

**RESPONSE TO THE DEPARTMENT OF SCIENCE AND TECHNOLOGY  
MINISTERIAL REVIEW COMMITTEE ON THE SCIENCE, TECHNOLOGY AND  
INNOVATION LANDSCAPE IN SOUTH AFRICA**

**1. INTRODUCTION**

HESA welcomes the opportunity to respond to the Ministerial Review Final Report on the Science, Technology and Innovation Landscape in South Africa.

This response is a consolidation of individual institutional responses, which include University of Johannesburg, Stellenbosch University, University of Cape Town, University of Pretoria, North-West University, University of the Free State, Vaal University of Technology and University of South Africa, as well as a submission from the Deputy Vice-Chancellors: Research Forum. Further, also included is an individual response, in his own capacity, from an expert in the higher education sector.

The DVCs: Research Forum's inputs in particular, which was developed in response to a call by the Ministerial Review Committee to contribute to the draft report, is important. HESA notes with appreciation that the vast majority of the Research Forum inputs, were incorporated into the current document. These inputs will not be repeated here, but the original document, submitted to the Review Committee, is included. The current submission essentially adds to and enhances the original 2011 submission by the DVCs: Research Forum.

Other universities may have submitted their responses directly to the Department of Science and Technology. Furthermore, it is expected that the South African Technology Network, representing the universities of technology, will submit their own response from a technology network point of view.

Nevertheless, while many of the points raised in the institutional responses are incorporated into this response, the individual institutional responses contain quite detailed inputs and these submissions are thus forwarded together with the sector response as stand-alone inputs to the final report.

However, while we are confident that the inputs contained in this submission will be supported, it should be noted that it has not yet been endorsed by the HESA Board. This consolidated submission will be circulated to all public higher education institutions and if endorsed, the HESA office will be able to confirm that it should be considered a sector response.

This response is structured as follows:

- Section 2 deals with some general remarks;
- Section 3 discusses governance,
- Section 4 looks at funding and financial implications;
- Section 5 discusses the quadruple helix (and more on funding);
- Section 6 deals with research infrastructure and equipment;
- Section 7 looks at human capital in the research community;

- Section 8 highlights some of the silences in the report, as well as discusses those areas where we consider more emphases are needed; and
- The final section (section 9) summarises this response and provides final comments.

## 2. GENERAL REMARKS

- 2.1 HESA commends the Minister of Science and Technology for commissioning this study and wishes to compliment the Ministerial committee for a comprehensive and candid report.
- 2.2 In our opinion, this is a well considered document and the insights and recommendations, in general, are supported.
- 2.3 The report thoroughly details the shortcomings in the current landscape and provides many welcomed recommendations to improve both the current landscape and to position South Africa as an international player over the next few decades.
- 2.4 The current challenges, all of which impact the higher education sector, include: an education system that does not deliver sufficient number of students who are adequately prepared for studies in SET; high drop-out rates of students; insufficient number of graduates at all levels with the right skills, knowledge and aptitude; insufficient number of academics to address the need to grow postgraduate numbers and research output; the competition between institutions for talent; insufficient infrastructure and equipment; maintenance of equipment and infrastructure; the need for additional research funding; the need for qualified technical support staff (instrument scientists and technical specialists); problems associated with the recruitment of international staff (visa applications, etc.); funding and tax issues associated with the postdoctoral fellows; insufficient collaboration between institutions regarding the sharing of equipment and human resources; insufficient collaboration between industry and universities on research projects; and insufficient funding for students and research projects.
- 2.5 The recognition of these shortcomings and the recommendations to address them is, by and large, welcomed and supported.
- 2.6 However, there are some concerns about definitions: defining innovation is, due to its many dimensions, a complex issue, but we are of the opinion that the definition accepted by the OECD countries better captures the essence of innovation: -
- *Innovation is the implementation of a new or significantly improved product (goods or service), process, new marketing method or a new organisation method in business practices, workplace organisation or external relations.*
  - The important word here is ‘implementation’. This distinguishes clearly the difference between ‘invention’ and ‘innovation’, i.e. an innovation is more than the generation of a novel idea or the dissemination of knowledge, it is about the implementation thereof.
- 2.7 Likewise, we are concerned about the employment of ‘research’ and ‘innovation’ in a somewhat *ad hoc* manner. These are quite distinct concepts, but the Review report does not consistently honour this difference. We would like to suggest that attention be given to definition of terms so as to have a coherent and clear philosophical basis and a shared understanding. Without a clear definition of terms, there is a strong ideological content to ‘innovation’ which results in rhetoric, rather than content.

### **3. GOVERNANCE**

- 3.1 The key diagnosis here is that a coherent understanding of the National Science and Innovation (NSI) in government, business and society has not been achieved. In particular, coordination between government departments has been weak and the New Strategic Management Model (NSMM) has not been effective. Indeed, it has taken too long to establish cooperation between DST and DHET, as well as with other Government departments. In addition, the review asserts that there is a poor response by the NSI to market and social demand that needs to be addressed.
- 3.2 With respect to the need for coordination and integration, we strongly agree with the notion that the present fragmentation and competitiveness between the different players are problematic and that these detract from national productivity at all stages of the innovation pipeline.
- 3.3 If the setting up of the National Council for Research and Innovation (NCRI) can assist with cooperation and coordination across the research system, then it should be supported, but if the NCRI is going to impose yet another layer of bureaucracy, it will not be useful.
- 3.4 Indeed, the need for an additional structure, (the NCRI), should be considered carefully, and the question should be asked whether there isn't more merit in a current entity, such as NACI, with an expanded mandate, to take on the role of the envisaged NCRI.
- 3.5 However, if such an entity were already in place it would probably have been equipped and able to recognise the serious implications of the IPR Act for Publicly Financed Research (IPR Act), on the future of dti's THRIP programme, the alienation of relationships between industry and the higher education sector, and the impact of all of this on international collaboration. It would also probably have identified the incompatibility between the IPR Act and the 'Open National System of Innovation' referred to in the report.
- 3.6 It is further hoped that such an entity will indeed be able to streamline the regulatory environment as mentioned under Recommendation 10. In this regard, the Exchange Control Regulations and the Biodiversity Act are worth mentioning. The ever more complex value added tax (VAT) environment in which Higher Education Institutions operate should also be high on the agenda of problems to be addressed by such an entity.
- 3.7 In this regard, an additional recommendation is that the unintended consequences of the IPR Act (2010) be evaluated, and that the Act be amended where necessary to avoid disincentives with regards to industry-university partnerships.
- 3.8 Nevertheless, should the establishment of the NCRI proceed, the composition of this Committee will be critical and the inclusion of active and knowledgeable players in this field is of the utmost importance. In addition, care should be taken to constitute the Committee in such a way that the important constituencies are not left under- or unrepresented at the highest level.
- 3.9 Furthermore, since the Review report presents business and private industry as 'saviours' of the NSI, these stakeholders should have significant and transparent representation.
- 3.10 What is of concern is that it does not appear that the NCRI will make provision for provincial/regional representation, whilst the report discusses initiatives at a provincial or regional level. It is worth noting that most of the most successful innovation hubs in the world were the result of regional initiatives that enjoyed support of their national governments.

- 3.11 Notwithstanding whether NACI becomes the NCRI or not, the transformation of this entity into a new Office of Research and Innovation Policy, which will, inter alia, become responsible for the national R&D and Innovation Surveys (Recommendation 3) and the establishment of a centralised facility to serve as a repository of evaluation information and the NSI (Recommendation 29) is supported, but this new Office should also coordinate all the relevant indicator groups, such as the indicator groups of the HSRC, NACI (as it currently exists) and of the DST, under one umbrella. Consequently, the establishment of this Office requires further interrogation and role clarification, also in the light of the expanded mandate suggested above.
- 3.12 In this regard, the current monitoring of the system is a combination of valuable data sets such as those collected by the DHET for HEMIS and the report on research outputs of HEIs, which is a consequence of a comparative analysis of performance. Other data sets are fragmented and of less value. We support a more systematic approach to the codification of agreed indicators and an enhanced capacity for analysis. The definition of the function of ORIP in these recommendations will provide a sound institutional base for assessing the performance of the NSI and it should collaborate with DHET in relation to HEMIS data collection.
- 3.13 Furthermore, the current planning and staffing capacity with regards to the national RIMS project should be urgently evaluated in view of the above. Also, the success (or lack thereof) of the RIMS needs further elaboration and discussion as its efficacy across the system is highly variable.
- 3.14 Nevertheless, the recommendation that three policy nexuses should be established is supported. The one focused on education is in nascent form, while the other two, one on business and enterprise development and the second on social development and social innovation need to be established rapidly. All are needed to achieve the significant coordination and coherence of government policy which is currently absent. In fact, given the difficulties around harmonisation of policies, we suggest that the focus should be on finding common ground and on developing a single policy on how the triple helix should manifest itself in addressing the future grand challenges in innovative ways. These coordination functions will need to be overseen by the new NACI/NCRI.
- 3.15 A review of the Technology Innovation Agency (TIA) has our full support. We accept that the merging of several entities is normally more complex than originally anticipated, but it is a fact that the commercialisation of viable technologies has been seriously jeopardised during the last few years. It was also, in the run-up to the creation of TIA, been suggested that there will be new funding models to bridge the innovation chasm – our experience is however the opposite, i.e. the current funding structure has actually broadened the chasm.
- 3.16 Furthermore, we support the recommendation that TIA and NIPMO be reviewed in order to clarify their roles.
- In research and development, the coordination between scientists and entrepreneurs should be supported and facilitated by TIA, but TIA is falling far short of its mandate;
  - The linkage between science, job creation and service delivery is key to national development and is poorly recognised or understood;
  - Coordination of these is needed at the national level, coupled with the recognition and understanding of social innovation and how to manage innovation to derive benefit from it.

- 3.17 The re-organisation of a better resourced external governmental agency system (which would require significant restructuring and improvement of management of the current NRF, while reducing exorbitant agency overhead costs by improving and simplifying processes, and particularly reducing the current piecemeal offerings), to focus primarily on the purposeful and adequate resourcing of well-performing, multiple output research groups, in order achieve funding alignment and coordination on behalf of all government departments, is strongly supported. We therefore support the proposal that the public grant making agency function be consolidated in the NRF and consider the review of NRF functions to be important, particularly in configuring the Board/Council to ensure that all current agencies are represented and the DST should not be able to ring-fence or earmark funding without its approval.

#### **4. FUNDING AND FINANCIAL IMPLICATIONS**

- 4.1 The review report points to the fact that research teams are not being adequately supported, that infrastructural requirements are not being met, that private investment needs to be further encouraged and that foreign direct investment in research and development needs to be encouraged.
- 4.2 The call for a significant increase in public and private funding for the NSI is therefore strongly supported: quantified short, medium and long term targets should be set (and monitored) in terms of expenditure on the NSI as a percentage of GDP.
- 4.3 Given the various modes of research (i.e. from fundamental/basic research to applied research closer to market) and the various funding agencies and departments, a mechanism where a 'seamless grant making regime' is created, should be established. This should be facilitated by the envisaged stronger central coordination and unitary research and innovation vote. Grant making is often one of the constraints for researchers and the success rate is decreasing. A seamless funding mechanism could act as a catalyst for greater success rates.
- 4.4 The proposed urgent increase in overall funding, in particular to successful researchers and their teams at HEIs, and the judicious increase in numbers of SARChI Chairs and CoEs, as well as the establishment of prestigious Research Institutes, are supported. Nevertheless, this does not exclude much needed support for young researchers during the extended time that it takes to become an established researcher.
- 4.5 However, while much weight is given in the review report to the success of the SARChI process, possible unintended consequences should be considered. While the Chairs initiative provides an excellent mechanism to bring new research direction and talent into the system, it can have a debilitating effect, in certain instances, when offered to those already in the system. For example, where these Chairs are awarded to well-established older South African academics in small highly productive departments (where they remain in these departments but in this new and different research role), the sudden loss of their committed involvement in academic leadership and teaching can hamstring these departments. Further, the infrastructural requirements needed to house SARChI Chairs can also lead to friction within these small space and resource-limited departments.
- 4.6 Of importance overall, it is not clear to what extent the financial implications of the recommendations have been taken into account. The implied cost related to some of the recommendations will however result in greater returns in the NSI due to higher efficiencies,

and increased output in innovation, increased human capital development and an accelerated drive towards transforming the economy from a resource intensive economy to a knowledge intensive economy.

- 4.7 Related to the above, the Review report fails to provide a model for calculating what resources are required in the input process/output model for the HEIs. It also does not adequately address the question of what the STI landscape will look like if all the recommendations are implemented successfully. While the demand side for doctoral graduates, research outputs, patents, innovation etc. is well understood, the report fails to provide a model for calculating what resources are required on the supply side, i.e. from HEIs. Without an increase in the resources on the supply side, the increased demand cannot be met.
- 4.8 We note the comment that venture capital is readily available in South Africa. Unfortunately the players in the venture capital arena are not investing in 'deep science', but rather almost exclusively in the ICT and software development area. Most HEI technologies also tend to be too early stage for venture capital investment.
- 4.9 Finally, we note a number of gaps in the discussion:
- Bearing in mind that the suggested revenue in relation to the establishment of Industrial and Research Innovation Funds will be derived from mineral royalty streams, we are concerned that there is no evidence in the report that industry (the mining sector in particular) was consulted on this matter.
  - The report also does not give due credit to industry's existing contribution to research and development at HEIs. Industry is actively contributing towards research – in some cases more than the government's contribution.
  - In addition, it seems that there is no knowledge of the existing tax incentives available for industry to support research and innovation, notably section 11D of the Tax Act. Universities are already benefitting from this incentive.
  - An assessment of the existing funding landscape, not only with reference to industry, but also in respect of the governments' existing innovation funding schemes from other departments, including the dti (IDC and SPII), SARS, the DST, the DHET and the NRF, would have been helpful. In this way, existing initiatives could be exploited optimally.

## **5. THE QUADRUPLE HELIX (and more about funding)**

- 5.1 It is recommended that collaboration in quadruple-helix strategies be facilitated by devising funding strategies that steer research and development around collaboration, improving economic and scientific infrastructure, creating networks and partnerships, developing markets and linkages and funding for business innovation activities.
- 5.2 In South Africa many of these components are currently delivered, but as noted earlier, through various fragmented programmes. An approach is needed that will seamlessly integrate funding across the innovation chain in tight quadruple-helix strategies. For this reason, a revision is required of the NRF funding modes, the TIA funding programmes and funding initiatives by the dti and the IDC to understand their boundaries and the effect these have on the 'innovation chasm', as well as the 'pre-commercial incubation gap' in order to ensure a value chain from fundamental/basic research to commercialisation.
- 5.3 It is further recommended that the transition between early pre-commercialisation (overlapping with the TIA role) and full scale industrialisation and commercialisation (more

the dti, IDC and private sector roles) be evaluated to ensure a seamless transition, especially since different agencies and different departments are involved. In fact, the entire funding regime must be visible to researchers to understand the context of their research along the innovation value chain. The establishment of a coordinated funding mechanism to prevent gaps or duplication, and to match needs to appropriate funding mechanisms, is required.

- 5.4 Furthermore, improved incentives to stimulate the formation of triple/quadruple helix partnerships and business/industry investments in research and innovation are required.

## **6. RESEARCH INFRASTRUCTURE AND EQUIPMENT**

- 6.1 The sector is of the opinion that without appropriate infrastructure and equipment and a recapitalisation strategy for infrastructure and equipment, the innovation circle will be incomplete.

- 6.2 However, to ensure effectiveness and efficiency in the deployment of infrastructure the maintenance cost of ensuring minimum research equipment downtime requires greater recognition. The long term costs of maintaining research equipment and employing, in some cases, additional technically competent research staff to take charge of high-end equipment and continue to drive the research agenda, often exceeds the original purchase cost of the research equipment. In the report the cost of sustaining the research infrastructure is not adequately addressed.

- 6.3 Nevertheless, the identified urgent need to address research infrastructure and equipment shortfalls, and the national imperative for expensive research equipment to be managed sustainably, according to reasonable pricing structures (for which researchers must receive adequate funding from the funding agency), and with the necessary specialist support staff, is appreciated.

- 6.4 Finally, the Review report is rather short on specific strategic interventions that will yield the desired impact. Although the report emphasises the importance of collaboration and sharing of equipment and resources between institutions; what is needed is more definite and detailed plans on how collaboration and sharing of equipment, facilities (laboratories, library, etc.) and human capacity will be 'enforced'.

## **7. HUMAN CAPITAL AVAILABILITY AND DEVELOPMENT**

- 7.1 The Review report notes that one of the key weaknesses of the South African NSI is the 'shortfall in human capital development', an issue with which the sector is very familiar. We support the view that the NSI system should be conceived as an internationally open system with 'inflows and outflows of all kinds, including skilled people' as one way of improving the current human capital crisis in the research community.

- 7.2 However, it should be noted that there is often tension between the need to expand the South African research community's interaction with the international research community, on the one hand, and a strong emphasis on the 'national', on the other. National political priorities often hamper South Africa's integration into an international knowledge economy which is characterised by exchange, openness, interaction, integration and cooperation – as well as competition. The latter is a positive impetus to innovation, the former preconditions innovation research.

- 7.3 Nevertheless, we support the presence of a strong human capacity development component in the different sectors of higher and further education as critical to an effective national system of innovation.
- 7.4 Post-doctoral fellows in particular can play an important role in the ‘implementation’ part of innovation – more so than Masters and PhD candidates. It is worth noting that a programme such as the Centres of Competence places a huge emphasis on capacity development in terms of Masters and PhD training. We would argue that a Centre of Competence should consider its main objective to be the implementation and commercialisation, and that focus should rather be on the appointment of postdoctoral fellows; Masters and PhD training should be the focus of the Chairs initiative and a Centre of Excellence.
- 7.5 Furthermore, encouraging and facilitating South African PhD graduates to add to their skills levels by entering postdoctoral research programmes outside of South Africa and opening opportunities to attract them back (we can learn from India in this regard), while at the same time attracting postdoctoral research fellows into the system, would be a useful initiative. A suggestion that foreign postdoctoral fellow should be given a seven year work permit has much merit as is the easing of immigration restriction to skilled academics and research support technicians.
- 7.6 However, the relevant government departments (i.e. DST, DHET, Home Affairs) must pursue this strategy in a much more organised, coherent and centrally-driven manner as opposed to leaving this to individual institutions to address.
- 7.7 In addition, the funding of a national competitive early academic career (post-postdoctoral) tenure track system (not dissimilar to the USA practice), aligned with the goals and funding cycles of the Thuthuka funding programme, would be a possible way to increase the pool of potential academics available to the system.
- 7.8 The desire to drive postgraduate studies and doctorates, particularly in SET should also be accompanied by strategies that address the significant shortages of adequately qualified teachers in science, maths and other scarce disciplines, and of academic staff more generally.
- 7.9 As school education is ultimately the stepping stone of developing scientists and innovators of the future, we suggest that far more attention needs to be given to incentives for the teaching of maths and science.
- 7.10 The higher education sector itself is under-resourced. Graduation rates have not improved in the past decade. This is not surprising, because despite an increase in enrolments, the number of academic supervisory staff has remained constant, and with it, the success rate. Setting targets for doctoral graduates will have no impact unless the pool of quality supervisors is expanded exponentially.
- 7.11 Also, although the need for broader-based qualifications, and the need for multidisciplinary and interdisciplinary qualifications is mentioned, we feel that this aspect is worth some further elaboration, particularly as this will impact on accreditation and quality assurance regimes already in place. Furthermore, multidisciplinary coursework degrees will be influenced by the current funding structures (which at the moment do not fund coursework degrees with the same status as other degrees).
- 7.12 Further, now that we know what South Africa’s future role in respect of the SKA is, the report should include specific strategies to build and grow sufficient capacity in all knowledge fields relevant to SKA.

- 7.13 Nevertheless, the proposed reassessment of, and improvement in, funding for postgraduate students, which should incorporate a significant funding mechanism for students from the rest of Africa registered at South African institutions, in view of the 'brain gain' imperative is supported. Also, the urgent adoption of a bench/running fee component of freestanding postgraduate bursaries is required.
- 7.14 Finally, the issues of academic staff salaries urgently need attention. Without a significant injection of financial resources for staffing, the under-resourcing of the university sector will continue to erode research productivity and human capacity development. More and more is expected of a decreasingly small pool of experienced academics to 'fix' the system from within without a commitment to increase staffing budgets so that more staff can be hired to spread the burden. Without an expanded base of productive researchers, the recommendations will have limited impact.

## **8. SILENCES AND WEAK EMPHASES**

- 8.1 The Review report does not grapple with the difficult issues around how the fundamental quality of openness chimes with equity, quota systems, pre-/post 1994 citizenship, nationality, and ethnicity that are inherent in the South African situation.
- 8.2 The report also does not seem to have sufficiently taken other emerging policy directions into consideration. While recommendation 16 deals with FET colleges, it falls short of the issue of articulation of FETs to universities. The articulation is crucial both as a conduit of strengthening academic background, but also as a way of expanding access.
- 8.3 Consequently, we do not think that the concept and importance of vocational education and training in innovation is appropriately addressed in the report.
- 8.4 The report is also silent on the relationship between the science, technology and innovation landscape and a differentiated post-school sector, including a diverse and differentiated higher education sector. The roles and functions of the various sectors therefore require further elaboration.
- 8.5 The sector is surprised that the report did not attempt to assess or understand the impact of existing science parks in South Africa, notably the Innovation Hub and Technopark and others.
- 8.6 In the same vein, the report puts a distinct focus on the role and importance of higher education in the innovation space, but it seems that the role of the Science Councils is rather underplayed. The briefings should have been inclusive of all major Science Councils, including those reporting to other government departments. Recommendations should include a very close working relationship of DST with the DoH, DHET and DAFF (to name but a few).
- 8.7 Current successes (and failures) are also not really addressed: there are several pilot projects (e.g. Wireless Mesh Network technology; essential oils SMMEs; the abalone hatchery project), which now need to be rolled out as fully fledged industrial ventures. It would be a test of DST strategic planning for innovation to see whether any of them can in fact be developed into full scale sustainable industries.
- 8.8 We also do not see an assessment of the success of the current science missions (the Agulhas and Antarctic research, SALT and Meerkat).
- 8.9 Other successful initiatives not discussed in the report include the Technology Top 100 programme, and the Southern African Young Scientists' Summer programme.

- 8.10 The need to view social innovation as an important potential product of research and development needs much more exploration and elaboration as it seems that the NSI has very little understanding of what this may entail. The establishment of a social innovation fund will require a deep understanding of the purpose and benefits of the fund, as well as a commitment from other government departments to be involved.
- 8.11 Finally, it is noted that the report is silent on entrepreneurship and the relationship between innovation and entrepreneurship. We must also develop entrepreneurs (who could be Master and PhD graduates), who are willing and capable to implement inventions and ideas.

## **9. SUMMARY AND FINAL COMMENTS (in no particular order of importance)**

- 9.1 The Review report should contain a final chapter where all the recommendations made throughout the report in the different sections and themes could be summarized – perhaps ranked in terms of priorities.
- 9.2 The DST Ten Year Plan for Innovation (2008) should be revised and updated to incorporate deviations from, and improvements to, the plan (such as reference to Generation IV reactor technology and PBMR, the notion of the Bio-economy, previously terms the Farmer-to-Pharma grand challenge, etc.) in rolling cycles.
- 9.3 While there is a recommendation to subsidise the national licences for high impact journals (which is supported), no reference could be found to subsidisation of database search engines such as SciFinder, Scopus and Web of Knowledge. Rapid access to prior knowledge across journal and discipline boundaries is necessary to rapidly advance the research and innovation agenda.
- 9.4 Recommendation 10 is supported but the implications of the IPR Act (see section 2) for the THRIP programme should be given urgent attention.
- 9.5 The importance of design is totally overlooked in the report. Economic growth requires novel and innovative products that must be designed by engineers and industrial designers. The work of the SABS (via its DISA Institute) should be noted in this regard. DISA has done much work in the past to promote innovation by means of industrial design.
- 9.6 To avoid wastage in the system, we strongly believe that all recommendations should be aligned with clearly identified goals and objectives. Currently the report is somewhat lacking in creative or inspiring plans.
- 9.7 Until now, research and innovation has been seen as primarily a supply side activity. An improved future requires a balance between supply of, and demand for research and innovation. The NPC is a major stakeholder on a possible demand side. Based on its Vision 2030, there are several areas that could benefit from research and innovation. The implication for the identification of these areas in growing a critical mass of researchers is important.
- 9.8 A final concern: there are 23 HEIs, but only four institutions were consulted. Furthermore, no previously disadvantaged university or university of technology was consulted. This may skew the views held in this report.

**Ends**