The African Observatory of Science, Technology and Innovation (AOSTI)

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Assessing Best Practices of Science, Technology and Innovation Observatories

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Foreword

The Lagos Plan of Action for Economic Development of 1982 is undoubtedly one of the strongest expressions of African leaders, which, together with the Abuja Statement of 1989, has influenced the thinking on the roles of science, technology and innovation (STI) in the socio-economic transformation of Africa. The Abuja Statement emphasises the enhancement of African research and innovation as well as their institutionalisation in the fabric of African society.

The adoption of Africa's Science and Technology Consolidated Plan of Action in 2005 was an important milestone in establishing the framework for the development and implementation of regional STI programmes. Encouraging results have been obtained thus far, but much more needs to be done in order to promote STI in policy circles and encourage financial interventions. Even then, there are serious gaps in the measurement of STI activities and the review and analysis of related policies.

The intention of the African Union in creating the African Observatory of Science, Technology and Innovation (AOSTI) was to institutionalise African efforts to develop and manage STI indicators and to create a centre for policy analysis. It is a logical and necessary response to the Abuja Statement to position STI prominently on the development agenda of African countries.

This report comes at a time when the African Union has to adopt statutes and a structure for AOSTI. It is a synthesis of best practices across national, regional and international STI observatories. The report describes the structures and activities of STI observatories and provides recommendations for the operation of AOSTI. The information in this report was obtained through desktop research, supplemented with interviews.

It is my sincere wish and expectation that the suggestions and recommendations presented in this report will be adapted for AOSTI requirements, to serve as the basis for AOSTI learning processes, and to provide guidelines for decision-making by AOSTI stakeholders.

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This study made extensive use of ideas from the seminal discussion organised by the NEPAD Agency in 2005, which resulted in the discussion document entitled 'The ASTII Implementation Programme: Toward an African Observatory of STI'. The most important recommendations of that discussion have been adapted in this work. We extend our sincere thanks to the NEPAD Agency and the relevant experts.

The study builds on the contribution of representatives of member states and experts who participated at AOSTI workshops where the project was discussed, namely, the AOSTI brainstorming workshop held in Malabo, Equatorial Guinea in January 2011, and the first AOSTI intergovernmental meeting held in Malabo in May 2012.

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Dr Philippe Kuhutama Mawoko

Interim Director, AOSTI

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Abbreviations

A*STAR	Agency for Science, Technology and Research (Singapore)
AECID	Spanish Agency for International Development Cooperation (Agencia Española de Cooperación Internacional para el Desarrollo)
AMCOST	African Ministerial Council on Science and Technology
ANRT	Association Nationale de la Recherche et de la Technologie (National Association of Research and Technology) (France)
AOSTI	African Observatory of Science, Technology and Innovation
ASIF	African Science and Innovation Fund (proposed by the CPA)
ASIF	African Science and Innovation Fund
ASTER	Agency for Science, Technology and Research (Syria)
ASTII	African Science, Technology and Innovation Indicators
AU	African Union
AUC	African Union Commission
CBDTM	Canadian Bibliometric Database
CCST	Caribbean Council for Science and Technology
CEA	Commissariat à l'Énergie Atomique et aux Énergies Alternatives (Alternative Energies and Atomic Energy Commission) (France)
CeSTII	Centre for Science, Technology and Innovation Indicators (South Africa)
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (Agricultural Research for Development) (France)
CIRST	Centre Interuniversitaire de Recherche sur la Science et la Technologie (Interuniversity Research Center on Science and Technology) (Canada)
COMSTECH	OIC Standing Committee on Scientific and Technological Cooperation
COSTECH	Commission for Science and Technology (Tanzania)
CNES	Centre Vational d'Études Spatiales (National Centre for Space Studies) (France)
CNRS	Centre National de la Recherche Scientifique (National Centre for Scientific Research) (France)
CORDIS	Community Research and Development Information Service

COTEC	Fundación para la Innovación Tecnológica (Foundation for Technological Innovation) (Spain)
CPA	Africa's Science and Technology Consolidated Plan of Action
CPU	Conférence des Présidents d'Universités (Conference of University Presidents) (France)
CTCAP	Comisión para el Desarrollo Científico y Tecnológico de Centroamérica y Panamá (Commission for Scientific and Technological Development of Central America and Panama)
CyTED	Ciencia y Tecnología para el Desarrollo (Science and Technology for Development) (an Ibero-American programme)
DRC	Democratic Republic of Congo
ECLAC	Economic Commission for Latin America and the Caribbean
EPO	European Patent Office
ERA	European Research Area
ESCWA	Economic and Social Commission for Western Asia
ESTO	European Science and Technology Observatory
ETEPS	European Techno-Economic Policy Support network
EU	European Union
GDP	Gross domestic product
GERD	Gross domestic expenditure on research and development
GO→SPIN	Global Observatory of Science, Technology and Innovation Policy Instruments
HRST	AUC Human Resources, Science and Technology
IADB	Inter-American Development Bank
INRA	Institut National de la Recherche Agronomique (National Institute of Agronomic Research) (France)
INRIA	Institut national de recherche en informatique et en automatique (National Institute for Research in Computer Science and Control) (France)
INSERM	Institut National de la Santé et de la Recherche Médicale (National Institute of Health and Medical Research) (France)
IPTS	Institute for Prospective Technological Studies
IRD	Institut de Recherche pour le Développement (Institute of Research for Development) (France)
JORDI	Jordanian Observatory of R&D and Innovation

JRC	European Commission's Joint Research Centre
LORDI	Lebanese Observatory of R&D and Innovation
MASTIC	Malaysian Science and Technology Information Centre
NEPAD	New Partnership for Africa's Development
NEPAD	New Partnership for Africa's Development
NESTI	OECD National Experts on Science and Technology Indicators
NISTEP	National Institute of Science and Technology Policy (Japan)
NOST	National Observatory of Sciences and Technology (Tunisia)
NOSTII	National Observatory for Science, Technology and Innovation Indices (Saudi Arabia)
NSF	National Science Foundation (USA)
NSI	National System of Innovation
NSTDA	National Science and Technology Development Agency (Thailand)
OCCyT	Observatorio Cubano de Ciencia y Tecnología (Cuban Observatory of Science and Technology)
OCES	Observatório da Ciência e do Ensino Superior (Observatory of Science and Higher Education) (Portugal)
OCTI	Observatorio Venezolano de Ciencias, Tecnología e Innovación (Venezuelan Observatory of Science, Technology and Innovation)
OCyT	Observatorio Colombiano de Ciencia y Tecnología (Colombian Observatory of Science and Technology)
OECD	Organisation for Economic Cooperation and Development
OECD	Organisation for Economic Cooperation and Development
OEI	Ibero-American States Organisation
OEI/CAEU	Science, Technology and Society Observatory of the Centre for Higher Education Studies
OIC	Organisation of Islamic Cooperation
OPTI	Observatorio de Prospectiva Tecnologia Industrial (Industrial Technology Foresight Observatory) (Spain)
OSPS	Observatoire Science, Politique et Société (Observatory for Science, Policy and Society) (Switzerland)
OST	Observatory of Science and Technology (France and Canada)

OSTI	Office of Science, Technology and Innovation (Ireland)
QOSTI	Qatar Observatory for Science, Technology and Innovation
R&D	Research and experimental development
REDES	Centro de Estudios sobre Ciencia, Desarrollo y Educación Superior (Centre for Studies on Science, Development and Higher Education) (RICyT)
RICyT	Red de Indicadores de Ciencia y Tecnología Iberoaméricana e Interaméricana (Network of Ibero-American and Inter-American Science and Technology Indicators)
S&T	Science and technology
SECAB	Secretaria Ejecutiva del Convenio Andrés Bello (Executive Secretariat of the Andrés Bello Convention)
SPIN	UNESCO Science Policy Information Network
STEPI	Science and Technology Policy Institute (South Korea)
STI	Science, technology and innovation
STIO	Science, technology and innovation observatory
STIO	Science, Technology and Innovation Observatory (Palestine)
UIS	UNESCO Institute for Statistics
UISTC	Union for Islamic Science and Technology Centres
UN	United Nations
UNCTAD	UN Conference on Trade and Development
UNECA	UN Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNU-MERIT	United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology
USPTO	United States Patent and Trademark Office
VISB	Virtual Incubator for Science-based Business
WIPO	World Intellectual Property Organisation

Executive Summary

The idea of establishing the African Observatory of Science, Technology and Innovation (AOSTI) is rooted in the development and formulation of Africa's Science and Technology Consolidated Plan of Action (CPA). The CPA was crafted to support the efforts of African countries to utilise science, technology and innovation (STI) for the socio-economic development of Africa. The CPA was endorsed in 2005 by African ministers of science and adopted in 2007 by the Heads of State and Government. Consequently, the Heads of State and Government established AOSTI through the African Union (AU) Assembly Decision/AU/Dec.232(XII) of February 2009, and in January 2013 AOSTI was created through AU Assembly Decision/AU/Dec.452(XX).

The CPA envisioned AOSTI as an organisation with the mandate to collect, process, analyse and disseminate statistical information on STI to support evidence-based policy-making in the member states of the African Union. The observatory is also expected to collect and review STI policies in member states, and to raise awareness of the potential roles and benefits of synergistic policy mixes, methods of implementing policies and ways of measuring impact.

The overall goal of this study is to undertake a survey of existing STI observatories and to provide a detailed synthesis of best practices in order to inform AOSTI activities at both the programme and governance levels. The objectives of the study include the following:

- To identify activities and governance structures of national, regional and international STI observatories across the world
- To review national, regional and international structures and provide insights and possible models for AOSTI
- To provide key observations and recommendations for AOSTI in the context of the AU STI system.

The first two objectives were achieved through desktop reviews and interviews. The descriptions of existing national observatories were obtained from published reports and websites, while supplementary information about international and regional observatories was collected from interviews with four officials from three key institutions.

The results of the study can be considered in two parts: firstly, a presentation of the main features of national, regional and international observatories, and secondly a summary of the recommendations based on observations of perceived best practices.

The main findings of the review are:

- There are very few science and technology (S&T) observatories worldwide, and they are of fairly recent origin, dating from the early 1990s. They have proved more popular in industrially

developing countries that have adopted policy agendas with an early focus on S&T policies (for example, the South-East Asian and Latin American countries). More recently, some African and Arab countries have set up S&T observatories.

- Two national institutions, namely, the Observatory of Science and Technology (OST) of France and OST Canada stand out as examples of successful national observatories.
- There are very few international S&T observatories. This study highlighted the achievements of the *Red de Indicadores de Ciencia y Tecnología Iberoaméricana e Interaméricana* (RICyT) (Network of Ibero-American and Inter-American Science and Technology Indicators). However, this is not an observatory in the classical sense, since it is a network rather than an administrative structure. A number of national observatories in the Latin American region have been successfully networked and coordinated to form the RICyT network.
- The various national and international observatories surveyed in this report exhibit a variety of administrative mandates, structures, operational frameworks, governance models and funding schemes.
- Strong political will to support continental STI efforts in AU member countries is a *sin qua non* for AOSTI to function effectively. Decisions and actions must be taken at the highest level to support the best possible conditions for the observatory.

The main body of the report discusses in more detail the implications for AOSTI of this worldwide review. Based on the critical review of existing observatories in various regions and countries, and a critical assessment of the current state of STI indicators in Africa, the following recommendations are made with respect to AOSTI:

- The success of AOSTI is closely related to its ability to clearly chart a set of activities and responsibilities over the coming years. AOSTI must develop a programmatic work plan for a defined period and establish appropriate mechanisms for monitoring and evaluation.
- The commitment of national entities will have a significant impact on AOSTI's success. AOSTI must develop lasting and effective relationships with data-producing national structures.
- Research and scientific cooperation in Africa are concentrated in a few regional poles. AOSTI should increase its efficiency by working in partnership with corresponding sub-regional structures. AOSTI should establish and strengthen its relations with existing STI structures such as the National Observatory of Sciences and Technology (NOST) in Tunisia, the Centre for Science, Technology and Innovation Indicators (CeSTII) in South Africa, and other organisations working in the field of STI, including the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Institute for Statistics (UIS), the United Nations University – Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT), and the Organisation for Economic Cooperation and Development (OECD) Directorate for Science, Technology and Industry.
- It is important to grant a fair degree of professional and scientific autonomy to AOSTI to carry out its activities, and to insulate it from the negative influences of political authorities or interest groups.

- Like many other observatories, AOSTI should be financed from the following sources: support from the host country; support from the AU; income for services provided to beneficiaries; and any other funding sources approved by the board of governors.

Conclusions

Creating a continental observatory such as AOSTI is an important political decision, which requires the consent of all parties for the project to succeed. The present report shows that the conditions for the establishment of national and international observatories are complex. In the light of experience gained elsewhere, it is inevitably a gradual process that takes time and resources. It is necessary to define the organisation and mission of AOSTI in relation to existing programmes of work and resources, and to guarantee its professional independence. AOSTI should provide STI indicators with international comparability, as well as indicators that are specific to the African environment. The principal success factors for AOSTI are financial sustainability, the dedication of all stakeholders, qualified personnel, and the establishment of appropriate networks with existing organisations in the field of STI indicators and related policies.

1. Introduction

Science, technology and innovation (STI) are widely recognised as key drivers leading to prosperity in modern economies. Africa is entering a new period of growth, as recently witnessed in substantial economic growth in several African countries. Sustaining that growth to transform Africa's economies into new knowledge economies will depend largely on how the continent harnesses, develops and applies science and technology for socio-economic development through the formulation and implementation of appropriate policies.

Assessing and monitoring the state of STI using relevant, high-quality and internationally comparable indicators, and using these as the basis for taking timely action nationally and regionally, are paramount. Maintaining the status quo, or leaving things 'as they are', will limit the returns on national investments and stunt socio-economic development. The collection and monitoring of STI indicators in Africa is thus an important requirement for African Union (AU) member countries.

Science and technology (S&T) indicators are statistics that provide answers to questions on S&T systems, their structure, their relations with the economy and society, and the degree to which they meet the goals set by managers and policy-makers (OECD, 1992). Indicators can be used to understand and improve the design and monitoring of STI systems for evidence-based policy, for instance, indicators such as gross domestic product (GDP), gross domestic expenditure on research and development (GERD), the number and qualification levels of personnel involved in research and experimental development (R&D), the number of patents produced by a country or a region, or the scientific and technological production of an entity (institute, country or region). Indeed, the design of policies and their implementation may be enhanced by improved interactions among those who gather and share rigorous data and research evidence, the policy-makers and those that bring about transformational change in the socio-economic system.

In that regard, Africa's Science and Technology Consolidated Plan of Action (CPA) of 2005, which stemmed from a series of discussions at the regional and continental levels, sets a common vision to develop and use S&T for socio-economic development and for the integration of Africa into the world economy. In the context of the African Science, Technology and Innovation Indicators (ASTII) initiative, the CPA emphasises the need for STI indicators to be embedded in the policy process in order to be used effectively. Among the indicators proposed for the successful implementation of the CPA was the establishment of the African Observatory of Science, Technology and Innovation (AOSTI).

AOSTI's mandate covers a range of activities including the collation, management and dissemination of STI indicators, the promotion of national and regional STI policy formulation, and the establishment of observatories at the national and regional levels.

There are very few STI observatories around the world, and most of them are located outside Africa. Although there are many commonalities between these observatories, there are also considerable differences in terms of size, mandate, governance, structure and mode of financing. This report is a synthesis of best practices across national, regional and international STI observatories. It describes several dimensions of existing observatories in order to provide recommendations for the operation of AOSTI. The information in this report was obtained through desktop research, supplemented with interviews.

2. STI observatories: concepts and activities

The development and implementation of STI policies involving a multitude of actors and interactions will undoubtedly involve fairly complex decision-making processes. Such decisions and the processes that lead to them will require significant quantitative and qualitative information regarding available resources, results attained, trends and future scenarios. As a result, the proper administration of STI will routinely require verifiable indicators to ensure progress towards the determined goals. Leaders will require review and forecast studies, policy analysis, trends analysis and predictions. Such considerations justify the permanent institutionalisation of these activities through the establishment of STI observatories.

This chapter describes the general role of observatories, as synthesised from several sources including the Organisation for Economic Cooperation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

2.1 STI observatories

In lay terms, science technology and innovation observatories (STIO) can be described as 'one-stop windows', or 'intelligence hubs' for the acquisition of information on the status of STI in a country or, by extension, on networks in a region. For the effective implementation of such an institution, it is imperative that information and data are collated through a systematic and acceptable mechanism that covers all available collaborative institutions for the purposes of producing STI indicators. STIOs allow a country, region or network to identify its own scientific activities and compare these with their partners or competitors. STIOs track changes over time, and are therefore important in informing decision-making for socio-economic development.

2.2 General objectives of STIOs

STIOs generally have the following objectives:

- Systematise and provide statistical information on STI directed at decision-making, monitoring and evaluation of the national innovation system
- Produce studies on relevant aspects of interest to innovation system actors
- Contribute to the development of the national statistical information system in science and technology, and to the strengthening of its producers and users, through technical assistance and training

- Promote methodological knowledge on the production of STI indicators and their use in producing strategic and forecasting studies and analyses
- Maintain relationships and cooperation with international agencies that specialise in the observatory's fields of competence.

2.3 Production of indicators

The main activity of STIOs is thus to produce STI indicators. This function requires the existence of regularly updated databases and analytical capacities derived from a steady accumulation of knowledge and competencies. The production of advanced and reliable indicators and their use in different types of studies is a primary function of observatories.

Access to relevant and reliable indicators leads to better decision-making and more effective action by simplifying, clarifying and making aggregated information available to policy-makers (UN, 2007). In broad terms, good indicators are those that are:

- Reproducible and comparable (over time and across space)
- Easy to interpret and understand
- Dependent on data that are readily available or available at a reasonable cost, adequately documented, of known quality and updated at regular intervals
- Policy-relevant
- Robust, scientifically compiled and conceptually well-founded.

The development of indicators is generally dependent on data that are already available, but intelligent forecasts and predictions often also have to be used. In fact, it is important to ensure that indicators are not based exclusively on existing data, as there is the risk that the lack of appropriate data may lead to 'measuring what is measurable rather than what is important' (Meadows, 1998). Unless this issue is properly addressed, there is the risk of establishing a system that continually reinforces the status quo rather than looking ahead to the future or even the unknown.

In situations where the observatories form part of national monitoring and evaluation systems, a good way of assessing the utility of the indicators is by verifying their alignment with the requirements of decision-makers. Policy-makers' needs for planning, evaluating the financial impacts of new S&T incentives, and choosing appropriate policies are identified and discussed in the following sections.

2.3.1 Input indicators on R&D resources

Input indicators allow the R&D activities of both the public and private sectors to be measured and monitored. Two inputs are measured: R&D expenditure and R&D personnel. Both are usually measured on an annual basis.

These indicators are based on data collected from the relevant institutions through national surveys. To be comparable at the international level, these indicators should be compiled according to

international standards proposed in guidelines such as the OECD Frascati Manual (OECD, 2002). The Frascati Manual provides recommendations and guidelines on the collection and interpretation of existing R&D data, as well as additional guidelines for R&D surveys.

Other input data can be produced that are tailored to local needs and to the national situation. Surveys are then undertaken to collect data for particular requirements; such surveys must meet regular quality standards in terms of sampling and data collection.

2.3.2 Output indicators

Output indicators correspond to the immediate tangible results of an activity. Output indicators usually measure the scientific and technological products of R&D activities.

There are two main types of output indicators of STI performance:

- Indicators on scientific publications derived from existing databases: The Thomson Reuters scientific databases, such as the Web of Science or the Science Citation Index, have traditionally been used for this purpose, but rival databases may also be used, for example, Scopus, Google Scholar or databases of publications by discipline, such as EconLit for economics). Customised national databases can be created to provide context-specific evidence. However, international comparisons may not be possible in such cases.
- Indicators on patents derived from patent databases: Patent databases include those of the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO), the World Intellectual Property Organisation (WIPO), national patent offices and other international patent databases. These indicators serve to measure and compare scientific and technical production and innovation in a fair amount of detail, at the levels of institutions, and scientific or technical domains and disciplines. As such, the measurement of patent data provides a proxy for measuring inventive performance. With more elaborate methodologies, such indicators can provide information on the dynamics of a domain or institution, or of a network of actors.

2.3.3 Innovation indicators

Innovation indicators usually focus on technological product and process innovation. The numerous innovation indicators are generally compiled through standardised surveys that follow international guidelines such as the OECD Oslo Manual (OECD/Eurostat, 2005). The European Commission's Innovation Union Scoreboard (2011), for example, summarises innovation indexes into three types (enablers, firm activities and outputs) and eight innovation dimensions (human resources; open, excellent and attractive research systems; finance and support; firm investments; linkage and entrepreneurship; intellectual assets; innovators; economic effects), capturing a total of 25 different indicators.

2.3.4 Outcome and impact indicators

Outcome and impact indicators are used to measure the downstream, non-academic effects of R&D. While outputs are the direct result or product of science, outcomes represent the use of the outputs, and impacts are the ultimate, but indirect, effect of science on society.

Impact measurement is based on the assumption that research is likely to produce effects in the socio-economic sphere, and that research efforts help in better meeting society's needs.

The construction of these indicators is extremely difficult due to obstacles related to the very nature of R&D activity and the innovation process, namely:

- The research life-cycle: As it may take a very long time for research to be completed, years or even decades could pass between the time of discovery and application; the timelines should be taken into consideration in impact measurement.
- The uncertainty of results: Research results are by nature unpredictable and uncertain, and the spin-offs are risky.
- The indirect and non-linear nature of research impacts: The ways in which research may affect society are based on complex iterative processes that are very difficult to analyse in detail.

It may therefore be preferable to measure outcomes, rather than the impact of research, by measuring the performance of R&D activities and codifying case studies.

2.3.5 Use of indicators

By providing STI indicators to report on the STI status of a country, STIOs help decision-makers assess the resources and performance of the national system of innovation (NSI) of a country and revise their strategies accordingly.[1] A variety of different actors require the information produced by STIOs.

a) Policy-makers (governments)

The regular production of indicators and sometimes of more specific analyses (for instance, focusing on the public or private sector, on an industrial sector or research domain) allows policy-makers to regularly review the performance of the NSI. This serves to measure the effectiveness of public-sector efforts, particularly the efficacy of research and innovation policy, and to adjust such policy accordingly. Reviewing the performance of the NSI also helps justify public spending on R&D.

1 The literature offers a variety of definitions of a national system of innovation (NSI). One of the most complete definitions is the following: "That set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artifacts which define new technologies" (Metcalfe, 1995).

The monitoring of STI indicators provides objective knowledge of the industrial sector's contribution to the research and innovation effort, which allows policy-makers to develop and adjust incentives that target this sector.

The detailed analysis of each scientific and technological domain assists in identifying priorities, either to strengthen particularly strong sectors or to support less-developed yet strategic sectors.

Finally, indicators produced according to international standards allow policy-makers to compare their country regionally or internationally. Such comparisons may be useful in learning lessons from other contexts.

b) Public research and higher education actors (universities and public research centres)

The indicators relevant to public research actors allow them to identify the strengths and weaknesses of public research and to adapt their efforts accordingly. These indicators also serve to justify funding requests on the basis of performance. If the indicators are sufficiently specific to compare institutions, the comparison contributes an element of competition. For the best-performing institutions, such performance indicators can be an important factor in attracting resources, including funding and human resources.

c) The private sector (industry)

The production of indicators on the public sector promotes the development of cooperation between the industrial and public sectors, as it provides better knowledge of the public sector's performance and strengths.

The production of indicators on the private sector encourages competition between companies at both national and international levels. The results provided by these indicators can form the basis for accessing further resources to develop strategic sectors, including higher education.

d) Society

The production and diffusion of indicators contribute to the transparency of national policies. Society is likely to be far more willing to support the investment of public resources in R&D, for example, if the results of such efforts are evident.

2.4 Summary

Observatories have a common remit to identify scientific activities and describe them in a format that allows both internal and external comparisons. This is achieved through the development of

indicators that capture as much of the innovation process as possible. Indicators should be developed with various end-users in mind.

Observatories are geographically represented in all the regions of the world, but they are more prevalent in South-East Asia and Latin America. STIOs fall into two broad categories in terms of geographical coverage, namely, national and regional/international. These are discussed in more detail in the next two chapters.

3. National STI observatories: geographical remits and operations

This chapter presents a brief overview of the existing or proposed national STIOs around the world. The STIOs exhibit considerable variety with respect to their objectives, institutional organisation, competences and capacities. The focus of this report is on their functions, institutional positioning, funding models and products.

3.1 Overview of national STIOs

While some STIOs have the title of 'observatory' and are thus readily identifiable, others are less easy to detect and to identify as national STIOs. The approach used in this report was based on the following broad definition of what constitutes a STIO, namely, an organisation whose mission includes not only the production and analysis of S&T indicators but also relates to broader policy initiatives. As shown in Table 1, a number of organisations in South-East Asia fall into this category.

Other organisations are more specialised in the fields of higher education (through research training or training for research) or new industrial technologies. Such organisations have been included in the report, because they generate important data that are relevant to STIOs with broader remits.

Table 1: List of observatories already in place

Region	Country	Name
SOUTH-EAST ASIA	Malaysia	MASTIC – Malaysian Science and Technology Information Centre
	Singapore	A*STAR – Agency for Science, Technology and Research
	Japan	NISTEP – National Institute of Science and Technology Policy
	South Korea	STEPI – Science and Technology Policy Institute
	Thailand	NSTDA – National Science and Technology Development Agency
LATIN AMERICA	Cuba	OCCyT – *Observatorio Cubano de Ciencia y Tecnología* (Cuban Observatory of Science and Technology)
	Venezuela	OCTI – *Observatorio Venezolano de Ciencias, Tecnología e Innovación* (Venezuelan Observatory of Science, Technology and Innovation)
	Columbia	OCyT – *Observatorio Colombiano de Ciencia y Tecnología* (Colombian Observatory of Science and Technology)
	Peru	*Observatorio Peruano de Ciencia, Tecnología, Innovación y Sociedad* (Peruvian Observatory of Science, Technology, Innovation and Society)

Region	Country	Name
EUROPE	Switzerland	OSPS – *Observatoire Science, Politique et Société* (Observatory for Science, Policy and Society)
	Ireland	OSTI – Office of Science, Technology and Innovation
	France	OST – *Observatoire des Sciences et des Techniques* (Observatory of Science and Technology)
	Portugal	OCES – *Observatório da Ciência e do Ensino Superior* (Observatory of Science and Higher Education)
	Spain	OPTI – *Observatorio de Prospectiva Tecnologia Industrial* (Industrial Technology Foresight Observatory)
WEST ASIA	Lebanon	LORDI – Lebanese Observatory of R&D and Innovation
	Syria	ASTER– Agency for Science, Technology and Research
	Palestine	STIO –Science, Technology and Innovation Observatory
NORTH AMERICA	Canada	OST – *Observatoire des Sciences et des Technologies* (Observatory of Science and Technology)
	USA	NSF – National Science Foundation
AFRICA	South Africa	CeSTII – Centre for Science, Technology and Innovation Indicators
	Tunisia	NOST – National Observatory of Science and Technology

Some countries have advanced the creation of a national observatory after benefiting from earlier feasibility and opportunity studies conducted under the auspices of regional partners. This was the case for the Arab countries of the Economic and Social Commission for Western Asia (ESCWA), namely Jordan and Qatar.

Algeria, Egypt and Morocco have also shown an interest in STIOs and have tried to benefit from scientific and technological partnerships with the European Union (see MIRA WP2 FP7 project).[2]

In 2012, two new observatories were created in Saudi Arabia and Hungary

2 www.miraproject.eu/workgroups-area/workgroup.wp1

Table 2: New or planned observatories

Region	Country	Name
MIDDLE EAST	Jordan	JORDI – Jordanian Observatory of R&D and Innovation
	Qatar	QOSTI – Qatar Observatory for Science, Technology and Innovation
	Saudi Arabia	NOSTII – National Observatory for Science, Technology and Innovation Indices
AFRICA	Egypt	No name yet
	Algeria	No name yet
	Morocco	No name yet
EUROPE	Hungary	Science and Technology Observatory

3.2 Functions of STIOs

Observatories can engage in a variety of roles, but they all have one common feature, namely, adding value to the available statistical information. Table 3 shows the various functions performed by STIOs, ranging from the production of primary information to forecasting and evaluation.

In most cases, the main output of STIOs is a national indicator report that is regularly produced and disseminated. In many countries, the information is also available through a web portal. Many STIOs also produce studies on specific topics. These may include thematic reports on topics such as STI research evaluation frameworks, and outlooks that identify current and emerging STI research issues. Some examples are shown in Table 3.

Table 3: Various functions of STIOs

STIO	Country	Producing and/or analysing indicators	Collecting S&T information	Foresight studies	Other types of studies
MASTIC	Malaysia	Yes	Yes	Yes	Yes
A*STAR	Singapore	Yes	Yes	Yes	Yes
NISTEP	Japan	Yes	Yes	Yes	Yes
STEPI	South Korea	Yes	Yes	Yes	Yes
NSTDA	Thailand	Yes	Yes	Yes	Yes
OCCyT	Cuba	Yes	Yes	No	No
OCTI	Venezuela	Yes	Yes	No	No
OCyT	Columbia	Yes	Yes	No	No
OSPS	Switzerland	Yes	Yes	No	No
OST	Canada	Yes	Yes	No	No
OST	France	Yes	Yes	No	Yes
OCES	Portugal	Yes	Yes	No	No
OSTI	Ireland	Yes	Yes	No	No
CeSTII	South Africa	Yes	Yes	No	No
NOST	Tunisia	Yes	Yes	Yes	Yes

3.3 Institutional positioning of STIOs

Table 4 presents the position of STIOs in relation to their respective activity sector and source of funding. Most of the STIOs presented are independent of their official administrative principals, because the nature of their role requires a degree of autonomy. Different organisational forms determine the priorities of STIO work programmes. For example, if a STIO is dependent on the official administration, decisions must take into account the balance between administrative needs and the interests of all stakeholders.

Most of the STIOs listed in Table 4 work under the aegis of a single public agency or administration (for example, NOST in Tunisia) or several public agencies or administrations (for example, OST in France). A few of the observatories are located in universities and treated as research centres (for example, OSPS in Switzerland, and OST in Canada).

Table 4: STIO positioning relative to activity sector and source of funding

Region	Activity sector	Source of funding	STIO
SOUTH EAST ASIA	Public	Public	MASTIC, Malaysia
	Public	Public	A*STAR, Singapore
	Public	Public	NISTEP, Japan
	Public	Public	STEPI, South Korea
	Public	Public	NSTDA, Thailand
LATIN AMERICA	Public	Public	OCCyT, Cuba
	Public	Public	OCTI, Venezuela
	Public	Public	OCyT, Colombia
	Public	Public	*Observatorio Peruano de Ciencia, Tecnología, Innovación y Sociedad*, Peru
EUROPE	University	Diversified	OSPS, Switzerland
	Public	Public	OSTI, Ireland
	Public	Mainly public	OST, France
	Public	Public	OCES, Portugal
	Public	Public	OPTI , Spain
NORTH AMERICA	University	Diversified	OST, Canada

3.4 Funding models of STIOs

The public sector plays a major role in funding STIOs, some of which are public agencies funded directly by the national fiscus (Table 4). Some STIOs also benefit from additional incomes generated by offering services. The French and Canadian OSTs function through such arrangements.

3.4.1 The French OST model

The French OST (www.obs-ost.fr) is internationally recognised among the national observatories, and is currently associated with the most important projects in the field of S&T indicators and international university rankings (U-Multirank, Helios and IREG Observatory on Academic Ranking and Excellence).

The French OST was founded in 1990 as a public interest group, a legal status that reflects its mission to serve the needs of R&D institutional actors. Its governance comprises a governing board and a scientific committee. Current members of the group include the French government ministries for higher education, research, defence, industry, infrastructure and foreign affairs. The OST also involves the Atomic Energy Commission (CEA) and other public research establishments such as CIRAD (agriculture and development), CNES (space studies), CNRS (scientific research), INRA (agronomic research), INRIA (research in computer science), INSERM (biomedicine), IRD (research for development), CPU (an umbrella organisation for the boards of French universities) and, representing private research, the National Association for Research and Technology (ANRT).

The main activities of the French OST include:

- Biennial publication of the OST Report on Science and Technology Indicators
- Online publications to disseminate ideas and the results of research undertaken by OST in collaboration with other research teams
- Seminars organised every two months to which renowned scholars are invited to debate STI matters with OST staff, STI communities and the public
- On-demand production of quantitative indicators
- Studies on specific topics
- Participation in R&D projects.

Twenty-two years after its creation, the French OST remains a relatively small organisation with targeted recruitment, which shows that good skills in this area are rare, even in a developed country such as France. The OST has:

- A staff of 25 people (including statisticians, computer scientists, research associates and support staff)
- An annual budget of 3.3 million euro, almost 40% of which is generated by work performed on contract
- A database with capacity of more than 10 terabytes that houses data sets covering research expenditure and personnel, students, publications and patents, participation in the European Commission's Framework Programmes, and other pertinent areas.

The French model demonstrates the relationship between buy-in and success. When strategies for enhancing national STI capabilities are developed, explicit performance assessments are established on the basis of clear concepts shared by all parties involved in the creation, dissemination, transfer and utilisation of STI knowledge within the institution or sector under consideration.

3.4.2 The Canadian OST model

A second example of a successful national STIO is the Canadian Observatory of Science and Technology (OST). As explained on the OST Canada website (www.ost.uqam.ca), this observatory, which was founded in 1997, is associated with the *Centre Interuniversitaire de Recherche sur la Science et la Technologie* (CIRST) (Interuniversity Research Center on Science and Technology).

OST Canada draws upon a group of researchers to create, develop and improve bibliometric indicators, build and maintain databases, train specialists, and develop and maintain data.

The main achievements of OST Canada include the construction and maintenance of major databases such as the Canadian Bibliometric Database (CBD)TM, the Awards search engines, and the database of Canadian patents filed in the USA.

OST Canada has about 40 Canadian partners comprising universities, government departments, and other public and semi-public organisations. It is funded by annual fees from its partners and from revenue generated by its data production activities. The observatory provides various services to these partners in exchange for the annual fees and also conducts knowledge transfer.

The communication approach at OST Canada is centred on publishing its research outputs in peer-reviewed journals, monographs, notes and reports, and an online publication called *L'Observation S&T*.

3.5 Summary

In summary, observatories are geographically represented in all regions of the world, but they are more prevalent in South-East Asia and Latin America, perhaps because these regions have recognised the need to constitute the basic requirements for conducting STI audits, which are an essential policy tool for participating in the global economy and the information age.

Although the structures of observatories around the world vary, some observatories stand out: the Economic and Social Commission for Western Asia (ESCWA) provides an example of a regional initiative leading to the creation of national STIOs, while the French OST and Canadian OST were initiated as national institutions and deliberately structured as lean and efficient organisations.

The purpose of this study is to look beyond national experiences and examine the features of international and intergovernmental organisations, where more complex challenges might be expected. The next chapter will provide descriptions of such international observatories.

4. International STI observatories: experiences and lessons

This chapter describes some regional and international structures that could provide insight and serve as models for AOSTI. The information has mostly been collated from the respective websites and meetings with stakeholders (see Annexure 2). The institutions that could serve as examples include:

- Ibero-American and Inter-American Network of Science and Technology Indicators (RICyT)
- European Techno-Economic Policy Support network (ETEPS)
- ESCWA Technology Centre
- GO→SPIN survey of science, technology and innovation.

These four STIOs are described in detail in the following sections. Other entities, such as Eurostat, Arabstats and the Union for Islamic Science and Technology Centres, are also briefly described.

4.1 Ibero-American and Inter-American Network Science and Technology Indicators (RICyT)[3]

The Ibero-American and Inter-American Network of Science and Technology Indicators (RICyT) was established by Latin American countries, together with Spain and Portugal, to promote the development of instruments for measuring and analysing science and technology in Ibero-America. This framework of international cooperation aimed to achieve better understanding of the instruments and their best use in decision-making processes.

RICyT was set up after a proposal by the first Ibero-American workshop on science and technology indicators, held in Argentina in 1994. The proposal to establish RICyT was adopted by the Ibero-American programme *Ciencia y Tecnología para el Desarrollo* (CyTED) (Science and Technology for Development) as an Ibero-American network and by the Organisation of American States (OAS) as an Inter-American network. RICyT became operational in April 1995. Currently, the network is funded mainly by the Ibero-American States Organisation (OEI), through the Science, Technology and Society Observatory of the Center for Higher Education Studies (OEI/CAEU). It also benefits from the support of the Spanish Agency for International Development Cooperation *(Agencia Española de Cooperación Internacional para el Desarrollo)* (AECID).

RICyT is an observer on the OECD National Experts on Science and Technology Indicators group

3 This section builds on Kouyoumjian, H., A Regional Science, Technology and Innovation Observatory, http://css.escwa.org.lb/ICTD/1224/10b.pdf.

(NESTI), which guides the measurement of STI indicators. In addition, RICyT works jointly with the UNESCO Institute for Statistics, the Inter-American Development Bank (IADB), the Economic Commission for Latin America and the Caribbean (ECLAC), the Executive Secretariat of the Andrés Bello Convention (SECAB) *(Secretaria Ejecutiva del Convenio Andrés Bello)*, the Caribbean Council for Science and Technology (CCST) and the Commission for Scientific and Technological Development of Central America and Panama (CTCAP) *(Comisión para el Desarrollo Científico y Tecnológico de Centroamérica y Panamá).*

Figure 1 shows RICyT's organisational structure and partners. The upper part of the figure shows RICyT's various scientific and administrative partners. The lower part shows the network entities, which may be observatories (OCyT, Colombia; OCCyT, Cuba; OCTI, Venezuela) or statistical units (in countries where there is no observatory). RICyT is an example of a regional observatory.

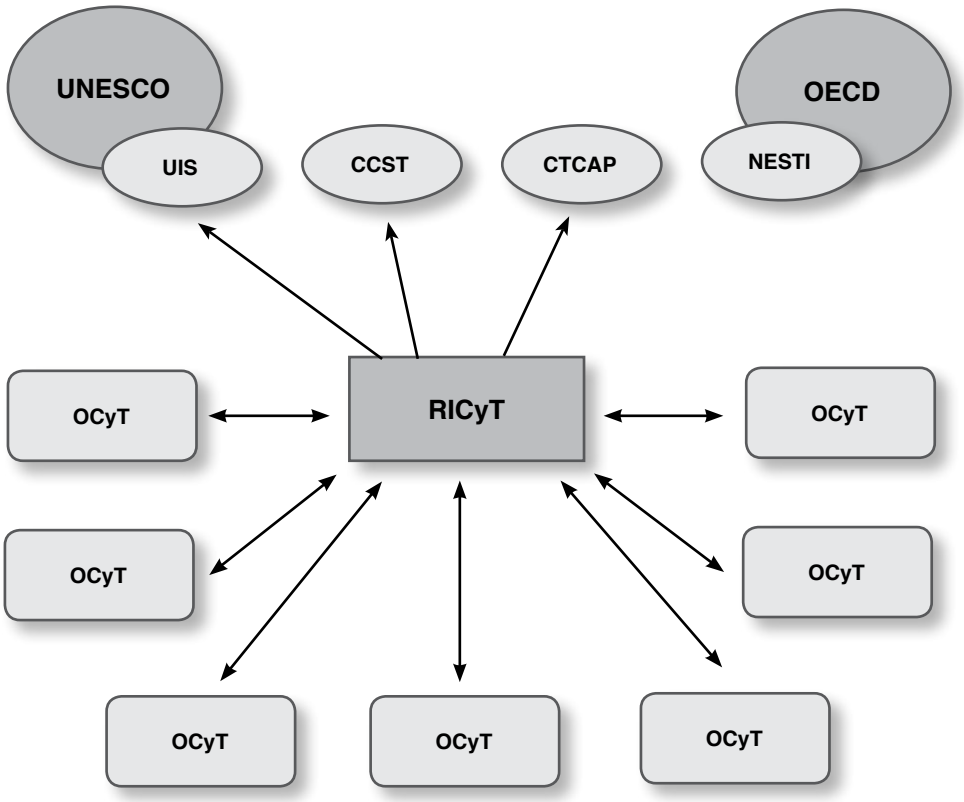

Figure 1: RICyT network

The objectives of RICYT are to:

- Design indicators for the measurement of STI in the Ibero-American and Inter-American region
- Provide international comparability and interchange of information on STI, and develop comparative studies

- Organise international and regional programmes for compiling information on STI
- Organise international workshops and meetings on the main topics covered by RICYT
- Publish information, papers and analysis of indicators, and develop information processes on STI
- Provide an interface for relations with public S&T statistics organisations
- Train experts on statistics and S&T indicators
- Promote the incorporation of the Ibero-American and Inter-American region in the international system of S&T indicators by adopting internationally accepted standards
- Generate a Latin American standard adapted to regional specificities, using institutional parameters according to the characteristics of national organisations
- Generate adequate input and output indicators for the region's S&T systems
- Generate adequate innovation indicators to profile the productive activities of the region.

4.2 European Science and Technology Observatory (ESTO)

The European Science and Technology Observatory (ESTO) was the first attempt by the Institute for Prospective Technological Studies (IPTS), one of seven scientific institutes of the European Commission's Joint Research Centre (JRC), to create a platform of experts engaged in monitoring and analysing scientific and technological developments, and their relation to and interaction with society. After about ten years, ESTO ceded its role to two new networks, namely, ERAWATCH and the European Techno-Economic Policy Support network (ETEPS).

a) ERAWATCH network

ERAWATCH is a European web-based service that presents information on national research policies, actors, organisations and programmes. ERAWATCH supports evidence-based policy-making in Europe and contributes to the realisation of the European Research Area (ERA).

Information is collected with the support of national nodes of the ERAWATCH network, gathering and analysing information relevant to research policy-making in each of the member states of the European Union and beyond.

ERAWATCH is a joint initiative between the JRC and the European Commission's Directorate-General for Research. The online service is provided through the Community Research and Development Information Service (CORDIS).[4]

4 For more information on ERAWATCH, see http://cordis.europa.eu/erawatch/. For more information on the activities and composition of ERAWATCH network, see http://erawatch-network.eu/.

b) ETEPS network

The European Techno Economic Policy Support network (ETEPS) is a network of European organisations that provides the Institute for Prospective Technological Studies (IPTS) with high-quality advice at a European level over the whole range of policy fields in which the institute operates. It follows up and replaces the ESTO network. In 2005, the IPTS signed a framework contract with a consortium of 19 members and 17 associated members, which brings together many of the leading national counterparts of the IPTS throughout Europe.

In terms of expertise, the consortium is able to operate in all 27 EU member states and covers policy subjects as diverse as agriculture, consumer protection, energy, environment, enterprise, health, information society, innovation, research, and transport.

The IPTS also draws upon other pools of expertise by networking with sister institutes of the European Commission's Joint Research Centre (JRC), especially in the energy and environmental fields.

In addition its customer-driven work, the IPTS also has a policy of engaging in competitive multi-partner projects within the Research and Technological Development Framework Programme. About 20 such projects are currently operational. These projects strengthen the IPTS's connections with the scientific community and are valuable in enabling it to benchmark itself against its peers.

4.3 ESCWA Technology Centre

The Technology Centre of the Economic and Social Commission for Western Asia (ESCWA) monitors and supports STI opportunities in its member countries.[5] The idea of establishing the ESCWA Technology Centre dates back to 1978, when the importance of setting up national STI observatories was acknowledged. The following quotation captures the thinking behind the creation of this centre:

> The need for setting up national 'observatories' dedicated to monitoring STI capabilities should, therefore, be an integral part of national STI policy design and implementation strategies. Additionally, it would be essential to create modalities that promote demand for information produced by these observatories, such as national STI policy research units capable of analysing national observatory outputs for the benefit of policy and decision-making. Designs aimed at implementing national STI strategies should include pilot activities aimed towards these ends and should be initiated as early as possible in the process of STI strategy implementation. It will be essential for national STI observatories and policy research units to reflect the multifaceted character of national STI capabilities and the large range of issues linked to their evolution. A considerable degree of specialisation must be reflected in the internal structure and manpower needs of those observatories and policy research arrangements.[6]

5 The ESCWA region includes, in addition to Arab Asian countries, two African countries (Egypt and Sudan) and since September 2012, also Morocco, Libya and Tunisia.

6 In New Indicators for Science, Technology and Innovation in the Knowledge-Based Society, E/ESCWA/SDPD/2003/5.

In view of the need to strengthen national capabilities in STI policy formulation and implementation, and to gain greater benefit from current economic activities and from the available human resources, ESCWA established the Technology Centre as a regional technology centre in 2010. Its mission is to assist member countries and their private and public organisations to acquire the necessary capabilities to accelerate socio-economic development and attain technological parity with other nations. Among the major issues to be addressed are:

- Making available the considerable technological capabilities currently sequestered in existing national industries
- Proposing mechanisms for more effective utilisation of national infrastructures and the human capital available in the region
- Facilitating access to information at low cost, and identifying and disseminating best practices in the region
- Providing assistance to member countries in achieving the Millennium Development Goals.

The ESCWA Technology Centre is expected to play a key role as the hub of a regional network of national observatories (ESCWA, 2007). Three national STIOs are already in existence, and three countries have requested assistance from ESCWA to set up STIOs.[7] Once national STIOs are in place in the region, the regional centre, or a network of national STIOs, is expected to emerge.

The aims and operational mandate of the ESCWA Technology Centre require the centre to promote the establishment of a network of STIOs, thus making the ESCWA Technology Centre an information hub through which national and regional cooperation could be promoted and facilitated. The ESCWA Technology Centre could provisionally operate as a regional observatory for science and technology statistics and indicators.

The ESCWA Technology Centre is well positioned to draw expertise from ESCWA divisions, including the Divisions of Information and Communication Technology, Sustainable Development and Productivity, and Statistics. It is generally considered important to fine-tune the operational, recruitment and administrative modalities of the centre and to harmonise these with the UN system.

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7 Three countries of the region, namely Lebanon, Syria and Jordan, have taken active steps, with the assistance and support of ESCWA, to set up their respective national observatories. The context, structure, hosting and financing arrangements of their respective action plans differ from one another: 1) The hosting structures vary in their current mandates; 2) The countries differ in terms of socio-economic considerations; 3) There are very different, or even non-existent, levels of cooperation with the productive private sector; 4) Cooperation among public sector partners is not well developed; 5) The formation of an independent management board in which operations will be vested is perceived differently; 6) As yet there are no firm and legally binding commitments by governmental authorities, although these are expected to be forthcoming; 7) No one country has as yet effectively gauged the willingness of potential partners to collaborate; 8) Legislation regarding the dissemination of information is generally lacking.

In these three countries, and in all the other ESCWA member countries, it is important to note the existence of a multitude of structures that have collected various types of S&T data over the years. By their own admission, however, these date were not necessarily harvested according to robust and internationally accepted methodologies, which that makes national, regional and international comparison impossible.

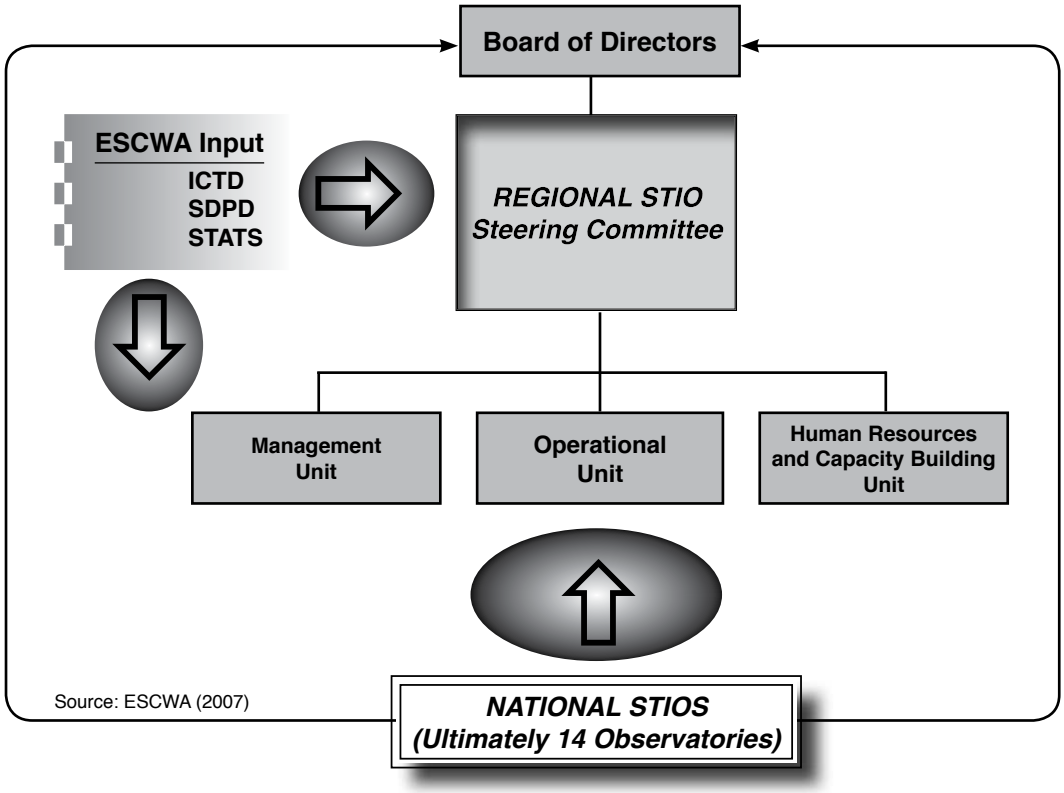


Figure 2: Structure of the ESCWA Technology Centre

Figure 2 shows the structure that has been established to allow ESCWA to work with and for the national STIOs:

- A steering committee composed of national focal points has been set up to oversee the planning and implementation of programmes. It prepares programmes and implementation plans, and calculates funding requirements. It also monitors and evaluates the activities of the ESCWA Technology Centre.
- The board of directors, which is independent of the national focal points, is responsible for overseeing the ESCWA Technology Centre (the regional STIO) and approving the programmes proposed by the steering committee. The board of directors evaluates the execution of the programmes, and may be supported in this role by an external evaluator. The nomination to the board is implemented through a process of consultation between ESCWA and ESCWA member countries.
- The management unit, headed by a senior officer, is in charge of programme coordination and organisational development, external relations and communication. It provides management support to the scientific units to implement their respective work plans.
- The operational unit is in charge of the development of methodologies and data collection, organisation and harmonisation.

It is expected that as the regional STIO expands, operations could be developed around the following themes or programmes, which in time could evolve into operational units:

- **Knowledge for Growth Unit:** The focus would be on the research–innovation–education triangle, and the unit would be responsible for collecting strategic techno-economic information supporting policy mechanisms in developing knowledge-based economies. This approach is similar to that adopted by the EU and it is expected to contribute to the acquisition of scientific and technological capabilities associated with industrial and development programmes in the region. Indicators will enable the region to benefit more effectively from the multiplier effects of scientific and technological knowledge. The ESCWA Technology Centre plans to develop a portal within its Information and Data Management Division that could in time interface with this unit.
- **Technology Market Unit:** This separate entity would collect and make available technology market data.

These units could play an important role in revenue generation. By following this model of developing a more commercial unit, AOSTI could generate significant funding comparable to the French OST, which generates 40% of its budget in this way.

One of the major roles of these scientific units will be to monitor the environment in order to find out what is available by way of resources and knowledge, and try to develop procedures for providing missing capabilities to the region (ESCWA, 2007).[8]

These units are expected to work collaboratively in addressing the systemic issues of the region and building indicators. The structure of the units will depend on the decisions made by ESCWA member countries in consultation with ESCWA. The primary aim of the two units will be to provide STI indicators and information on strategically identified areas for innovation (ESCWA, 2003), namely:

- Framework and infrastructure conditions that determine the range and opportunities for expansion
- Science and technology capabilities for knowledge generation
- Human resources
- Social and cultural factors.

4.4 GO→SPIN project

The Science Policy Information Network (SPIN) (www.unesco.org) was launched in 2010 by UNESCO's Regional Bureau for Science in Latin America and the Caribbean. SPIN covers the 33 countries of the Latin American and Caribbean regions, and its databases are regularly updated. UNESCO plans to extend the SPIN platform to the rest of the developing world and to cover

8 The two units are expected to respond to regional needs as outlined in the study report entitled 'Detailed Assessment of Regional Needs and Priorities and Identification of Implementation Mechanism', which was commissioned in preparation for the establishment of the ESCWA Technology Centre.

approximately 130 developing countries by 2015.

UNESCO aims to develop a Global Observatory of Science, Technology and Innovation Policy Instruments (GO→SPIN) by teaming up with the European Commission's ERAWATCH platform. This will cover approximately 70 developed and emerging countries.

It is expected that once GO→SPIN is in place, it will provide regularly updated information on:

- STI policies
- Operational STI policy instruments
- STI legal frameworks
- STI national systems, organisational charts and STI priorities
- Data analysis software for managing more than 300 temporal series of indicators, including economic, social, educational, industrial, scientific, technological, innovation, infrastructure, and information and communication technologies
- A database listing organisations that provide technical and financial cooperation on STI issues
- A web semantic text-mining multilingual tool with different applications for selecting STI strategic priorities
- A digital library housing more than 900 UNESCO documents on STI policies.

4.5 Other entities:

The following organisations do not fall under the broad definition of observatories, but have aspects in common with AOSTI and are therefore useful to examine:

- **UNESCO** Institute for Statistics (UIS) collects S&T data from more than 200 countries and territories through its biennial R&D survey and partnerships with other statistical organisations, such as EUROSTAT, RICyT and the OECD.
- **ARABSTATS** is sponsored by the UN Development Agency as a repository of statistics on human development in the Arab region. Users of the site can generate comparisons and charts of any knowledge economy indicator in the Arab world.
- **EUROSTAT's** mission is to supply EU members with high-quality statistical information. EUROSTAT does not collect any information. The respective statistical services of the member countries collect information and send it to EUROSTAT for consolidation and harmonisation.
- **Union for Islamic Science and Technology Centres (UISTC)** facilitates scientific and technological collaboration among member states for the development of knowledge-based economies, and promotes the collection and maintenance of a high-level technological databank in order to disseminate suitable technologies for members. UISTC has established the Science and Technology Investment Initiative for employment creation and poverty alleviation through the promotion of linkages between industry and research.

- **Virtual Incubator for Science-based Business (VISB)** is an initiative to help the COMSTECH technology exchange forum achieve its objectives of promoting industrial and technological collaboration and cooperation among member states of the Organisation of Islamic Cooperation (OIC) by sharing useful technologies for industrial production. COMSTECH is a ministerial standing committee on scientific and technological cooperation established by the Third OIC Islamic Summit Conference in January 1981. Its mission is to help strengthen the individual and collective scientific and technological capacity of OIC member states through mutual cooperation, collaboration and networking of resources. COMSTECH enables OIC member states to use science and technology as a major contributor towards socio-economic development and rapid industrialisation in the OIC region. It is entrusted with following up science and technology-related decisions of the Summit and creating successful implementation strategies.
- **UN Conference on Trade and Development (UNCTAD)** forms part of the Commission on Science and Technology, and falls under the umbrella of its Science and Technology for Development Network. UNCTAD has developed a gateway that provides access to information in areas of science and technology with the aim of building awareness of S&T developments that are particularly important for socio-economic development. The various economic and social commissions that fall under UNCTAD, including the UN Economic Commission for Africa (UNECA), have developed their respective policies and action plans in order to meet the challenge of socio-economic development. The establishment of AOSTI falls under these activities.

4.6 African Union STI system

Over the last decade, the development and implementation of STI programmes and related policies in Africa have been shaped largely by Africa's Science and Technology Consolidated Plan of Action (CPA). The genesis of the CPA can be traced to a series of grassroots continental workshops and consultations on the needs of the African STI community, and subsequent vertical integration. The CPA was adopted in 2005 by the Assembly of the African Union (AU), the supreme organ of the AU.

The CPA has thus become the AU's framework for common STI programmes and related policies. As a consequence, the AU STI system can be better understood by examining the roles and responsibilities of the various actors – including governments, regional economic communities, businesses, educational and research institutions, development partners, private not-for-profit institutions – and their dynamic linkages in pursuing the objectives of the CPA. In the following paragraphs, succinct descriptions of the key actors and their functions are provided in order to better advise on the optimal functioning of AOSTI in the AU STI system.

In addition to the AU Assembly, which approves and directs AU policies, the executive council, comprising ministers of foreign affairs, proposes decisions on policies for consideration and adoption by the Assembly. Recommendations from sectorial ministries, including those from the African Ministerial Council on Science and Technology (AMCOST), are directed to the Assembly through the

executive council. The executive council is advised by the Permanent Representatives Committee, which is composed of the permanent representatives of member states accredited to the AU, as well as other duly accredited plenipotentiaries of member states resident at the AU headquarters. In this way, the needs of member states in areas of interests are attended to in a collective manner.

AMCOST is mandated to promote Africa's scientific and technological development and to set continental priorities and policies pertaining to the development, harnessing and application of S&T for Africa's socio-economic transformation. It functions through two subsidiary bodies, namely, the AMCOST Bureau, which comprises five ministers responsible for science and technology, one from each of the five regional economic groupings of the African Union; and the AMCOST Steering Committee, which comprises ten permanent secretaries or their equivalents in the ministries responsible for science and technology, two from each of the five regional groupings in Africa. It should be noted that the activities of AMCOST are not limited to government departments of science and technology. Promoting STI requires the involvement and coordination of a number of other departments and agencies.

An equally important actor in the system is the AU Commission. The Commission plays the role of the secretariat of the AU. It is entrusted with executive functions and convenes AMCOST meetings, among other ministerial conferences. AMCOST comprises ten officials, namely, a chairperson, a deputy chairperson and eight commissioners, as well as staff members. One of the commissioners is in charge of the Human Resources, Science and Technology (HRST) portfolio, which is responsible for the governance of STI programmes on the continent. To that end, HRST has been mandated by the AU Assembly to oversee the implementation of AOSTI.

The Assembly's technical arm for implementing CPA programmes is the responsibility of the New Partnership for Africa's Development (NEPAD) Agency. Through NEPAD, several networks of actors have been formed in order to deliver on the CPA mandate. Notwithstanding the entities within the formal structures of the AU, the AU STI system is interdependent with other related systems with which it has explicit or implicit linkages. These include knowledge centres and networks, the cluster of UN centres, as well as international partners and not-for-profit organisation.

The various actors interact in different ways, including the flow of financial resources to run the programmes. Funding mechanisms and resource flows to sustain STI programmes come in different forms. National funding of R&D has not, in any of the AU member states, reached the target of 1% of GDP set by the AU. The African Innovation Outlook 2010[9] observed that, "For Africa to become more competitive with respect to scientific output will required greater investment in human capital development, the strengthening of scientific institutions and equipment, as well as significantly higher funding for science."

Among this mosaic of actors, AOSTI should work in partnership with other actors in a manner that

9 African Innovation Outlook 2010, p. 107

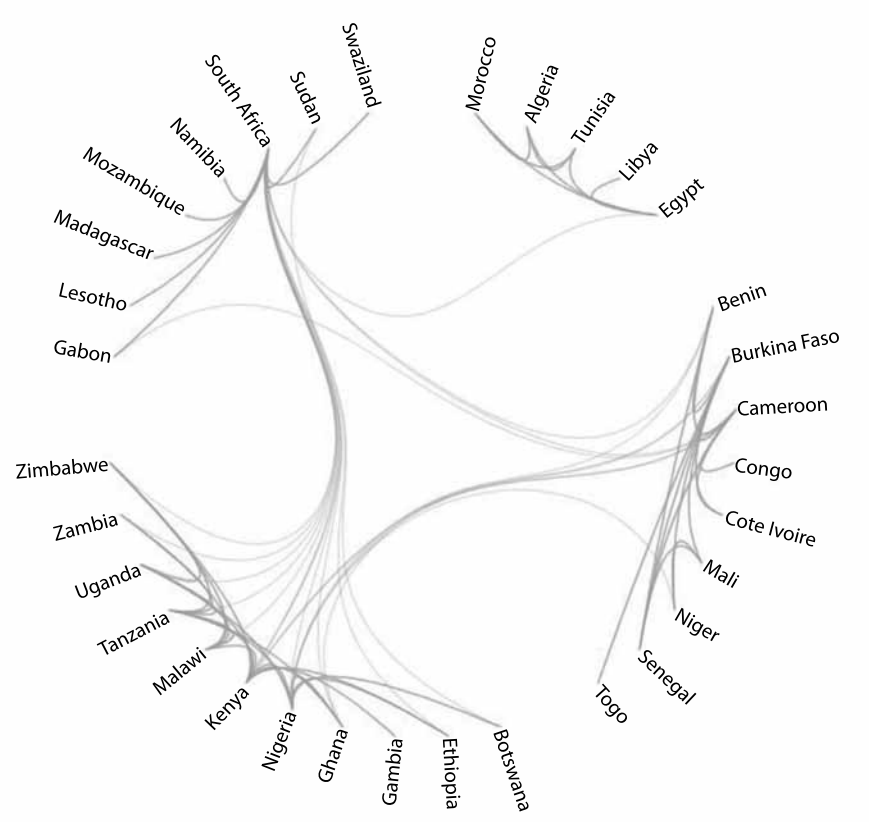
involves a combination of governmental and non-governmental institutions, processes, instruments and actors to address problems of mutual concern. AOSTI should attempt to draw on the largely untapped potential of the business sector and individuals citizens to address the public interest.

4.7 The regional scene: uneven capacities

Africa is a very diverse continent, with 54 AU member states at different levels of socio-economic development, wealth, population, literacy, tertiary education, STI institutional development and institutional collaboration. However, the AU member states are unified through numerous other aspects under the umbrella of a multitude of organisations and structures. Relatively recent bibliographic studies (Adams, King and Hook, 2010) indicate that STI collaboration and interaction in Africa are concentrated around a few regional poles. This suggests the possibility of the observatory expanding the level of intra-African cooperation in future by developing partnerships with sub-regional relay entities. This may not necessarily require the creation of new institutions, but rather focus on building a network of regional partners that are recognised for their expertise in the areas of activity of the observatory. The National Observatory of Sciences and Technology (NOST) in Tunisia, and the Centre for Science, Technology and Innovation Indicators (CeSTII) in South Africa could serve as potential nuclei for this undertaking.

Across the member states, sub-regional groupings exist that portray varied patterns of interaction. Figure 3 shows patterns of bibliographic interactions among African countries. For example, the patterns indicate the existence of interaction among North Africa countries, which happen to share a common language and culture. Another research group in central Africa revolves around Cameroon, and these countries have French as a common cross-national business language. Other clusters are observed in the East African region, where Kenya seems to take the lead. A strong anglophone influence appears to be the main unifying factor for Nigeria, Ghana and Gambia. South Africa is a strong node, with links that spread into other regional groups. South Africa and Nigeria, along with Kenya and Egypt, have the strongest cross-continental links and are also key nodes for links with global research networks.

As demonstrated in this empirical example, the polarisation of research and scientific cooperation around regional poles shows that there are opportunities for the African observatory to work in partnership with sub-regional relay structures. It is therefore necessary for the observatory to network with regional partners that are recognised for their expertise in STI. Such a network could include established bodies such as the National Observatory of Sciences and Technology (NOST) of Tunisia, the Centre for Science, Technology and Innovation Indicators (CeSTI) of South Africa, and the Commission for Science and Technology (COSTECH) in Tanzania, to name just a few.



Source: Web of ScienceSM (2010) (Analysis: Daniel Hook)

Figure 3: Patterns of bibliographic interaction among African countries

At the national level, most of the AU member states have trained scientific personnel who have accumulated expertise through participation in regional activities such as the African Science, Technology and Innovation Initiative (ASTII) workshops and training programmes, which focus on creating platforms for the collection and analysis of STI data. The UIS website provides information on national structures involved in various aspects of STI data collection.[10]

While a comprehensive view of the accomplishments of African countries is not yet available, it is also widely recognised that national and regional mechanisms for collating and disseminating information do not meet the needs of decision-makers. This is mainly due to reluctance to provide the required information. The prevailing culture suggests that information cannot be readily accessed even in countries where it is available.

Overall, greater efforts need to be expended in all African countries, to different degrees, in collecting and analysing statistics and other information on the evolution of their STI capabilities. Additional manpower, financial and institutional resources will be required in order to:

- Develop national systems of indicators that reflect national aspirations and particularities, while remaining compatible with regional and international metrics
- Establish units dedicated to the development and implementation of STI indicators as part of efforts to review and update national STI policies
- Allocate resources for training activities, capacity building, the development of software packages and other efforts to standardise the use of STI indicators.

4.8 A niche for a regional network of STIOs or statistical units

The paucity of publicly available information in Africa is an important reason for improving data gathering and harnessing activities across the region. This dearth of information presents a strong case for improving and extending the capabilities of regional organisations, including those of AU Statistical Services. It will be difficult for AU member states to use evidence-based information to work their way out of their developmental crises without improved data in all relevant areas.

Most AU member states have STI-related structures capable of serving as a nucleus for further development. A useful starting point would be to build up national 'STI observatories' in different areas, which would develop progressively to form a single collective 'STI observatory'. As noted in previous chapters, a regional STIO could provide support in this regard, as well as giving the national STIOs enough flexibility to reach their potential through networking.

There is limited experience in the region of conducting centrally coordinated activity in relation to STI. The NEPAD ASTII programme is one such undertaking. However, it is still in the initial stages, and the results obtained thus far are not sufficiently comparable, as they reflect different commitments by countries, which are moreover at differing levels of socio-economic development. This may be due to the varied perceptions and expectations of countries and their willingness to provide all the relevant information and data to the coordinating organisation. Nevertheless, they provide a useful starting point and insight into the STI capabilities of participating countries, as well as tangible products such as the first African Innovation Outlook (2010).

Having looked at the establishment of STIOs in various countries, common needs have been identified that will have to be addressed systematically in order to establish a regional STIO. The elements of such an approach could be summarised as follows:

- The need for a national collaborative effort by all potential players – including private and public sector institutions, universities, R&D firms and non-governmental organisations – to share information in an open space
- Acknowledgment that when certain areas are not addressed by the private sector, the government could create an environment for collaborative action
- Development of modern forward-looking STI policy for countries through a process of consultation with stakeholders

- Establishment of a national STI statistical unit or STI observatory, preceded by the formulation of national STI policy; this would allow national authorities to evaluate the success of R&D efforts and to adapt their strategies where necessary
- Capacity building and cooperation with similar regional and international organisations in order to further the STI visibility of the region, share experience and solicit financial and technical assistance
- Support from the highest level of government, good governance and transparency.

Once the context has been set, the following needs should be addressed by the regional STIO:

- Design of indicators for the region in order to measure the STI effort
- Analysis of region-specific problems in order to introduce solutions to methodological issues, including collecting data, building or acquiring databases (for example, for bibliometrics) and developing relevant STI indicators
- Evaluation of the institutional capabilities of regional STI organisations in order to ensure their active and effective participation in compiling and disseminating STI statistics
- Promotion of methodological instruments for the production of STI indicators and their use in forecasting trends and needs for the region
- Organisation of training programmes and workshops in order to upgrade the professionalism of personnel for better input and output of STI data
- Integration of African countries into international systems by adopting common methodologies
- Establishment of methods and mechanisms for disseminating STI-related information in order to raise the profile of the region
- Provision of seed funding and identification of resources required for implementation.

Emulating the RYCyT experience, AOSTI might consider engaging in relevant complementary activities, such as:

- Promoting university–industry linkages in order to bridge the gap between the sectors and move technologies closer to the market
- Acting as a platform to facilitate dialogue and create awareness of science and technology and identify the major providers of information.

Developing and transitional countries face formidable challenges in their attempts to compete in a knowledge-driven global economy due to structural shortcomings and financial restrictions, exacerbated by the global financial crisis. However, efforts by a regional organisation such as the AU to hasten the implementation of the AOSTI vision could contribute significantly to the AU's aim of regional integration and accelerated socio-economic development. AOSTI, as part of the AU STI system, would be a positive step in this direction.

It is important to note that there is no universally accepted blueprint for a regional STIO. The next chapter will try to address the following questions:

- What functions should the regional STIO have?
- Which position should it have in the monitoring and evaluation of the STI system?
- How should it be organised internally?
- Where does its funding come from?
- What profiles should its staff have?
- What are its products?
- Who are its users and what are their needs?

4.9 Summary

African Union member countries are covered by some of the initiatives that have been discussed. More importantly, these structures have a wide range of experience that could provide important direction to decision-makers involved in planning the structure and direction of AOSTI.

As indicated previously, there are very few S&T observatories around the world, and thus also few models. This study has highlighted the work of the RICyT network. This is not an observatory in the classical sense of the term, since it is a network rather than an administrative structure. Nevertheless, one of the key success factors of RICyT is providing flexibility to a number of national Latin American observatories.

In contrast, European countries have been more successful in producing and analysing indicators at the national level than at the regional level. Europe is well advanced in developing European observatories as entities that conduct structural analysis, forecasting and information. However, the European experience with the evolution of ESTO indicates that African observatories should reflect on their longer-term potential as well as immediate development issues. Over the longer term, regional observatories tend to take on a broader set of functions and missions than gathering and disseminating S&T indicators.

5. AOSTI: Building success

The African Observatory of Science, Technology and Innovation (AOSTI) was established to raise the continent's profile with respect to STI and to formulate a flexible framework for producing indicators that countries can use to map their research and knowledge systems and identify national and regional priorities in a culturally, socially and economically diverse context.

5.1 Design conditions for AOSTI

Based on the analysis of existing national and international observatories presented in chapters 3 and 4, and in light of the general considerations of the African context (as outlined), certain conditions for the successful implementation of AOSTI have been identified. In the following sections, these conditions are discussed in more detail:

a) Strong political support, with a clearly defined mission and work programme

Strong political will is essential to creating an efficient AOSTI. Decisions and actions must be taken at the highest level to support the observatory with the best possible conditions.

It is also essential to have buy-in for AOSTI and its mission from the various STI actors. It is thus desirable that stakeholders involved in the development of AOSTI should share the overall vision, objectives and resources needed to achieve them. It is important to define the role of AOSTI and its objectives, bearing in mind the needs of different stakeholders and existing resources, while avoiding duplication of effort.

A work programme covering a period of about three to four years, with financial commitments, should be developed as a starting point.

b) Autonomy of AOSTI, together with partnerships and cooperation

Decisions on the positioning and status of AOSTI will ultimately be the responsibility of decision-makers. However, it is important to preserve the autonomy of the structure and independence of AOSTI, which provide the necessary guarantees for the proper functioning, credibility and legitimacy of its activities.

The participation and involvement of different STI actors from the public and private sectors in the activities of the observatory will showcase its legitimacy and credibility. Over time, such participation will lead to the establishment of a steering committee in which stakeholders will be represented. It is

essential to involve the steering committee in various working groups of the observatory. Liaison with entities that produce and use STI information is crucial. These relationships are essential not only for strategic reasons, but also for operational reasons. Links with universities are equally important, because they are both the providers and users of information, and as such they can contribute to improving the production and development of knowledge in the areas of expertise of the observatory.

Furthermore, although a national observatory may not exist in many countries, efforts have been made to produce data on national systems of innovation. Since AOSTI is not responsible for generating primary data, it is important for AOSTI to develop lasting and effective relationships with data-producing national structures in a targeted and complementary way.

c) Balance between representative governance and management autonomy

The existence of a steering body (such as a board of directors or steering committee) comprising representatives of various stakeholders of AOSTI would help provide strength and stability to the institution. However, the observatory must have sufficient flexibility and professional independence in terms of its direction to ensure that it remains aligned to its goals. Clearly defined leadership and management roles for the director, and the selection of a suitable director, are central to the success of AOSTI.

d) Funding model compatible with the missions of AOSTI and its work programme

It will be particularly important to ensure that the resources of the observatory are compatible with its objectives. In other words, ambitious plans cannot be achieved without adequate funding. Adequate infrastructure, equipment and access to databases must be guaranteed. This implies that it is critically important to secure sufficient funding for AOSTI to ensure its long-term development. In addition, AOSTI funds earmarked for specific projects, such as contracts or participation in international programmes or projects, would be necessary.

e) A portfolio of products that represent the work of AOSTI, ensuring its quality and usefulness

The quality and relevance of AOSTI products is of paramount importance. The regular production of a regional report presenting and analysing STI indicators is generally regarded as a key element with respect to the utility, visibility and legitimacy of AOSTI. The presentation of indicators compiled from multiple sources of information, and addressing the specific needs of policy-makers, will reflect the capabilities of the observatory. To meet this criterion, it is advisable to establish a clear set of products with established specifications, strict quality standards, adequate funding, and the support of a highly professional team. The current trend is towards the electronic dissemination of the products of observatories, or access to such products through a website.

Over time, the activities of AOSTI could be expanded to reflect the interests of its members. Topics of interest might include:

- Priority-setting methods
- Evaluation of the impact of STI research
- Mapping of STI research expenditures
- Mapping of the success rates of STI research funding
- Management of intellectual property.

f) Learning capacity

The observatory should be designed and managed so as to allow future evolution. It is necessary to periodically assess the activity of an observatory and the quality of its work, recommend performance improvements, analyse gaps, and adjust its work programme to the changing national and international contexts. A dynamic balance should be maintained in the activities of the observatory, based on its core mission and its ability to adapt to changing contexts. To achieve this, participatory development of the work programme is advisable, accompanied by periodic evaluation of the observatory.

g) A network of cooperation with institutions, groups and individuals at national and international levels

The quality and relevance of the work of AOSTI are directly related to its position in the network of experts, policy-makers and other groups affected by its activities at the regional and international levels. Links with centres of knowledge production in the field are essential at both the regional and international levels.

The advantages of networking in this context include:

- Providing input to the observatory's research priorities
- Participating in the research by providing information to the observatory team
- Accessing information from multiple countries on policies, strategies and processes related to research
- Making cross-national comparisons and sharing good practice
- Early access to observatory reports
- Opportunities to engage and collaborate with observatory stakeholders.

5.2 Proposed structure and staff needs

A discussion document on the African Science, Technology and Innovation Indicators (ASTII) implementation programme established the rationale for an African Observatory of Science, Technology and Innovation (NEPAD, 2005), namely:

A knowledgeable and active Secretariat is essential to the development of comprehensive programmes of indicators. The skills required by the Secretariat include knowledge of the subject matter (science system dynamics, industrial dynamics, human resource development, information systems) as well as the organisational, management and negotiation skills needed for dealing with policy departments, regulators, and statistical offices in participating countries.

Entrepreneurial and communication skills are also needed for the production and distribution of publications such as the African Innovation Outlook.

This report refers to human resource requirements at the French OST, Canadian OST and RICyT in order to estimate the size of the staff complement required by AOSTI in the short term. For AOSTI to deal with 54 countries in Africa would require a staff complement of about 20 people in the first five years, comprising professional, technical and support staff. This number might increase if the provision of capacity-building expertise to countries is taken into account. Based on the experience of the three reference observatories, it is suggested that AOSTI should initially have the following core functionality:

- Administration and coordination
- Training
- Information analysis
- Information management
- Publishing.

Thus, the following departments and divisions could be considered for inclusion in the structure of AOSTI:

- Office of the Director
- Corporate Services
- Science, Technology and Innovation Divisions.

At least the following staff would be required for these departments and divisions:

- Executive Director
- Receptionist/secretary
- Policy analyst/researcher/experts
- Administrative and financial officers
- Data analyst
- Systems developer
- Publications officer
- Interns.

The AOSTI structure should not be rigid, since its needs and requirements will evolve and change over time. RICyT provides a good example in this regard.

5.3 Financial considerations

Since AOSTI is an institution of the African Union, the AU should be the primary funder of the observatory. AOSTI should receive a direct allocation, either directly from the AU or through a special fund such as the African Science and Innovation Fund (ASIF) proposed by the CPA. Other important sources to consider include support from the host country and income through services provided to beneficiaries. As AOSTI adds value to end-users, these will contribute to the observatory once they realise the benefits they could reap. Additional revenue could be generated by charging for access to database products.

Early expenses to be catered for will include set-up activities, salaries, operational expenses, honoraria, training costs, the organisation of workshops, and fees for consultants. However, it should be realised that even if additional funding is made available, the resources will always be scarce. This calls for strong promotion of regional collaboration wherever possible, and international cooperation through bilateral links.

In conclusion, the observatory should endeavour to mobilise sufficient resources to support its activities in addition to funding from the host country in terms of the agreement signed between the host country and the AU. The AU should maintain separate trust funds for donations for technical cooperation projects or other special contributions to the activities of the observatory. Finally, the financial resources of the observatory must be administered in accordance with the financial rules and regulations of the AU.

5.4 Summary

Based on the analysis of existing national and international observatories, and in light of general considerations of the African context, certain conditions for the successful implementation of AOSTI have been identified. The observatory should be designed and managed so as to allow for future evolution. It is necessary to periodically assess the activity of the observatory and the quality of its work, recommend performance improvements, analyse gaps, and adjust the work programme to the changing national and international contexts. The quality and relevance of the work of AOSTI are directly related to its position in the network of experts, policy-makers and other groups affected by such activities at the regional and international levels. Links with centres of knowledge production in the field are essential at both the regional and international levels.

By referring to the staff requirement of other majors STIOs, it is recommended that about 20 staff members would be needed to run AOSTI in the short term; the staff complement should be adapted to the prevailing conditions over time. The suggested funding sources for AOSTI include the contributions of the AU and the host country, income generated through services, and other sources of funding approved by the governing body.

6. Conclusions

Political leaders and policy-makers are facing a burgeoning range of complex social, economic, ethical and political issues concurrently with the rapid growth of scientific and technological developments. These leaders and policy-makers, like other decision-makers across the world, need to base their decisions on information from robust and relevant sources. They need to receive support and advice derived from rigorous data and research evidence using the best knowledge and experience available. They need to know where to go for the kind of research that could help them make the right choices. Genuine efforts have been undertaken in recent years through the Consolidated Plan of Action (CPA) of the African Union and the New Partnership for Africa's Development (NEPAD). The African Science and Technology Indicators (ASTII) initiative established the foundation for launching the first continent-wide surveys and collation of STI indicators and creating the African Observatory of Science, Technology and Innovation (AOSTI).

AOSTI was established by the Decision of the African Heads of State and Government Assembly Decision AU/Dec.452 (XX) of January 2013) as a continental STIO for Africa. Although designed specifically to address Africa's need for STI indicators in a globalised world, AOSTI could benefit from the experience of existing STIOs. This study therefore analysed STIOs around the world to provide recommendations for the operation of AOSTI.

The study found that observatories are geographically represented in all the regions of the world, but are more prevalent in South-East Asia and Latin America, perhaps because these regions have recognised the need to constitute the basic requirements for conducting STI audits, which are an essential policy tool for participating in the global economy and the information age.

STIOs exhibit a variety of structures, governance and financing models. This study analyses a number of STIOs and describes in detail the key elements of some STIOs that stand out as possible models for AOSTI. ESCWA provides an example of a regional initiative, leading to the creation of national STIOs. The study highlighted the French OST and the Canadian OST as successful national observatories.

It is important to emphasise that Africa has enough assets and skills to create a structure that will serve as an observatory for science, technology and innovation. It is noteworthy that consensus exists on the importance of creating such a structure. It is up to politicians and policy-makers to rise to the challenge and provide the necessary conditions for the observatory to ensure its regional character, carefully consider the best possible position for the observatory, taking into account its mission and current circumstances, and finally ensure the provision of skills, including new skills, and resources to enable the structure to continue to fulfil its mission.

The improved production of quality statistics is a prerequisite for supporting the establishment of

AOSTI. In this context, experts stress the importance of strengthening the expertise that exists in many African countries. The ASTII programme provides opportunities to do so, but national institutions must also make other efforts to support training. In strengthening the skills for AOSTI, the special skills required for STIO activities must be recognised in order to generate sustainable human resources.

It is assumed that AU member states will provide the necessary budget for their statistical units to carry out the requisite surveys, collation, management and dissemination of relevant data for AOSTI. The financial sustainability of AOSTI is a critical success factor, and this report has therefore proposed a number of possible funding mechanisms.

In order for AOSTI to play its intended role to the full, its reputation must be protected through appropriate work ethics and communication strategies, and its professional and scientific autonomy must be guaranteed. AOSTI will not collect data on individual institutions, but will receive aggregated data for collation and dissemination. Statistical units must maintain the strict confidentiality of STI data sources in order to retain and improve the participation of respondents.

Finally, the perceived value of AOSTI will depend upon the relevance, quality, completeness, timeliness and accessibility of the information that it disseminates. AOSTI must therefore have unrestricted access to aggregated information, as well as access to key stakeholders in the national systems of innovation of member countries.

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ANNEXURES

Annexure 1: Useful websites

- www.arabstats.org
- www.europa.eu
- www.eurostat.eu
- www.iscte.pt
- www.jrc.es
- www.oecd.org
- www.ricyt.org
- www.unctad.org
- www.sciencedev.net
- www.unesco-ci.org
- www.visbdev.net
- www.comstech.org
- http://ipts.jrc.ec.europa.eu/
- www.hsrc.ac.za/CeSTII.phtml

Annexure 2: Interviews conducted

Name	Function	Institution	Day/Time of the meeting	Place
Laurence Esterle	Former General Manager	OST, France	2012-09-19 (09:00–10:00)	Rabat, Morocco
Ghislaine Filliatreau	General Manager	OST, France	2012-09-19 (10:30–11:30)	Rabat, Morocco
Lucas Luchilo	Coordinator	Centro REDES-RICyT	2012-05-11 (19.00–20.30)	Malabo, Equatorial Guinea
Fouad Mrad	General Manager	ESCWA Technology Centre	Several meetings	Amman, Jordan

Annexure 3: STIO websites

Website	Country	Name
http://www.mastic.gov.my/	Malaysia	MASTIC – Malaysian Science and Technology Information Centre
http://www.a-star.edu.sg/	Singapore	A*STAR – Agency for Science, Technology and Research
http://www.nistep.go.jp	Japan	NISTEP – National Institute of Science and Technology Policy
http://www.stepi.re.kr/eng	South Korea	STEPI – Science and Technology Policy Institute
http://www.nstda.or.th/	Thailand	NSTDA – National Science and Technology Development Agency
http://www.occyt.cu/	Cuba	OCCyT – *Observatorio Cubano de Ciencia y Tecnología*
http://www.oncti.gob.ve/	Venezuela	OCTI – *Observatorio Venezolano de Ciencias, Tecnología e Innovación*
http://ocyt.org.co/html/	Columbia	OCyT – *Observatorio Colombiano de Ciencia y Tecnología*
http://www.ricyt.org/		RICyT – *Red de Indicadores de Ciencia y Tecnología Iberoamericana e Interamericana*
http://www.unil.ch/osps	Switzerland	OSPS – *Observatoire Science, Politique et Société*
http://www.ost.uqam.ca/	Canada	OST – *Observatoire des Sciences et des Technologies*
http://www.obs-ost.fr /	France	OST – *Observatoire des Sciences et des Techniques*
http://www.mctes.pt/	Portugal	OCES – *Observatório da Ciência e do Ensino Superior*
http://www.deti.ie/science/	Ireland	OSTI – Office of Science, Technology and Innovation
http://www.cotec.es/	Spain	COTEC – *Fundación para la innovación tecnológica*
n/a	Tunisia	NOST – National Observatory of Science and Technology
http://etc-un.org/pr/default.aspx	Jordan	ETC – ESCWA Technology Centre
http://www.hsrc.ac.za/CeSTII.phtml	South Africa	CeSTII – Centre for Science, Technology and Innovation Indicators

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