commissioned. Over 85% percent of the research expenditure comes from non-governmental sources. This is understandable, given government's dwindling subsidies, and very limited funds from its research agencies like the National Research Foundation. The stringency of the processes of peer review and ratings used by some agencies in order for researchers to have access to a limited pool of money, might not always be worthwhile to engage in, when more resources are available elsewhere.

The commissioning and commercialisation of research mitigate against the focus on the SAPSE output system (in the form of journal articles) as the only reliable measure of research performance in the country (Mouton 1998). Intellectual property rights and patenting are key considerations in this type of research (Kemp 1999). And there are phenomenal pay-offs for institutions that take advantage of such opportunities. The larger universities would be irresponsible if they were to forego such pay-offs and produce more SAPSE output to reach the DoE's target. Hence, there will be circumstantial resistance from these universities to conforming to the DoE's benchmark, and rightly so, as the White Paper for Science and Technology (1995) encourages innovation for economic growth through commercialisation of research findings.

The proliferation of ill-designed coursework Masters' and Doctoral programmes could further hamper SAPSE research outputs (Naidoo & Lange 1999). Our institutions have not yet taken full advantage of postgraduate research by turning students' dissertations and theses into SAPSE publications. Coursework programmes at this level will further stunt postgraduate research, the generation of new researchers, and, as argued above, potential SAPSE publications. We further argue that, should the DoE not introduce a differentiated funding mechanism for coursework and research-based postgraduate programmes, with the latter accorded higher funding, it must inevitably expect a deterioration in research outputs.

Among the HBUs, UDW has the highest SAPSE output per full-time academic. It averaged 0.35 units per full-time academic between 1998 and 2000. It took ten years to improve this rate from 0.2 to 0.35. In the short-to-medium term, it will be virtually impossible to move the rate to 1 unless there is a dramatic injection of resources, and unless top-performing researchers, academics and senior management prioritise research as a key core function of the university. Alternatively, one could argue UDW's output on the basis of return of investment, and, on that basis, conclude that the SAPSE output for UDW is better than UCT's.

On average, R8 000 000 is spent annually on research at UDW, whilst UCT spends R180 000 000. Yet, the SAPSE output differential between the two institutions is double, while the resource input differential is 25 times between these institutions. In this inequality, we exclude the cost of available infrastructure and equipment that facilitate research at UCT. It would be reasonable to argue that, despite UDW's institutionalised problems over the years, it produces better return on investment than UCT. In a nutshell, the cohort of productive researchers at UDW is more productive than its counterpart at UCT.

Another interesting observation is that smaller institutions like Rhodes have a higher SAPSE output per full-time academic than the bigger institutions like UCT and UP. A similar pattern is observed in the technikons. Free State Technikon, which is smaller than Cape and Natal Technikons, has a much higher SAPSE output per full-time academic. This suggests that the size of an institution influences research production. Quite clearly, there is a minimum threshold beyond which student:staff ratios become detrimental to the research project. If this is true, then the proposed merger of institutions into larger units could result in severe research output decreases. It would be informative to conduct studies and analyse the influence of shape, size and student:staff ratios on research performance.

Is SAPSE an Appropriate System?

With a few exceptions, most higher education institutions do not monitor their research performance (Mouton 2001) in any comprehensive manner. Most institutions use SAPSE output as a measure of research output. At the individual researcher level, the National Research Foundation too, uses, in the main, SAPSE research output to rate researchers. Both the NRF and the DoE use research outputs as a measure of research quality and performance, and, because of the influence of these organisations, such measurement systems have become 'the order of the day' for those institutions that monitor research performance. However, to equate measures of quantity with quality and performance is inappropriate. In a multi-disciplinary team research environment, and in a problem-oriented, development-based approach through which we expect to improve the quality of life and the standard of living of our masses, these measures are unacceptable and should be subjected to critical scrutiny. However, it appears that the DoE system will continue to be influential, since it will determine the future postgraduate programme mixes for institutions and provide the bulk of the start-up funds for research. It is for this reason that the focus of this paper is on the SAPSE system and the proposed new benchmarks.

Ever since the introduction of the SAPSE system many researchers have raised objections. These include the following:

- Many academics from the HBUs and some from the English liberal universities refused, for political reasons, to publish in SAPSE accredited journals during the apartheid era. The politics of publishing would only help later to slacken their re-introduction to the networks developed without them during their self-exile from the journals.
- Some researchers describe the system as a 'black box'. That is, they do not know the basis on which journals become SAPSE accredited, and who takes such decisions, with what competence. Some claim that journals from Afrikaans medium universities are easily accredited as opposed to those based at other institutions. The lack of transparency, clear criteria and credible peers within the SAPSE system is a continuous source of contention.
- The SAPSE system only accredits journals, books and refereed proceedings, with journal publications taking precedence. Many researchers contest the narrowness of the set of these outputs. Policy briefs and documents that ushered in profound changes in national and provincial directions during the dawn of our new democracy are not counted. Outputs from creative, performing and visual arts are not included. Other outputs that are central to sustaining a quality research system, such as annotated bibliographies, indices, academic reviews, user reviews and popular reviews for the mass media, are not considered by the SAPSE system. Other important items not included are short works by literature scholars, editorships of conference proceedings, commissioned research reports and reports for policy analysis purposes.
- There is an over-emphasis on paper publications, and an under-valuing of electronic publications. Yet, and rightly so, during the era of information and communications technology, the electronic publications industry is growing at an incredible rate.
- There is an under-valuing of student research training and production of trained postgraduate research students. Given that our current research output, as alluded to earlier, is produced mainly by ageing white males, it raises concerns for both our demographic research profile and the sustainability of our research system. Our current research profile is unsustainable and we need to produce more young researchers who are black and women. Through the sheer numbers of blacks and women, there is greater potential to produce a critical mass of researchers from amongst their ranks. Hence, postgraduate student output should be a key measure for the national system to monitor. As argued above, that postgraduate output should be more research-based, as opposed to coursework-based. And appropriate resources must be made available. In this way, we can

address the past imbalances and ensure the sustainability of research production by producing a new generation of researchers for the system.

- The system is ahistorical, and as a result, discriminates against HBUs. For some strange reason, it has become unfashionable to talk about redress. It is often argued that redress should not be institutional, but individualised, because HWUs now have double the number of black students enrolled at HBUs: a classical liberal argument. And yet, if you revisit our earlier argument about return on investment between UDW and UCT, some HBUs may have performed better. Academics at HBUs work in comparably poorer research conditions than their counterparts at HWUs. This is a problem of investment versus return on investment. And yet research performance in both sectors of institutions is measured equally on the sole basis of output, although it is much more difficult to produce that output at HBUs. At almost all HWUs computers and good libraries are considered standard features for good teaching and research, while in most HBUs these are luxuries. For example, at UDW, over 85% of the academics in the Humanities Faculty do not have computers in their offices as part of standard office furniture. They have to purchase them from their own funds or research grants. At the University of Venda there are no funds available to renew their journal subscriptions.
- There are sub-optimal considerations of the quality and impact of research. One could argue that the SAPSE system enforces quality control indirectly by only accrediting publications that satisfy a minimum quality assurance standard as set by peers. Yet, in reality we know that journals have different quality standards, based on what constitutes quality (Garfield 1996). Because of its quality demands it is much harder to publish in *Nature* as opposed to the *South African Journal of Science*. On the other hand, *Nature* is interested in publishing articles that have global significance (normally basic research) to the natural scientific community while the *South African Journal of Science* encourages the publication of research with an impact on local development (normally applied research). A researcher-engineer who does development-oriented research in partnership with ESKOM, for instance, might not produce earth-shattering research deserving of publication in an international journal. But the impact of that research in raising the standards of living and the quality of life of the rural poor might be high. In the current system, the quality of research and the quality of its impact cannot be equated. Our country needs both quality basic and applied (development-oriented) research in order to meet our development challenges.
- It takes a year before research output is processed by the DoE, and there could be further delays in releasing subsidy funds. It takes even longer to accredit new

journals for SAPSE purposes, and in recent times, the accreditation of new journals has been suspended. The latter point is worth emphasising. Given that we have unique problems in Africa—issues that countries of the North might have less interest in—to what extent do we recognise journals from Africa and other third world countries? Would we expect a top American journal to concern itself with problems of cholera and malaria in Africa, for example?

- There are cumbersome administrative requirements and burdens placed on institutions in processing publications before sending them to the DoE for evaluation and accreditation. This has placed incredible demands on HBUs in particular, as their administrative systems regarding research are often poorly developed.

Some Commonly Used Research Evaluation Systems

The promotion and monitoring of research performance and quality is central to enabling the development of vibrant and relevant knowledge production systems for the country (Verleij 1999). There are many ways to evaluate research performance (Link 1993). These range from output-quantitative measures such as SAPSE output and bibliometrics to more comprehensive systems that capture both qualitative and quantitative measures of input, process, outputs and impact of research evaluated by peers (Mouton *et al.* 2001). In the United Kingdom, the Higher Education Funding Council for England (HEFCE) research evaluation of University departments takes the latter format.

Currently, in most developed countries, bibliometrics is the most popular measure of research (Narin *et al.* 1994). Bibliometrics uses counts of publications, patents, and citations to develop science and technology performance indicators (Narin 1976; Narin *et al.* 1977). Bibliometrics is used:

- As a count of publications and patents to indicate the level of activity in a cognate area or at an individual, departmental, institutional or country level.
- As a measure of impact by counting the number of times these patents or articles are cited by subsequent researchers.
- As a linkage measurement from articles to articles, from patents to patents, and from patents to articles that provide intellectual linkages between organisations and researchers.

Since the origin of bibliometrics, citations have played a very important role in measuring research quality and impact. Citation analysis is historically a by-product of citation indices developed by Eugene Garfield, founder of the Institute for

Scientific Information (ISI) with Science Citation Index (SCI) as its main measure of research production, quality and impact (Harriet 1998). First, its citation counts were used to indicate the importance and the quality of journals. Nowadays, SCIs are used to indicate the quality and impact of research within the scientific community (Garfield 1997). The assumption is that the more often a paper is cited, the greater is its significance in that field of study. This would then be interpreted to imply the importance and the standing of a researcher within the research community. More recently, a Social Science Citation Index (SSCI) and an Arts and Humanities Citation Index (A&HCI) have been developed to measure research in related disciplines.

Although citation indices are widely used, they have limitations and have not survived without criticism (Narin *et al.* 1994; Magri *et al.* 1996). These include the following.

- Citation indices assume that only relevant, important and high-quality research will be cited, and that all citations are of equal importance to research advancement.
- Many researchers self-cite and distort the importance of their past research work.
- If multiple authors are accredited, how would one determine if the co-authors contributed equally to a piece of research, and importantly, the quality of the contributions of each of them?
- Many scientists have the same surnames and initials. How does one distinguish in such cases?
- Large differences in citation counts may exist from one year to another, which causes citation data to be restricted in time.
- Citation rates vary from field to field. In disciplines with a smaller number of researchers, authors are cited less often compared to larger disciplines.
- The ISI database only captures English language publications, hence favouring research appearing in English.
- The ISI is USA-biased. Most of the US publications are captured on the ISI database, hence privileging US research.
- The current ISI database is incomplete and not all publications are captured. In the case of South Africa, approximately 300 SAPSE journals are not captured.
- Approximately 10% of the South African journals that deal mainly with natural science are in the ISI database. It is not representative of all domains of science, does not capture all research in South Africa, and, therefore, cannot be an accurate measure of research quality in South Africa. It would be a disaster for

any South African agency to adopt ISI as the measure of research quality and impact in South Africa.

- ISI privileges research of global significance or basic research as opposed to local problem-solving research. Although basic research is important, equally important is applied research geared towards the problem ridden development context of South Africa and Africa generally.

Given the development challenges and the urgent need to solve some of these problems, it is important to use a research evaluation system that will not counteract the practice of applied research. Hence, the exclusive use of SCI and other indices used by ISI to measure research quality would be inappropriate for South Africa.

Qualitative approaches using evaluative case studies undertaken by peers represent another extreme of quantitative measures. A version of this is the research assessment exercise for university departments, used by HEFCE for funding purposes in the UK. Peer panels are used to evaluate the research performance by departmental staff on site. The evaluation is ex-post and normally focuses on disciplines. These panels assess the publication quality and other data that is made available to the panels from the departments. In 1996 each department that wanted to be evaluated was asked to submit:

- An overall staff summary containing information on all academics staff and research support staff, whether or not they are included as active research staff;
- Details of active research staff;
- Publications and other public output (up to four) for each active member;
- An overview of research students and research studentship;
- A statement of external research income, including the amount and source of research income;
- A statement of research plans.

Although the panels ask for a variety of information, they assess mainly the quality of research output. Each department is given a score which determines its research funding level. Some of the problems with this system are:

- It encourages the 'poaching' of top researchers from one institution by another.
- Those institutions that are well-endowed can easily attract top researchers by paying them good salaries and providing optimum working conditions and research infrastructure. In the case of South Africa, the HBUs would suffer further and regress back into being teaching institutions if this situation prevails. Moreover, this would discourage research capacity development, as the majority

of black academics are in HBU's. Researchers would focus on research performance and neglect training of postgraduate students and the next generation of researchers. Redress and equity would be undermined, as few black and women researchers would be given opportunities to work and train with these good researchers.

- It is expensive. At least four to six panel evaluators are used to evaluate each department on site and this process lasts for at least two days. It requires efficient administrative back-up. It would mean that the Department of Education would have to develop a good administrative system. Yet it still has difficulty implementing its new policy outlined in 1996.
- It relies on high quality peers with integrity. Researchers with good research reputations act as peers. In the case of South Africa, the research community has been tainted by historical privilege and disadvantage. Besides having a small research community, there is suspicion among researchers, especially from a race and gender perspective and according to institutional type. The politics of publishing and research networks would also rear their ugly heads when research considered to be in opposition to that of some members of the panels could be strategically under-valued.

In Australia, the research performance of each institution is measured using the system referred to as Research Quantum for funding purposes (Geuna *et al.* 2001). Research Quantum is based on input and output indicators. Both research input and output indicators are incorporated into a composite index which determines the amount of funding an institution receives. The indicators contained in the composite index are:

Research Input Indicators

- The amount of each university's funding from other national agencies;
- Other public sector research funding;
- Industry and other research funding.

Research Output Indicators

- Number of research and scholarly publications produced by staff and students;
- Number of higher degrees (masters and doctors) completed.

The major limitation of this system is that it relies on the data received from each institution to develop the composite index. The second limitation is that it is exclusively quantitative and is unable to measure the quality and impact of the research. Lastly, it does not examine institutional support for research. Relevant questions in this regard would be: Does the institution have a well-resourced

research office to support researchers; does it provide good infrastructure and a positive work climate for researchers; does it provide steering mechanisms to develop capacity for in-service training.

It might seem obvious that each institution should have the freedom to choose the nature and type of research it wishes to pursue. But, if there are national and regional goals to be met, that approach could easily defeat them. And, unless there could be strict measures and monitoring of expenditure, managements could use the available funds for purposes other than research. It is well-known in this country that the current SAPSE system includes in its formula some funding for research and postgraduate studies. Equally well-known is that institutional managements do not necessarily allocate those funds to research activities.

Hence, the monitoring and evaluating of research performance is complex and fraught with many difficulties (Adams 1993; Adams *et al.* 1994; Ball 1997). The variety of solutions to the problems we pose below would prove this assertion. Firstly, what is considered or defined as research? Secondly, the definition of research quality and performance is highly contestable. Thirdly, the criteria and mechanisms used in evaluating quality and performance are not easy to develop, and once developed they might not be applied consistently. Fourthly, whether the measuring of research performance should be used to develop incentive or punitive measures is unclear. Fifthly, how does one measure and factor the various elements that enable or retard research performance and quality? Sixthly—and an important imperative in South Africa—how should redress and equity be factored into the measuring of research performance? Lastly, probably the most important aspect concerns the fitness of the evaluation or measurement for the purposes or goals of the research system.

A Proposed System For South Africa

What system of research evaluation should we use at the institutional level for South Africa? Besides relying on SAPSE publications, most South African higher education institutions have not attempted to develop a set of comprehensive indicators to monitor research performance. Given the above discussion, we propose that the research evaluation system should be based on the following.

- Fitness for purpose, i.e. use an evaluation approach that will advance the goals of the research system (Verkleij 1999);
- Advance the goals of White Paper 3 for Higher Education and the White Paper for Science and Technology;
- Advance basic, applied, strategic and development research;

- Promote research capacity development by enabling the next generation of researchers through participating in research projects and postgraduate education led by the most illustrious and seasoned of our researchers;
- Promote redress and equity among women and black researchers;
- Optimise knowledge production among all higher education institutions in South Africa;
- Promote good support and infrastructure development at all institutions for researchers;
- Provide incentives for research outputs and impact;
- Be easy to administer;
- Be fair, just and credible.

Each institution should be asked to produce a research plan together with its three-year rolling plan. The plan should identify strengths, weaknesses, opportunities, and threats for research and its development (Van der Westhuizen 1998). It should outline the institution's historical performance and its proposed strategies to improve its performance. Lastly, it should outline its proposed niche areas and targets for research performance. The Department of Education should request the statutory quality assurance body of the Higher Education Quality Committee (HEQC) of the Council for Higher Education (CHE) to carry out the research evaluation. The research evaluation exercise should be conducted by HEQC peer panel mechanisms every three years for each institution. Peer panels for each institution should evaluate the quality and feasibility of the plan. The criteria for selecting peers should include:

- Researchers with good and credible track records within the research community;
- Some young and upcoming researchers so that the plight of 'underdog' researchers can be heard;
- Peers who are familiar with the contexts and histories of different institutional types, with international trends, and with the country's and the continent's development challenges;
- Peers with research management experience particularly at the senior management level of institutions, like Deputy Vice-Chancellors or Directors/Deans: Research;
- Peers who have some experience with research evaluation;
- Researchers representing a diversity of modes of knowledge production and domains of science;
- A selection of researchers that is balanced with regard to race, gender and institutional type.

The peer panels should measure research performance by considering the inputs (examples include funding and facilities available for research), processes (examples include research environment and culture) and outputs (examples include journal articles) jointly in order to establish a measure of research quality and performance. Based on the earlier discussion and a survey of literature (Averch 1993; Bauer 1990; Cave et al. 1991; Cazes 1972; Cozzens 1995; Davis 1996; Garfield 1979; Johnes 1998; Kells 1992; Kemp 1999; Kingsley 1993; Mouton *et al.* 2001; Ravjee 1999; Rip 1998; Weingart 1997; Van der Westhuizen 1998; Naidoo 1999) the following indicators are suggested as possible measures of research performance at the institutional level. The plan and evaluation should focus on the following criteria and benchmarks.

Input Measures

Post-graduate Enrolments Disaggregated by Race and Gender

- * Post-graduate enrolments as percentage of total enrolments;
- * Enrolments in research-based post-graduate programmes;
- * Honours, Masters, and Doctoral enrolments as a percentage of total post-graduate enrolments;
- * Number of Post-doctoral candidates registered.

Postgraduate Scholarships Disaggregated by Race and Gender

- * Number of applicants and recipients for internal scholarships;
- * Number of applicants and recipients for external scholarships;
- * Percentage success rate of applicants for external scholarships.

Percentage of Recurrent Grants Allocated

- * Library;
- * Research Grants;
- * Scholarships;
- * Computing;
- * Research laboratories;
- * Seminar rooms;
- * Research Equipment;
- * Publishing and Press.

Awarding of Competitive Grants

- * University's ratio of internal/external grant income per staff member;
- * Number of new grants/year from internal and external sources—differentiate between national and international.

Awarding of Commissioned Research

- * Number of commissioned research projects;
- * Total Rand value of commissioned research.

Process Measures

Quality of Staff Disaggregated by Age, Race, and Gender

- * Percentage with doctorates;
- * Percentage actively supervising post-graduates;
- * Percentage actively doing research;
- * Percentage currently holding research grants;
- * Percentage of researchers that are international project leaders;
- * Number of NRF rated scientists;
- * Number of ex-CSD research units;
- * Number of invitations for keynote addresses.

Research Facilities (Quality - Conditions, Access, Needs-driven, Service Orientation)

- * Library;
- * Computing;
- * Research seminar rooms;
- * Laboratories and equipment;
- * Publishing and editing;
- * Commissioning of Research;
- * Commercialisation, Intellectual Property Rights and application of research;
- * Disseminating and Marketing of research.

Support for Researchers and PGE Students

- * Study facilities;
- * Communication facilities (e-mail, phone, etc.);
- * Access to computing facilities;
- * Conference support per student;
- * Methodology expertise and consultancy services;
- * Training opportunities for proposal writing etc.
- * Staff qualification upgrading;
- * Total staff:student teaching and research ratios.

Research Management and Administration:

- * Number of research management and administration staff;
- * Research management and administration that is proactive and supportive;

- * Established policies, procedures, practices and performance indicators;
- * Information management system designed for research;
- * Induction of new staff members.

Research and Post-graduate Education (PGE) Quality

- * Established policies, procedures and practices to monitor research and PGE quality;
- * Frequency of training workshops to promote research and PGE quality.

Research Culture

- * Frequency of Seminar series;
- * Number of visiting fellows;
- * Frequency of research fairs and expo's;
- * Presence of and functioning of a PGE student association;
- * Special awards and functions that highlight postgraduate and research performance;
- * Regularity of communication with researchers via newsletters, etc.
- * Number of international linkages that relate to research;
- * Number of international linkages that relate to PGE programs.

Output Measures

Research Outputs

Peer Evaluated (Refereed) Publications:

- * Papers in refereed journals;
- * Editorships of refereed journals;
- * Book reviews that appeared in refereed journals;
- * Responses to articles that appeared in refereed journals.

Grey Literature (Excluding Journal Articles)

- * Research reports, policy analyses and conference papers, which have not yet been through an external peer review process, but have been circulated by their authors because of their perceived immediate theoretical, practical, policy or other relevance;
- * Authored books;
- * Edited books;
- * Short works (including chapters in books, letters to journals, short papers, and official reports, review articles, monographs, entries in encyclopaedias and dictionaries, and working papers);
- * Conference proceedings;

- * Editorships of conference proceedings;
- * Research reports including commissioned reports on policy analyses and annotated bibliographies;
- * Indices and other research capacity development tools such as bibliographies or overviews of sources (papers and books) relevant to particular areas of research (with brief critical comments on the content of each if necessary).

Academic Reviews

- * These focus critically on the quality of evidence and the firmness with which findings are supported by that evidence, and then endeavour to integrate findings into a coherent theory.

User Reviews

- * Written with specific groups of teachers or policy-makers in mind and focus on particular findings that are credible and relevant to that audience.

Popular Reviews

- * Articles that appear in newspapers or the popular press that demystify and promote the public understanding of research findings.

Output in the Performing/Visual Arts

- * Original music scores, theatre scripts and paint/sculpture exhibitions.

Output in the Architectural, Engineering and Computer Sciences

- * Design of databases and software programs; architectural and engineering designs; maps; and patents.

PGE Completion Times Disaggregated by Race and Gender

- * Student satisfaction;
Annual reviews;
Exit surveys.

Examination Results

- * Percentage of theses accepted without major revision;
- * Examiner's comments;
- * Awards/Prizes won by postgraduate.

Publications by Postgraduates

- * Conference presentations;

- * Refereed publications.

Graduate Destinations

- * Postdoctoral placement;
- * Employment in appropriate jobs;
- * Employer surveys.

In line with the HEQC's mission, the first round of evaluation should be strongly developmental in that it should assist institutions to improve research performance. At the end of a three-year cycle, each institution should be evaluated based on the above criteria and benchmarks to determine the levels of success attained and the amount of financial support that National Education will provide. Incentives should be given to institutions that attain their goals. Those that do not attain their goals should provide explanations and develop remedial measures. If these institutions fail to produce these explanations and remedial measures, these institutions should be penalised.

If the existing software programmes cannot be adapted to take all the variables listed above into account, some software might have to be developed in such a way that departments could complete and report in some of the fields, whilst research offices and information management units fill in the rest.

Conclusion

Evaluation of research performance is fast gaining currency in the world. The recent establishment of the HEQC, recent proposals by the DoE on research funding and research output benchmarks engender greater accountability for spending taxpayer money. These systems would accelerate this global development within South Africa, in respect of research performance. As illustrated, there are many approaches and systems for evaluating research performance. Clearly, from our arguments above, the current SAPSE system is deficient, and the proposal for 1 SAPSE unit per full-time academic is unrealistic and inappropriate as a measure of research quality and impact. We propose an evaluation system based on a variety of performance indicators.

This system is relevant and will be mutually beneficial to the DoE and individual institutions. For institutions, the benefits in developing performance indicators would be to improve and monitor research performance, quality and impact, not only based on output measures, but on input and process measures. For the DoE, there will be better co-ordination with and among institutions, and the system would produce more efficient, accountable and effective mechanisms to

assess how research funding allocations are utilised, and what the return on investment is. Further, the DoE would realise increased research outputs and more trained researchers to meet the development challenges of South Africa and our continent. This would help to reposition our country in a fiercely competitive global economy.

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* Note: When this article was written, both these authors were senior managers of research at the University of Durban-Westville.

References

- Adams, D, M Ginsburg, Y Wang, & J Sylvester 1994. *Improving Educational Quality: A New Approach*. Unpublished memo.
- Adams, D 1993. *Defining Educational Quality*. Arlington: IEQ Publication 1: Biennial Report.
- Averch, H 1993. Criteria for Evaluating Research Projects and Portfolios. In Bozeman, B & J Melkers (ed): *Evaluating R & D Impacts: Methods and Practice*. Dordrecht, Kluwer Academic Publishers.
- Ball, DF 1997. Quality Measurement as a Basis for Resource Allocation: Research Assessment Exercise in UK Universities. *Research and Development Management* 27,3.
- Bauer, M 1990. Sweden. In Kells, HR (ed): *The Development of Performance Indicators for Higher Education: A Compendium for Eleven Countries*. OECD.
- Breier, M 2001. *Curriculum Restructuring in Higher Education in Post-apartheid South Africa*. Bellville: University of Western Cape.
- Castells, M 2001. The New Global Economy. In Muller, J, N Cloete, S Badat, (eds): *Challenges of Globalisation: South African Debates with Manuel Castells*. Cape Town: Maskew Miller Longman.
- Cave, MHS & M Kogan 1991. *The Use of Performance Indicators in Higher Education: A Critical Analysis of Developing Practice*. London: Kingsley.
- Cazes, B 1972. The Development of Social Indicators : A Survey. In Shonfield, A & S Shaw (eds): *Social Indicators and Social Policy*. London: Heinemann Educational.

- Cozzens, S 1995. U.S. Research Assessment: Recent Developments. *Sociometrics* 34,3:351-362.
- Davis, D 1996. *The Real World of Performance Indicators: A Review of their Use in Selected Commonwealth Countries*. Report Prepared for the Commonwealth Higher Education Management Service (CHEMS), London.
- Garfield, E 1955. *Citation Indexes—New Dimension in Documentation*. (Citation Index to the Bible). Presented at the American Documentation Institute, Penn-Sherwood Hotel, Philadelphia, Pa. November 2-4.
- Garfield, E 1979. *Citation Indexing: Its Theory and Application in Science, Technology, and Humanities*. Philadelphia: ISI Press.
- Garfield, E 1996. The Significant Scientific Literature Appears in a Small Core of Journals. *The Scientist* 10,17:13.
- Garfield, E 1997. *Concept of Citation Indexing: A Unique and Innovative Tool for Navigating the Research Literature*. Speech presented at Far Eastern State University, Vladivostok, September 4.
- Geuna, A, D Hidayat & B Martin 2001. Resource Allocation and Research Performance: The Assessment of Research. In Mouton, J & J Dowling (ed): *Benchmarking Research Performance at South African Higher Education Institutions*. Stellenbosch, Centre for Interdisciplinary Studies, University of Stellenbosch.
- Harriet, O 1998. ISI Spins a Web of Science. *Database Magazine* 21,2:37-41.
- Johnes, G 1990. Performance Indicators in Higher Education: A Survey of Recent Work. *Oxford Review of Economic Policy* 8,2:19-34.
- Kells, HR 1992. *Performance Indicators for Higher Education: A Critical Review with Policy Recommendations*. PHREE Background Paper Series, Education and Employment Division, World Bank.
- Kemp, David 1999. *New Knowledge, New Opportunities: A Discussion Paper on Higher Education Research and Training*. Canberra: Commonwealth of Australia.
- Kingsley, G 1993. The Use of Case Studies in R&D Impact Evaluations. In Bozeman, B & J Melkers (eds): *Evaluating R&D Impacts: Methods and Practice*. Dordrecht: Kluwer Academic Publishers.
- Link, A 1993. Methods for Evaluating the Return on R&D Investments. In Bozeman, B & J Melkers (eds): *Evaluating R&D Impacts: Methods and Practice*. Dordrecht, Kluwer Academic Publishers.
- Lundall, P & H Deedat 1997. *A Tracer Study of Post-secondary Participants on the Kagiso Trust Bursary Project*. Belville: University of the Western Cape Press.
- Magri, M & A Solari 1996. *The SCI Journal Citation Reports—A Potential Tool for Studying Journals*. 1. Description of the JCR Journal Population-based on the Number of Citations Received, Number of Source Items, Impact Factor, Immedia-

- cy Index and Cited Half-life. *Sociometrics* 35,1:93-117.
- Mouton, J 1998. *Between Adversaries and Allies: The Notional of Strategic Science in Post-apartheid South Africa*. Seminar: Science and Society in South Africa. Sussex: University of Sussex Press.
- Mouton, J & J Dowling (ed) 2001. *Benchmarking Research Performance at South African Higher Education Institutions*. Stellenbosch: Centre for Interdisciplinary Studies, University of Stellenbosch Press.
- Muller, J, N Cloete & S Badat (eds) 2001. *Challenges of Globalisation: South African Debates with Manuel Castells*. Cape Town: Maskew Miller Longman.
- Naidoo, P 1998. Research in Science and Technology Education. In Naidoo, P & M Savage (eds): *African Science and Technology Education into the New Millennium: Practice, Policy and Priorities*. Cape Town: Kenwyn, Juta.
- Naidoo, P 1999. *Developing Performance Indicators for Research*. Paper delivered at the Research Management Workshop—Managing Research through Performance Indicators: Towards the Benchmarking of Research in Higher Education, 23 September 1999, NRF, Pretoria.
- Naidoo, P & L Lange 1999. *Postgraduate Education and Scholarship Grants: Challenges and Possibilities in the Context of the New Education Policy*. Unpublished monograph.
- Narin, F 1976. *Evaluative Bibliometrics: The Use of Publication and Citation Analysis in the Evaluation of Scientific Activity*. Cherry Hill: Computer Horizons.
- Narin, F & JK Moll 1977. Bibliometrics. *Annual Review of Information Science and Technology* 12:35-38.
- Narin, F & D Olivastro 1994. Bibliometrics/Theory, Practice and Problems. *Evaluation Review* 18,1:65-77.
- Ravjee, N 1999. *Modes of Knowledge Production and Higher Education in South Africa: A Critical Review of the Literature*. CENIS Research Report.
- Rip, A 1997. A Cognitive Approach to the Relevance of Science. *Social Science Information* 36,4:615-640.
- Rip, A 1998. Postgraduate Training and Research in South Africa: An International Perspective. *SAUVCA Publication Series* 98,3:69-80.
- Stanley, G & P Reynolds 1995. Performance Indicators and Quality Review in Australian Universities. *Higher Education Research and Development* 14,2:245-253.
- Tognolini, J et al. 1994. A Methodology to Choose Performance Indicators of Research Attainment in Universities. *Australian Journal of Education* 38,2:105-117.
- University of Durban-Westville. Working Group 2000. HDI's: Development Institutions of the Future. Paper presented at ASAHDI Conference on Higher

- Education: Imperatives of Equity and Redress, 19 and 20 October 2000, Sandton Convention Centre, Johannesburg.
- Van der Westhuizen, LJ 1998. *Assessment of Research in South Africa*. Unpublished paper.
- Verkleij, AC 1999. Different Approaches to Defining Research Quality. *Bulletin* March 1999.
- Weingart, P 1997. From 'Finalization' to 'Mode 2': Old Wine in New Bottles? *Social Science Information* 36,4:591-613.