SOUTHERN AFRICA INNOVATION SUPPORT PROGRAMME

STUDY ON REGIONAL INNOVATION
IN THE SADC REGION

FINAL REPORT

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STUDY ON REGIONAL INNOVATION
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### Acronyms

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AFDI</td>
<td>African Development Bank</td>
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<tr>
<td>AIO</td>
<td>African Innovation Outlook</td>
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<tr>
<td>AMCOST</td>
<td>African Ministerial Council on Science and Technology</td>
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<td>ANIS</td>
<td>Analysis of National Innovation’s Systems</td>
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<td>ARIPO</td>
<td>African Regional Intellectual Property Organization</td>
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<td>ASTII</td>
<td>African Science Technology and Innovation Indicator Initiative</td>
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<tr>
<td>AU</td>
<td>African Union</td>
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<td>EC</td>
<td>European Commission</td>
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<td>FDI</td>
<td>Foreign Direct Investment</td>
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<td>GCI</td>
<td>Global Competitiveness Index</td>
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<td>GEM</td>
<td>Global Entrepreneurship Monitor</td>
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<td>GERD</td>
<td>Gross domestic expenditure on R&amp;D</td>
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<td>NEPAD</td>
<td>New Partnership for Africa’s Development</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>PESTE</td>
<td>Political, Economic, Social, Technological and Environmental</td>
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<tr>
<td>PROs</td>
<td>Public Research Organizations</td>
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<tr>
<td>RISPD</td>
<td>Regional Indicative Strategic Development Plan</td>
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<tr>
<td>SABTIA</td>
<td>Southern Africa Business and Technology Incubation Association</td>
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<td>SADC</td>
<td>Southern Africa Development Community</td>
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<td>SADCC</td>
<td>Southern African Development Coordination Conference</td>
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<td>SAIS</td>
<td>Southern Africa Innovation Support</td>
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<tr>
<td>TTO</td>
<td>Technology Transfer Office</td>
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<td>UNCTAD</td>
<td>United Nations Conference on Trade and Development</td>
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The main objective of this consultancy service is to carry out a “Study on regional innovation in the SADC region for the Southern Africa Innovation Support Programme”.¹

This document represents our Final Report and it contains a description of SADC’s innovation landscape, a proposal for an optimized innovation analysis framework relevant to the region, an International Benchmarking which includes the identification of practices that are relevant to the gap areas identified in the SADC innovation framework, the elaboration of general recommendations for the development of SADC’s innovation system and finally, a set of recommendations for specific activities to be carried out under SAIS’s Component 4.

In this report we have also included the information gathered in the field study in the four SAIS pilot countries plus South Africa which have been extremely useful to identify the gap areas in the innovation system of the Region and to propose best cooperation international practices in our Benchmarking Section.

This Final Report includes all elements and deliverables required in the Terms of Reference for the consultancy, either as part of its main body or appended as annexes.

¹ It is necessary to remark that the word “regional” in this context refers to SADC as a region and not as an intra country initiatives.
1. Description of SADC’s innovation landscape

1.1 Characterization of the SADC region and its countries

The purpose of this section is to characterize Innovation Systems in the SADC region. This will include a characterization of SADC’s innovation system environment through the analysis of the history of the Southern Africa Development Community (SADC) region and the use of innovation related indicators.

1.1.1 Introduction and history of the SADC region

Our analysis commences with a Political, Economic, Socio-cultural, Technological and Ecological/Environmental (PESTE) analysis of the SADC, a regional bloc that is now 21 years old, having emerged from its predecessor the Southern African Development Coordination Conference (SADCC). SADCC was founded in Gaborone, Botswana in 1982, and arose out of opposition to the economic destabilization activities of South Africa. Newly independent Zimbabwe was the leading voice in SADCC, providing as its first Executive Secretary Arthur Blumeris who held office until his early untimely death two years later. He was followed by Dr Simba Makoni, also of Zimbabwe.

SADCC emerged from an attempt to counter South Africa’s regional economic hegemony, and was essentially the economic twin to the more political Frontline States initiative that sought to end minority rule through political, diplomatic and covert military means. With the 1980 independence of Zimbabwe, the Frontline States were strengthened diplomatically, militarily and economically, and this provided the spur to launch SADC.

Zimbabwe was then the strongest political and economic actor in SADC having inherited a diversified and strongly self-sufficient economy after its 1980 independence.

As of 1982 a full-scale civil war raged in Angola, Mozambique and northern South-West Africa, with spillovers into the then Zaire, Zambia, Zimbabwe, Botswana, Lesotho, Swaziland and Tanzania. These were wars triggered by resistance (supported by the USSR and sometimes PRC) to Portuguese imperial rule, and the European minority governments of Rhodesia and South Africa. In effect the sub-continent became a theatre for the proxy conflicts of the Cold War. South Africa sought to keep ‘the communist tide’ at bay beyond its borders and successfully kept the major military conflicts out of the then South-West Africa and South Africa itself.

Military stalemate in Angola between Cuba and South Africa subsequently led to the December 1988 New York Agreement of Angola, Cuba, and South Africa whereby the latter two countries withdrew their forces from Angola, leading to the 1990 independence of Namibia.

It should be noted that from 1920 to 1990 Namibia was essentially administered as a fifth province of South Africa.
The 1988 agreement occurred in the context of Soviet glasnost and perestroika as the Cold War thawed. 1990 also saw the normalization of political activity in South Africa that opened the path to the Windhoek Agreement of 1997 whereby SADCC became SADC and democratic South Africa emerged as the dominant political actor in the region.

Zimbabwe’s 1998 entry into the Zaire/DRC war then precipitated domestic political and economic instability.


An Inter-State Defense and Security Committee (ISDSC) deals with conflict resolution. SADC (South Africa and Botswana) intervened militarily in Lesotho in 1998, and Botswana supported a UN mission in Mozambique in 1994. Tanzania has contributed forces for service beyond SADC borders. Regarding peacekeeping activities elsewhere in SADC, South Africa has contributed troops and materiel to the UN for duty in Zaire and through the African Union in the Central African Republic.

During the Mbeki presidency over 1999 to 2008 South Africa played a key role in promoting the idea of the African Renaissance and together with Senegal, Nigeria and Algeria was instrumental in establishing the New Partnership for Africa’s Development (NEPAD) as a mechanism to strengthen Africa’s institutions and create an investor-friendly environment. In addition South Africa played a leading role in transforming the Organization of African Unity (OAU) into the African Union (AU), headquartered in Addis Ababa. At present South Africa’s former Foreign Minister is the Chairperson of the AU. NEPAD is now a programme of the AU.

SADC now comprises fifteen member states with a total population of 287 million (roughly one third of Africa). The population is youthful, with an unusually low life expectancy rate. Five SADC states are landlocked; three are islands.

Offshore are the small island states of Seychelles and Mauritius, and the large mass of Madagascar, which is among the politically unstable countries.

In terms of democratic norms, Freedom House ranks Mauritius (18), Botswana (30), South Africa (31), Lesotho (55), and Namibia (72) as ‘free.’ One should note that four of the ‘free’ states are members of the SA Customs Union. The Economist intelligence Unit Democracy Index is provided in parentheses for each country, indicating that the majority of SADC states score poorly on this index. The other SADC member states are either ‘partly free’ or ‘not free.’

The combined SADC Gross Domestic Product is in the order of USD 600 billions, and is strongly based on commodities, with the agriculture sector contributing some 17% to GDP. SADC displays highly diverse levels of growth and development, including the very high growth economies of Angola, Botswana, Mozambique and Tanzania. SADC’s Protocol on Trade requires Member States to implement measures eliminating all existing non-tariff barriers and to refrain from adding any new ones. “Special cases apply to certain goods, namely sugar. Because the sugar industry in
certain Member States is uniquely volatile, SADC recognizes that Member States would not benefit from the artificially low market that free trade of sugar would create. As a result, the Protocol on Trade contains the Sugar Agreement, which allows sugar-producing Member States duty-free access to members of the Southern Africa Customs Union but does not require similar duty-free access to their markets in return” (SADC, 2014).

The World Economic Forum Global Competitiveness Index ranks seven SADC states as factor driven economies: Lesotho (LS), Madagascar (MG), Malawi (MW), Mozambique (MZ), Tanzania (TZ), Zambia (ZM), Zimbabwe (ZW); two as between factor and efficiency: Angola and Botswana; four as efficiency driven: South Africa (ZA), Swaziland (SZ), Namibia (NA) and Mauritius (MU), with tiny Seychelles (SC) as efficiency/innovation driven. Democratic Republic of Congo (DC) is not classified.

Mining plays a dominant role in economies of the region even though there have been decades-long attempts by many countries to diversify their economies through import substitution industrialization. In the case of Zambia these date from the 1920s; other countries like Tanzania, Zambia and Zimbabwe embarked on this path as a result of the economic blockades resulting from the regional war to preserve/overthrow minority rule.

Thus, mineralization is extensive across SADC with coalfields stretching from Namibia through Botswana and Zimbabwe to Mozambique and into South Africa. Angola is rich in oil and diamonds; Namibia in copper, uranium coal, and diamonds; South Africa in diamonds, gold, coal, iron, chrome, titanium, platinum and manganese; Botswana in diamonds, coal and copper and in a virtually endless list of minerals. DC is rich in tantalum, cobalt and tungsten all of which have high technology applications.

Other than in Angola, Oil &Gas represent green field opportunities as in Mozambique, Tanzania and to a small extent in South Africa; shale gas is another new unexploited resource. The offshore gas fields in the Mozambique channel are thought to be larger than those of the North Sea.

Hydropower is important in Mozambique, but under developed in DC, where the Congo River is assessed as having 40GW of potential. Lesotho is a major exporter of water and hydropower.

South Africa is the leading SADC economy, and though its exports are mainly primary products, its domestic economy is highly diversified, with services comprising 66% of GDP. This dominance spills over into SADC and takes many forms as for example through the SA Customs Union (SACU) - ZA, NA, LE, BW, SW-, the oldest continuously operating customs union in the world. SACU customs tariff transfers from its central fund to the recipient states comprises a highly significant component of state revenues: 40% for Namibia and following the financial crisis, 30% for Botswana. This allows for considerable political leverage should the occasion arise.

Two significant obstacles to development are the low status of health and education in the region, MU excepted. HIV/AIDS, tuberculosis and malaria (especially in the tropical regions) are significant causes of morbidity and mortality, with life expectancy having fallen over the last decades in most
states. Only Botswana and South Africa have been able to implement large-scale treatment programmes to treat these diseases.

Primary level net enrolment ratios (Global Education Digest, 2012) are generally above 86% (Lesotho 103% and Namibia 86%), though no data are available for Madagascar, Seychelles, Tanzania and Congo. Secondary level education net enrolment ratios are much lower, ranging from Angola at 12% to Botswana at 61%. Data for 2012 are unavailable for seven states, including Zambia, and Zimbabwe. For Namibia the 2011 figure was 54%, while that for South Africa may be estimated at close to 80% by using the data of its Department of Basic Education.

The overall picture is that in the more advanced countries average primary school net enrolment ratios are close to full participation, with a steep fall-off in the senior secondary phase. However the quality of school education is generally poor.

All countries have at least one main university, but higher education is essentially concentrated in South Africa that provides subsidized places to nearly 40,000 SADC students in fulfilment of the SADC Protocol on Education and Training.

Unemployment, poverty and inequality are strong features of all SADC member states, with Namibia and Zambia demonstrating among the highest recorded Gini coefficients. GDP per capita varies from below $1000 (Congo) to $20000 (Seychelles), with a SADC average of around $2000 per capita.

Turning now to infrastructure, SADC already exhibits one very strong unifying infrastructure project, the Southern African Power Pool (SAPP) that is headquartered in Harare and includes all twelve SADC continental states.

In a sense SAPP reflects South Africa’s electricity utility Eskom’s massive dominance in the region. Eskom operates power generation as far afield as Uganda (not an SADC country) and is among the largest electricity utilities in the world.

Eskom is far and away the largest SAPP player, even though it is struggling to meet domestic and regional demand. This in part explains the recent agreement between South Africa and Congo to construct the 4 Gigawatt Inga III hydropower station on the Congo River, an investment that is intended to boost the Congo economy (in which South Africa has mining interests) and pave the way for the Grand Inga project that could one day add 40 Gigawatts to the SAPP grid.

Another aspect of South African regional dominance is in rail, where the so-called “Cape Gauge” of 1067mm is standard across South Africa, Namibia, Angola, southern Congo, Swaziland, Zambia, Zimbabwe, Malawi and Tanzania, allowing for the use of common rolling stock from Cape to Congo, over a distance of some 3000km. Not quite Rhodes’ vision of “Cape to Cairo,” but a useful contribution to the seamless movement of goods. The problem is that line capacity is limited, and neither South Africa nor Mozambique could fully exploit the benefit of the commodity super cycle, being unable to shift sufficient volumes at the peak of the cycle. South Africa has now committed to large-scale rail and rolling stock upgrading, including manufacturing capacity.
Recognizing the importance of infrastructure, SADC has demarcated several Spatial Development Initiatives (Figure 1).

Figure 1. Spatial Developments Initiatives

References:
1) Central Development Corridor SDI
2) Tazara Development Corridor
3) Mtwara Development Corridor SDI
4) Nacala Development Corridor SDI
5) Zambezi Valley SDI
6) Beira Development Corridor SDI
7) Limpopo Valley SDI
8) Maputo Development Corridor
9) Gariep SDI
10) Walvis Bay SDI
11) Trans Kalahari Corridor
12) Namibe Corridor
13) Lobito Development Corridor
14) Malange Corridor

Source: Authors’ own elaboration based on SADC-Japan Infrastructure Investment Conference 2012

These corridors are at various stages of development. The Trans Kalahari and Maputo links are two effective corridors.

The SADC region stretches from the Equator to 34°S, with ecosystems varying from rain forest through savannahs, swathes of desert, the unique Cape Fynbos and island habitats, tropical and sub-tropical zones. The region is expected to be extremely vulnerable to global warming with fears of desert expansion and rising ocean levels. Namibia, Botswana, Zimbabwe, Zambia, and Lesotho are particularly drought-prone. Trans-border pollution is dealt with under the 2008 Lusaka Agreement, while the Regional Strategic Action Plan for Integrated Water Resources Management and Development (RSAP-IWRM) deals with the contested matter of catchment areas and river basins. The region is relatively stable geologically, with poor soils in the South. Mozambique, Angola, Zimbabwe, Zambia and DC have considerable agricultural potential.

The SADC coastal zone is roughly 6000 km in extent, and embraces the cool South Atlantic and warm Agulhas/Indian Oceans. Marine life is abundant but has been under severe threat through overfishing by foreign countries (Spain, Taiwan, China) and most SADC countries lack the resources to combat poaching and overfishing. Shellfish are in high demand, with abalone a much-prized item. Here again the East offers the greatest draw for this delicacy, and criminal syndicates are heavily involved in its exploitation. All the SADC maritime states have some fisheries research
capacity; inland Malawi is a leader in freshwater fisheries research. There is an SADC Protocol on Fisheries.

Concerning the use of information and communication technologies (ICTs), mobile telephony is reasonably well developed across SADC with a median penetration rate of 63% (International Telecommunication Union, 2013) ranging from Congo, Madagascar and Malawi at 30% to 120% for South Africa and 150% Botswana and Seychelles. On the other hand, Internet subscription rates are much lower, with median value of 13%, ranging from Congo 1.7% to Mauritius and South Africa at 41%. Thus, one observes strong correlation between GDP per capita, mobile penetration rates and Internet usage. Zimbabwe is an outlier with lower GDP/capita but higher connectivity rates.

Most SADC states display essential institutional elements associated with a system of innovation – a dedicated STI policy locus in government, public research organizations (PROs) in health and agriculture, academies of science, science funding bodies, and a range of regulatory authorities including standards.

In this latter area the SADC Standardization, Quality assurance Accreditation and Metrology (SQAM) is the oversight body for SADC STAN, SADCMEL (SADC Cooperation in Legal Metrology), SADCMET (SADC Cooperation in Measurement Traceability), and SADCA (SADC Cooperation in Accreditation). These activities are grouped under the SADC SQAM Expert Group.

Two Protocols have direct relevance to the functioning of national systems of innovation (NSIs), namely those for Education and Training (1997) and Science and Technology (2008).

The Protocol on Education and Training allows for the free movement of students and researchers, as well as requiring member states to set aside 8% of university places for other SADC students who will pay domestic student fees. The Protocol on Science and Technology is less specific and more concerned with promoting an ethos in which research (and innovation) can be conducted.

South Africa is both the SADC and African leader in science, technology and innovation (STI). In recognition of this ascendancy, as well as its debt to the region, a debt incurred both through labour exploitation and the wars of liberation, its Ministry and PROs have spent considerable effort to build links with Ministries, universities and PROs across the region.

These linkages have taken the form of bilateral S&T agreements, specific funding programmes, as well as networks jointly funded by South Africa and foreign partners as for examples SANBio/BioFISA, The European Union Framework Programmes, and now the Square Kilometre Array (SKA).
1.1.2 Definitions of Innovation

The current version of the OECD’s Oslo Manual (2005a) defines innovation as the implementation of a new or significantly improved product (good or service) or process; a new marketing method; or a new organizational method in business practices, workplace organization, or external relations. It distinguishes four types of innovation: product innovation, process innovation, marketing innovation, and organizational innovation. Furthermore, the concept of new may mean new to the firm; new to the market; or new to the world. A common feature of an innovation is that it must be connected to the market. Product innovation implies that the product has to be new or significantly improved and, similarly, process innovation entails that the means of producing the product or delivering the product to the market has to be new or significantly improved.

Finally, the manual considers the role of linkages and collaboration in innovation: that is, whether innovations are developed mainly by the firm itself, in association with others, or mainly by others.

In the case of developing countries, innovation should not be defined just in terms of shifting global frontier technology but in terms of what is new to the country. Because the global stock of knowledge is increasing rapidly, innovation in the context of developing countries should be considered, not just in terms of the creation of new knowledge (that is new to the world), but also in terms of products or services or forms of organization that are new to local practice, (not necessarily to global practice). Furthermore, innovation can be new to the country, new to the sector, or at a more micro level, new to the firm. Therefore, it is useful to distinguish five innovation related concepts:

(i) **Acquisition** implies acquiring technology that already exists abroad;

(ii) **Creation** implies the domestic creation of relevant new knowledge;

(iii) **Adaptation**: technology, whether domestically created or imported from abroad often has to be adapted to local conditions;

(iv) **Dissemination**; and (v) **Effective Use**: the new knowledge, whether it has been created locally or imported from abroad has to be disseminated and effectively used throughout the economy.

We argue that an innovation strategy should consider policies and mechanisms that improve a country’s ability to draw on global knowledge as well as domestic R&D effort. Such strategy should consider policies that have to do with trade, foreign investment, technology transfer, domestic R&D, human capital and education, in general.

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3 This is particularly true in agriculture, where new technologies such as hybrid seeds are very sensitive to specific local conditions. Thus further research and experimentation is often required to adapt them to specific temperate, soil, and water conditions as well as local pests. To a lesser extent even industrial technologies have to be adapted to local conditions, including local raw materials, special characteristics or other local idiosyncrasies such as sources of power or local standards, and climate or health conditions, etc.).
1.1.3 Innovation related indicators

In this section we introduce a description of SADC’s innovation profile through the use of indices and statistics. First, we provide a broad comparative overview of the SADC region, focusing on the levels of economic performance and showing the great diversity of SADC region through a number of development indicators. Second, we introduce a description of the business landscape of SADC countries. Third, entrepreneurship and financing indicators are presented followed by R&D related indicators that complete the description of SADC region.

Here we present a summary and a selection of indicators to characterize the SADC region. A more extensive set of indicators is presented in Annex 2.

1.1.3.1 Growth and Development indicators

In the past decade, after 20 difficult years of flat and often negative growth in several countries Africa’s growth rates have averaged well above 5 per cent. This impressive performance in the 2000s has been only temporarily interrupted by the global economic downturn and it is very similar to that observed in other regions of the world such as Southeast Asia (SEA) and Latin America and the Caribbean (LAC) (Figure 2).

![Figure 2. Gross Domestic Product growth per World Regions](image)

Source: World Development Indicators (WDI)
Notes: Growth rates are average, weighted on GDP share of country members’ regions

However, these high economic growth rates have not yet turned into improved living standards as those observed in other regions with a similar growth performance – SEA and LAC (Figure 3).

Thus, despite the recent dynamism of African countries, striking differences in per capita income persist both within and across world regions. In 2011, Gross Domestic product GDP per capita in
Latin America, Southeast Asia, and the SADC region amounted to USD 12145, USD 6299, and USD 3549 respectively.

Probably, the low starting point and the comparatively shorter period of above-average growth, has not yet led to the same magnitude of rising living standards that has been observed in these other regions with similar growth performance. Consequently, what really matters is if this impressive growth rate will be built on the types of productivity enhancements that are associated with rising living standards. A recent UN-WIDER study (Page and Shimeles, 2014) claims that rising growth does not translate into poverty reduction since most African economies are still too dependent on subsistence agriculture and have not appreciably transitioned to higher productivity manufacturing failure.

**Figure 3. GDP per capita – Purchasing Power Parity (current international USD)**

Comparing Africa and SADC’s performance and experiences with other, more advanced and developing regions helps to identify the region’s overall strengths and weaknesses. SEA provides an insightful benchmark for a large number of African economies: although both regions registered approximately the same levels of GDP per capita in the 1980s, Southeast Asia has since risen considerably more rapidly than SADC.

Inside the SADC region we observe a great diversity. One of the most obvious differentiators is the size of the country or the economy. The size of a national economy has implications for the scale and scope of the domestic market and may therefore condition a country’s economic development through its effect on such economic variables as the size distribution of firms, their industrial specialisation and export orientation. The region consists of relatively small countries in terms of surface or population such as Mauritius, Seychelles and Swaziland, but also larger ones such as the Democratic Republic of Congo. However, the most populous countries are not the...
largest in term of GDP, as in the cases of the Democratic Republic of Congo and Tanzania with large populations but poor economies (Figure 4).

**Figure 4. Share of GDP and Population (%) for Southern African Development Community Region by Member States – 2012**

The differences in population and GDP are reflected in large variations in gross domestic product (GDP) per capita. In Figure 5 we observe that Botswana, Mauritius, Seychelles and South Africa are the middle-income countries with the highest GDP per capita (constant 2005 USD) of the region. Among the non-fragile low-income economies Madagascar, Malawi, Mozambique and Tanzania are well ahead of the middle income countries just mentioned. Making a regional comparison, in this figure 5 we can also observe that in terms of gross national product (GDP) per capita Botswana, Mauritius and Seychelles are well above the Latin America and the Caribbean countries (LAC) and Southeast Asia averages.

In addition, the SADC states exhibit diversity in the composition of GDP.

African economies rely heavily on agriculture; for the SADC region, the agriculture sector’s share in GDP was 17.5% in 2009, and provided employment to more than 47% of the labor force. Globally, agriculture’s share in GDP is only 3.2%. On the other hand, the contribution of manufacturing to African countries’ GDP is smaller than the global average. Growth of informal activities and rapid urbanization is responsible for the sizeable share of the services sector, which can therefore not be interpreted as a maturing of African economies⁴ (c.f. Page and Shimeles, 2014).

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⁴ OECD Fact Sheet (2011). This fact sheet is jointly published by the United Nations Office of the Special Advisor on Africa (OSAA) and the NEPAD-OECD Africa Investment Initiative.
As Figure 6 shows, the richest countries in terms of GDP per capita PPP – Botswana, Mauritius and South Africa – have the smaller portion of their GDP explained by agricultural activities. From Figure 7 we also observe that the percentage of labor force employed in the agriculture sector is larger in the poorest economies as observed in the case of Lesotho, Madagascar, Tanzania, Zambia and Zimbabwe. This variability has implications for the place and dynamics of innovation activities in the countries of the region.

Figure 5. GDP per capita, per country (constant 2005 USD), 2012

Source: World Development Indicators

Figure 6. Value added by economic sector (% of GDP) - 2009

Source: World Development Indicators
Note: Namibia unavailable for the selected year (2009)
1.1.3.2 Business sector innovation indicators

The depth and diversity of innovation capabilities that are accumulated by, and deployed in, business enterprises are key to determining the effectiveness of innovation systems.

In this subsection we provide a brief introduction to the business landscape of SADC countries and we explore the reasons for their diverse performance in R&D and patenting. Next, we discuss the role of foreign firms and subsidiaries, which are a defining feature of the industrial landscape in any region.

1.1.3.2.1 Business landscape

Our main source of data for innovation and R&D indicators has been The African Innovation Outlook, which is the outcome of the first phase of the African Technology and Innovation Indicator (ASTII) initiative, an AU S&T Flagship Programme. It is important to remark that the information contained in the African Innovation Outlook (AIO) (2010) is a first attempt to collect information on STI in the region and was designed to serve as a learning mechanism based on implementing R&D and innovation surveys\(^5\), analysing the data and using the results in policymaking. It certainly implies that the data presented here are not free of inaccuracies and can

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\(^5\) The R&D and innovation surveys are underpinned by international best practice. The R&D surveys are informed by the definitions in the OECD Frascati Manual and the innovation surveys by the OECD/Eurostat Oslo Manual.
present some consistency problems, so in the text we have pointed some areas where readers are advised to exercise caution in interpreting certain related statistics.

The information contained in the African Innovation Outlook (AIO) (2010) allows us to provide a picture of the innovation activities performed by firms in the region.

The first ASTII finding is that innovation was present in all the participating countries, in both small and large firms. The innovation included product and process innovation as well as organisational and marketing innovation. In all cases, some of the resulting goods and services from innovative firms were sold outside of the producing country. Trade is a means of connecting the firm not just to purchasers, but to knowledge of markets, technologies and practices in other countries. The connection of innovative firms was a clear result in all participating countries. It also has found that, the client or customer is the lead source of ideas for innovation outside the firm itself. This was the case for every country, but one (where data was available). In the case of Mozambique, competitors were as influential as clients. Public institutions such as universities and technikons, governments and public research organisations were low on the list of external sources. Below, we cite some of the main findings included in that report.

- Product innovation (including goods or services) was done principally by the firm, but there was significant evidence of collaboration with other enterprises or institutions. There was also evidence of product innovation being done by other institutions, which was particularly strong in the case of Lesotho.

- Process innovation was also done principally by the firm, but there was also significant collaboration and some evidence of innovation by other institutions.

- The lead innovation activity was the acquisition of machinery, equipment and software, followed by R&D conducted by the firm. This order was reversed in the case of Ghana and Tanzania.

- Most countries considered the main impact of innovation to be the improved quality of the goods and services offered, followed by flexibility in production, an increased range of products, and increased capacity to produce. Tanzania and Zambia reported the importance of meeting government regulatory requirements as an impact of innovation.

- The barriers most frequently cited were the lack of funds in the enterprise and the cost of innovation.

- Other barriers included the domination of the market by established enterprises and the lack of information on both technologies and markets. Burkina Faso found the lack of qualified personnel to be the most significant barrier.

- Innovation activities, such as R&D, as well as innovation itself, are related to the size of the firm.
• Innovation can and does happen without the need for in-house R&D within the firm, but this raises questions about the source of the knowledge supporting the creation of value in the firm. For those countries that reported this statistic, the percentage of firms that were innovative and performed R&D is near 50% with the exception of Mozambique where 24% of innovative firms conducted R&D.

• Another finding was that process innovation was done mainly by the firm, but sometimes in collaboration with others. In fewer cases, process innovation was done by organizations outside the firm, an example of which was the firm’s purchase of a new process technology, thereby making it innovative at the level of ‘new to the firm’ with respect to process innovation.

1.1.3.2.2 Foreign firms and subsidiaries

As we mentioned above, acquisition is one of the most important channels through which technology is transferred across countries (specially in developing countries) and by encouraging Foreign Direct Investment (FDI) and Multinational Enterprises (MNEs) to establish local facilities, governments hope to generate the transfer of technology to local firms (OECD, 2011).

That is the case, for example of Southeast Asian countries where large foreign firms and their subsidiaries dominate the economies of Singapore, Malaysia and Thailand, accounting for large parts of high technology exports and constituting the main patent filers. Certainly, this is not the case of SADC region countries where only South Africa has an important role as a foreign affiliates host, although well behind Asian Developing Countries.

Figure 8. Number of foreign affiliates by country, 2010. SADC Region

Source: United Nations Conference on Trade and Development (UNCTAD)
In Figure 10 we can observe a striking difference between FDI inflows to the SADC region versus other developing regions. The rationales for foreign investment by multinational enterprises vary, depending on firm-level strategies and conditions in the host country. Certainly, SADC member countries do not look attractive for foreign investors.

**Figure 10. Foreign Direct Investment inflows to SADC, Central America, South America and Southeast Asia, from all investors (USD millions)**
As to FDI in the SADC region, the main source is now China, with South Africa in second position. As in SE Asia, some of this FDI is ‘efficiency enhancing’ at the point of production, but much is also going into ‘shifting dirt’ through the construction of railways, harbours and airfields. It is notable that both the US and Japan, as a reaction to Chinese influence, have recently shifted attention to Africa. Japanese Premier Abe recently visited Mozambique to sign off $577m in loans. The stellar growth of FDI in Angola, Botswana, Mozambique and Tanzania has resulted from a very low base and is entirely commodities led.

By contrast South Africa, even with one of the twenty most active and largest bourses in the world seems stuck in a middle-income trap of its own making, as its polity seems unable to achieve sufficient consensus among state, labour and capital to create new firms and jobs at home. Instead South African capital has flowed northwards over the Limpopo River in the form of a “brand trek” of its services companies. The extent of this footprint is suggested in Table 1.

The Table itemises the presence of leading South African firms in the four countries that comprise the SAIS project.

With the exception of Madagascar there are bourses in all SADC states. In general they are of low volume, with few listed companies, reflecting the weak state of private enterprise in the countries.

1.1.3.3 Entrepreneurship and investment finance indicators

New business ventures can play important roles in upgrading the aggregate productivity of economies. They can displace firms with lower productivity and place incumbents under competitive threat. And they can enable the exploitation of knowledge that might otherwise remain unexploited in large firms, universities and research organizations, which makes them especially important in breakthrough innovations.

However, the vast majority of start-ups innovate very little compared to large firms, and there is just a small group of highly innovative and high-growth-potential firms with important individual impacts on jobs and productivity (OECD, 2010).

The Global Entrepreneurship Monitor (GEM) provides useful data on both the extent and nature of entrepreneurial activity. A recent Report on Subsaharan Africa allows us to make some conclusion on entrepreneurship on SADC region.  

Total early-stage entrepreneurial activity (TEA) is the key indicator of GEM and measures the percentage of adults (18 to 64 years) who are in the process of starting or who had just started a business.

The GEM survey distinguishes entrepreneurs who start a business as a result of an opportunity (“opportunity entrepreneurs”: those who seek to exploit a perceived business opportunity to generate income or wealth or gain independence in their life) from those who start it from

---

necessity (“necessity entrepreneurs”: those who start a business because they lack other realistic options for generating income and wealth).

Table 1. South African Johannesburg Stock Exchange (JSE) listed firms in SAIS countries

<table>
<thead>
<tr>
<th>Entity</th>
<th>Botswana</th>
<th>Mozambique</th>
<th>Namibia</th>
<th>Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Business</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BHP Billiton</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SABMiller</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Barclays ABSA</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard Bank</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>First National</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SASOL</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anglo Coal</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>MTN</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Vodacom</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Nandos (not listed)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mr Price</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pick n Pay</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Game</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Shoprite</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Makro</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Anglo</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Bidvest</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Grindrod</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sanlam</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Old Mutual</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Santam</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Tiger Brands</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Woolworths</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mediclinic</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altech</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Murray &amp; Roberts</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Aveng</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Illovo</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>SAPPI</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mondi</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nampak</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>De Beers</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Source: Authors’ own elaboration
In SADC region, most of the economies are in the factor-driven stage of development. Exceptions are South Africa and Namibia, which are considered efficiency-driven economies\(^7\). GEM research has consistently shown a relationship between GDP per capita and TEA rates. Generally, TEA rates are highest in the factor-driven stage.

In Zambia -as reported in Figure 11- 41,5% of the adult population is starting or running a new business, the highest rate among all the economies participating in the 2012 survey. The factor-driven economies also tend toward relatively high proportions of necessity-motivated entrepreneurs, which explains, at least in part, these higher TEA levels. Economies in the efficiency-driven stage typically show lower TEA rates. This could explain the lower TEA levels for Namibia (18,2%) and South Africa (7,3%). In many cases, this is due to increased industrialisation in this stage, which leads to more job opportunities with larger companies that displaces some entrepreneurial activity.

Thus, in economies with a low GDP per capita, TEA rates are generally high, with a correspondingly higher proportion of necessity driven entrepreneurship.

Figure 12 shows relatively high levels of necessity-driven entrepreneurship across the region, particularly in Malawi. High levels of necessity entrepreneurship reflect a lack of job opportunities. When comparing to other regions, on average, Latin America and Developing Asian countries present a higher percentage of opportunity-driven entrepreneurship.

\(^7\) According to the Global Economic Forum classification.
Concerning innovation activities at entrepreneurial level and to understand more about the level of innovation of new firms, GEM looks at two main variables with regard to the entrepreneur’s products or services: the degree of newness they represent to customers and the extent to which competitors are not offering the same products or services.

Figure 13 shows the percentage of entrepreneurs who perceive their products or services to be new to all, some, or no customers. This figure shows a low level of newness in general: many entrepreneurs believe that none of their customers would consider their offerings to be new, reinforcing the concept that many are starting ‘me too’ businesses. This is especially the case in Botswana and Zambia, where 67% and 68% state that there is no novelty in their products or services. In Angola, Malawi, Namibia and South Africa, a majority of respondents indicate that a high percentage of their products or services are new to some or all customers. This may indicate a higher degree of novelty in their offerings. Yet these findings must be regarded with caution. Some or many entrepreneurs may be selling less novel products into new markets, where customers are not familiar with them.
We now turn to the issue of enterpreneurial investment financing. Across all SADC’s countries, there are significant barriers to SME innovation performance, including access to internal and external financing. Internal finance is by far the most common source of investment finance in the group. The proportion of investments that is financed by equity or stock sales is low, as these options appeal to a segment of firms that is still largely underdeveloped in most countries. The second source of financing is the bank sector and the proportion of investment financed by this source is more common on medium size enterprise rather than in small ones.

The proportion of investment financed by equity is almost zero in all SADC countries (even for large size enterprises) reflecting the generally underdeveloped financial markets in the region.

Figure 14 shows the percentage of firms that consider access to finance as a major constraint. In the case of Congo, D.R. and Zimbabwe more than 60% of SMEs consider access to finance as the main obstacle in developing a business. On the other hand, South Africa and Namibia (efficiency-driven economies) present the lowest percentage of firms considering access to finance a a major problem.
Figure 14. Percent of firms identifying access to finance as a major constraint

Source: Enterprise Surveys (www.enterprisesurveys.org), World Bank

1.1.3.4 Science and technology performance and linkages indicators

The process of measuring countries' innovation performance and linkages is certainly a very difficult task, and even more so for developing countries where data is scarce and traditional indicators, such as R&D expenditures, are perhaps less relevant. A first section compares patterns of R&D expenditures and funding and R&D personnel across the region and beyond - essentially R&D inputs and capabilities. This is followed by a discussion of scientific and technological outputs across the region, in the form of publication and specialisation patterns this suggests.

Of the different types of science, technology and innovation (STI) indicators, research and development (R&D) statistics are probably the most widely used. In recent years several emerging economies, the People’s Republic of China in particular, have become significant actors in the global innovation system. There is evidence that R&D played a role in the takeoff of Asian economies such as China and Korea (Ang and Madsen, 2011). Along with other economic and social objectives, R&D aims to increase the stock of knowledge in order to introduce new applications and products, processes and services.

As we mentioned above, for R&D and innovation indicators our main source of data has been The African Innovation Outlook (AIO). The Outlook presents R&D and innovation indicators on the basis of the Frascati and Oslo Manual type surveys conducted by the national Focal Points. We also use data from the Unesco Institute of Statistics, World Intellectual Property Organization (WIPO) database and the World Development Indicators (WDI) databank.
R&D human resources

It is important to estimate the human resources that are available, and actually utilised, to do research in a country. If such resources are not available in sufficient quantities, then it does not matter how much a country is prepared to spend on research and experimental development. It may also be possible that human resources are available but not sufficiently qualified (AIO, 2010).

Table 2 reveals some interesting information. Among the countries surveyed, South Africa has by far the highest number of human resources available for R&D activities, with a researcher density of 815 per million inhabitants. At the other end of the scale is Mozambique with a researcher density of 24.8

As a rule the share of researchers among the R&D personnel is between 55% and 75% in most OECD countries (OECD 2010c). In the case of South Africa, Lesotho, Madagascar and Tanzania the share is higher than 67.5%. However, in some countries the ratio is as low as 25% (Malawi and Mozambique) with 30% for Zambia. This could be interpreted in different ways. If it is assumed that the ‘normal’ researcher/research personnel ratio would lie between 55% and 75%, the fact that the ratio is far lower in some countries could mean that researchers in some countries are supported by a much larger staff than in other countries, and this is not necessarily a bad thing. However, it could also indicate that there is an inefficiency problem in such countries. Another – rather simple explanation – is that ‘researcher’ has been defined differently in the surveyed countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>R&amp;D personnel</th>
<th>Researchers</th>
<th>Researcher % of R&amp;D personnel</th>
<th>R&amp;D personnel per million inhabitants</th>
<th>Researchers per million inhabitants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi ##</td>
<td>2007</td>
<td>2884</td>
<td>733</td>
<td>25</td>
<td>194</td>
<td>49</td>
</tr>
<tr>
<td>South Africa##</td>
<td>2007</td>
<td>59344</td>
<td>40084</td>
<td>68</td>
<td>1207</td>
<td>815</td>
</tr>
<tr>
<td>Tanzania##</td>
<td>2007</td>
<td>3593</td>
<td>2755</td>
<td>77</td>
<td>87</td>
<td>67</td>
</tr>
<tr>
<td>Zambia##</td>
<td>2008</td>
<td>2219</td>
<td>612</td>
<td>28</td>
<td>180</td>
<td>50</td>
</tr>
<tr>
<td>Mozambique##</td>
<td>2007</td>
<td>2082</td>
<td>522</td>
<td>25</td>
<td>95</td>
<td>24</td>
</tr>
<tr>
<td>Congo, D.R.#</td>
<td>2009</td>
<td>34820</td>
<td>12470</td>
<td>36</td>
<td>576</td>
<td>206</td>
</tr>
<tr>
<td>Madagascar#</td>
<td>2008</td>
<td>2702</td>
<td>1825</td>
<td>68</td>
<td>136</td>
<td>92</td>
</tr>
<tr>
<td>Lesotho#</td>
<td>2009</td>
<td>414</td>
<td>229</td>
<td>55</td>
<td>208</td>
<td>115</td>
</tr>
</tbody>
</table>

Sources: # Unesco Institute for Statistics (UIS) / ## African Innovation Outlook

In order to do research, it is, of course, desirable that the researcher has a solid and adequate educational background. All the participating countries collected information on this important aspect of R&D human resources. Details for researchers are not available for countries surveyed from ASTII initiative and published in AIO (2010), but data are available for R&D personnel as a

8It is not clear if these huge differences are real or just reflect different definitions of ‘researcher’, as discussed. This issue warrants further investigation. Thus, it is often considered that a researcher should have a PhD, or equivalent, but this is not necessarily the case.
group. On the other hand, the data that comes from Unesco Institute for Statistics (UIS) are at researcher level.

As we can observe in Table 3, there are striking differences between countries. South Africa (32%) and Lesotho (36%) have high percentages of PhDs among their R&D staffs. It is interesting that these are also the countries with the highest researcher densities. On the other extreme, there are several countries with low percentages of PhDs and high percentages of R&D personnel with non-tertiary education. This is particularly the case with Malawi, Madagascar and Mozambique. Although this is a fact that requires attention, it does not necessarily mean that research projects in these countries are staffed by less competent R&D personnel.

Table 3. R&D Personnel by Level of Education

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>R&amp;D personnel</th>
<th>PhD</th>
<th>Theoretically base university studies</th>
<th>Other Higher education</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi ###</td>
<td>2007</td>
<td>2884</td>
<td>208</td>
<td>436</td>
<td>350</td>
<td>1890</td>
</tr>
<tr>
<td>South Africa ###</td>
<td>2007</td>
<td>59344</td>
<td>19008</td>
<td>21712</td>
<td>18624</td>
<td>0</td>
</tr>
<tr>
<td>Tanzania ###</td>
<td>2007</td>
<td>3593</td>
<td>399</td>
<td>919</td>
<td>913</td>
<td>1362</td>
</tr>
<tr>
<td>Zambia ###</td>
<td>2008</td>
<td>2219</td>
<td>316</td>
<td>625</td>
<td>735</td>
<td>543</td>
</tr>
<tr>
<td>Mozambique ###</td>
<td>2007</td>
<td>2082</td>
<td>36</td>
<td>349</td>
<td>104</td>
<td>1593</td>
</tr>
<tr>
<td>Congo, D.R. ###</td>
<td>2009</td>
<td>12470</td>
<td>1852</td>
<td>10618</td>
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</tr>
<tr>
<td>Madagascar #*</td>
<td>2008</td>
<td>1825</td>
<td>131</td>
<td>1507</td>
<td>179</td>
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</tr>
<tr>
<td>Lesotho #*</td>
<td>2009</td>
<td>229</td>
<td>82</td>
<td>143</td>
<td>..</td>
<td>..</td>
</tr>
</tbody>
</table>

Sources: # Unesco Institute for Statistics / ## African Innovation Outlook
Notes: * Figures for Researchers only

R&D expenditures

R&D intensity (R&D expenditure expressed as a percentage of gross domestic product [GDP]) is an indicator of an economy’s relative degree of investment in the production of knowledge and is widely used for target-setting purposes. According to AIO (2010) SADC economies differ widely in their R&D intensity (see Figure 15). Malawi has the highest R&D intensity with gross domestic expenditure on R&D (GERD) of 1.7% of GDP\(^9\), followed by South Africa with 1.05%\(^{10}\). R&D spending in economies such as Tanzania, Zambia and Mozambique account for 0.25-0.48% of GDP. Congo, Dem. Rep., Madagascar and Lesotho are among the least R&D-intensive countries in the SADC region, with GERD ranging between 0.03-0.14% of GDP. It is worth to mention that GERD is

\(^9\) The AIO indicates that although this data might seem surprising it could be explained by the fact that Malawi hosts many international research institutions, especially in the health sector, including the Welcome Trust, Global AIDS Research Initiative and many others. There have also been important capital equipment investments in this field. Another sector in which international research institutions are represented in Malawi is agriculture, including the Consultative Groups on International Agricultural Research (CGIAR) centres, many of which have relocated to Malawi. Another reason is that Malawi receives considerable donor funding for R&D activities.

\(^{10}\) This data for South Africa are not in line with its own official statistics that was 0.95%.
only a partial measure (especially when compared to GDP) of the potential and the capabilities in innovation activities of a country, especially for developing ones, where innovation can and does happen without the need for R&D.

**Figure 15. Gross domestic expenditure on R&D (GERD) as % of GDP (R&D intensity)**

R&D intensity for the countries of the SADC region is, in general, well below the intensity of Latin America and Developing Asia countries. Only South Africa and Malawi present figures comparable to those regions and are still lower to the R&D intensity verified in OECD countries. We can also observe that some SADC countries, such as Congo, Lesotho, Madagascar and Mozambique have experienced declines, possibly explained by the financial and economic crisis.

**Performers of R&D**

National data on R&D track spending patterns of all major performers in the overall R&D system: government, higher education, business and private non-profit institutions.

The business sector is the main performer of R&D in the more advanced economies. In the OECD area it accounts for nearly 70% of the R&D performed. Japan’s and Korea’s business contribution to GERD is among the highest in the OECD area, with 77% and 75% respectively. In Southeast Asia, Malaysia’s business sector accounts for the largest share of GERD, with around 71% of total R&D in 2008, followed by Singapore (62%) and the Philippines (57%). Most countries that are now at the technological frontier have experienced a slow shift from a system in which government institutes
are the main public performers of research to a system in which universities are central. Countries differ, but the direction of the trend is clear in most OECD countries.\(^{11}\)

However, the landscape for SADC is different (Table 4). With the exception of South Africa and Malawi, the public sector (comprising the government and higher education sectors combined) accounted for the largest share of R&D expenditure in all of the countries surveyed. The two sectors combined accounted for over 50% of total GERD. The private non-profit sector accounted for a relatively small share of total R&D activity.

<table>
<thead>
<tr>
<th>Country</th>
<th>By Sector of performance (% GERD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Business sector</td>
</tr>
<tr>
<td>Malawi #</td>
<td>23,7</td>
</tr>
<tr>
<td>South Africa #</td>
<td>57,7</td>
</tr>
<tr>
<td>Tanzania #</td>
<td>*</td>
</tr>
<tr>
<td>Zambia #</td>
<td>2,0</td>
</tr>
<tr>
<td>Mozambique #</td>
<td>*</td>
</tr>
<tr>
<td>Congo, D.R. ##</td>
<td>0,0</td>
</tr>
<tr>
<td>Madagascar ##</td>
<td>0,0</td>
</tr>
<tr>
<td>Lesotho ##</td>
<td>0,0</td>
</tr>
</tbody>
</table>

Sources of R&D funding

The distribution of national R&D funds by source can be a useful indicator of government and business commitment to R&D, of the prominence of other national sources and of funding from abroad.

The financing of R&D does not necessarily come from the same source as where it is performed. Although it is no doubt the case that R&D expenditure in the business enterprise sector as a rule comes from the same sector, and the same is true for the government sector, it is not unusual for the government to finance part of the R&D expenditure in the business enterprise sector, and vice versa. Large amounts of the higher education expenditure on R&D usually come from the government but may also be financed by the business sector and private non-profit institutions.

With regard to funding of R&D, the business sector is the dominant source for the majority of OECD countries as well as for the biggest Developing Asia countries (Singapore, Philippines and Thailand).

\(^{11}\) OECD (2013).
While government funding of R&D is the second major source in most OECD countries, it is the most common funding source in the SADC region especially if higher education is lumped together with government. It is sometimes difficult to separate these two sectors in R&D accounting, and the experience of the ASTII surveys is no exception. In addition to financing its own research institutes, government also finances R&D at public universities, but universities sometimes finance R&D from their own funds. It is thus sometimes difficult to determine and distinguish financial sources.

Consequently, to obtain for a more realistic comparison of the role of governments, one might rather look at the sum of expenditure of the government and higher education sectors.

Thus, R&D activities in Africa are to a large extent financed by international donors and other foreign sources. This support is important to register, since the dependency should be expected to decrease over time, despite the fact that the international support is important at a capacity-building stage.

Among the countries surveyed, Mozambique is currently the most dependent on foreign donors, in that more than 50% of its R&D is financed from abroad, followed by Tanzania (38.4) and Malawi (33.1%).

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Business Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi ###</td>
<td>2007</td>
<td>22,8</td>
</tr>
<tr>
<td>South Africa ###</td>
<td>2007</td>
<td>42,7</td>
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<tr>
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</tr>
<tr>
<td>Lesotho #</td>
<td>2009</td>
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</table>

Table 5. GERD by source of funding (percentage)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
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<tbody>
<tr>
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<td>2007</td>
<td>32,9</td>
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<td>2007</td>
<td>27,7</td>
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<td>100,0</td>
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<td>0.6*</td>
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<tr>
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<td>2007</td>
<td>9.4*</td>
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<td>0*</td>
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<td>Zambia ###</td>
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<td>Lesotho #</td>
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<table>
<thead>
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<td>Mozambique ###</td>
<td>2007</td>
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<tr>
<td>Congo, D.R. #</td>
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</tr>
<tr>
<td>Madagascar #</td>
<td>2008</td>
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</tr>
<tr>
<td>Lesotho #</td>
<td>2009</td>
<td>..</td>
</tr>
</tbody>
</table>

Sources: # Unesco Institute for Statistics / ### African Innovation Outlook
* Including General University Funds

Scientific output

It is well understood that a more realistic and complete picture of the science, technology and innovation landscape in participating countries will require additional indicators to those produced from the R&D and innovation surveys. The analysis uses Scopus database as the main data source, but we have to mention that the vast majority of local African journals remain excluded from Scopus12. This ‘under-coverage’ is especially severe for disciplines in the humanities and social

12 AIO (2010)
sciences. This means that figures reported for these fields in this chapter generally represent lower estimates of actual output, especially for the larger countries.

South Africa dominates article output in the SADC region, with around 13627 articles authored or co-authored in 2012 -representing 80% of the regional total-. During the same period, 902 articles were published by authors in Tanzania, followed by authors in Malawi with around 407. The other countries in the region account for far fewer publications. The supremacy of South Africa in scientific output is obvious.

<table>
<thead>
<tr>
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<td>Botswana</td>
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<td>82</td>
<td>101</td>
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<td>Swaziland</td>
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<td>Angola</td>
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<td>15</td>
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<td>63</td>
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<tr>
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<td>11</td>
<td>20</td>
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<tr>
<td>Lesotho</td>
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<td>15</td>
<td>31</td>
<td>38</td>
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<tr>
<td>Seychelles</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>37</td>
<td>37</td>
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</table>

Source: SCIMAGO. Scopus database (Elsevier B.V.)

The shape of knowledge production

Differences in the shape and distribution of scientific output across scientific fields in different countries and regions of the world are determined by many factors. Some of these include the changing research demands (particularly the demands of agrarian economies compared with industrialising economies) and the strengths of scientific establishments (taking historical and cultural influences into account), as well as the state of governance and funding of scientific research. National knowledge production is also steered and shaped by national policies and the social inscription of science, in other words, what kinds of science (basic and strategic science areas) are prioritized and whether the social sciences and humanities are appreciated and supported, or merely tolerated and even ignored. Ultimately, size matters – larger science systems have the capacity for more diversity and more coverage of the full scope of the sciences; small systems, by definition, are limited in their ability to invest in specific scientific domains.
Whereas agricultural research dominated the research agendas of African countries in the 1990s, research in medicine and related fields now dominates. In addition to the challenges of dealing with traditional tropical and other infectious diseases such as sleeping sickness and malaria, the HIV/AIDS pandemic and the continuing effects of tuberculosis have led to renewed R&D effort in these areas. Issues related to food security, the effects of drought, poor crops, and the impact of internationalisation and open trade on certain markets have yet to generate appropriate R&D.

South Africa and Tanzania have developed some local capacity in the engineering sciences, especially metallurgical and mining engineering, chemistry and chemical engineering, and physics (including nuclear physics and astrophysics). Coupled with growing pockets of expertise in electronics, mathematics and computing sciences, the shape of knowledge production in these countries differs markedly from the rest of the continent.13

It should be noted that Africa’s share of world science continues to decrease. The few African countries where scientific output is substantial and even growing are not as productive as developing countries elsewhere in the world; these countries therefore do not have a significant effect on the overall findings in this regard. For Africa to become more competitive with respect to scientific output will require greater investment in human capital development, the strengthening of scientific institutions and equipment, as well as significantly higher funding for science.

It is important to remark two important things concerning the data of the bibliometric analysis presented in Annex 2. First, former English speaking countries have the advantage of the language for publication (just look at the distribution). Second, the way of counting the productivity is just a local address in a paper (whole counting) meaning that the role of the local people in the paper could be marginal and the amount of papers is shaped by increasing the co-authorship rate, which could explain why biomedicine is gaining relevance.

**Patents**

Patents are another way to measure R&D output. When using patent statistics, it is important to recall that not all inventions are patented. Other more informal modes are trade secrets and non-disclosure agreements. Furthermore, different fields and sectors demonstrate a varied proclivity to patent. Table 7 shows the number of patent applications in selected SADC economies under the Patent Cooperation Treaty (PCT). South Africa is well ahead in the number of PCT applications. The other countries in the region have few PCT applications: for example, in 2011, there were 19 from Namibia, 4 from Mauritius and 2 from Madagascar.

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13 AIO (2010)
For the period 2000-2011, the number of PCT applications has increased over time worldwide. In general, PCT data indicate that applications in emerging economies, such as Brazil, China and India, are increasing, while those in OECD countries have scarcely changed, with the notable exceptions of Korea and Japan. In Southeast Asia, Malaysia shows strong growth in patenting followed by Singapore, Thailand and the Philippines. The SADC region, on the other hand, patent filings showed an average annual growth rate almost null and in some cases a downward trend for the same period.

Global Innovation Index

Finally, in order to provide a full innovation landscape for the SADC region, we report the evolution of the Innovation pillar of the Global Competitiveness Index (GCI)\(^{14}\).

Innovation can emerge from new technological and non-technological knowledge. Non-technological innovations are closely related to the know-how, skills, and working. However, the Innovation pillar of GCI focuses on technological innovation.

On average, African economies trail the rest of the world in competitiveness: 14 out of the 20 least competitive economies are from Africa. Their performance is benchmarked against that of the OECD average, providing a sense of how these regions compare with a group of the world’s more advanced economies. It is also measured against the performance of Southeast Asia and Latin America, which are more comparable benchmarks in terms of stage of development.

Figure 16 shows that SADC economies consistently underperform the Southeast Asian and Latin America average across the Innovation Pillar of the GCI.

\(^{14}\) Global Competitiveness Report (World Economic Forum).
SADC has increased its score from 2.1 points seven years ago up to 2.94 (on a scale of 1–7), the region has converged gradually to close the gap with developing Asia and Latin America.

In Figure 17 we can observe the level of heterogeneity in the performance of innovation across SADC member countries. South Africa, evidently, increase the average of the region and Zimbabwe is the worst performer in the world.
South Africa, Mauritius, and Seychelles have already made significant gains toward international competitiveness, ranking highest in the region on 2012-2013’s World Economic Forum Global Competitiveness Report. Other Member States are also improving. The World Bank’s 2012 Doing Business Report for the SADC region cites that the Democratic Republic of Congo has reduced the time required to complete company registration and obtain a national identification number. Likewise, Madagascar has eliminated the minimum capital requirement for starting a new business and South Africa has implemented a new company law, which removed the requirement to reserve a company name and simplified incorporation documents.

Despite good progress, the 2012 SADC’s Doing Business Report shows that business procedures remain uneven throughout the region. While it takes only six days to start a new business in Mauritius, it takes up to 90 days in Zimbabwe. Likewise, the cost to start a new business (as a percentage of income) is 0.3 % in South Africa, but 551.4 % in Democratic Republic of Congo. It takes just 16 days to register property in Botswana, but 184 days in Angola. These variations harm the competitiveness of the region as a whole. For this reason, SADC is dedicated to working with its Member States to reduce these barriers, thereby increasing the economic productivity of the region.¹⁵

1.2 Innovation System of the SADC Region

Having presented a PESTE analysis and some innovation related indicators, we now turn to the task of describing the SADC innovation system as a whole.

Firstly, we present a characterization of the innovation system of SADC countries (individually and through a “typical” analysis) using the Analysis of National Innovation System (ANIS) approach.¹⁶ We also present the Field Study data to characterize the 4 SAIS pilot countries and South Africa in order to have a complete picture of the innovation system of these countries and the region. Finally, with the information coming from the desk study and Field Study we obtain a fuller picture of the innovation system of the region presented as through the ANIS perspective.

Analysis of SADC’s Innovation System

In order to provide a first insight into the Innovation System of the SADC region and its member countries we use an ad hoc application of the ANIS Approach. This is a powerful tool that will allow us to obtain a general perspective of the Innovation system in the region and to identify gaps in some areas or elements of the system. The ANIS approach is based on the assumption that an innovation system is mainly influenced by 30 determinants grouped according to a three-level hierarchy (see Box 1):

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• Policy (Macro) Level
• Institutional and Programmatic (Meso) Level
• Innovation (Micro) Level

Box 1. ANIS approach levels

<table>
<thead>
<tr>
<th>Macro Level – Innovation Policy Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the macro-dimension, national and regional innovation policies directly influence the framework conditions of an Innovation System. Laws, decrees and regulations, etc. at that level may often be path breaking, in a positive or a negative way. Public investment in innovation directly relies on decisions made at a policy level. However such political decisions may only influence the framework conditions for innovation and might not turn innovation into practice.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meso Level - Institutional Innovation Support Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutions operating at the meso level are typically technology transfer centres, clusters, innovation service providers and funding agencies. They may be considered as the relevant tools to turn any political decision regarding innovation into practice. In emerging countries such institutions are often publicly-owned. They mainly aim at fostering stakeholders’ competitiveness and capability to innovate. Rather than own different programmes to support innovation, those institutions usually provide in-kind contributions such as training, consultation, conducting applied R&amp;D or products’ improvement. These institutions remain a key instrument for improving and encouraging the innovation capabilities of firms, especially in countries where public investment is limited.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meso Level: Programmatic Innovation Support Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmatic innovation support includes public funding programmes and initiatives which aim at turning innovation policy into practice. This represents the second pillar in improving the innovation capabilities of stakeholders within an NIS. Such programmes might be managed either by policy makers or by innovation support institutions. Any measures at that level would require significant public investments. A programme in the ANIS sense indicates a targeted, time bound set of funds to support research or innovation in order to implement the national science and technology policy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Micro Level: Innovation Capacity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The micro level provides an umbrella for the main actors and enablers within an NIS such as SMEs, entrepreneurs, universities, public or private R&amp;D institutions, innovators or financial organisations.</td>
</tr>
</tbody>
</table>

The 30 determinants’ level classification is shown in Figure 18. A comparison between the determinants of these different levels allows the identification of key policy areas requiring a potential intervention to strengthen an innovation system.
1.2.1 Analysis of the Innovation System of a “typical” SADC country

Much of the thinking underlying ANIS is based upon European experience of the workings of innovation systems at national, regional and local level, including the role of clusters, and various institutional support mechanisms. An attempt has also been made to apply ANIS to the Latin American environment, notably to the innovation system in Brazil’s state of Manaus or in Mexico at the federal level and in most of the Mexican states.

Applying ANIS to the 15 SADC states is no mean task. Given the paucity of data with which to populate the 30 attributes, these have been augmented with additional data which is presented in Annex 3 (Table 11).

This enables one to construct a “typical” SADC state.

The typical state is a factor-driven, low-income economy, which scores poorly on democracy indices. It displays a very weak school system, and occupies the position 151 in the Human Development Index from 186 countries surveyed in 2012 indicating its poor performance in the indicators summarized in this index. Life expectancy is low and the burden of disease, especially infectious diseases, is high. Little by way of an autonomous needs-driven research system is in place, and the state offers but limited higher education opportunities, and probably no doctoral programmes in science, engineering and technology (SET). There is a science policy statement, but

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17 The human development index (HDI) is a composite statistic which takes three main factors into account: Life Expectancy at Birth, Literacy rates combined with stats about primary, secondary, and tertiary education levels, and finally Standard of Living which is a logarithm of Gross Domestic Product at Purchasing Power Parity.
the ratio of gross expenditure on R&D (GERD) to GDP is in the order of 0.2% or less. The typical state Research Fund has little access to national sources of funds, so that donor funds and foreign pharmaceutical funded clinical trials dominate the research landscape.

No independent measures of innovation are available and patent awards are typically less than 10 per year, while trademarks are overwhelmingly registered by non-resident concerns.

**The typical state** has a central high-profile agency that actively promotes foreign investment, though its efforts are retarded by the difficulty of doing business, with the ‘ease of doing business’ at 139th in the world\(^8\).

These observations are captured in the SADC-wide SWOT analysis in Table 8.

### 1.2.2 Analysis of the Innovation System of the SAIS programme pilot countries

The four states comprising SAIS stretch from the South Atlantic in the west across to the Indian Ocean in the east. Namibia has a long border with Botswana, while both meet Zambia and Zimbabwe at the four country crossing point of Kazungula. Zambia has a long border with Mozambique.

Namibia and Botswana have climatic and economic similarities: large desert areas, with savannah to the north along the Kunene and Okavango rivers respectively. They are sparsely populated (2 million inhabitants approximately), host large numbers of subsistence farmers, and are rich in mineral resources. Zambia and Mozambique have higher rainfall and more fertile soils, and much larger populations of around 14 million and 25 million inhabitants respectively.

Concerning transport infrastructure, Botswana and Namibia are linked by the Trans Kalahari highway and railway; Botswana to Zambia by road through Kazungula, and Zambia and Mozambique by road via Zimbabwe. Besides, there are few direct air links between the four capital cities, with Johannesburg acting as the hub for Windhoek – Gaborone; Lusaka- Windhoek is direct bi-weekly; Gaborone-Lusaka direct thrice weekly; Mozambique flights are all via Johannesburg.

With regard to the Science, Technology and Innovation indicators, the African Innovation Outlook (NEPAD, 2011) records a GERD of 0.25% for Mozambique and 0.37% for Zambia. The UNESCO World Science Report 2010 records 0.5% for Botswana, while Namibia is estimated to be around 0.3% (UNESCO, 2014).

\(^8\)Ease of doing business ranks economies from 1 to 189, with first place being the best(1=most business-friendly regulations). A high ranking (a low numerical rank) means that the regulatory environment is conducive to business operation. The index averages the country’s percentile rankings on 10 topics covered in the World Bank’s Doing Business. The ranking on each topic is the simple average of the percentile rankings on its component indicators.
Table 8. SWOT Analysis for a SADC “typical” state

<table>
<thead>
<tr>
<th>WEAKNESSES</th>
<th>STRENGTHS</th>
</tr>
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<tbody>
<tr>
<td>Weakly performing education systems</td>
<td>Peaceful co-existence across SADC</td>
</tr>
<tr>
<td>High burden of infectious disease</td>
<td>Framework of SADC Protocols</td>
</tr>
<tr>
<td>Rhetorical adherence to innovation policy</td>
<td>Visa free travel</td>
</tr>
<tr>
<td>Absence of a culture of reflection</td>
<td>Access to ZA universities and PROs</td>
</tr>
<tr>
<td>Inadequate measurement and evaluation systems</td>
<td>SA Power Pool</td>
</tr>
<tr>
<td>High cost of doing business</td>
<td>SADC rail and road network</td>
</tr>
<tr>
<td>Complex land tenure systems</td>
<td>Functioning standards authorities</td>
</tr>
<tr>
<td>Inadequate air links</td>
<td>Functioning IP registries</td>
</tr>
<tr>
<td>Small domestic markets</td>
<td>Regulation of clinical trials</td>
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<tr>
<td>Disarticulated innovation systems</td>
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<tr>
<td>Supply side approach to innovation</td>
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<thead>
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<th>OPPORTUNITIES</th>
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<td>MNC capture of innovation space</td>
<td>Rapid economic growth in some SADC states</td>
</tr>
<tr>
<td>Science system capture by interest groups</td>
<td>Greenfield mineral exploitation through state-MNC equity sharing</td>
</tr>
<tr>
<td>Brain drain out of SADC</td>
<td>Coal and O&amp;G reserves untapped</td>
</tr>
<tr>
<td>High levels of corruption</td>
<td>Renewable energy potential</td>
</tr>
<tr>
<td>Resource curse and Dutch Disease</td>
<td>Expansion of arable agriculture</td>
</tr>
<tr>
<td>Youth unemployment</td>
<td>S&amp;T partnerships with foreign PROs</td>
</tr>
<tr>
<td>Rising burden of non-communicable disease</td>
<td>Culture of connectivity</td>
</tr>
<tr>
<td>Poaching</td>
<td>Entry into supply chains for MNCs: goods and services, including STS</td>
</tr>
<tr>
<td>Illicit mining</td>
<td>Tourism</td>
</tr>
<tr>
<td>Porous borders</td>
<td>Development of low cost ICT applications</td>
</tr>
<tr>
<td>Environmental damage of mining</td>
<td>Software development in <em>lingua franca</em> (Swahili; Portuguese)</td>
</tr>
<tr>
<td>Over fishing</td>
<td>Improvements to transport corridors</td>
</tr>
<tr>
<td>Limited capacity to manage animal and plant diseases</td>
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<tr>
<td>Deforestation</td>
<td>Young population</td>
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</tbody>
</table>

Source: Author’s own elaboration

WIPO patenting and trademark data show that patenting is limited in the four countries, while trademark registration is growing strongly. The rise in trademark registration is entirely non-resident driven and will be largely due to the protection sought by foreign firms for products disseminated in these countries rather than the registration of new local products. One might speculate that the bulk of the trademark registrations are to South African firms.
Table 9. Various innovation indicators - 2012

<table>
<thead>
<tr>
<th></th>
<th>ISI</th>
<th>Patent grants</th>
<th>Trademark awards</th>
<th>GCI Innov</th>
<th>GCI Tech Readiness</th>
<th>GII/rank</th>
<th>Ease of doing business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>290</td>
<td>-</td>
<td>2199</td>
<td>3.0</td>
<td>3.1</td>
<td>31.4/85</td>
<td>56</td>
</tr>
<tr>
<td>Mozambique</td>
<td>191</td>
<td>1</td>
<td>2558</td>
<td>2.6</td>
<td>2.8</td>
<td>26.3/110</td>
<td>139</td>
</tr>
<tr>
<td>Namibia</td>
<td>160</td>
<td>2</td>
<td>2457</td>
<td>3.0</td>
<td>3.3</td>
<td>34.1/73</td>
<td>98</td>
</tr>
<tr>
<td>Zambia</td>
<td>315</td>
<td>-</td>
<td>2266</td>
<td>3.4</td>
<td>3.0</td>
<td>26.4/107</td>
<td>83</td>
</tr>
<tr>
<td>South Africa</td>
<td>13627</td>
<td>5296</td>
<td>31286</td>
<td>4.1</td>
<td>3.9</td>
<td>37.6/54</td>
<td>41</td>
</tr>
</tbody>
</table>

Sources: WoS; WIPO; WEF; INSEAD; World Bank

The “Ease of Doing Business” index points to problems for all four countries plus South Africa. Regulations designed to ensure the entry of nationals into the market may have the effect of limiting the emergence of new firms or even the expansion of existing firms. South Africa innovation performance falls short of its world rank by GDP, scientific outputs and financial market sophistication. Whilst the last indicator is strongly subjective, the former two are not.

South Africa has no room for complacency, it is achieving good returns across SADC by introducing its goods and services into these booming markets, but the issue for this country is how long this dominance can be maintained. On the other hand, the issue for the SAIS countries is for locals to compete with the MNCs, whoever they might be.

1.2.3 Field Study - Analysis of the Innovation System - SAIS 4-pilot countries plus South Africa

A field study was carried out from 20 to 29 of January, 2014 in the SAIS programme pilot countries (Mozambique, Botswana, Namibia and Zambia) plus South Africa. The field study involved exploratory talks and interviews based on a semi structured template. The interviewees included Government officials dealing with issues related to their National (and SADC) innovation System, researchers and senior level management of some publicly-funded research institutions, representatives of major industries associations and some privately-held firms. Annex 4 presents the list of institutions visited during out Field Study.

The idea was to complement the assessment of the innovation system in the region with insights from actors belonging to the macro, meso and micro level of the innovation map.

This study was found to be worthwhile in the sense that it not just undertakes an extensive effort to bring out comprehensive, factual data on various components of the region innovation system – some hitherto not widely known - but also in the sense that it enables a quasi-empirical characterization of the system as perceived by various stakeholders, both from the public and private sector.

The following Country reports are based on this research.

Botswana now displays a PCI of PPP$15700, the highest of the mainland SADC member states, well above South Africa’s PPP$11300, ahead of Brazil and just below Malaysia.

This shift, from a low-income country that at independence in 1966 was wholly dependent on S A Customs Union receipts, has been achieved in two generations. It rests largely upon shrewd exploitation of its considerable gem diamond deposits that were unknown in colonial times.

With the commissioning of the massively rich Jwaneng mine, the Botswana government renegotiated its equity share in holding company Debswana to 51%. More recently, in recognition of Botswana’s apex role in world diamond production, government was able to ‘persuade’ De Beers to move its London diamond sales or “sights” to Gaborone. This move is intended to stimulate a local cutting and polishing industry. Other mineral resources include coal and copper.

Prudent management of diamond revenues has generated a booming economy with a skilled and well-paid class of technocrats. There is a well-developed school system and primary health care network, though the latter has been stretched to cope with the HIV pandemic. This is being dealt with by a large programme of antiretroviral (ARV) dispensing.

The visitor to Botswana’s main centres is immediately struck by the massive penetration of South African services in retail, wholesale, banking, insurance, leisure, technical services and logistics. Proximity of South Africa has meant that industrial diversification has been slow. As one interviewee put it “we are an auxiliary of South Africa.” For its part the World Economic Forum (WEF) classifies Botswana as transitioning from factor to efficiency driven, with its innovation index at 3.3 compared with South Africa’s 4.1. What is then the future role for innovation in Botswana?

The Botswana innovation system includes the modern institutions that one might expect to find in a middle income economy: a leading university (University of Botswana), at least one RTO (the newly constituted Botswana Institute of Research, Technology and Innovation), many intermediary organizations (the Botswana Innovation Hub, the Botswana Bureau of Standards, the Botswana National Productivity Institute, the National Food Technology Research Institute); but little obvious R&D in the industrial sector. STI indicators are incomplete and out of date, with the last R&D Survey conducted in 2006, and no evidence of an Innovation Survey. Patent activity is very low, while trademark registration is foreign dominated. This suggests that technological innovation plays a minor role in the current growth path. The bedding down of the young Botswana International University of S&T (BIUST) should contribute to local innovation capacity. At present however, the startup phase of BIUST seems to be weakening the University of Botswana as it l siphoning off staff with offers of higher remuneration that offered in Gaborone.

But this is only part of the answer to the earlier question. The massive dominance of foreign capital in mining and services might imply that local interests will be entirely crowded out. However the careful political management of the resource bonanza has allowed for a shared
wealth to accrue to the state and foreign capital, whilst the services sector has presented a space into which Botswana entrepreneurs can grow, as in the supply of products to South African MNCs in the form of bulk quantities of red meat, poultry, and vegetables, and of security, IT and transport services. This penetration of well-established technologies has been facilitated by means of a suite of financial incentives including loans at well below market rates with security provided by the new business itself. It is clear that the technical skills needed for such large-scale, intensive animal production (now including pigs) is available locally. Entrepreneurs have identified market opportunities and have captured these. In other words new firms based on tried and tested technologies have come into being through various financial innovations.

There is also evidence of the emergence of local providers of technical services such a quantity surveying, land surveying, architecture and medical. As yet Specialized Technical Services (STS) has not emerged as a sector, though considerable consulting services emanate from the University of Botswana.

A wide range of financial institutions are at play in Botswana: these include large funders such as the Botswana Development Corporation, intermediate agencies such as NORSAD and smaller players such as the Citizen Entrepreneurship Development Agency, and the Local Enterprise Authority. Funding to expand innovation activities is therefore not the issue: the issue is the generation of innovation itself and the linkages among those engaged in innovation activities. The latter are weak, and skills are below the critical mass that will be needed; the implication is that Botswana may be constrained in breaking out of an emerging middle-income trap.

Interviewees were essentially unanimous in a view that SADC plays a negligible role in the local innovation space. South Africa is the dominant player and is regarded in a positive, rather than negative light. The Botswana Technology Centre (BOTEC), predecessor to the Botswana Institute For Technology, Research & Innovation (BITRI) has a long-standing Memorandum of Understanding with the Council for Scientific and Industrial Research (CSIR) of South Africa; there is cooperation between Botswana Vaccine Institute (BVI), Botswana Agriculture College and SA’s ARC; thousands of Botswana attend university in South Africa. In a sense the South Africa’s NSI stretches across the border into Botswana, a stretch that is given substance through organizations such as Regional Research Alliance (RRA) and the Southern Africa research and Innovation Management Association (SARIMA), not to mention the secondment of SA DST officials to SADC headquarters.

None of the above should be read as overly negative. The next few years will be critical for the way that the Botswana SI evolves — there are highly skilled persons in top positions whose task will be to define a few key issues to pursue and to do so with vigour. Achieving such focus requires political access and endorsement; given the present leadership in Botswana, it is attainable.

**B- Country Report: Zambia, “Leaping out of the box: from landlocked to landlinked”**

In the early 2000s Zambia broke out from its long status as an LDC and is now moving strongly upward toward middle income status with a current PCI of PPP$1500.
At independence in 1964 the economy was wholly dependent on exports of copper. This went southward through the then Rhodesia, via whom all manufactured imports also flowed. With Rhodesia’s isolation, the deepening of conflict in Angola and Mozambique, Zambia found itself in a rough neighborhood with its border virtually sealed. China then provided a northward lifeline through the construction of the Tazara railroad from Kapiri Mposhi to Dar es Salaam. Even so its completion in 1975 could not stave off external pressures, a slump in copper prices and poor domestic political choices were combined and produced an economic collapse.

Recovery has been slow in coming, but is now running strongly with new infrastructure, and prospects for the diversification of mining and industry. The country is fertile, water is abundant, but tropical diseases and HIV continue to exact a heavy toll on its people. Nonetheless the prospects for Zambia are good. It has not suffered serious conflict within its borders and shows a respect for the rule of law. Strong measures that were taken to localize skills on the mines have given some depth to engineering and technical skills.

Since the 1990s Government has adopted a range of measures to promote an investor friendly market economy. The process of moving from a centrist to a freer economy is however incomplete, and the cost of doing business remains high.

The WEF classifies Zambia as a factor driven economy, with its innovation index at 3.4 compared with South Africa’s 4.1. As is the case in the other SAIS countries one finds the presence of South African services in retail, wholesale, banking, insurance, leisure, technical services and logistics. What then the future role for innovation in Zambia?

The Zambia innovation system includes many institutions dating from the socialist period: a leading university (University of Zambia), the National Institute of Scientific and Industrial Research, the Zambia Agricultural Research Institute, the Tropical Diseases Research Centre, the National Malaria Control Centre, and the Zambia Bureau of Standards. There is little obvious R&D in the industrial sector. Government leadership comes through the Ministry of Education, Science, Vocational Training and Early Education (MESVTEE) and its Department of Science and Technology, with the National Science and Technology Council (NSTC) providing overall coordination. The same Ministry is also responsible for Higher Education.

Interviewees felt that SADC plays no role in the local innovation space. Instead it is COMESA that is regarded as the natural player.

STI indicators are incomplete and out of date, with last R&D Survey conducted in 2009 and no evidence of an Innovation Survey. GERD/GDP was reported as 0.37%. Patent activity is very low, while trademark registration is foreign dominated. This suggests that local technological innovation plays a minor role in the current growth path.

As in the case of Botswana the innovation space is largely crowded by foreign capital, but in Zambia there are few cases where local entrepreneurs have entered the MNC supply chains. The exceptions are Tradekings, which is becoming a diversified industrial group, and Zambeef, a chain
of butcheries and processed meat outlets. Opinion was divided regarding the willingness of MNCs to open their supply chains to local providers.

In theory many institutions are in place to support SME entry into the market, and perhaps to engage in innovation activities. The sentiment is that in practice a host of factors limit progress. These include lack of finance, patronage networks, perceived corruption, problems of land tenure and poor appreciation of innovation potential. If anything government focus on R&D is felt to be incorrect as such activities only give a long-term return and there are many immediate issues that should rather be addressed.

The National Institute for Scientific and Industrial Research (NISIR) is still emerging from its earlier import substitution industrialization function and the trying period of ‘care and maintenance,’ and is slowly building new capacity in post-harvest technologies, tissue culture, and food safety. There are many opportunities to engage, with a pressing need to capture the innovation space out of the hands of South Africa and China. Finally is the case of the Technology Development and Advisory Unit of the University of Zambia (UNZA) that seems to be struggling to define its role in the changed environment. It is obvious that they have severe budget constraints. One notes that UNZA ‘encourages’ academic consulting, taking a 10% overhead, and including the consulting record in its promotion criteria. This is worth examining further.

The general impression gained from the various stakeholder interviews is one of aged infrastructure, small budgets, inadequate high-level leadership, but of resilience under difficult conditions.

C- Country Report: Mozambique. Entrepreneurship as a road to innovation

Starting from a very low base, Mozambique has been experiencing rapid economic growth (increases of 6.3% -2009-, 7.1% -2010-, 7.3% -2011- and 7.4% -2012-) mostly due to the intensive exploitation of mineral resources (with expectations of becoming the world's largest coal exporter). Incomes remain low (for 2012, Gross National Income per capita was US$ 1,000\(^{19}\)), while unemployment and underemployment of an increasingly young labor force remain very high.

Consistently with its level of development, Mozambique is at the very beginning of science, technology and innovation development, still exploring the different elements needed for an innovation system, and lacking a general direction for development (despite having strategy documents). There is a recognition of the need for this dimension of national development from different sectors of society, however there are no clear commitments from government, university or private sector that may signal clear changes towards an innovation agenda. Although there are several government supported institutions with research and technology transfer mandates, still these organizations are at their infancy and need much strengthening. AICIMO, the Mozambican

\(^{19}\) Based on Purchasing Power Parity.
Scientific Research Association is a voice for this yet unmet needs. The emphasis is on having the basis for research in place, and it is not there yet on innovation proper.

Arguably, the single most important innovation related initiative (in terms of total resources) has been the Cooperation in Science, Technology and Innovation Between Finland and Mozambique (STIFIMO) Program. This initiative has been providing budget supplement to the Ministry of Science and Technology. This initiative is helping amalgamate incipient individual efforts from different organizations. For instance, the "Fora da Caixa" (out of the box) business idea competition has been organized as a series of preparatory workshops in the main cities of the country (Nampula, Tete, Beira and Maputo) to identify entrepreneurs that start an ICT based company. Awards are geared to support winners' business implementation with a combination of cash and technical assistance. Additional partners in this initiative are GAPI (an investment agency), Ideia Labs (a business incubator), STV (Television company) and Ologa (an ICT company).

ICTs has been an area of opportunity in Mozambique for some time. There have been different difficulties, such as those experienced by the Mozambique ICT Institute (MICTI) at University Eduardo Mondlane, to establish itself as a continuous operation. The Maputo Living Labs (MLL) is showing promise. Started as a donor/led project is looking forward to establishing itself as an NGO. In partnership with a tourism company, youth at MLL developed mGuide, a mobile application pointing to tourist sites and transportation options in Maputo. Another interesting application is moWoza, for micro entrepreneurs (Mukheristas) to order merchandise and make payments over the phone, avoiding trips across borders to buy supplies. moMoza involves Mozambican South African and Ugandan entrepreneurs.

There is a growing interest on entrepreneurship development and incubation type of activities as a key tool to tackle youth unemployment. Emerging incubators are Ideia Labs, Maputo Living Labs, Nampula Incubator (Polytechnic University) and Moamba Incubator (Machado's Holding). Mozambique could benefit from establishing a network of stakeholders interested in entrepreneurship promotion, to foster this agenda nationwide.

Mozambique presents plenty of opportunities to innovate in rural development, both in agribusiness and clustering around mining, and entrepreneurship and incubation promotion could be an important toll in this regard. Also, promoting innovation in existing SMEs. Financing for these activities could be part of a beneficiation scheme to be agreed with mining companies.

D- **Country Report: Namibia. "Beyond producing what she buys"**

Namibia has a very recent history as a country, having gained its independence from South Africa in 1990. Its economic structure mainly consists in the exploitation and export of unprocessed minerals (copper, diamonds, gold, uranium coal) and the imports of finished products, in addition to a thriving service sector, animal husbandry and fisheries. Interviewees would summarize this situation by saying that "Namibia produces what she does not need and imports what she needs". Clearly, there is a need to widen the scope of the economy, and not necessarily focusing on import
substitution. Along with Zambia, Namibia shows the highest recorded Gini coefficients for the SADC region, also characterized by high unemployment, poverty and inequality.

Namibia has the main types of "institutional building blocks" needed for innovation to happen: knowledge institutions, government proactivity, business development support organizations, entrepreneurs, financing institutions and commercialization business savvy. However, these building blocks are disconnected among them for the most part, and each institution is working on its own in separate small projects "fueled" by donor money, and not by the interest of exploiting synergies across organizations.

On the government side, the promotion of science and technology development resides in the Ministry of Education's Directorate of Research, Science and Technology, having three focus areas:  
- Science and technology policy development and capacity building  
- Research, technology development and planning  
- Industrial linkages and beneficiation

In addition, the government has been putting in place an overarching governance mechanism to promote science and innovation, establishing the National Commission for Science and Technology. A pending task in the agenda is to establish an innovation fund or a competitive grant mechanism to stimulate science, technology and innovation activities. Although in principle government could raise such type of funding from royalties on mineral exploitation (as it is done in several countries around the world), there is a feeling that there may be already too many or too different types of levies or royalties imposed on big mining companies, such as environmental and training levies, and that additional "taxation" could drive these companies away to other countries.

There are capabilities in Namibia's educational and research institutions that can be applied to add value to its natural resources and to agriculture leading to wealth and job creation. The National Botanical Institute, the Zero Emissions Research Initiative and the Multidisciplinary Research Center (the last two at the University of Namibia), are examples of centers oriented towards innovation, which need to be strengthened. The centers have good links with rural agricultural communities, having provided technical assistance that resulted in some value added to rural produce, such as methodologies for the sustainable production of devil's claw (*harpagophytum procumbens*) or the development of a prototype for a mushroom based nutraceutical. Yet, the devil's claw is mostly exported just as dried slices (valued at about USD 12 million per year) and nutraceuticals will not be commercialized unless proper linkages are established with other innovation stakeholders.

Supporters of existing small businesses include the Namibian Chamber of Commerce and Industry, SMEs Compete, and the Polytechnic of Namibia's Centre for Enterprise Development. These organizations are having an impact at the level of business management development and competitiveness at the firm level. However, they are not yet facilitating access to value chains or inspiring innovation. The relatively new Business Innovation Centre at the Polytechnic of Namibia is focusing on the stimulation of entrepreneurship and innovation in a new area for Namibia (ICTs)
when much more value could be obtained working with existing small companies or promoting company creation in association with rural, agricultural communities.

On the financing side, the Development Bank of Namibia could play a pivotal role financing innovation related activities in a sustainable manner, for instance establishing a project preparation facility, which could partly subsidize feasibility studies to innovate, tackling opportunities in existing value chains. Definitively, Namibia has clear opportunities for innovation development in food production, and value added derivatives of natural products, such as nutraceuticals and cosmetics. In addition, opportunities to add value to minerals should be exploited as well.

E- Country Report: South Africa

In the 1960s economist Simon Kuznets is reputed to have claimed there were four kinds of economies: developed, undeveloped, Japan and Argentina. To this one might have added, ‘and South Africa.’ Through to the 1980s South Africa seemed to be about to break out and attain the same technological trajectory as the core OECD states. It was then way ahead of Korea and Malaysia; both have since surpassed the country in terms of GDP/capita, and in the case of Korea, R&D and patenting. This however was not to be, as the squander of apartheid social engineering, runaway arms expenditure and ultimately financial sanctions brought the country to the edge of bankruptcy and opened the way to a negotiated settlement.

‘Post apartheid’ the technological trajectory has remained at similar levels to that of the 1980s except that South African industry has acquired a highly successful global footprint. Whilst the traditional innovation system indicators suggest that its NSI has barely grown and is underperforming, it has arguably provided the necessary underpinnings for the country’s global performance.

The leading counters on the Johannesburg bourse in many cases derive half their revenues abroad, and the resultant Rand flows into the country are nicely inflated by the downward trend of the Rand to the US Dollar. The expansion of South Africa into Africa has already been documented in Table 1 that demonstrated the extent of the footprint across the various sectors. This footprint is even wider than tabulated since one must also include the penetration of state-owned enterprises Transnet, South African Airways, and Eskom. The ‘brand’ trek across the Limpopo draws on the expertise of the universities and business schools, and to some extent the sunk investment of its PROs.

Private sector investment using funds raised in capital markets as well as own resources, has since 2000 been complemented by the activities of one South Africa’s four leading development finance institutions, namely the Industrial Development Corporation (IDC). IDC now has a continent wide portfolio e.g. Dangote Cement in Nigeria, that complements SA Tiger Brand investment in Dangote Flour. Meanwhile Dangote has invested in a new cement mill in South Africa. IDC is working closely with various African development funding institutions. At home IDC also performs a venture capital role for potential innovations that need to move through proof of concept toward
commercialization. A second important SA Development Finance Institution is the Public Investment Corporation that invest public sector pension funds in equities and that has now become a leading player on the Johannesburg Stock Exchange.

Even so, research and innovation policy makers are not satisfied with the performance of the NSI, claiming that the business sector has failed to commit the necessary investments in R&D that would enable GERD/GDP to break through the 1% level. Further, the steady rise in scientific publication outputs is also viewed as somewhat deficient in that patenting by the universities remains at very low levels. Government, for its part, has put in place what it feels to be best of breed innovation policy and incentives, yet the patenting rate remains low. At an even higher level the National Development Plan (Presidency, 2012) speaks eloquently to the importance of research and innovation and makes the case for the associated investment. What is salutary however is the statement in the Plan, made without supporting evidence, to the effect that the state knows what investment in R&D needs to be made both by PROs and industry.

One might note the OECD (2007) review of innovation policy that claimed this to be excessively focused on the role of the state. Indeed the National Development Plan speaks to a stronger role for the state in national development, and suggests that what should be striven for is a “capable, and developmental state”. It is exactly such an approach that is spilling over into the SADC dialogues on research and innovation policy, with the various policy experiments of South Africa gaining traction in the neighbouring countries, at least in their policy circles. The vectors for the spillover include government, through the actions of the International Branch of DST, through South African support for the SADC STI Desk and that of NEPAD and the African Union, support for the AU S&T Flagship Projects (African Laser Centre; African Institute for Mathematical Sciences), the Southern African Biosciences Network, and of course the Square Kilometre Array telescope megaproject.

Arguably the most important contribution of South Africa to the development of human resources in the SADC region is in the provision of subsidized places for SADC students in its universities, at a cost to the fiscus in excess of R1,5 billion annually.

An additional non-governmental vector comes through the actions of SARIMA, as well as those of the Regional Research Alliance (RRA). SARIMA has since cloned similar organizations in East, Central and West Africa, as well as the Caribbean, and maintains fraternal links with international organizations such as the Association of University Technology Managers (AUTM), the International Network of Research Management Societies (INORMS) and Alliance of Technology Transfer Professionals (ATTP).

The Regional Research Alliance (RRA) has emerged from the Global Research Alliance of nine international PROs (CSIR, CSIRO, etc.) and currently links CSIR, BITRI (Botswana) and SIRDC (Zimbabwe) through a voluntary association. RRA has had limited success in staff exchange and the dissemination of research on water quality, low cost roads, and wireless mesh technology.
The policy spillovers include movement toward establishing innovation funds, science parks, technology transfer offices, and the more careful management of intellectual property.

As in Botswana, one has the impression that there is no real shortage of financing for well-thought policies through commercial projects, along with well-designed research initiatives.

1.2.4 Analysis of the Innovation System of SADC from a regional perspective

In an increasingly global and knowledge-based competition, regional and national economic development is based on the understanding of the trans-nationalizing framework and conditions of the innovation economy. While the business “super structure” of innovation economy and the innovation system have always been considered international (Cooke 2004), the international dimension has become an increasingly important part of the “governance structure” and innovation policies. According to OECD (2010) “a whole-of-government approach to policies for innovation is needed to encourage innovation in its many forms. It requires stable platforms for coordinating actions, policies with a medium- and long-term perspective, and attention from policy makers at the highest level. It also calls for coherence and complementarities between the local, regional, national and international levels” and further, “In addition, the governance of multilateral co-operation on innovation will require increased attention as the international community seeks collective solutions to global problems.” (OECD; 2010: 2)

There are a number of African and international institutions with programmes focusing on helping African countries to advance in the area of STI, such as the African Union (AU), the New Partnership for Africa’s Development (NEPAD), the African Development Bank (AfDB), the World Bank and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Other (sub) regional bodies with initiatives in the area of STI are the East African Community (EAC) and the Southern African Development Community (SADC).

The efforts and initiatives of these institutions are mainly focused on research and development and little emphasis has been made on issues of technological innovation that is key in turning scientific and technological knowledge into goods and services that boost economic development.

SADC and NEPAD’s initiatives and programmes have been specially taken into account in our analysis. In our Field Study we visited SADC and NEPAD’s offices (located in Botswana and South Africa respectively) which offered an inside picture of the status of the policies implemented at regional level (Box 2).
### Box 2: NEPAD and SADC. Activities in the STI area

*During the past decade a number of regional, continental and international initiatives for STI policy development have been launched in Africa. The Regional Economic Communities (RECs) have integrated STI issues or considerations into their treaties and protocols.*

NEPAD. NEPAD is a programme of the African Union (AU), adopted in 2001 by African leaders, with the primary objectives of poverty eradication, promotion of sustainable growth and development, and the empowerment of women through building genuine partnerships at country, regional and global levels. Under the auspices of the AU and its *New Partnership for Africa’s Development (NEPAD)*, in 2005, African countries designed and adopted Africa’s Science and Technology Consolidated Plan of Action (now commonly referred to as the CPA). The CPA contains programmes for research in the areas of biotechnology, biodiversity and indigenous knowledge, water, energy, ICTs, drought and desertification, mathematical sciences, manufacturing, material sciences, laser and postharvesting technologies, and space science. It also has programmes for improving the quality of STI policies and the establishment of science and innovation parks. The CPA was endorsed by African Heads of State and Government at the AU Summit in January 2006. Since then, the AU Commission and NEPAD Office of Science and Technology have used various means and processes to promote its implementation. NEPAD has established a number of networks of centres to implement specific research projects. These include the African Biosciences Initiative (ABI), AIMS, the African Laser Centre (ALC) and the African Science, Technology and Innovation Indicators Initiative (ASTII).

SADC. The Southern African Development Community (SADC) is a Regional Economic Community comprising 15 Member States. Established in 1992, SADC is committed to Regional Integration and poverty eradication within Southern Africa through economic development and ensuring peace and security. In December 2008, the SADC Ministers responsible for Science, Technology and Innovation launched the “Science Technology and Innovation Desk,” which is responsible for coordinating interaction between Member States, mobilising financial resources, establishing strong linkages with other partners, and recordkeeping on regional issues. The Science Technology and Innovation Desk is a temporary structure that will ultimately culminate in a unit within the SADC Secretariat. The Protocol on Science, Technology and Innovation was signed by Heads of State and Government in 2008. The Protocol outlines the framework of cooperation between Member States regarding science and technology within the region.

For our regional analysis we again make use of an *ad hoc* application of the ANIS approach to characterize SADC region and to obtain a first assessment of policies/institutions and programmes present at regional level. We will consider the following types of determinants to characterize the SADC innovation system:

- **Regional determinants**: to decide whether a determinant is of regional nature the determinant will have to be:
  - originated by SADC; or
  - present in at least two countries; or
  - present in one country and serve at least another country.
• National determinants: we will identify national determinants within SADC that have the potential to become regional. The criteria to select these determinants include the following:
  - demonstrable results;
  - replication potential; and
  - sustainability potential.

In Figure 19 we have presented the ANIS regional determinants by levels (Policy, Institutional, Programmatic and Micro). In that Table we have adopted a traffic light or colored system to identify the presence or not of policies/institutions/programmes/actors at regional level. Thus, a determinant will be colored:
  - Green, if we have found regional (or national with potentiality) examples.
  - Amber, if there are just few initiatives and/or they are in the pipeline and yet to be implemented.
  - Red, if we have not found examples of regional determinants (or national with potentiality).

In Annex 5 we have presented a brief description of each regional determinant identified.

From the information contained in Figure 19, we can mention the following conclusion concerning SADC’s innovation system from a regional perspective.

**Policy level**

SADC have implemented a series of **master plans and protocols** in the key priority areas considered in the Regional Indicative Strategic Development Plan (RISDP) of the SADC. From an innovation systems perspective, *inter alia* these protocols cover S&T, education and training, trade, communications, energy, standards and the environment, all of which are in principle essential to create a generally positive ethos for knowledge production, the movement of people, goods and services, within and beyond SADC.

Also, there are **innovation friendly regulations** policies as those present in the ARIPO Lusaka Agreement.

Specifically concerning the **Regional Innovation Policies**, SADC adopted the STI protocol in 2008, though its ratification is still pending by some states. In December 2008, the SADC Ministers responsible for Science, Technology and Innovation re-launched the “Science Technology and Innovation Desk,” which is responsible for coordinating interaction between Member States, mobilizing financial resources, establishing strong linkages with other partners, and recordkeeping on regional issues. However, in 2010 it was reported the SADC STI Desk was weak and under-
resourced and Development partners are reluctant to support STI Desk.  

At regional level there is no **Cluster Policy**, although there have been studies – by the Economic Comission for Africa-analyzing the possibility of mineral clusters (with pilot studies in South Africa and Mozambique).  

**Institutional Level**

Concerning regional initiatives there is a lack of Regional **Technology Transfer Offices (TTO)**. Currently, SAIS Programme is sponsoring a project about establishing regional open and publicly accessible Technology Transfer offices in Botswana (University of Botswana), Namibia (Namibia Business Innovation Centre (NBIC)) and Zambia (National Technology Business Centre (NTB)).  

Besides, South Africa’s Department of S&T has pushed the idea of TTOs at universities and its Science Councils in an attempt to promote research uptake for commercial end use. This concept has diffused into SADC through direct interaction with DST and through SARIMA.

The creation of **Technology Parks** at regional level are one of the objectives of the NEPAD STI Consolidated Plan of Action. Not only to exploit synergies across countries but also present a bigger market that is more attractive to foreign investment. AU and NEPAD can play a crucial role in facilitating the establishment of regional technology parks. There are S&T parks in South Africa (Innovation Hub in Pretoria; Stellenbosch Technology Park) and the Botswana Innovation Hub is in launch phase, as is Maulana near Maputo in Mozambique.

Regarding **National Determinants** within the SADC that have potential to become regional, the example of pioneering South Africa’s initiatives could help to trigger the adequate policies, institutions and programmes for the rest of countries of SADC region. South Africa’s considerable effort to adopt and adapt world best practise innovation policy has had a spillover effect into the region. These spillovers are found in the formulation of the SADC Protocol on S&T, and through the involvement of its PROs in the ground activities across SADC. In effect, this amounts to S&T policy as an active component of foreign policy, even it is not articulated as such. The benefit to ZA has come in the African Union (and SADC) endorsement of ZA’s SKA bid and its ultimate success. Broadening SKA to include 8 other African partners was an astute strategic move on the part of ZA.

Unsurprisingly the majority of national determinants with regional potential included in the Table are South African examples. However, a regional focus is needed and the benchmark with other region of the world is necessary in order to select the best practices that could be implemented in SADC region taking into account the socio-economic situation of the region.

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20 There has been a SADC S&T “Desk” for the last two decades. The responsibility was originally given to SZ, but nothing much appeared to happen. Subsequently, the desk moved to SADC Secretariat in BW, where it continued to languish. Late 2013 ZA seconded an experienced senior manager to revitalize the Desk.

21 We should consider for later the idea that Cluster policies have resulted mainly as local initiatives (.e.g. from governments in one country); in our context promoting “clusters” will mean to accept somehow a distribution of task and division of labour among countries involved (unless boarder areas are identified).

22 [http://www.ub.bw/researchdet/rs_id/2076/ac/1/fac/8/research-details/]
Study on regional innovation in the SADC region for the Southern Africa Innovation Support Programme
Final Report

Figure 19. Regional Determinants – ANIS Approach

<table>
<thead>
<tr>
<th>Policy Level</th>
<th>Institutional Innovation Support Level</th>
<th>Programmatic Innovation Support Level</th>
<th>Innovation Capacity Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional Innovation Policies</td>
<td>Technology Transfer Centres</td>
<td>STI Funding Schemes (more examples in Annex 7, Table 25)</td>
<td>Universities</td>
</tr>
<tr>
<td>- SADC STI Protocol (not yet in force)</td>
<td>- SADC Initiative/University of Botswana Namibia Business Innovation Centre (NBIC) and Zambia National Technology Business Centre (NTBC)</td>
<td>- SADC Programme</td>
<td>- SARUA</td>
</tr>
<tr>
<td>- bilateral S&amp;Y agreements</td>
<td>Technology Parks</td>
<td>Technology</td>
<td>- ZA: Five research universities – UCT, Wits, Pretoria, Stellenbosch, Kwazulu-Natal; eight mid range uni’s – Free State, Western Cape, North West, Nelson Mandela, Rhodes, South Africa, North West, Tshwane</td>
</tr>
<tr>
<td>- AMCOST CPA</td>
<td>Incubators</td>
<td>- Energy and Environment Partnership (EEP)/Southern and East Africa</td>
<td>- African Institute for Mathematical Sciences (AIMS)</td>
</tr>
<tr>
<td>Master Plans</td>
<td>- Botswana Innovation Hub</td>
<td>- African Incubator Network (AIN)</td>
<td>- Next Einstein Initiative.</td>
</tr>
<tr>
<td>- Sectoral Protocols</td>
<td>Clusters</td>
<td></td>
<td>- U Zimbabwe; National U of S&amp;T ZW; U Botswana; Eduardo Mondlane MZ, etc.</td>
</tr>
<tr>
<td>Training and Education</td>
<td>Technology Transfer Centres</td>
<td>- The Innovation Hub South Africa</td>
<td>Innovations Friendly Regulations</td>
</tr>
<tr>
<td>- Education Protocols</td>
<td>Technology</td>
<td></td>
<td>- SQAM MoU in SADC Protocol of Trade</td>
</tr>
<tr>
<td>Innovation Friendly Regulations</td>
<td>Technology Parks</td>
<td>- Southern Africa Business and Technology Incubation Association (SABITA)</td>
<td>Cluster Policy</td>
</tr>
<tr>
<td>- SQM&amp;M MDU in SADC Protocol of Trade</td>
<td>Clusters</td>
<td>- Africa Incubator Network (AIN)</td>
<td></td>
</tr>
<tr>
<td>- Lusaka Agreement of African Regional Intellectual Property Organization (ARIPO)</td>
<td>Innovation Service Providers</td>
<td></td>
<td>Foresight R&amp;D Agenda</td>
</tr>
<tr>
<td>Cluster Policy</td>
<td>Funding Agencies</td>
<td>- SADC Plant Genetic Centre</td>
<td>VA ran a foresight programme over 1995 - 1999</td>
</tr>
<tr>
<td>Foresight R&amp;D Agenda</td>
<td>Business Promotion Agencies</td>
<td>- SADC Climate Service Centre</td>
<td></td>
</tr>
<tr>
<td>VA ran a foresight programme over 1995 - 1999</td>
<td></td>
<td>- African Agricultural Technology Foundation</td>
<td></td>
</tr>
</tbody>
</table>

References: To be implemented or few examples // Initiatives in place // Complete lack of initiatives
### Box 3. Examples of Innovation Capacity Level Determinants

<table>
<thead>
<tr>
<th>Institutions for Fundamental R&amp;D</th>
<th>Institutions for Applied R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>- African Institute for Mathematical Sciences (AIMS)</td>
<td>- CSIR ZA</td>
</tr>
<tr>
<td>- African Laser Centre</td>
<td>- Agriculture research Council ZA</td>
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<td></td>
<td>- Medical Research Council ZA</td>
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<tr>
<td></td>
<td>- Human Sciences Research Council ZA</td>
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<tr>
<td></td>
<td>- Council for Mineral Technology ZA</td>
</tr>
<tr>
<td></td>
<td>- SA National Space Agency</td>
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<tr>
<td></td>
<td>- NRF National Facilities ZA</td>
</tr>
<tr>
<td></td>
<td>- Council for Geosciences ZA</td>
</tr>
<tr>
<td></td>
<td>- Medical Research Councils in SADC</td>
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<tr>
<td></td>
<td>- Ditto Agriculture Research</td>
</tr>
<tr>
<td></td>
<td>- Mauritius Sugar Research Institution</td>
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<table>
<thead>
<tr>
<th>Institutions for Applied R&amp;D</th>
<th>Institutions for Applied R&amp;D</th>
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</thead>
<tbody>
<tr>
<td>- CSIR ZA</td>
<td>- Agriculture research Council ZA</td>
</tr>
<tr>
<td>- Agricultural Research Council ZA</td>
<td>- Medical Research Council ZA</td>
</tr>
<tr>
<td>- Human Sciences Research Council ZA</td>
<td>- Council for Mineral Technology ZA</td>
</tr>
<tr>
<td>- SA National Space Agency</td>
<td>- NRF National Facilities ZA</td>
</tr>
<tr>
<td>- Council for Geosciences ZA</td>
<td>- Medical Research Councils in SADC</td>
</tr>
<tr>
<td>- Medical Research Councils in SADC</td>
<td>- Ditto Agriculture Research</td>
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<tr>
<td>- Mauritius Sugar Research Institution</td>
<td>- Council for Geosciences ZA</td>
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<thead>
<tr>
<th>R&amp;D in agriculture</th>
<th>R&amp;D in mining</th>
</tr>
</thead>
<tbody>
<tr>
<td>- AFGRIL Ltd, South Africa</td>
<td>- Element Six, ZA</td>
</tr>
<tr>
<td>- Kamano, Zambia</td>
<td>- AngloGold Ashanti ZA</td>
</tr>
<tr>
<td>- MRI Seed, Zambia</td>
<td>- Anglo Platinum ZA</td>
</tr>
<tr>
<td>- Pannar, South Africa</td>
<td>- De Beers ZA</td>
</tr>
<tr>
<td>- Progene, Zambia</td>
<td>- BHP Billiton ZA</td>
</tr>
<tr>
<td>- SeedCo, Zimbabwe</td>
<td>- Anglo Research ZA</td>
</tr>
<tr>
<td>- Zamseed, Zambia</td>
<td>- Rio Tinto ZA</td>
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<tr>
<td></td>
<td>- Anglo Research ZA</td>
</tr>
<tr>
<td></td>
<td>- Impala Platinum ZA</td>
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<table>
<thead>
<tr>
<th>Entrepreneurs</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>- Patrice Motsepe ZA</td>
<td>- Element Six, ZA</td>
</tr>
<tr>
<td>- Strive Masiyiwa ZW</td>
<td>- AngloGold Ashanti ZA</td>
</tr>
<tr>
<td>- Isabel Dos Santos AO</td>
<td>- Anglo Platinum ZA</td>
</tr>
<tr>
<td>- Monica Musonda ZM</td>
<td>- De Beers ZA</td>
</tr>
<tr>
<td>- Yusuf Dada BW</td>
<td>- BHP Billiton ZA</td>
</tr>
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<table>
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<tr>
<th>Large companies</th>
<th></th>
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<tbody>
<tr>
<td>- NANDO’s South Africa</td>
<td>- Element Six, ZA</td>
</tr>
<tr>
<td>- MTN South Africa</td>
<td>- AngloGold Ashanti ZA</td>
</tr>
<tr>
<td>- ECONET Zimbabwe</td>
<td>- Anglo Platinum ZA</td>
</tr>
<tr>
<td>- Pick and Pay South Africa</td>
<td>- De Beers ZA</td>
</tr>
<tr>
<td>- Famous Brands South Africa</td>
<td>- BHP Billiton ZA</td>
</tr>
<tr>
<td>- Bidvest ZA</td>
<td>- Anglo Research ZA</td>
</tr>
<tr>
<td>- Grindrod ZA</td>
<td>- Rio Tinto ZA</td>
</tr>
<tr>
<td></td>
<td>- Anglo Research ZA</td>
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<td></td>
<td>- Impala Platinum ZA</td>
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</tbody>
</table>
2. Proposal of an innovation analytical framework relevant to the SADC region: The Public Policy Innovation Platform

Thus far, we have used an ad hoc application of the ANIS approach to elaborate the landscape of the SADC’s Innovation System. ANIS is useful to check how innovation related policies (macro level) translate into supporting institutions and programs (meso level) and in turn into improved capabilities of innovation stakeholders (micro level). However, ANIS presents some drawbacks and may not be the most adequate framework for analyzing the innovation system of SADC region. For example, within a globalized world all Innovation Systems may be affected by external influences, but in the ANIS approach external factors are not considered.

Based on our findings from the previous activities and taking into account the innovation landscape of the SADC region, we consider that the most suitable analytical framework for the innovation system of the region would be a macro level policy oriented framework. This will allow us to make an assessment and identify gaps in the current situation of the Innovation system of SADC region.

Taking this into account, we have elaborated an “eclectic” framework drawing in part on “The Innovation Policy Platform (IPP)”, a joint initiative developed by the OECD and the World Bank.23 The IPP is based on a number of theoretical and analytical developments constructed on “national and sectorial innovation systems approaches”. The aim of this platform is to provide policy practitioners around the world with a simple and easy-to-use tool, supporting them in the innovation policy-making process; but in fact it should be recognized that Public Policy Innovation Platform (PPIP) is a kind of evolution or spin off of the ANIS approach. Our proposed analytical framework is shown in Figure 20 below.

We feel that this schema emphasizes the basis for innovation, starting with the framework conditions to provide an adequate environment for innovation to happen, covering from political stability to quality standards. Very importantly there are needs to have a strong human resource base. It is real people who innovate while being part of organizations that compose the knowledge infrastructure and/ or making linkages among them. Finally, we feel it is important to close the policy making loop, bringing our attention to monitoring and evaluation and to the identification of the processes and mechanisms to promote “incentives” for regional cooperation in innovation. In Annex 6 we have presented a brief description of each component of the proposed analytical framework.

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23 https://www.innovationpolicyplatform.org/
Figure 20. Proposed Framework for analyzing SADC innovation system: The Public Policy Innovation Platform (PPIP)

Source: authors’ own elaboration based on OECD Innovation Policy Platform

In Figure 21 we have reclassified the determinants identified for the ANIS exercise using the proposed policy-oriented framework, which allows us to make a more complete and accurate assessment of the innovation system in the region as presented in the following section.
Figure 21. Proposed framework. Regional determinants

**Framework Conditions**
- (i) Political Stability and Economic Prosperity
- (ii) Financing Innovation (more examples in table 5)
  - International Donors
  - SADC-DFC
  - AfDB
  - FARA
  - AFIS NEPAD/AU not yet implemented
  - Southern Africa Trust (SAT)
  - Private R&D Institutions:
    - Southern Africa Business and Technology Incubation Association (SABTIA)
    - South Africa Business and Technology Incubation Association (SABTIA)
    - South Africa Business and Technology Incubation Association (SABTIA)
    - Botswana Innovation Hub
    - The Innovation Hub South Africa
- (iii) Intellectual Property Rights
  - Lusaka Agreement of African Regional Intellectual Property Organization (ARIPO)
- (iv) Markets, Competition and Standards
  - Southern African Development Community Accreditation Service (SADCAS)
  - SQAM MoU in SADC Protocol of Trade
- (v) Government Policy and Governance
  - SADC STI Protocol
  - Bilateral S&T Agreements
  - AMCOST CPA
  - Sectorial Protocols

**Human Resource Development**
- (i) Basic Schooling
  - Education Protocol
- (ii) University and Technical Education
  - Education Protocols
- (iii) Skills for Innovation
  - Education Protocol

**Knowledge Infrastructure**
- (i) Innovation in Firms
  - Large Companies (see Box 1)
  - SMEs - New and innovative (www.eureka.co.za - fasteners)
  - Private R&D Institutions:
    - R&D in agriculture (see Box 1)
    - R&D in mining (see Box 1)
- (ii) Innovative Entrepreneurship
  - Entrepreneurs (see Box 1)
  - Innovators: Mark Shuttleworth ZA
- (iii) Universities and Public Research Institutes
  - SARUA
  - ZA: Five research universities – UCT, Wits, Pretoria, Stellenbosch, KwaZulu-Natal; eight mid range uni’s – Free State, Western Cape, North West, Nelson Mandela, Rhodes, South Africa, North West, Tshwane
  - African Institute for Mathematical Sciences (AIMS)
  - Next Einstein Initiative.
  - U Zimbabwe; National U of S&T ZW; U Botswana; Eduardo Mondlane MZ, etc
  - Institutions for Fundamental R&D (see Box 1)
  - Institutions for Applied R&D (see Box 1)
  - SADC Plant Genetic Centre
  - SADC Climate Service Centre
  - African Laser Centre
- (iv) Public Sector Innovation
- (v) Non-Governmental Institutions
  - FARA
  - SAIS Programme
  - Energy and Environment Partnership (EEP)/Southern and East Africa
  - African Agricultural Technology Foundation

**Promotion of Linkages**
- (i) Technology Transfer and Commercialization
  - SAIS initiative
  - University of Botswana Namibia Business Innovation Centre (NBIC) and Zambia National Technology Business Centre (NTBC)
- (ii) Innovation Network and Clusters
  - Southern Africa Business and Technology Incubation Association (SABTIA)
  - Africa Incubator Network (AIN)
  - ZA Automotive Industries Development Programme
  - Botswana Innovation Hub
  - The Innovation Hub South Africa
- (iii) International Linkages
  - Takes the former of bilateral agreements and participation in Northern networks:
    - European Union Framework Programme 7 projects
    - CAAST Net Plus
    - ERAfrica
    - The Square Kilometre Array (SKA) projects

**Mechanisms for Policy Learning**
- (i) Monitoring and Commercialization
  - NEPAD ASTII
- (ii) Incentives for Regional Cooperation and Good Management

Source: authors’ own elaboration based on OECD Innovation Policy Platform
2.1. **Assessment of the SADC innovation system using the Public Policy Innovation Platform (PPIP)**

In general terms, from our Field study we can characterize the actors of the innovation systems in the SADC region in the following way:

**CULTURE:**
- Silo mentality at government level, lacking collaboration and coordination among different players; and
- No sharing of information.

**INNOVATION AWARENESS:**
- There is talk about it, and recognition of its importance. However, there is no clear understanding of the gist of it, of what of that is in practice and examples are exceptional and not widely diffused.
- Emphasis is on the first stages of the innovation process (discovery, piloting) and not in the follow through to wide implementation, which is a requisite for a real innovation (otherwise it was an invention or a methodology that was not used and therefore did not benefit people).
- Over-emphasis on a belief in science-led innovation.
- Poor linkages with the business sector.

On the other hand, considering the findings from our Desk and Field study and taking into account our proposed Public Policy Innovation Platform analytical framework to make the assessment, we can reach the following conclusion concerning SADC’s innovation system from a regional perspective.

**Framework Conditions**

While most SADC States have a policy statement declaring the importance of STI, in practice, funding is restricted. Resources do not flow into the sector, to the extent that even the colonial era agricultural and mining research institutions are often in a neglected state. On top of this, there is a capture of the local ‘innovation space’ by new foreign interests, especially China and South Africa, so that innovation activity may be crowded out. Inadequate framework conditions - the high cost of doing business, poor logistical infrastructure, weak governance – may further mitigate innovation activities.

It is evident that there is an important vacuum in the financing of innovation. Although there are some examples of financing agencies at regional level, they are mainly represented or funded by international donors and their initiatives are mainly focused on research and development (and not innovation). In general, there is a lack of endogenous financial mechanisms for Innovation support programmes coordinated at regional level. The cross-country analysis clearly reflects that the vast majority of the countries do not have viable innovation funding agencies. Where such institutions exist, they tend to be weak because they lack adequate funds, and other kind of financing instruments such as venture capital or formal banking facilities to innovative projects are also undeveloped. R&D
and related activities are fundamentally financed by external donors, who tend to finance just a few projects as opposed to whole programmes.  

In Annex 7 we have presented an analysis and review of the existing financial mechanisms operating at the institutional and programmatic level in SADC region. This is a non-exhaustive list of regional and national initiatives that provides financial support for innovation activities.

**Human resource development**

In the section related to Science and technology indicators reference was made to the cases of China and Korea where investment in human development have been a key factor in their impressive socio-economic take-off. One might also have included Japan as a reference state since it provides an earlier example of the importance of what might be termed “learning by immersement.” This concept refers to the processes of rapid industrialization that unfolded in that country in the form of the Meiji Restoration during which large numbers of Japanese engaged in study programmes in Europe and the United States. A centralized education system with a strong emphasis on mathematics and literacy was introduced, and then imposed upon Japan’s new conquests in Korea, Taipei and Manchuria. These territories were then industrialized, so despite the ravages of the Second World War, there was already a basis, built upon generations of artisanship and proto-factories, for the rapid growth that later characterised the ‘Asian Tigers.’

In terms of transferable lessons, the first consideration should be on the importance of a strong and respected education system that lays the basis for technological learning, and what Lundvall describes as ‘doing, using, interacting’ (Lundvall et al, 2009). Human resource development, at all levels (primary and secondary, technical and higher education) are vital elements of technological catch up, absorptive, and adaptive activities. At domestic level, Human Resource Development provision is patchy, especially at secondary level, where enrolment rates are below par.

The four SAIS participants and SADC as a whole generally enjoy donor support -both overt and tacit- that offers the opportunity - the risk of brain drain notwithstanding - for an educated elite to be built by further study abroad. Within SADC, the destination of choice for such scholars is South Africa, whose support is provided by meeting the requirements of the SADC Protocol on Education and Training. The risk of brain drain has now mutated in the desired form of brain ‘circulation’ or, to use a less judgmental term, into mobility. Where ‘home’ offers attractive possibilities, it will be home where the heart lies, and those studying abroad will return of their own volition, in order to avail themselves of domestic possibilities. Botswana has consistently displayed this attribute.
**Knowledge Infrastructure**

As already mentioned in the Framework Conditions, knowledge infrastructure, is weakly developed. Were one to take a leaf from the Asian Tigers book, it would be to strengthen technical education, engineering, design and ICT. The massive demand of the infrastructure projects, mining and agricultural development will call for the upgrading and expansion of the associated institutions. This demand will be largely met through diploma and undergraduate courses; advanced study will necessarily be restricted in volume, and may be catered for abroad.

As to PROs that address research market failure, the choice may come down to pooling effort into a multi-purpose CSIR-type of body, or the adoption of a sectoral approach. The issues of health and agriculture are both so large, and local, that institutions dedicated to each are probably desirable. Beyond this however one would argue for demand-led public research according to the ‘client-contractor’ principle. In addition there is a strong case to be made for ensuring incubation spaces – zero or low cost environments where startups can be launched, and where uncertain entrepreneurs may receive on-the-job business planning support, including access to broadband.

**Promotion of Linkages**

The very idea of a system is predicated on the existence of the linkage between given inputs and designed outputs. In the case of an innovation system, linkages take many forms: contracts to carry out research and innovation, joint research projects, co-patenting, co-publication, consultancy, sharing of information, rotation of staff, and so on. If none of these are in place, for example when university researchers do not routinely interact with industry, government labs, and policy makers, then the system may be broken, or disarticulated (Soete, 2009).

With the new emphasis on ‘value for money’ and ‘lean government’, policy makers have been critical of university researchers for their alleged failure to commercialize their research. If the research was actually use inspired, or needs driven, and still remained in the ivory tower, this could point to an absence of linkage or incompetence, and could be described as ‘network failure.’ The insistence on value for money challenges the basis of the linear model of innovation that came to the fore in the immediate post Second World War period that saw a large expansion of publicly funded university research and the proliferation of public research organizations around the globe. Much of the university activity was basic research whose pay off would necessarily be in the order of two to three decades in the future. By its very nature applied research should offer quicker returns.

In many SADC countries the universities are cash-strapped; industry is undeveloped and PROs are rebuilding. It would be surprising therefore to find evidence of strong linkages, consultancy and staff rotation excluded.

**Mechanisms for Policy Learning**

Policy learning refers to the ability and willingness of policy makers to engage with quantitative and qualitative information and feedback concerning the functioning of policy in practice, whatever the domain of interest might be. In the case of the innovation system the possibility of policy learning
turns upon the availability of reliable, accurate, complete and timely information obtained from system measurement and evaluation. The mere fact of conducting systematic measurement is part of the learning process both for the parties carrying out the measurement and the respondents. It is for this reason that the ASTI Initiative is so important: the results may not be complete, but the act of measurement is a first step toward that goal.

Of the SADC states South Africa is the only one that has regular measurement in place, even though it too has some difficulties with consistency of measurement and full usage of the available and somewhat scattered information sources.

Two sources of information concerning innovation outputs are under-exploited, namely information on plant breeders rights, and registration of trademarks; instead attention tends to focus on patenting that is in fact a very minor activity.

2.2. SADC’s Innovation System Gaps

From our Assessment of the SADC Innovation System we have identified different policy areas displaying gaps and where policy recommendation may be focused on. It is important to emphasize what is first and more feasible.

Accordingly, we believe that recommendations should focus on the Human Resource Development pillar. That means to support the improvement of the educational infrastructure but to focus on the increase the supply of qualified human resources, to improve the technical and professional training of the population. Such programmes or actions, if defined in the context of the region (even if SA only plays a steering and funding role), could be planned with the aim of increasing regional integration. Certainly, the lesson from the Asian tigers, as we mentioned above, is a clear example of the importance of this policy area at national level.

Consolidating Knowledge Infrastructure should be a second priority for action. Universities and Higher Education (HE) institutions are a central part of the knowledge infrastructures alongside PROs and research and technology organizations (RTO).

As regards Framework Conditions there is much room for improvement in the area of funding of STI activities (multilateral or regional). As we have observed, initiatives are mainly fund by external donors and local STI innovation funding agencies are in general under-resourced. On the other hand, venture capital, business angels, etc. are investor strategies for long term and we defer these for later consideration. In general, we observe that for the majority of SADC country members the State is playing the role of venture capital, business angel and development banker. Thus, endogenous financial mechanisms for the region could be an area to be explored in order to increase the amount of resources oriented to STI policies. Some international experiences emerge as shown below.

Regarding the Promotion of Linkages pillar, we identify two problems: The first is how to promote the need of adaptation of the HE institutions to the needs of the local or regional firms. The second one is
how to guarantee the promotion of new training areas that could help to build up the sectors of the future. What the HE policies probably need to do is to guarantee that the trained people become integrated in firms (and government) to improve the quality of the management and technology base of the firm. Promoting linkages could start in the area of “internship schemes” to facilitate access of trainees to firms during or just after finishing the degree) or, in the case of development of master thesis and dissertations, suggestion to build programs like the French “CIFRE” to support the development of dissertation and thesis in companies. The metaphor is “college to work.”

On the other hand, we do not consider the idea of building “TTOs” as a major priority. TTO tend to run the risk of becoming bureaucracies inside the bureaucracy, so one should try to create mechanism that are needed to help (not addition to structures that then do not provide the services).

Regarding the Mechanism for Policy Learning pillar, the ASTII initiative is interesting because it could help to monitor and to get more comparable data, but it has a very limited focus on POLICY. Probably, the idea of building up a repository of “cases” and “policy initiatives” could be of interest. Here, the experience of the ISME initiative could be taken as an examplar.

The need for collective regional activity is greater than ever, because more problems and opportunities are transnational. On the demand side, investment is needed in the capacity to exploit market-driven opportunities and to negotiate rules and standards for better competition. On the supply side, investment in knowledge for addressing emerging challenges, such as transboundary diseases, climate change, water scarcity, and increased price volatility in global markets. All of these challenges have significant implications for the knowledge system and do not recognize country borders. Moreover, opportunities provided by advances in certain areas of STI (such as biotechnology) require concentrated investments in infrastructure, advanced computing, and scarce human capacity that call for central hubs and platforms that offer economies of scale.
3. Benchmarking with other regional innovation cooperation initiatives

This section includes the identification of successful innovation collaboration experiences in the main world regional blocks and the identification of practices that could be implemented to fill in the gaps within the SADC innovation framework. Benchmarking allows regions to learn from and be inspired by other regions.

Sustainability of regional arrangements depends on the incentives for participation by all parties. A regional role allows a host country to move to a higher level of complexity in its innovation system. The collapse of regional organizations is precipitated most often by national decisions by a member country that free rides, shirks responsibility, becomes unable to carry out commitments to the collective action, or determines it is not sharing equitably in the benefits. These problems need to be addressed by governance and financing mechanisms, methods of ensuring access to and sharing of benefits, and some formal policing of commitments. Sustainable regional organizations will require a higher-order political and financial mechanism committed to a regional strategy. Self-sustaining regional centers can emerge when a host-country institution accepts a regional role and has a business model that sustains it through a national core commitment, research grants, service fees, and projects. A mutual accountability framework that provides incentives for all partners to deliver on their commitments is necessary (World Bank, 2012).

3.1. Successful Experiences identified for the SADC Gap Areas

It is important to restate that the majority of the countries in SADC region are factor-driven and thus confront the main role of innovation for the region and local actors, is to “absorb” knowledge and technology and to start to work regionally (in a way to open more chances to compete internationally).

That is precisely why some successful innovation collaboration experiences in these gaps areas in Latin America and the Caribbean and the European Union have been identified in order to provide policy-direction at the regional level. As we mentioned above, we have focused on priority areas. In Figure 22 we have presented the list of international experiences that could be examples of policies to apply in order to fill the gaps in the SADC region.
From these successful international experiences we observe that someone could serve as examples for policies action for several pillars from our proposed analytical framework.

It also worth remarking that policy measures must be altered to suit the regional context, including institutional factors, industry specialization and size. As a result, policy instruments that may be effective in improving innovative performance in one region may be less effective or even inappropriate in another. A simple “cut-and-paste” approach, where policy areas are randomly copied and applied by low-performing countries could easily be detrimental to innovation performance. However, we are confident that our analysis will serve as an inspiration in designing policies that help improve overall innovation performance.

On the other hand, we consider that implementing regional policies on “Technological or Science Parks” and “Cluster Policies” may not be appropriate at a time of “take off” in terms of science and technology as it appears to be the case in SADC countries. So, we do not focus on these innovation policies areas in this benchmark exercise.
In Table 10 we present the main features of the international experiences that could help as inspiration for policies for the SADC region. After this brief characterization we present a wider explanation of the functioning of each of these international experiences policies selected and we also have included a comment concerning its relevance to the SADC region.
### Table 10. International experiences

**Pillar: FRAMEWORKS CONDITIONS**

**ENDOGENOUS FUNDING MECHANISMS**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Innovation for Competitiveness Fund -Chile-</th>
<th>Prociencia – Fonacide Fund -Paraguay-</th>
<th>Science, Technology and Innovation Fund -Colombia-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>To finance innovation projects to help diversify and boost their economies and to reduce the country’s vulnerability to external shocks.</td>
<td>To strengthen national capacities for scientific research and technological development, so as to contribute to the increase in productive capacity, competitiveness and to improve living conditions in the country.</td>
<td>To increase the Science, Technology and Innovation capabilities of the regions through projects that contribute to the production, use and integration of knowledge.</td>
</tr>
<tr>
<td>Activities/ Priorities</td>
<td>(i) the promotion of science and technology, (ii) human capital formation and (iii) innovation in business, culture, institutional structures, infrastructure and regions.</td>
<td>(i) the promotion of scientific research; (ii) strengthening human capital; (iii) formation of a system of researchers in Paraguay; (iv) the initiation and social appropriation of science and technology.</td>
<td>(i) Technological Research and Development: basic research, applied and experimental research and high skilled human capital formation; (ii) Innovation activities; (iii) Technological and scientific services.</td>
</tr>
<tr>
<td>Financed by</td>
<td>Funded by a new tax on mining companies with annual sales exceeding 12000 tonnes of fine copper, paid in installments based on a mine’s operating taxable income.</td>
<td>Fonacide currently manages the USD 360 million that Paraguay has received from the sale of electric energy in hydropower from Itaipú dam and at least USD 97,067,613 will be allocated over the next five years the Paraguayan Program for the Development of Science (Prociencia).</td>
<td>The General Royalties System (SGR) which invests 10% of total receipts from the exploitation of non-renewable natural resources in a fund to finance STI projects. The SGR, on average have a collection of 3.5 billions of dollars per year.</td>
</tr>
</tbody>
</table>
## Endogenous Funding Mechanisms

### Table 10. International experiences. (cont.)

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Ghana Education Trust Fund -Ghana-</th>
<th>Sectoral Funds -Brazil-</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td>To provide finance to supplement the provision of education at all levels by the Government.</td>
<td>To encourage the strengthening of the national S &amp; T system and to create a new model of management, with the participation of various social segments, and promote greater synergy between universities, research centers and industry.</td>
</tr>
<tr>
<td><strong>Activities/ Priorities</strong></td>
<td>(i) the development and maintenance of essential academic facilities and infrastructure in public educational institutions particularly, in tertiary institutions; (ii) grant of scholarships to gifted but needy students for studies in second-cycle and accredited tertiary institutions in Ghana; (iii) operation of students loans schemes for students in accredited tertiary institutions through loan scheme mechanisms and agencies, approved by the Minister; (iv) grants to tertiary institutions, to train brilliant students as members of faculties and to undertake research and other academic programmes of relevance to national development.</td>
<td>It is based on the creation of several sectoral funds (12 at start, 14 now) and two transversal funds for innovation. FUNDS: 1) AERO; 2) AGRO; 3) AMAZONIA; 4)AQUA; 5) BIO; 6) ENERGY; 7) HEALTH; 8) HYDRO; 9) INFO; 10) INFRA; 11) MINERAL; 12) PETRO; 13) SPACE; 14) TRANSPO; 15) GREEN-YELLOW; 16) FUNTEL. They have enabled the deployment of thousands of new projects in STIs, which aim not only to generate knowledge, but also their transfer to companies. Partnership projects have stimulated greater investment in technological innovation by businesses, helping to improve their products and processes and also balance the relationship between public and private investments in science and technology.</td>
</tr>
<tr>
<td><strong>Financed by</strong></td>
<td>(i) An amount of money, equivalent to two and one half percent out of the prevailing rate of the Value Added Tax to be paid by the Value Added Tax Service to the Fund; (ii) Such other money as may be allocated by Parliament for the Fund, and (iii) Money that accrues to the Fund from investment made by the Board of Trustees of the Fund (iv) Grants, donations, gifts and other voluntary contributions to the Fund, and (v) Other monies or property that may in any manner become lawfully payable and vested in the board of Trustees for the Fund.</td>
<td>Each fund is financed by channelling specific rents from each sector to the federal fund; in addition, a percentage is channeled to the transversal funds to finance R&amp;D infrastructure (Infrastructure Fund) and cooperative R&amp;D projects between universities and firms (FVA-Green-Fellow Fund). The Sectoral Funds are still valuable instrument of national integration policy, because at least 30% of its resources are necessarily directed to the North, Northeast and Midwest, promoting devolution of S &amp; T activities and the consequent spread of its benefits.</td>
</tr>
</tbody>
</table>
Table 10. International experiences. (cont.)
Pillar: HUMAN RESOURCE DEVELOPMENT

<table>
<thead>
<tr>
<th>Aspects</th>
<th>ERASMUS</th>
<th>COST</th>
<th>FOBESII</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td>Its purpose is to provide exchange options for students from within the European Union. Involves many of the best universities and seats of learning on the continent.</td>
<td>It is an intergovernmental mechanism for sponsoring and promoting international science and technology cooperation.</td>
<td>The main purpose of the Bilateral Forum on Higher Education, Innovation and Research (FOBESII) is the sustained economic development and social welfare in the United States (U.S.) and Mexico by training human resources, research and innovation.</td>
</tr>
</tbody>
</table>
| **Activities/ Priorities** | Each student receives a grant which covers partly the costs of the stay abroad. Students going on exchange under the ERASMUS programme do not pay any university fees. Students can choose the length of time they spend abroad, with a minimum of three months recognised as the qualifying period, and the general idea behind Erasmus is to engender the sharing of languages throughout the EU states. | COST funds pan-European, bottom-up networks of scientists and researchers across all science and technology fields. These networks, called 'COST Actions', promote international coordination of nationally-funded research. COST does not fund research itself, but provides support for networking activities carried out within COST Actions. | – To increase undergraduate and graduate student mobility  
– To significantly increase scholarships  
– Increase academic mobility and the creation of knowledge networks  
– Encourage exchanges and cooperation between programs and university-industry consortia in both countries  
– Etc. |
| **Beneficiaries** | The programme is open to 33 countries: Member States of the European Union, EU candidate countries and European Free Trade Association (EFTA) / European Economic Area (EEA) members. Apart from the students, the mobility offered by the Erasmus programme is dedicated for professors and universities' staff as well. | COST Actions are bottom-up science and technology networks open to researchers and stakeholders, with a four-year duration and a minimum participation of five COST Countries. COST Actions are open to researchers from universities, public and private research institutions, as well as to NGOs, industry and SMEs. | Students, researchers, teachers, companies, value chains and clusters from US and Mexico. |
### Table 10. International experiences. (cont.)

**Pillar: PROMOTION OF LINKAGES**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>FONTAGRO -Latin America-</th>
<th>CONNECTAMERICAS -Latin America-</th>
<th>EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY –COST-</th>
<th>INTERNATIONAL NETWORK FOR SMALL AND MEDIUM ENTERPRISES -INSME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objectives</strong></td>
<td>To finance S&amp;T research and innovation projects in the agricultural sector in order to achieve: (i) poverty alleviation; (ii) improvement of the competitiveness of the agrarian value chains; (iii) sustainable management of natural resources.</td>
<td>It is a brand new virtual platform to promote the internationalization of the Latin American and Caribbean (LAC) SMEs.</td>
<td>It is an intergovernmental mechanism for sponsoring and promoting international science and technology cooperation.</td>
<td>To promote the transnational cooperation of SMEs around innovation and technology transfer.</td>
</tr>
<tr>
<td><strong>Activities/ Priorities</strong></td>
<td>Funding is awarded through a competitive process. Eligible projects must include teams of at least two countries. Topics: improvement of productive efficiency, genetic resources, technical improvement in the agrarian chain, climate change, food security, competitiveness, commercialization, etc.</td>
<td>The platform is built as an open social network and aims to provide in a friendly and organized manner all the available information about the private and public programs enhancing and supporting trade and investment by firms of the LAC countries as well as of other countries belonging to the IADB. The platform is built around 3 main pillars: Learning, Connecting, and Financing.</td>
<td>COST funds pan-European, bottom-up networks of scientists and researchers across all science and technology fields. These networks, called 'COST Actions', promote international coordination of nationally-funded research. COST does not fund research itself, but provides support for networking activities carried out within COST Actions.</td>
<td>(i) INSMEAcademy, a webinar-based training program on relevant topics concerning innovation, creativity, strategic partnerships, and entrepreneurial spirit; (ii) Financing Programs, providing information about the international, national and regional initiatives and programs aimed at financing intermediaries, networks of intermediaries, and SME’s operating in the field of innovation, competitiveness and technology transfer; (iii) Etc.</td>
</tr>
<tr>
<td><strong>Beneficiaries</strong></td>
<td>Promotes partnerships and alliances among the science and technology instances and institutes of the different member countries, with centers of excellence of the region and of other places, with universities and research centers, the International Consultative Group for Agrarian Research, etc.</td>
<td>SMEs</td>
<td>COST Actions are bottom-up science and technology networks open to researchers and stakeholders, with a four-year duration and a minimum participation of five COST Countries. COST Actions are open to researchers from universities, public and private research institutions, as well as to NGOs, industry and SMEs.</td>
<td>SMEs</td>
</tr>
</tbody>
</table>
Table 10. International experiences. (cont.)

Pillar: PROMOTION OF LINKAGES

<table>
<thead>
<tr>
<th>Innovation Networks</th>
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<tr>
<td><strong>Aspects</strong></td>
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<tr>
<td><strong>Objectives</strong></td>
</tr>
<tr>
<td><strong>Activities/Priorities</strong></td>
</tr>
</tbody>
</table>
| **Beneficiaries** | Agreement associates:  
- a French legal firm (associations, public institutions, and territorial governments are excluded). The subject must be part of an economic development perspective;  
- a candidate holding a degree from an engineering, business, management school or from recent in-depth studies (secondary education +5 years postsecondary education). The candidate must be registered of a Doctorate from a doctoral school, but must not have engaged in doctoral studies for over one year. For this person it consists of a first company post. |

Pillar: MECHANISMS FOR POLICY LEARNING

<table>
<thead>
<tr>
<th>Incentives for regional cooperation and good management</th>
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</thead>
<tbody>
<tr>
<td><strong>Aspects</strong></td>
</tr>
<tr>
<td><strong>Objectives</strong></td>
</tr>
</tbody>
</table>
| **Activities/Priorities** | (i) INSMEAcademy, a webinar-based training program on relevant topics concerning innovation, creativity, strategic partnerships, and entrepreneurial spirit;  
(ii) Financing Programs, providing information about the international, national and regional initiatives and programs aimed at financing intermediaries, networks of intermediaries, and SME’s operating in the field of innovation, competitiveness and technology transfer;  
(iii) Etc. |
| **Beneficiaries** | SMEs |
3.1.1. International experiences: characteristics and functioning

FOCEM Mercosur (Mercosur Estructural Convergence Fund).  

Relevance for SADC countries: The four countries that make up Southern Common Market (MERCO SUR) display pronounced differences, both in terms of the size of their economies and their degree of development. This evidence has sparked an intense debate, the salient question in which is whether disparities or structural asymmetries affect the customs union members’ performance or whether the integration process tends to even out their levels of per capita income. The creation of the FOCEM, with the objective of financing programs to develop competitiveness and promote structural convergence and social cohesion – particularly “in the smaller economies and less developed regions” – seeks to remove or mitigate asymmetries, while implicitly acknowledging that in addition to these asymmetries between the partners, there are very marked differences in terms of levels of development across their component regions. As we have previously observed there are notorious differences and asymmetries in SADC countries in terms of growth, development, R&D and innovation related activities. Countries like South Africa and Botswana could be considered as the potential “providers” of financials fund and resources to diminish the asymmetries in SADC region.

i) Main objectives: the MERCOSUR Structural Convergence Fund (FOCEM) was set up by CMC (Consejo Mercado Común - Common Market Council) Decision N° 45/04, with the objective of financing programs to develop competitiveness, and to promote structural convergence and social cohesion, particularly in “the smaller economies and the least developed regions”, with the implicit acknowledgment that, in addition to the asymmetries between the MERCOSUR partners, there are very marked differences in the levels of development of their component regions.

ii) Main functions/activities: FOCEM projects are to be framed in four programs: Structural Convergence (Program I), designed to promote development, structural adjustment and interconnect systems of smaller economies and less developed regions.; Competitiveness Development (Program II), aimed at promoting more competitiveness of the internal production, through projects that enhance regional commerce, integrate the production chain, strengthen quality control and develop new products and processes; Social Cohesion (Program III), with the goal of social development, especially in border areas, and may include common interest projects in the areas of health, poverty alleviation and employment policies; and Strengthening of the Institutional Structure and the Integration Process (Program IV), designed to better the functioning of MERCOSUR’s institutional framework, under the responsibility of the SM. C MC Decision N° 18/05 established that, in the Fund’s first four years, priority ought to be given to the provision of physical infrastructure (Program I), particularly to facilitate the integration process, and that no more than 0.5% of the annual budget should be spent on Program IV. Specifically, the Competitiveness Development Program has the following functions/activities:

a) Generation and diffusion of technological knowledge directed to dynamic product sectors.

b) Metrology and quality certification of products and processes.

c) Tradability and sanity control of animals and vegetables. Safety and Quality Warranty of products and by-products of economic value.

d) Development of productive chains in dynamic and differenced economic sectors.

e) Promotion of the entrepreneurial sector vitality, formation of consortia and networks of exporters and producers.

f) Development of competencies associated to execution, management and improvement of manufactures services and business processes.

25 www.mercosur.int/focem
g) Transformation, growth and associativity of small and medium size enterprises, their links with regional markets and the promotion of creation and development of new entrepreneurships.

h) Professional Training, productive organization for cooperation and enterprise incubation.

i) Promotion and diversification of national systems of technological and scientific innovation.

### iii) Who gives financial support

There is a clear difference between the contributions from each of the MERCOSUR countries and the distribution of resources among them. With an annual contribution to the Fund of US$100 million, it will be conformed according to the following percentages which have been established taking into account the historical average GDP of MERCOSUR members:

1. • Argentina: 27%
2. • Brasil: 70%
3. • Paraguay: 1%
4. • Uruguay: 2%

The fund may also receive spontaneous contributions from member States, non-member States and international organizations.

### iv) Who are the beneficiaries

In the yearly distribution of resources for three of the four existing programs, to which one adds the non-allocated resources in previous years,

1. Paraguay has the right to 48%,
2. Uruguay has the right to 32%
3. Argentina has the right to 10%
4. Brazil has the right to 10%

Since we are not talking about loans to the beneficiaries, the resources are nonrefundable. The counterpart of the State that benefits from the fund transfer is to shoulder at least 15% of the project’s eligible expenditure, which may not be substituted by other expenses on ongoing projects or even infrastructure related moneys in the benefited territorial unity. A company may provide goods or services if its headquarters are in one of the member States.

### v) Outcomes

Between the Fund’s creation and December 2011, 39 projects for over US$1.1 billion were approved, almost 74% of which was funded through the FOCEM. The classification according to the four programs referred to in the FOCEM Regulations shows that 17 projects correspond to the Structural Convergence Program, 11 to Competitiveness Development, 8 to Social Cohesion, and 3 to Strengthening of the Institutional Structure. The differences are even more pronounced when we look at the amounts earmarked for each programme: structural convergence projects account for nearly 90% of the total amount of projects approved, followed by Social Cohesion (5.7%) and Competitiveness Development (5.4%). These figures do not allow us to assess the trend seen in recent years, which shows a higher preponderance of infrastructure projects in the FOCEM budget. Figure 1 shows that, whereas these projects accounted for 64% of funds to 2008, this value has risen to 94% in the last three years (2009-2011). On the downside, both the funds earmarked for Competitiveness Development and Social Cohesion fell from 18% to around 3%. This situation shows a change in the priorities granted to structural funds by the MERCOSUR Member States, through the presentation of large-scale projects related to infrastructure works.

### Chile: Mining Royalties: Financing Innovation with Commodity Revenues

**Relevance to SADC region:** Mining in SADC remains a predominant industry as it contributes about 60% to the total foreign exchange earnings, 10% to total GDP though in some member States it goes up to 50% and about 5% to direct formal employment. SADC is also an important player on the

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international mineral market with shares between 11% and 45% of the world supply of eight major commodities which includes chromite, cobalt, diamond, gold, manganese, copper, platinum and uranium and has considerable potential in the dimension stone sector and other industrial minerals.

In addition SADC possesses some of the world’s richest deposits for a number of minerals.

i) Main objectives: The law regulating mining royalties was introduced in Chile in 2005 (Law 20 026). This legislation established a specific tax on mining, which was implemented based on the idea that Chile’s regions needed extra funds to finance innovation projects to help diversify and boost their economies and to reduce the country’s vulnerability to external shocks from rising and falling international copper prices.

ii) Main functions/activities: Chile’s economy has been booming partly because of high revenues from copper exports. To invest those revenues wisely, the government decided to invest heavily in moving away from a predominantly resource-based economy (agriculture and mining) toward a knowledge intensive economy. For this purpose, it created a national innovation fund for competitiveness (FIC, Fondo de Innovación para la Competitividad), funded by a new tax on mining, in 2005. A newly created national innovation council for competitiveness (CNIC, Consejo Nacional de Innovación para la Competitividad), in which the various sectors and interest groups are represented, advises FIC on how to allocate its resources, while an interministerial committee on innovation (CMI, Comité de Ministros para la Innovación) is responsible for implementation.

iii) Who gives financial support: The tax is on mining companies with annual sales exceeding 12000 tonnes of fine copper and is paid in instalments and based on a mine’s operating taxable income. For annual sales exceeding the value of 50000 tonnes of fine copper, a single tax rate of 5% is applied. For annual sales between 12000 and 50000 tonnes, a tiered rate is applied, which can range from 0.5% to 4.5%, based on tonnage categories. Mine operators whose sales are 12000 tonnes or below are exempt from paying the tax.

iv) Who are the beneficiaries: The primary recipient of the royalty funds is the National Innovation Fund for Competitiveness (FIC), whose aim is to finance the promotion of science and technology, human capital formation and innovation in business, culture, institutional structures, infrastructure and regions. The FIC is the financing instrument of the executive branch with budgetary support for the implementation of national and regional innovation policies. These policies aim to strengthen the innovation system at the national and regional levels and provide transparency, flexibility and competitive and strategic direction to state action. As part of this new initiative, CNIC has formulated a national innovation strategy. After extensive study and consultation, CNIC selected five economic clusters on which to focus science, technology, and innovation (STI) investments: agro-food, aquaculture, mining, tourism, and global services. For each selected cluster, a strategic board with public and private representation has been created to set cluster-specific priorities. Moreover, despite their name, competitive funding schemes are being used to cement stronger links within the innovation system by promoting cross-institutional collaboration between universities and research institutes and by promoting public-private partnerships in the form of “technology consortia.” The latter instrument not only cements collaboration between a research agency and the private sector but between companies that share a common technology platform.

v) Outcomes: The creation of the FIC has led to a significant increase in the budget for innovation in Chile. However, as is often the case in the early stages of new funds, budget execution has been low. The difficulties of managing these resources include the need to generate a consensus among regional governments, as royalties from the production of natural resources traditionally go to the community where mining takes place as compensation. The generation of adequate mechanisms for dialogue between government levels is critical to advance in the use of these resources as an additional source of funding for competitiveness. Since FIC’s creation in 2005, public STI
investments in Chile have more than doubled in real terms (reaching US$530 million in 2009). Public STI investments are projected to continue to grow by 10–15 percent per year over the coming ten years. Parallel to the STI initiative, the Chilean government established a major scholarship scheme (Becas Chile) in 2008, which will allow some 30,000 Chileans to study abroad over the next ten years. The budget for this scheme is some US$6 billion and is also financed out of mining royalties.

Paraguay: Prociencia (Paraguayan Programme for the Development of Science)\(^{27}\)

**i) Main objectives:** The Main goal is to strengthen national capacities for scientific research and technological development, so as to contribute to the increase in productive capacity, competitiveness and to improve living conditions in the country. It consists of four main components: 1) the promotion of scientific research, 2) strengthening human capital, 3) formation of a system of researchers in Paraguay and 4) the initiation and social appropriation of science and technology.

**ii) Main functions/activities:** 1) The goal of the first component is to promote scientific research aimed at stimulating investment in knowledge generation and strengthen the transfer of results to the private sector and public activities of Paraguay. Through this component will be different instruments for the allocation of financial resources to support the implementation of research and development projects. 2) In order to strength Human Capital qualifications, the program will provide opportunities conducive to the formation of researchers through doctoral programs and master's degrees in Paraguayan universities, would provide short and supplementary grants, national and international granting full scholarships and funding for participation in scientific events. 3) The third component is aimed at the formation of a system of researchers from Paraguay, which aims to stimulate the improvement and sustainability of highly skilled human capital. It is one of the pillars of the national science and technology policy, specifically for training and strengthening of human resources in research, considering key the implementation of the "research career" in Paraguay. 4) The fourth component aims at promoting acloser link between the civil and science society through learning spaces based on experimentation and interaction.

**iii) Who gives financial support:** Law No. 4758/2012 created the National Fund for Development and Public Investment (Fonacide). Fonacide currently manages the US$ 360 million that Paraguay has received from the sale of electric energy in hydropower in Itaipú dam and are this amount should be invested in education, health and infrastructure. The Government decided that US$ 97,067,613 will be allocated over the next five years the Paraguayan Program for the Development of Science (Prociencia), administered by the National Council for Science and Technology (CONACYT).

**iv) Who are the beneficiaries:** Universities, academic centers, institutes or research centers, government or non-governmental, public or private agencies.

**v) Outcomes:** It is a recent program with no results yet.

Brazil: Sectoral Funds.\(^{28}\)

Relevance to SADC region: The governance structure and the articulation between different institutions are essential to determine the success of a policy. This is reflected in the scheme of the

\(^{27}\)http://secit.conacyt.gov.py/prociencia-0

\(^{28}\)http://www.finep.gov.br/pagina.asp?pag=fundos_o_que_sao
sectoral funds in Brazil, which focus on innovation and co-operation. The sectoral funds supporting science, technology and innovation activities in Brazil, are built on co-ordination between stakeholders and use sectoral revenue as a source of funding. They guarantee significant returns and promote co-participation among all stakeholders (companies, universities, governments and research institutions) in project planning and the administration of funds. Besides, they have an equalitarian philosophy (to reduce development asymmetries) since a portion of the funds necessarily have to be directed to the lagged regions.

i) Main objectives: In 1999, Brazil introduces a system of technological sectoral funds to finance scientific and technological development. The creation of Sectoral Funds is establishing a new standard of funding for the sector, with an innovative mechanism to encourage the strengthening of the national S & T system. Its goal is to ensure the stability of features for the area and create a new model of management, with the participation of various social segments, and promote greater synergy between universities, research centers and industry. The Sectoral Funds are still valuable instrument of national integration policy, because at least 30% of its resources are necessarily directed to the North, Northeast and Midwest, promoting devolution of S & T activities and the consequent spread of its benefits.

ii) Main functions/activities: It is based on the creation of several sectoral funds (12 at start, 14 now) and two transversal funds for innovation. Each fund is financed by channelling specific rents from each sector to the federal fund; in addition, a percentage is channeled to the transversal funds to finance R&D infrastructure (Infrastructure Fund) and cooperative R&D projects between universities and firms (FVA-Green-Fellow Fund). Each fund is managed by a committee composed by members from the Ministry of Science, technology and Innovation, other sectoral ministries, regulatory agencies, the scientific community and the business sector. The Sectoral Funds were created in the prospect of being complementary sources of funding for the development of strategic sectors for the country. They have enabled the deployment of thousands of new projects in ICTs, which aim not only to generate knowledge, but also their transfer to companies. Partnership projects have stimulated greater investment in technological innovation by businesses, helping to improve their products and processes and also balance the relationship between public and private investments in science and technology.

Funds: 1) AERO; 2) AGRO; 3) AMAZONIA; 4) AQUA; 5) BIO; 6) ENERGY; 7) HEALTH; 8) HYDRO; 9) INFO; 10) INFRA; 11) MINERAL; 12) PETRO; 13) SPACE; 14) TRANSPO; 15) GREEN-YELLOW; 16) FUNTEL.

iii) Who gives financial support: FUNDS:

1) AERO: 7.5% of the Contribution for Intervention in the Economic Domain - CIDE, whose collection comes from the incidence rate of 10% on the remittance of funds abroad to pay for technical assistance, royalties, technical services professionals or established by Law No. 10.168, of 29/12/2000.

2) AGRO: 17.5% Contribution of Intervention in the Economic Domain- CIDE, whose collection come incidence rate of 10% on the remittance of funds abroad to pay for technical assistance, royalties, technical services or professionals.

3) AMAZONIA: Minimum of 0.5% of gross revenues of companies which have as their purpose the production of IT goods and services manufactured in Manaus Free Zone.

4) AQUA: 3% portion of the proceeds of the Freight Surcharge for Merchant Marine Renewal (AFRMM) that fits the Merchant Marine Fund (FMM).

5) BIO: 7.5% of the Contribution for Intervention in the Economic Domain – CIDE, whose collection comes from the incidence rate of 10% on the remittance of funds abroad to pay for technical assistance, royalties, technical services or professionals.
6) ENERGY: 0.75% to 1% on net revenues of concessionaries generation, transmission and distribution of electricity.
7) HEALTH: 17.5% Contribution of Intervention in the Economic Domain – CIDE, whose collection comes from the incidence rate of 10% on the remittance of funds abroad to pay for technical assistance, royalties, technical services or professionals established by Law No. 10168 de 29/12/2000.
8) HYDRO: 4% of compensation currently taken by companies generating electricity (equivalent to 6% of the production of electric power generation).
9) INFO: Source of financing: At least 5% of the gross sales coming from sale of informatics goods and services in the internal market from firms that receive tax incentives of the Informatics Law.
10) INFRA: 20% of the resources allocated to each Fund for Scientific and technological Development.
11) MINERAL: 2% of Financial Compensation in the Mining Sector (CFEM) payable by companies holding mining rights.
12) PETRO: 25% of the portion of the royalties that exceed 5% of the production of oil and natural gas.
13) SPACE: 25% of revenues for the use of orbital positions, 25% of the revenues earned by the Union for the releases, 25% of the revenue earned by the Union on the marketing of data and images obtained through tracking, control and rocket telemetry and satellites, and the total income earned by the Brazilian Space Agency (AEB), arising from the granting of licenses and permits.
14) TRANSPO: 10% of the revenue collected by the National Departments of Roads – DNER- in contracts with telephone companies, communications companies and the like, using the infrastructure of land transport services of the Union.
15) GREEN-YELLOW: 50% of the Contribution for intervention in the Economic Domain – CIDE, whose collection comes from incidence rate of 10% on the remittance of funds abroad to pay for technical assistance, royalties, technical services and professionals, 43% of estimated revenue of IPI levied on goods and products benefits from tax incentives of the Informatics Law.
16) FUNTEL: 0.5% of net revenues of XXX companies providing telecommunications and contribution of 1% of the gross revenues of participatory events held through phone calls, plus initial equity resulting from the transfer of US $100 million Fund Telecommunications Supervision (FISTEL)

iv) Who are the beneficiaries: Earmarking of the resources: resources can not be transferred between the Funds and should be applied to stimulate the chain of knowledge and innovation process of the sector in which they originate. Multiannual: It could be programmed support actions and projects with more than one tax year term. The resources of Sector Funds generally are applied in selected through public call, whose edicts are published on the websites of FINEP and CNPq projects

v) Outcomes: This system is considered among the main reasons for Brazil’s recent rapid growth in science, technology and innovation (reaching levels of investment in R&D of around 1.2% of GDP in 2009). However, they also have intrinsic weaknesses, which may explain why there is still a low level of disbursement of allocated funds. One particular area of weakness is management and administration, due to the high level of complexity and the number of actors involved in steering committees, as well as the potential overlap of interests that may cause problems in coordination.29

29 ECLAC_CEPAL (2012)
Relevance to SADC region: VAT is a consumption tax that is relatively easy to administer and difficult to evade and it has been embraced by many countries of the world. Since Malawi first introduced a VAT system to its Surtax in 1989 and South Africa introduced VAT in 1991, 10 of the 13 SADC Member States have introduced VAT with 3 of these countries since 2001. Zimbabwe is the most recent in January 2004. Three countries have alternative domestic indirect tax systems, Angola, Congo and Swaziland.

i) Main objectives: The goal of the Fund is to provide finance to supplement the provision of education at all levels by the Government.

ii) Main functions/activities: For the purpose of attaining this object, the monies from the Fund are to be expended as follows:

a) To provide financial support to the agencies and institutions under the Ministry of Education, through the Ministry, for the development and maintenance of essential academic facilities and infrastructure in public educational institutions particularly, in tertiary institutions;

b) To provide supplementary funding to the Scholarship Secretariat for the grant of scholarships to gifted but needy students for studies in second-cycle and accredited tertiary institutions in Ghana;

c) To contribute monies from the Fund toward the operation of students loans schemes for students in accredited tertiary institutions through loan scheme mechanisms and agencies, approved by the Minister,

d) To provide, through the National Council on Tertiary Education, grants to tertiary institutions, 1- to train brilliant students as members of faculties 2- to undertake research and other academic programmes of relevance to national development, and

e) To provide monies to support such other educational activities and programmes for the promotion of education as the Minister in consultation with the Board may determine.

iii) Who gives financial support:

a) An amount of money, equivalent to two and one half percent out of the prevailing rate of the Value Added Tax to be paid by the Value Added Tax Service to the Fund or such percentage not being less than two and one half percent of the Value Added Tax rate, as Parliament may determine;

b) Such other money as may be allocated by Parliament for the Fund, and

c) Money that accrues to the Fund from investment made by the Board of Trustees of the Fund

d) Grants, donations, gifts and other voluntary contributions to the Fund, and

e) Other monies or property that may in any manner become lawfully payable and vested in the board of Trustees for the Fund.

iv) Who are the beneficiaries: The Fund’s beneficiaries are the citizens of Ghana, who are provided with quality education for all levels of education.

v) Outcomes: Since 2001, the GET Fund has disbursed funds for the following purposes:

- Subsidies for Tertiary Academic Facility User Fee
- Trucks for carting of materials/books to Basic Schools
- Grants for Annual Best Teacher Award
- Grants to Students Loan Scheme
- Grants to Scholarship Secretariat
- Provision of Computers and other Equipment for Tertiary institutions, setting up ICT centres
- Construction of dormitory blocks for Secondary Schools

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– Construction of classroom blocks for Second-Cycle and Basic schools
– Funding elimination of schools under trees
– Construction of Pre-Schools
– Construction of VOTEC Resources centers in all regions
– Payment for school Text Books
– Funding Faculty Development Programme
– Grants for research in Tertiary Institutions
– MPs Emergency Fund
– Provision of buses for Private Tertiary institutions/Construction of hostels for Public Tertiary Institutions
– Provision of buses for Teacher Training Colleges
– Payments for numerous Infrastructural Projects in the Tertiary Institutions
– Provision of vehicles for Tertiary Institutions
– Provision of buses for all Girls Secondary Schools
– Grants to GIMPA, College of Physicians and surgeons, Regional Maritime University, Maths, Science & Technology Scholarship Scheme. (MASTESS), Military Academy & Training School.

Erasmus - EuRopean Community Action Scheme for the Mobility of University Students

i) Main objectives: The ERASMUS programme is a European student exchange programme established in 1987 offering university students a possibility of studying or working abroad in another European country for a period of at least 3 months and maximum 12 months. Its purpose is to provide foreign exchange options for students from within the European Union and it involves many of the best universities and seats of learning on the continent. Since 2007 the Erasmus project is a part of The Lifelong Learning Programme, which is determined for the years 2007-2013. For the period 2014-2020 the Erasmus + Programme will be implemented. It aims to boost skills and employability, as well as modernising Education, Training, and Youth work. The seven year programme will have a budget of €14.7 billion; a 40% increase compared to current spending levels, reflecting the EU’s commitment to investing in these areas.

ii) Main functions/activities: The programme is open to 33 countries: Member States of the European Union, EU candidate countries and European Free Trade Association (EFTA) / European Economic Area (EEA) members. Each student receives a grant which covers partly the costs of the stay abroad. Students going on exchange under the ERASMUS programme do not pay any university fees. Students can choose the length of time they spend abroad, with a minimum of three months recognised as the qualifying period, and the general idea behind Erasmus is to engender the sharing of languages throughout the EU states.

iii) Who gives financial support: Erasmus is funded by many of the EU member nations and is aimed at cross-border cooperation between states to aid the growth of international studying. It is a part of the EU’s Lifelong Learning programme and accounts for more than 40% of its budget. The EU provides annual grants to national agencies in the 33 participating countries. National agencies are responsible for organising calls for proposals and for signing grant agreements with universities, schools, colleges and other educational institutions in their country. Students apply for an Erasmus grants through their home university which is responsible for paying them the agreed grant.
The overall Erasmus budget for student and staff mobility is allocated to different countries on the basis of the following factors:

(i) Population: number of students, graduates and teachers in higher education (level 5-6 of the International standard classification of education, ISCED).

(ii) Cost of living and distance between capital cities: used as corrective factors, applied to the population factor.

(iii) Past performance indicator: calculated on the basis of the number of outbound staff and students in the past.

Nearly 90% of the Erasmus budget is invested in student and staff mobility. Erasmus also supports cooperation projects and networks which account for around 4% of the budget. These are managed centrally by the Education, Audiovisual and Culture Executive Agency (EACEA) in Brussels.

iv) Who are the beneficiaries: Apart from the students, the mobility offered by the Erasmus programme is dedicated for professors and universities' staff as well.

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**FOBESII - BILATERAL FORUM ON HIGHER EDUCATION, INNOVATION AND RESEARCH**

i) Main objectives:

The main purpose of the Bilateral Forum on Higher Education, Innovation and Research (FOBESII) is the sustained economic development and social welfare in the United States (U.S.) and Mexico by training human resources, research and innovation. It was created on May 2nd, 2013, in Mexico City, and seeks to develop a strategic approach to existing cooperation programs in these areas, in order to promote human capital and economic development in Mexico and the U.S., with the ultimate goal of transforming North America into a region of knowledge. The Forum will emphasize areas and sectors that will increase the competitiveness of the two countries, through university-industry linkages.

ii) Main functions/activities:

a. To increase undergraduate and graduate student mobility.

b. To significantly increase scholarships and programs for:

   i. undergraduate stays

   ii. graduate studies

   iii. post-doctorate

   iv. Internships

c. Increase academic mobility and the creation of knowledge networks.

d. Encourage exchanges and cooperation between programs and university-industry consortia in both countries.

e. Increase the number of joint research and innovation projects.

f. Encourage bi-national public-private partnerships, networks and consortia.

g. Create virtual research and innovation centers.

h. Increase funding for joint research programs

iii) Who gives financial support:

It was proposed to create bi-national fund with contributions from:

a. Government ministries for projects in areas of their interest, e.g., the Ministry of Energy and the Department of Energy for energy-related projects.

b. Universities to waive part of tuition payments to allow under- and graduate mobility and to contribute with mobility funds.

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c. NSF and CONACYT for joint research and mobility joint projects from researchers and postdoctoral students.
d. Business associations and companies from both countries to support the efforts developed by Mexican and U.S. governments and agencies.

iv) Who are the beneficiaries: students, researchers, teachers, companies, value chains and clusters from US and Mexico.

CIFRE - Industrial Agreements for Training through Research

i) Main objectives: Industrial agreements for training through research (CIFRE) propose a framework and financing that is particularly suited to students interested in development research and the careers that may be available in companies. The CIFRE agreements are organized and managed by the National Association of Technical Research (ANRT) for the account of the ministry of Postsecondary Education and Research. They have the objective of helping businesses when they hire a young graduate with secondary education +5 years postsecondary education starting in a first research and development post.

ii) Main functions/activities: Each agreement places the doctoral student in a research team of high academic quality and in a company that is involved in medium or long-term issues. Students are asked to make contact with the designated person, according to the subject they are interested in. This contact is used to discuss the conditions of the company agreement, the detailed content of the subject and the identity of the supervisors (tutor, partner research unit). It is the company that sets up each CIFRE agreement. An application will be put together with the ANRT.

The doctoral student's status under a CIFRE agreement is that of an employee on a fixed-term contract of a maximum three years.

The work must be carried out in direct collaboration with a recognized research team, outside the company, to whom the manager confides the mission in assuring the supervision on a scientific level, which is the gauge of true training by research.

iii) Who gives financial support: The CIFRE agreements aim to develop public-private research partnerships based on theses jointly financed by firms and the ANRT. The firm concerned, eligible for Research Tax Credit (CIR), receives an annual grant from the ANRT, on behalf of the State, for three years (€14,000 in 2009). Under the tutelage of the Ministry in charge of Research, the CIFRE programme not only gives firms access to cutting-edge public research, but also helps the students to get a foothold in the firm in terms of their future job prospects.

iv) Who are the beneficiaries: The CIFRE procedure is open to candidates of all nationalities. Agreement associates:
- a French legal firm (associations, public institutions, and territorial governments are excluded).
- The subject must be part of an economic development perspective;
- a candidate holding a degree from an engineering, business, management school or from recent in-depth studies (secondary education +5 years postsecondary education). The candidate must be registered of a Doctorate from a doctoral school, but must not have engaged in doctoral studies for over one year. For this person it consists of a first company post.

FONTAGRO. (Latin American and Caribbean Regional Fund for Agrarian Technology) 32

Relevance to SADC region: FONTAGRO’s experience can be of interest for the SADC countries. The Fund shows a flexible and transparent mechanism for R&D cooperation in agriculture-related

http://www.fontagro.org

32
projects involving the participation of groups belonging to different countries. It is also a flexible initiative to incorporate in the individual projects the participation of innovation teams from third countries of outside the region. The evolution of FONTAGRO’s funding shows that technical assistance and experimental innovation funds need to be clearly financed. Projects need to be independently assessed as well as carefully monitored. Finally, efforts have to be made on the dissemination of learning as well as on fund raising and the establishment of strategic alliances with private and public partners with similar objectives. FONTAGRO has shown to be a useful cooperation mechanism for R&D and agricultural extension among the LAC countries. It has also been instrumental to transfer good technologies and practices to the innovation institutions of the region.

i) Main objectives: FONTAGRO is a partnership of Latin American and Caribbean Countries (LAC) established to finance S&T research and innovation projects in the agricultural sector. The fund aims to three main objectives: poverty alleviation, improvement of the competitiveness of the agrarian value chains, and the sustainable management of natural resources. FONTAGRO member countries are: Argentina, Bolivia, Chile, Costa Rica, Ecuador, Spain, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay, Dominican Republic, Uruguay and Venezuela. FONTAGRO is emphasizing much more its efforts in: (1) knowledge management and dissemination, (2) the establishment of streamline procedures for project identification as well as for the monitoring and assessment ex-ante y ex-post of projects; and (3) the maximization of synergies with other organization with similar aims.

ii) Main functions/activities: In order to achieve its objectives, FONTAGRO promotes partnerships and alliances among the science and technology instances and institutes of the different member countries, with centers of excellence of the region and of other places, with universities and research centers, the International Consultative Group for Agrarian Research, etc.

iii) Who gives financial support: The Fund was created in 1998 by a 3 million USD grant of the IADB. The whole idea at the origin of FONTAGRO was leveraging the interest provided by the original grant (net of provisions to compensate for inflation) with counterpart resources allocated to individual competitive projects by other agencies (World Bank, Inter-American Development Bank, international cooperation agencies, countries themselves, etc.). Most recently, FONTAGRO has established interesting cooperation venues with the Government of New Zealand and with the Global Environmental Fund (GEF) for themes related with the adaptation and mitigation to the climate change. The Fund has recently signed a Memorandum of Understanding to strengthen the cooperation with the Chinese Academy of Agrarian Sciences. FONTAGRO is currently negotiating with the Government of Israel as well as with the World Cocoa Foundation to establish additional cooperation agreements. FONTAGRO has been able to mobilize until the end of 2013 over 83 million USD. Aggregate performance of the Fund shows a leveraging factor for FONTAGRO funds of almost 2. This means that 1 USD of FONTAGRO funding has been able to mobilize almost 2 additional USDS from third parties. Since 2008 and following years until 2012, FONTAGRO had a survival crisis. Due to its funding structure (interests of an endowment leveraged by third party resources), low income derived from the very low interest rates in the international markets had a severe impact on the ability of FONTAGRO to perform. As a consequence of this crisis the Fund modified in 2013 its funding structure, so that it evolved towards a direct allocation of resources for projects of up to a yearly amount of USD 2 million.

iv) Who are the beneficiaries: Funding is awarded through a competitive process. Eligible projects must include teams of at least two countries. Proposals are assessed by external specialists taking into consideration criteria such as technical feasibility, economic, social and environmental impact, institutional capabilities, etc. 73 projects out of more than 360 proposals got financing by the Fund. Topics of those projects were: improvement of productive efficiency, genetic resources,
technical improvement in the agrarian chain, competitiveness, commercialization, climate change, food security, etc.

CONNECTAMERICAS: A PLATFORM FOR THE INTERNATIONALIZATION OF SMES. 33

Relevance to SADC region: CONNECTAMERICAS is a pioneering initiative aiming to connect SMEs with the global economy. The platform emphasizes the fact that in today increasingly globalized world, connecting firms means connecting people, and as such the program, using an advanced and user friendly virtual platform, delivers knowledge to the people and institutions responsible for the internationalization of firms. It is important that the platform is anchored around a relevant multilateral financial institution capable of connecting knowledge and technical assistance with financing and good practices and experiences. Strategic alliances must be implemented so that the virtual platform is fed with relevant information and no single institution appropriates differentially the benefits generated by the flow of information. The success of the virtual platform derives of its ability to perform as a social network. As in many innovative programs early successful experiences are of paramount importance to consolidate the legitimacy of the program as well as the interest of the potential beneficiaries to participate. Therefore, virtual activities must be complemented with actual initiatives: i.e. seminars and meetings, internship programs, project financing, good practice sharing, etc.

i) Main objectives: CONNECTAMERICAS is a brand new virtual platform launched by the InterAmerican Development Bank (IADB) to promote the internationalization of the Latinamerican and Caribbean (LAC) SMEs.

ii) Main functions/activities: The platform is built as an open social network and aims to provide in a friendly and organized manner all the available information about the private and public programs enhancing and supporting trade and investment by firms of the LAC countries as well as of other countries belonging to the IADB (see www.iadb.org). IADB is implementing CONNECTAMERICAS in collaboration with three strategic partners: Google, DHL and VISA, as well as with several local partners in the region: chambers of commerce, banks, trade and investment promotion agencies, universities, etc.). The platform is built around 3 main pillars: Learning, Connecting, and Financing. Parallel to the launching of CONNECTAMERICAS the IADB made available a complementary supporting program called Access2InternationalSMEs. This is an ad-hoc SME internationalization financing venture to finance both trade and investment into foreign markets. The line includes both: (1) a financing line to LAC banks to provide medium-term loans and credit partial guarantees; and (2) a trade facilitation guarantee line. Besides, in 2012 the IADB launched a pilot initiative: The Exchange of Ibero-American graduates (from Spain and Portugal) for Internships in LAC’s SMEs to provide advise for their internationalization with particular emphasis into the European Community.

iii) Who gives financial support: The design and development of ConnectAmericas is being funded by a variety of resources and operations, including funding from the Fund for the Financing of Technical Cooperation for Initiatives for Regional Infrastructure Integration (FIRII) (RG-T2361; RG-T2359; RG-T2241; RG-T2304; RG-M1218)and INT’s Administrative (RG-K-1073).

iv) Who are the beneficiaries: Although the platform provides useful information for all type of companies and the general public, CONNECTAMERICAS focuses on the SME sector. There are almost 900 thousand SMEs in the LAC region generating close to the 90% of the regional employment, but only less than 20% of them have some international activity. Therefore, and overarching objective of the platform is to facilitate the flow of knowledge and information to firms and other relevant stakeholders for them to improve trade and investments outside their

33 www.connectamericas.com
own traditional markets. By doing so, companies will also be able to strengthen their local markets as well as increase their overall competitiveness.

COST . (European Cooperation in Science and Technology). 34

Relevance to SADC region: What is relevant, as benchmarking practice for the SADC region, are the experiences learned in the formative years and, especially the intergovernmental way and means of promoting the cooperation (despite the answer to the question where the money come from?). The operation of COST is quite flexible ("a la carte") and functioning is based on the demand and interests of the countries involved. Additionally, in a more practical sense, COST, because its international orientation could be open to negotiations promoted by SADC countries to become partners.

i) Main objectives: COST (European Cooperation in Science and Technology) is an intergovernmental mechanism for sponsoring and promoting international science and technology cooperation. COST was established in 1971, a time in which the European Communities had only the six funder countries (Belgium, France, Germany, Italy, Luxemburg and The Netherlands) and the agreement was open to all European countries.

ii) Main functions/activities: COST funds pan-European, bottom-up networks of scientists and researchers across all science and technology fields. These networks, called 'COST Actions', promote international coordination of nationally-funded research. COST does not fund research itself, but provides support for networking activities carried out within COST Actions. COST Actions are bottom-up science and technology networks open to researchers and stakeholders, with a four-year duration and a minimum participation of five COST Countries. COST Actions are active through a range of networking tools, such as meetings, workshops, conferences, training schools, short-term scientific missions (STSMs) and dissemination activities. COST Actions are open to researchers from universities, public and private research institutions, as well as to NGOs, industry and SMEs. COST Actions are open to international cooperation, by also allowing the participation of researchers from Near Neighbour Countries and International Partner Countries on the basis of mutual benefit. In addition, COST has signed Reciprocal Agreements with Argentina, New Zealand and South Africa as a pilot exercise to facilitate cooperation with researchers from these countries.

iii) Who gives financial support: Over the years COST has been subject to various evaluations of functioning and impact assessments, it has evolved and in the last years it become and instrument of international cooperation of the European Union, because right now the European Union provides the funding for its activities. Right now there are, in operation, more than 300 Actions and the budget provided by the EU amounts for millions of euros.

iv) Who are the beneficiaries: COST funds cooperative networks called "COST Actions", fostering researchers' mobility and cooperation among nationally-funded research projects. Funding is only provided for networking and cooperation, meaning that those funds ‘levers’ (and help to coordinate) scientific and technological resources that are provided and funded by national sources. The funding covers networking activities such as meetings (e.g. travel, subsistence, local organiser support), conferences, workshops, short-term scientific exchanges, training schools, publications and dissemination activities. COST does not fund research itself. Right now, for Actions involving an average of teams from 20 countries, the funding could be more than a 100.000 Euros a year (now provided by the European Union Framework Programme).

Cooperation activities are proposed by the research community by bottom-up mechanisms. The Government representatives select and approve the initiatives. Researchers from all the member

34 http://www.cost.eu
countries could ask to joint the Actions, however the participants should formally be proposed by their national governments.

COST has an ethos of flexibility and responsiveness to proposals originating from all areas and domains of the scientific community. COST provides an openness and equality of access for participants nominated by member countries in its activities that is probably unique amongst current S&T co-operation modalities.

Thus COST meets a demand of intergovernmental coordination of national research activities by nominating of national experts for each action, in that way COST is also of S&T collaboration in which national governments are the main players in the selection of the researcher involved from the different countries.

v) Outcomes: COST has been evaluated in various occasions and the leverage effect identified has went to billions of euros per year involving thousands of researchers per year in research activities carried out by its networks. A number of separate national evaluations of COST have indicated that it is the smaller COST countries, which seem to have benefited proportionally more from their participation in COST networks. This has been principally a result of having equal access and equal influence as the larger states. This “integration” function of COST is significant.

INSME: INTERNATIONAL NETWORK FOR SMALL AND MEDIUM ENTERPRISES

Relevance to SADC region: INSME is an excellent platform to be updated about best practices in innovation policy and practice worldwide. Its membership is wide-open and includes governmental bodies, practitioners and intermediary organizations. It is a good networking point for policy and implementation discussion. Nonetheless, in order to take full advantage of the networking and exchange capabilities of the platform it is necessary to have a minimum level of local institutional development. And as such, the role of the SADC is of paramount importance. SADC might consider providing the yeast to articulate individual countries already existing innovation support instances. By creating strong local ecosystems it is possible to create a SADC-Countries regional ecosystem capable to articulate with the global economy.

i) Main objectives: The mission of INSME is to promote the transnational cooperation of SMEs around innovation and technology transfer. INSME emphasizes the importance of policy makers and other intermediary instances (chambers of commerce, technology centers, universities, etc.) in the provision of services, advice, and assistance to SMEs. Policy makers define the regulatory and legal framework for the operation of SMEs, fund the innovation system and define the general framework for financing. Intermediaries provide hands-on relationship and advice to firms aiming to solve their actual problems. INSME evolved from being an informal multi-stakeholder community of governmental bodies, international organizations, NGO’s, intermediary agencies and their networks, and practitioners to become in 2004 an independent legal entity. Initially was founded by Italy, Romania, Spain and Switzerland. INSME is headquartered in Rome because it was created with an important support of the Italian Government within the Bologna Process on SMEs. A relevant characteristic of the SME support eco-system is the multiplicity of institutions acting on behalf of smaller firms. In order not to duplicate efforts, INSME works as a network of worldwide networks, and establishes strategic alliances with other organizations as well as with other international partners. As such, INSME is a member of:

- The European Trade Association for Business Angels, Seed Funds and other Early Market Players (EBAN): www.eban.org
- World Business Angels Association (WBAA): www.wbaa.biz
- The European Association of Development Agencies (EURADA): www.eurada.org

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35 www.insme.org
• Institute for Small Business and Entrepreneurship (ISBE): www.isbe.org.uk
• International Society for Professional Innovation Management (ISPIM): www.ispim.org
• ANIMA Investment Network for a competitive Mediterranean (ANIMA): www.animaweb.org
• World Technopolis Association (WTA): www.wtanet.org

Besides current INSME membership includes 17 Governmental Bodies from all over the world, 19 International Organizations, 9 International NGO’s, and 54 Networks and Intermediaries.

ii) Main functions/activities: By taking advantage of its trans-border connections, INSME provides services to its members through:
• The INSME Portal
• Annual Meetings (2014 INSME Meeting is taking place in Abu Dhabi, next March)
• A Monthly Newsletter: www.insme.org/insme-newsletter/2014
• Joint International Training Meetings
• Library, with guidebooks, reports and analysis, statistics and indicators, communications and official documents, papers and studies
• INSMEAcademy, a webinar-based training program on relevant topics concerning innovation, creativity, strategic partnerships, and entrepreneurial spirit. The academy organizes free expert-talk sessions with question and answer time. For instance, February 14 session will be delivered by the Director of an Australian Small Scale Offering Board on the topic: “How small businesses can embrace crowd-funding for success”
• Financing Programs, providing information about the international, national and regional initiatives and programs aimed at financing intermediaries, networks of intermediaries, and SME’s operating in the field of innovation, competitiveness and technology transfer.
• Project Development Groups: They are transnational projects, programs and initiatives managed by by INSME members and related with SME competitiveness and innovation. Highlighted current projects are: Strategy Lab, aiming to develop Smart Specialization Strategies as a tool for competitiveness; JEUPISTE and J-BILAT are projects to support EU-Japan cooperation in Science, Technology and Innovation; MIRRIS, a program to promote institutional reforms for better R&amp;I systems/Institutions; GReaC, a program to support would be entrepreneurs in Eastern Europe; 3G S TPS a training program for science and technology partners
• Events, Calls for Papers and Proposals, and Call for Tenders

iii) Who are the beneficiaries: SMEs
4. Recommendations


The assessment, benchmarking and the elaboration of the SADC’s Innovation Framework have allowed us to provide recommendations, taking into account realistic efforts that SADC country members’ policy makers and donors could be willing to provide.

It is important to remark again that most of the countries composing the SADC region are confronting early industrial development phases and innovation is mainly concerned with absorbing knowledge and technology and creating capabilities to open more chances to compete internationally. In general the local innovation space is crowded out by foreign actors and the challenge for local actors is to gain access to this space by entering in the value chains, to start participating in collaborative activities that address clear national needs and to undertake some unique start up activities.

The South African Development Community (SADC) as the dominant multilateral organization could be a cooperation actor, but none of the proposed initiatives should be conditioned to the slow international process of political agreements. SAIS programme could promote “regional innovation cooperation” for SADC countries focusing on cooperation with other players in the region in addition to SADC itself. Thus far, the partners of SAIS are “local institutions” in some of the host countries. It is important to identify additional key “regional” actors.

In our view South Africa should be considered as a special partner for developing and implementing cooperation initiatives in the region; however that should be done under specific conditions in which the added value is made clear from the project design.

With the above in mind we have developed general recommendations within each pillar of our proposed analytical framework for the region – the Public Policy Innovation Platform. These recommendations have taken into account the gaps areas identified and some international successful experiences in filling those areas. These are general, long-term recommendations for the SADC region as a whole. We believe that SAIS can catalyse the changes needed suggested by the recommendations. In section 4.2 we identify specific recommendations for activities SAIS can do to further catalyse innovation at the regional level, in line with the recommendations given below.

**Framework conditions:**

There is much room for improvement in the Financing of Innovation. The promotion of innovation is a long term investment, and requires continuous and substantial resources. We noted examples of endogenous funding mechanisms connected to royalties on natural resource exploitation that could be important for the region, taking into account the strong mining structure of several SADC countries. Although there is also a need of Business Angel and Venture Capital Funding Mechanisms, it may be too early to tackle them until seed funding mechanisms are in place. Thus, we offer the following recommendations:
1. **To consider the establishment of endogenous innovation funding mechanisms such as **Sectorial Funds or Royalties Financed Funds**, where the government takes a small percentage of profits or natural resource royalties -respectively- and lodges these in an Innovation Fund that supports research and innovation in targeted activities. The Innovation Funds must operate according to well-defined rules and governance structures involving the major stakeholders. There is ample experience around the world on this type of financing, and we described several examples in our benchmarking exercise.

2. **To analyze the current and potential role of development finance institutions (DFIs) in support of innovation activities.** Relevant DFIs include the African Development Bank (AfDB) and the Development Bank of Southern Africa (DBSA). One might take as a model the role that the Inter-American Development Bank (IADB) has played in financing research and innovations operations in Latin America, with a combination of targeted grants and loans, to both, the public and private sectors.

**Human Resource Development:**

We consider that policies oriented to the Human Resource Development in the SADC region should be the highest priority.

At the outset it is important to note the very positive role that South Africa has been already taken for supporting Human Resource Development in the region. South Africa hosts 35,000 SADC students in its Universities and treats them as domestic students with respect to fees and accommodations.

As examples of international experiences in this area we have presented some mobility programs such as ERASMUS and COST that exemplify the role of regional cooperation in creating research and innovation capabilities. Although in early implementation, the FOBES II program of academic mobility and exchange between the United States and Mexico could also be relevant to SADC. Thus, as general recommendations for this pillar we mention:

3. **To promote an International Exchange Pilot Programme of final year Science and Engineering students**
   The asymmetries between South Africa and the rest of SADC countries could be an opportunity for promoting a sponsored international mobility program for advanced students. This program could build on what South Africa is already doing and include additional host countries, particularly in disciplines they have strengths on.

4. **To launch a COST-type pilot programme or negotiating access to COST**
   A program like this one would promote bottom-up networks of scientists, technologists and staff from NGOs and SMEs around specific problems science and technology can help solve. Although negotiating access to COST would increase the cost of operation because most of the actions are developed in Europe it may speed the start-up of activities.
Knowledge infrastructure:

Certainly, one policy principle for innovation is to ensure that a modern and reliable knowledge infrastructure that supports innovation is in place, accompanied by the regulatory frameworks which support open access to networks and competition in the market. It is also critical to provide sufficient investment in an effective public research system and improve the governance of research institutions.

In the case of SADC innovation system, consolidating the Knowledge Infrastructure should be, certainly, a second priority for action. Here we recommend:

5. To promote a sectorial approach in Universities and Public Research Institutes in health, agriculture, mining and energy where there is a high demand for innovation and knowledge. This is to perform classic mission-oriented research and technology organizations, closely associated with users. This means to promote the inclusion of STI issues into the agendas of the Sectorial Ministries of charge of those issues.

6. To promote the establishment of incubation spaces – low cost environments- where startups can launch, and where novice entrepreneurs may receive on-the-job business planning support, mentoring and access to broadband. These incubation spaces may be linked to the sectorial approach proposed above, as a conduit for commercialization of know-how and technologies developed as a result of collaborative research and development.

Promotion of linkages:

In this area we consider that there is a need to strengthen interactions between firms, higher education institutions and public research organizations, in order to integrate trained people into firms and to improve the quality of the management and the technological base of the firm. In this area, we have presented the French experience of the CIFRE initiative.

On the other hand, promoting international collaboration can also benefit innovative business through technology and knowledge transfer, skills enhancement and facilitating access to foreign markets.

Thus, as general recommendations for this pillar we mention:

7. To launch pilot programmes inspired on international experiences such as ISME; CONNECTAMERICAS, and FONTAGRO initiatives, which provide examples of powerful tools to promote international cooperation.

8. To include in the agendas of the Foreign Affairs Ministers the issue of international cooperation in STI, as a tool for development.

9. To develop attachment programmes that seek to develop individuals that show the talent and inclination to enter the scientific and technical services sector.
Mechanisms for policy learning:

In this area we consider that appropriate measurement is critical for policy to support innovation since it helps policy makers in several respects, including in: (i) assessing the contribution of innovation to achieve social and economic objectives; (ii) understanding the determinants of and obstacles to innovation so as to design policies with higher chances of success; (iii) evaluating the effectiveness of different policy approaches, and consequently adapting current policies or designing new ones; and (iv) benchmarking innovation performance and conditions for innovation to those of other countries.

Also, another policy principle for innovation is to provide incentives for regional cooperation that support innovative public policy solutions conceived by means of collective action among the countries of the region. We recommend:

Monitoring and Measurement for Policy:

10. To promote participation of more SADC countries in NEPAD’s ASTII Initiative, so as to have more complete data related to innovation in SADC countries. Thus, more SADC countries will be showcased in ASTII’s African Innovation Outlook

11. To build up a repository of “cases” and “policy initiatives” to contextualize innovation related indicators and as a way of monitoring developments in the innovation environment.

Incentives for Regional Cooperation and Good Management:

12. To strengthen SADC’s organizational activities concerning STI, considering the following possibilities:
   - To define a minimum dedicated structure to have a lasting impact: one staff person may be a good beginning, however it will not be enough
   - To support innovation champions in SADC countries
   - To bring key government players together around innovation issues. Beyond Ministries of Science and Technology, it is necessary that relevant Ministries (e.g., Industry, Economy, and Agriculture) have a common understanding of what innovation means, since innovation does not belong to one ministry. However, one ministry may be a main driver at the operational level so it is important to clarify roles across ministries.
   - To promote knowledge networks specific to the SADC region.
4.2. Specific Recommendations for activities to be carried out under SAIS’ Component 4.

We have identified concrete activities SAIS could carry out to start filling the gaps in the SADC innovation system. Our objective is to define actions that can trigger further development by SADC’s stakeholders. Thus, here we list some actionable recommendations for SAIS to implemented in the very short term (until the end of the current project) and in the medium term (in the event of continuation through a SAIS II project).

4.2.1. What SAIS can do in the next 1.5 year

1. To organize an international conference on regional innovation policies and practices with the participation of leaders from both, the public and private sector, including representatives from Government, Chambers of Commerce, Trade Associations, Development Finance institutions, with the following objectives:
   i) To present lessons learnt from SAIS’s activities
   ii) To raise awareness on innovation issues at political – national and SADC-level.
   iii) To present real cases of international successful experiences initiatives on STI policies related to funding tools, networking, and human resource development

2. To organize a set of workshops or seminars with development economists and SADC country member policy makers, especially in relation to barriers to and outputs from innovation systems. Special emphasis could be placed in improving the understanding of the economic rationale behind the different types of levies or royalties imposed on big mining companies and to what extent they affect (or not) profitability and attraction of foreign investment. Policy makers from countries that implemented innovation financing reforms would be invited to present their experience.

3. To expand SAIS’s Mobility Fund to pilot additional types of regional mobility inspired in successful international experiences such as for:
   i) Final year science and engineering students, with an emphasis in entrepreneurship (using ERASMUS as a reference)
   ii) Innovators as members of networks, or with the purpose to establish a new network (using COST and FORBESII as a reference)
   iii) Researchers and industry representatives, to strengthen university-industry linkages through attachments and exchanges (using CIFRE as a reference)

4. To identify key partners for SAIS II that have regional relevance, considering particularly the following:
   i) South Africa
   ii) African Development Bank (AfDB)
   iii) Development Bank of Southern Africa
   iv) Regional Research Alliance
4.2.2. What SAIS II can do

5. **To develop a special partnership with South Africa** – broaden SAIS to include South Africa to carry on in partnership several of the activities envisaged in the regional innovation actions for the SADC region. In-kind support for STI activities is mostly expected since direct funding may only be viable in Namibia and Botswana.

6. **To establish a Regional Innovation Observatory** to create and disseminate knowledge on innovation by providing access to a systematized collection of country innovation activities (successful and unsuccessful). Some of the functions of the observatory could be:
   i) To maintain a watching brief on continental innovation support models e.g. iHub (Kenya); Bandwidth Barn (South Africa);
   ii) To maintain a watch of relevant policy developments, e.g. African Mining Vision.

   In order to establish this Observatory SAIS could implement the following activities:
   i) To create an Observatory online platform and a newsletter to periodically present its findings. This will enable users to understand, share, discuss and evaluate innovations in the public sector. It could also be discussed the possible options and features for the online platform such as the degree of interactivity, access and users.
   ii) To provide access to categorized innovative practices, and potentially a forum where innovators can discuss and learn from each other’s experiences
   iii) To leverage knowledge partnerships with external non-government stakeholders (e.g. academia, other international organizations, NGOs)

7. **To consider the possibility of seconding Finnish staff to the SADC STI Desk**, as it was done for the Mozambican Ministry of Education in the STIFIMO program.

8. **To promote the establishment of a regional network of technology brokers.** This network will consist of representatives of organizations interested in technology adoption, adaptation and transfer. On one hand, they will identify concrete needs that could be met with existing technologies or technologies that may be adapted. In the other hand, they will identify technologies/ methodologies/ procedures developed as a result of regional projects (e.g. SANBio) that have a potential for socio-economic impact and will identify interested users or beneficiaries. The idea is to promote matchmaking and do so as a network, though collaborative efforts, as there is not yet critical mass at the country level.
5. Annexes

In the attached file you will find the following annexes:

5.1 Annex 1. Region’s country members

5.2 Annex 2. Innovation Related Indicators

5.3 Annex 3. Application of ANIS. Construction of the “average” SADC Country

5.4 Annex 4. Institutions visited during the field trip

5.5 Annex 5. Regional Determinants

5.6 Annex 6. Innovation Policy Platform. Elements that compose this analytical framework

5.7 Annex 7. Analysis of financial mechanisms operating at the institutional and programmatic levels
6. References


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