

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



UNIÃO AFRICANA
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AOSTI Working Papers No. 2, 2013

**Science, Technology and Innovation
Policy-Making in Africa:
An Assessment of Capacity Needs
and Priorities**





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Citation:

AOSTI (African Observatory of Science, Technology and Innovation) (2013), Science, Technology and Innovation Policy-making in Africa: An Assessment of Capacity Needs and Priorities, AOSTI Working Papers No. 2

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ISBN: 978-1-920550-61-5

Publication compiled under the supervision of: Philippe K. Mawoko

Copyediting: Write Connection, Pretoria, South Africa

Desktop composition and printing: DS Print Media, Johannesburg, South Africa

Design: ISK-Multimedia, Dakar, Senegal

Foreword

The African Union Commission (AUC) emphasises the role of capacity development in all its programmes of work in order to sustain and increase its service delivery to the African community.

Over the last decade, there has been a remarkable upturn in the pace of adoption of science, technology and innovation (STI) programmes to underpin socioeconomic development in African Union member states and the Regional Economic Communities (RECs). The establishment of the African Observatory of Science, Technology and Innovation (AOSTI) comes at an appropriate moment, when knowledge and evidence-based policy making is taking central stage in policy debate on the continent. The African Union Commission has therefore mandated AOSTI to support these efforts in gathering statistics and other evidence for STI policy formulation, implementation, monitoring and evaluation. Member states echoed this demand during the intergovernmental meeting on AOSTI held in Malabo in May 2012.

This report on the assessment of national STI policy capacity needs should not be seen as a once-off event, but rather as a rolling approach that will be reviewed in the short, medium and long term, enabling AOSTI to contribute to the development of skilled critical mass in STI among African citizen. I strongly encourage active interaction between AOSTI and the various STI stakeholders, including governments and regional structures.

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Acknowledgements

This is the second working paper of the African Observatory of Science, Technology and Innovation (AOSTI). The AOSTI Secretariat wishes to acknowledge and thank all the people and entities that contributed to the completion of this study.

Profound gratitude is expressed to the government of the Republic of Equatorial Guinea for providing seed funding to the African Union for the start-up activities of AOSTI and for hosting the AOSTI headquarters in Malabo.

This work was contracted to Dr John Ouma Mugabe, Professor of Science and Innovation Policy, University of Pretoria. He deserves special mention since he is responsible for most of the material included in this volume.

Deep appreciation is also extended to the African Union Commission for their leadership and support to this project, particularly to Prof. Jean-Pierre Ezin (Commissioner: AUC-HRST) and Dr Abdul-Hakim Rajab Elwaer (Director: AUC-HRST).

The study benefited from the contributions of representatives of member states of the African Union and international experts who participated in the first AOSTI intergovernmental meeting held in Malabo in May 2012. We extend our sincere thanks to those experts.

Dr Almamy Konte (Senior Expert, Innovation Policy) is acknowledged for his important role of coordination and other contributions as project manager in the AOSTI office. The contributions of other colleagues in the AOSTI office are also acknowledged: Dr Bi Irie Vroh (Senior Expert, Science and Technology Policy) and Mr Johnston Kimanzi Kang'otole (Expert, Finance and Administration).

Dr Philippe Kuhutama Mawoko
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Abbreviations

AAS	African Academy of Sciences
ACODE	Advocates Coalition for Development and Environment (Uganda)
ACTS	African Centre for Technology Studies
AfDB	African Development Bank
AIDS	Acquired immune deficiency syndrome
AISPI	African Institute for Science Policy and Innovation
AOSTI	African Observatory for Science, Technology and Innovation
ASSAf	Academy of Science of South Africa
ASTII	African Science, Technology and Innovation Indicators
ATPS	African Technology Policy Studies Network
CREST	Centre for Research in Education, Science and Technology, Stellenbosch University (South Africa)
AUC	African Union Commission
CSO	Civil society organisation
DAFF	Department of Agriculture, Forestry and Fisheries (South Africa)
DEA	Department of Environmental Affairs (South Africa)
DEIP	Design and Evaluation of Innovation Policy in Developing Countries, UNU-MERIT
DMR	Department of Mineral Resources (South Africa)
DoH	Department of Health (South Africa)
DST	Department of Science and Technology (South Africa)
DWA	Department of Water Affairs (South Africa)
FMST	Federal Ministry of Science and Technology (Nigeria)
GSTM	Graduate School of Technology Management, University of Pretoria (South Africa)
HIV	Human immunodeficiency virus
HRST	AUC Human Resources, Science and Technology



HSRC	Human Sciences Research Council (South Africa)
ICT	Information and communication technologies
IDRC	International Development Research Centre (Canada)
ITI	Institute for Technological Innovation, University of Pretoria (South Africa)
MHEST	Ministry of Higher Education, Science and Technology (Kenya)
NACETEM	National Centre for Technology Management (Nigeria)
NACI	National Advisory Council on Innovation (South Africa)
NCST	National Council for Science and Technology (Kenya)
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organisation
NISER	Nigerian Institute for Social and Economic Research
NRIC	National Research and Innovation Council (Nigeria)
OECD	Organisation for Economic Cooperation and Development
PhD	Doctor of Philosophy
PREST	Policy Research in Engineering, Science and Technology (previous name of the Manchester University Institute of Innovation Research)
REC	Regional Economic Community
S&T	Science and technology
SADC	Southern African Development Community
SAREC	Swedish Agency for Research Cooperation
STI	Science, technology and innovation
DTI	Department of Trade and Industry (South Africa)
TIA	Technology Innovation Agency (South Africa)
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development (
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNU-MERIT	United Nations University-Maastricht Economic Research Institute for Technology
USA	United States of America
USAID	United States Agency for International Development

Executive Summary

Overview

Many African countries have projects or activities to formulate and/or to revise national policies for science, technology and innovation (STI). These efforts have been stimulated by a wide range of factors including the following. First is the increasing recognition by African leaders and the public of the critical roles that STI play in economic change and human development. African leaders now recognise that their countries need to increase investments in STI in order to achieve economic growth, reduce poverty, fight diseases such as HIV/AIDS and tuberculosis, stem environmental degradation, and to integrate themselves into the global knowledge economy. This recognition is reflected in political and policy statements that are frequently made by the leaders.

Second, there is a growing public constituency for STI. In the 1970s to the 1990s issues of STI promotion and debates on the roles of scientific research and technological innovation were confined to small circles of eminent African scientists and engineers. Today, the general public increasingly recognising the importance of STI and there is an emergence of African civil society organisations and think tanks that are dedicated to raising awareness of STI issues in areas such as biotechnology and information and communication technologies.

Third, the growth in public awareness and political recognition of STI has been accompanied by more donors getting interested in supporting STI programmes including those for policy development. In the 1990s there were very few donors that supported programmes for STI policy development. There is now a variety of bilateral and multilateral donor institutions that are supporting African governments to formulate and implement STI policies.

Lastly, during the past decade a number of regional, continental and international initiatives for STI policy development have been launched in Africa. In 2007 the African Union (AU) and its New Partnership for Africa's Development (NEPAD) launched the African Science, Technology and Innovation Indicators (ASTII) Initiative to support countries to generate statistical evidence for STI policy development. The Regional Economic Communities (RECs) have integrated STI issues or considerations into their treaties and protocols. The AU has been instrumental in getting African leaders to start making policy and declaratory statements on STI. The United Nations Educational, Cultural and Scientific Organisation (UNESCO) has renewed its support for STI policy programmes in Africa.

African countries have different or varied capacities and experiences in managing STI policy development. Indeed they have different human and institutional capacities for STI policy formulation, implementation and evaluation. However, one common characteristic of STI policy formulation in



all the countries is the long gestation period from agenda setting to adoption of policy regimes. It is taking most countries not less than five years to initiate and complete STI policy development.

The African Observatory for Science, Technology and Innovation (AOSTI) of the African Union commissioned this study to provide an indicative or preliminary survey of African countries' common capacity needs and priorities for STI policy development. The survey is intended to generate empirical information on the needs and priorities in order to inform the design a comprehensive programme for STI policy capacity development. It is based on reviews of reports (e.g. proceedings of workshops) on national STI policy development activities, reviews of outcomes of policy development efforts, and interviews with key stakeholders in governments and donor institutions.

Conceptual Issues

What is STI policy? The phrase 'STI policy' has acquired wide usage by policy-makers and researchers but rarely is it properly defined. It is not uncommon to come across 'STI policy' being equated to 'R&D policy' or even being reduced to 'technology policy'. Generally, it is about the governance of STI. By this we mean decisions and actions that are taken by governments to promote, regulate and use STI. STI policy is actually a regime or body of many policies. It has two facets: policies for STI and STI for policy. These facets are not separable but constitute a useful typology for studying STI policy making.

Policies for STI are about actions that governments or decision-makers take in order to promote scientific research, development of technology, and diffusion and adoption of technological and organisational innovations. Such measures include choice of R&D projects, choice of technology, allocation of resources for scientific research and technology development, economic and legal incentives for private firms to adopt and use new technologies, regulations on procurement of new technologies, regulations for research and clinical trials, biosafety, and the protection of intellectual property rights.

STI for policy is when science, technology and innovation are used for policy development. Scientific data or information, information on the nature and impacts of a technology and data on innovation are used to inform policy-makers with the aim of influencing and enhancing their abilities to make decisions. This is about the use of science and related technological information to determine or influence decision-making in the wider sphere of governance. It also includes the use of STI to identify and build understanding of problems such as climate change and loss of biological diversity.

This study focused policies for STI. This is mainly because most of the current efforts of many African countries are about designing policies to promote STI. There are several reasons as to why policies for STI matter. First, market and systems failures are the core rationales for STI policy. 'Market failure' is when private sector cannot be relied on to invest in scientific research or knowledge production and as such government intervenes in R&D or knowledge creation. Public resources are used or relied on to close investment gaps in R&D.

The 'system failure' rationale for STI policy is when existing organisations are not configured or when there are no appropriate organisations to produce scientific knowledge, develop technologies, and effectively engage in innovation processes. In this case STI policy is needed to address the problems of institutional design and articulation. It has also to focus on such aspects as building marketing and entrepreneurial capabilities within firms and R&D institutions.

What is STI policy capacity? It is the ability to organise and manage processes of decision-making on how best to promote STI. STI policy capacity has three interrelated components: skills, institutions and overall socio-economic and economic context. Skills are embodied in persons who are trained, experienced and used to conduct STI policy research and analysis, and organise and manage policy-making processes. Such skills are multidisciplinary or generally involving adequate conceptual understanding of STI and related broader issues of development.

Institutions are critical elements or components of STI policy capacity. They are the main vehicles for mobilising, creating, nurturing and using skills or expertise for STI policy research and analysis. Institutions are used to design and manage STI policy processes, including the formulation, monitoring, evaluation and implementation of specific policies. They possess, or are expected to possess, such infrastructure as funds and libraries. Institutions are the legitimate loci of STI policy-making. Individuals cannot in their personal capacities claim authority for national STI policy-making. It is not the mere existence of agencies or organisations that constitute the institutional component of capacity but how each of the agencies or organisations are configured within a country to create the necessary space for the creation, mobilisation and utilisation of the skills and other resources. Intra-institutional or agency articulation is, thus, an important factor to consider in the assessment of STI policy capacity.

The third component of STI policy capacity is the overall context in which the skills and institutions evolve and are utilised. The context comprises of the overall economic, political, socio-cultural conditions, national physical infrastructure, inter-institutional/organisational articulation (how and whether institutions or agencies in a country communicate), the nature (including adequacy) of other policy regimes (non STI policies, laws and administrative measures) and how and whether these are implemented or enforced on the basis of agreed upon or set benchmarks.

Building STI policy capacity involves creating, mobilising, utilising, enhancing or upgrading, and converting skills/expertise, institutions and contexts. Skills are mobilised in various ways including networking of individuals and can be enhanced through training. Institutional strengthening involves providing organisations with more resources—human, financial and infrastructural. It is also about giving organisations more authority and autonomy to experiment and function. In the case of STI policy institutions this may entail giving an organisation more legislative powers to conduct research, and coordinate and convene policy making processes.



Empirical Findings

This study focused on organisational, finance, expertise, infrastructure, and information aspects of policy-making capacity. Its key findings are outlined below.

Organisational capacity—Many African countries have created departments and ministries for STI policy activities. Some (for example Kenya and Uganda) have also councils or commissions for science and technology in addition to the ministries. It was not possible for this study to assess the organisational capacities of the individual departments, ministries and councils or commissions. It put emphasis on whether these institutions were appropriately located in the whole of executive structure of policy-making. One of its key findings is that in many African countries ministries and departments responsible for STI policy *tend to operate in isolation from the rest of other policy agencies of government and have weak links to academic institutions and private sector*. They are also not adequately linked to international and the few African think tanks in policy research. As such they are not able to easily access empirical material and ideas for STI policy-making.

Funding STI policy activities—the survey for this study showed that most countries do not have budgets dedicated to STI policy activities, particularly for research or evidence gathering. Some rely on short-term project funding that is linked to events such as workshops and consultancies to review R&D systems or to collect STI indicators for UNESCO and NEPAD. Important aspects of STI policy development such as monitoring and evaluation are not budgeted for and thus not resourced in most countries.

Infrastructure capacity for STI policy—Most countries have the requisite ICT related infrastructure in the relevant ministries and/or departments for STI policy. Only respondents from three out of 18 countries identified ICT as a priority for capacity building. For some of the countries, infrastructure capacity needs relate to access to Internet and easy email communications.

Human resources or expertise for STI policy—Most ministries of and/or departments responsible for STI policy-making are not staffed with persons with relevant research and analytical skills. Many of the officials involved in or required to be in charge of drafting policy documents are not really versed with or trained in STI policy and have no experience in evidence based policy making. On the whole, expertise in (skills for) STI policy development is in short supply in most African countries.

Information capacity needs—In most countries, ministries and/or departments for STI policy do not have libraries or their staff do not have easy access to sources of relevant information for policy-making purposes. There is a paucity of local evidence-based analysis for policy development.

In addition to the capacity needs and priorities outlined above, there is a need to improve overall conditions or contexts for STI policy development. This includes strengthening executive and political leadership engagement in STI policy. National presidents and/or prime ministers need to play a more active leadership role in promoting STI and the formulation of relevant policies. Parliamentary committees on STI need to be strengthened to be actively engaged in STI policy activities. In most

of the countries these committees do not have research capacity or support for policy analysis, lack specific programmes and tend to work on ad hoc basis, do not dedicated budgets, and many of their members do not have adequate understanding of the wide range of STI policy issues that the committees are expected to handle.

Civil society organisations and think tanks for STI policy are nascent, almost non-existent in most of Africa. Although there are civil society organisations (CSOs) focusing on sectoral STI policy issues such as biosafety, climate change, biodiversity and other aspects of environmental regulation, these institutions do not focus on and/or participate in the development of overall national STI policy regimes in the countries.

Recommendations for AOSTI

The formulation, implementation, monitoring and evaluation of STI policies will increasingly preoccupy African countries as they seek to integrate their economies into the global knowledge economy. Many countries are going to seeking support build capacity for STI policy activities. The AOSTI has been established by the African Union (AU) to help African countries to build capacity for STI policy. AOSTI is now developing a comprehensive programme of work that will include or cover STI policy capacity building activities or initiatives. Based on this assessment it is recommended that AOSTI should focus on the following:

(a) *Mobilising and making available existing African and international expertise to support STI policy activities in Africa*—Many departments and/or ministries of STI do not have access to information on the available STI policy expertise in the continent and abroad AOSTI can be instrumental in supporting African governments to access and use the existing STI policy expertise by making information on the experts available through an organised database. AOSTI should design and manage web-based database of experts in STI policy. The database should contain information on the individual experts' education background, research outputs and experience in STI policy research and participation in national policy processes.

(b) *Establish a consortium for STI policy training*—the assessment shows that there is a variety of STI policy training courses. Some of the courses are tailored for government officials in departments or ministries of S&T. The UNU-MERIT DEIP course is tailored a specific country's needs. It has been offered to Ethiopia, Senegal and Nigeria. The new UNESCO-SADC STI policy course focuses on S&T policy review and R&D indicators. AOSTI should consider establish a platform or consortium that brings together the different institutions offering the courses in order to design and implement one comprehensive programme for STI policy training. The programme would be spearheaded by AOSTI but implemented by the consortium members as a partnership arrangement.

(c) *Develop a virtual resource centre or unit on STI policy information*—Almost all of the countries that participated in this survey or assessment exercise identified provision of STI policy information (with emphasis on STI data and statistics and on concepts of innovation and systems



of innovation) as need and priority in capacity building. All of them identified this as one area where AOSTI can play an important role of supporting them to have access to information and literature relevant to STI policy formulation and implementation in Africa. AOSTI should consider establishing a well-structured policy-makers' web-based STI policy library. This would be a virtual centre or unit that is tailor made to suit information needs of African policy-makers.

(d) *Develop a policy-makers' guide to innovation concepts and innovation policy formulation—* This survey of STI policy capacity also showed that the concepts of innovation, systems of innovation or innovation systems, and innovation policy are not well understood by most policy-makers and thus current efforts at STI policy formulation seem to lack clear conceptual clarity. AOSTI should consider developing an accessible African policy-makers' guide (with examples of practices drawn from other parts of the world) on definitions and application of innovation concepts as well as guidelines for innovation policy formulation, implementation, monitoring and evaluation.

Many countries are engaged in various activities to design modern STI policy regimes. However, most of the countries do not have the necessary capacities for STI policy formulation. The study recommends that AOSTI should incorporate STI policy capacity building with emphasis on first mobilising existing expertise, develop STI training programme that explicitly focuses on innovation policy, establish an information centre on STI policy and design a policy-makers' guide on innovation concepts and innovation policy.



1. INTRODUCTION

The first decade of this millennium will be remembered as the epoch of science, technology and innovation (STI) policy-making and programming in Africa. At the beginning of the millennium, many African countries initiated national projects to design policies for STI. By the end of 2010, at least 37 countries had either adopted new STI policy regimes or had on-going policy formulation activities and/or processes. Countries that have adopted new STI policy regimes during the past ten years or so include Angola, Burundi, Democratic Republic of Congo, Egypt, Gabon, Lesotho, Kenya, Malawi, Mozambique, Rwanda, South Africa, Uganda, Nigeria and Zimbabwe. Zimbabwe adopted its first policy regime in 2002, and a new regime in June 2012. Botswana and the Seychelles are about to adopt new policy regimes for STI.

The resurgence of interest in STI policy is accounted for by several factors. Firstly, the past decade has witnessed increased recognition among the general public as well as politicians of the role of STI in socio-economic development. African leaders now recognise that their countries need to increase investment in STI in order to achieve economic growth, reduce poverty, fight diseases such as malaria, HIV/AIDS and tuberculosis, stem environmental degradation, and integrate into the global knowledge economy. This recognition is reflected in various ways, including frequent political and policy statements by leaders.

Secondly, there is also a growing public constituency for STI. From the 1970s until the 1990s, interest in issues of STI promotion and debates on the roles of scientific research and technological innovation were confined to small circles of eminent African scientists and engineers. Today, the general public increasingly recognise the importance of STI, and there has been an emergence of African civil society organisations and think tanks dedicated to raising awareness of STI issues in areas such as biotechnology, and information and communication technologies (ICT).

Thirdly, the growth in awareness and political recognition of STI has been accompanied by increasing numbers of development partners becoming interested in supporting STI programmes, including those for policy development. In the 1990s, there were very few development partners supporting STI policy development programmes. Those that were involved included the International Development Research Centre (IDRC) of Canada and the Swedish Agency for Research Cooperation (SAREC), which is now part of the Swedish International Development Agency (SIDA). Institutions such as the World Bank, the African Development Bank (AfDB), the United States Agency for International Development (USAID) and private foundations were largely disengaged from STI policy development activities in Africa. Today these institutions are starting to play an active role in supporting African governments to formulate and implement STI policies.

Lastly, during the past decade a number of regional, continental and international initiatives for STI

policy development have been launched in Africa. In 2007, the African Union¹ and its New Partnership for Africa's Development (NEPAD)² launched the African Science, Technology and Innovation Indicators (ASTII) initiative to support countries to generate statistical evidence for STI policy development³. The Regional Economic Communities have integrated STI issues or considerations into their treaties and protocols. The African Union has been instrumental in getting African leaders to start making policy and declaratory statements on STI. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has renewed its support for STI policy programmes that review and formulate national STI policies in Africa.

In general, there has been increased attention on STI policy development in Africa. The countries have now built up a variety of experience in managing STI policy processes. They also have different human and institutional capacities and capabilities for STI policy formulation, implementation and evaluation. However, a common characteristic of STI policy formulation in all the countries has been the long gestation period from agenda-setting to the adoption of policy regimes. It takes most countries at least five years to initiate and complete STI policy development.

The African Observatory for Science, Technology and Innovation (AOSTI)⁴ commissioned this study to provide an indicative or preliminary assessment of African countries' common capacity needs and priorities for STI policy development. The purpose of the assessment is to generate empirical information on the needs and priorities in order to inform the design of a comprehensive programme for STI policy capacity development.

This report provides a preliminary assessment of the STI policy capacity needs and priorities of African countries. It is based on reviews of reports on national STI policy development activities (for example, proceedings of workshops), reviews of the outcomes of policy development efforts, and interviews with key stakeholders in governments and development partner institutions. A questionnaire framework was designed and sent to ministries or officials responsible for science and technology to collect specific data.

The rest of the report is organised as follows:

- Section 1 starts with a discussion of what constitutes STI policy and why it is important for countries to engage or invest in the formulation and implementation of STI policies. It outlines key STI issues that decision-makers should address in policy development processes. This is followed by an analysis of key features or characteristics of good STI policy development processes as well as the kinds of capacities that countries require in order to manage such processes.
- Section 2 presents the methodology that was used to conduct the assessment. It also outlines

1 www.au.int

2 www.nepad.org

3 www.nepad.org/astii

4 www.aosti.org



the terms of reference for the study.

- Section 3 provides empirical information on STI policy development and governance in Africa, with emphasis on how African countries organise and manage STI policy-making, from agenda-setting to policy implementation. Emphasis is placed on the nature and sources of expertise.
- Section 4 discusses STI policy capacity needs and priorities, including skills and personnel needs, organisational capacity needs, budgetary considerations, infrastructural and information capacity needs, and leadership and contextual issues.
- Section 5 discusses current STI policy capacity-building initiatives in Africa, including short profiles of selected existing institutions and programmes.
- The concluding section makes recommendations with respect to a framework for an AOSTI STI policy capacity-development programme.

2. CONCEPTUAL ISSUES

2.1 What is science, technology and innovation policy?

The concept of ‘STI policy’ has gained considerable currency in the past two decades or so. It has been taken up in the lexicon of government decision-makers, researchers, development partners and development practitioners, yet its meaning is rarely explored. The concept or phrase is increasingly used in the titles and texts of many policy documents and studies, but it seems to mean different things to different people. The concept is thus subject to misuse and abuse. It is vital to establish some measure of conceptual clarity of what constitutes STI policy. Conceptual clarity is crucial for any initiatives that are aimed at building STI policy capacity.

It is important first to define STI before focusing on STI policy. This is because there is a tendency to use the three words in the STI acronym interchangeably, namely, ‘science’, ‘technology’ and ‘innovation’. It is not unusual to come across the term ‘science’ being used to refer to ‘technology’, and vice versa, or ‘innovation’ being used to refer to ‘technology’, and vice versa. Though interrelated, ‘science’, ‘technology’ and ‘innovation’ do not mean the same thing. ‘Science’ is systematic inquiry into nature and natural things. It is about gaining a deeper understanding or knowledge of the world. “Science is a mode of knowledge production.”⁵

‘Technology’ is the application of science to modify natural things. According to Ziman, “technology is science in *application*.”⁶ Most people think of technology only in terms of hardware or artefacts such as computers, but technology is more than tangible products. The processes of developing and using technological artefacts also form part of technology. Often technology is confused with innovation. ‘Innovation’ is the introduction and diffusion of new ideas, processes and ways of doing things into an economy or institution. It also entails the introduction and diffusion of new organisational practices such as improved communication and new marketing techniques. “In an essential sense, innovation concerns the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organisational set-ups.”⁷

There is a large body of academic literature explaining the innovation process. The thinking on innovation has moved away from the conventional linear approach, which associated innovation rigidly with research and development (R&D), based on the assumption that R&D efforts automatically led to innovation.⁸ Innovation is an interactive process in which firms interact among themselves and with other institutions, mainly R&D institutes, customers, businesses and regulatory bodies. The

5 Ziman, J. (2000). *Real Science: What it is, and What it Means*. Cambridge: Cambridge University Press, p. 56. See this book for a detailed discussion of what science is and how it is organised and practised.

6 Ziman, J. (2000). *Real Science: What it is, and What it Means*. Cambridge: Cambridge University Press, p. 14.

7 Dosi, G. (1988). ‘The nature of the innovative process’, in Dosi, G., Freeman, C. et al. (eds.) (1988): *Technical Change and Economic Theory*. London: Pinter Publishers.

8 In Africa, most policies are still influenced by the conventional linear approach to innovation.



actors, their interactions and the overall context in which innovation takes place constitute what is now commonly referred to as ‘systems of innovation’.

Science, technology and innovation are coupled and interrelated. Scientific advances stimulate many contemporary technological developments. For instance, the design of computer chips depends, to a significant extent, on scientific understanding of the electrical properties of materials such as silicon. Technology is also the basis for many of the scientific research activities. For example, meteorologists use supercomputers to run simulations and study climate change. Today, most scientists cannot operate without computers, telephones and the internet.

Then, *what is STI policy?* Generally, it is concerned with the governance of STI. By this we mean decisions and actions that are taken by governments to *promote, regulate and use* scientific advances, technological development and innovation. STI policy is actually a regime or body of many policies. It has two facets:⁹ *policies for science, technology and innovation, and STI for policy*. These facets are not separable and but constitute a useful typology for studying and understanding STI policy-making.

Policies for STI are about actions that governments or decision-makers take in order to promote scientific research, the development of technology, and the diffusion and adoption of technological and organisational innovations. Such measures include the choice of R&D projects, the choice of technology, the allocation of resources for scientific research and technology development, economic and legal incentives for private firms to adopt and use new technologies, regulations on the procurement of new technologies, regulations for research and clinical trials, biosafety, and the protection of intellectual property rights.

Some of the policies for STI are explicit, while others are implicit. Explicit policies are those that are deliberately instituted to promote and/or regulate scientific, technological and innovation activities. Implicit STI policies are those measures or decisions that are taken to address other issues, largely non-STI issues, without having STI promotion and/or regulation as deliberate goals; however, such measures impinge on the conduct and promotion of STI.

STI for policy is when science, technology and innovation are used for policy development. Scientific data or information, information on the nature and impacts of a technology, and data on innovation are used to inform policy-makers with the aim of influencing and enhancing their abilities to make decisions. Science and related technological information are used to determine or influence decision-making in the wider sphere of governance. STI for policy also includes the use of STI to identify and build understanding of problems such as climate change.

2.2 Why STI policy matters?

“State patronage inevitably brings politics into science—and science into politics. The more generous the patronage, the more political activity it entails. Governments nowadays find

9 Stine, D. (2009). Science and Technology Policymaking: A Primer. Washington DC: Congressional Research Service. This CRS report for Congress provides a useful typology of science and technology policy.

themselves allocating very large sums of public money to various bodies for various forms of research. Academic science is just one part of a loosely articulated 'R&D' system, whose activities range from basic science to near-market technological development. This system is too large to be left to its own devices. The emergence of science policy—more generally, science and technology policy—is a major factor in the transition to a new regime for science."¹⁰

In a paper written in 2000, Metcalfe identified *market and systems failures* as the core rationales for STI policy.¹¹ Simply explained, 'market failure' is when the private sector cannot be relied upon to invest in scientific research or knowledge production, and the government therefore intervenes in R&D or knowledge creation and diffusion in general. It is when the 'optimal' level of investment in R&D is not attained, and public resources are used or relied upon to close investment gaps.¹²

The 'system failure' rationale for STI policy is when existing organisations are not configured, or when there are no appropriate organisations to produce scientific knowledge, develop technologies and engage effectively in innovation processes. In such cases, STI policy is needed to address the problems of institutional design and articulation. STI policy also has to focus on such aspects as building marketing and entrepreneurial capabilities within firms and R&D institutions:

"From this system failure perspective, the role of policy in the innovation process is clear. It is the embedded nature of firms in a wider network of knowledge producing organisations which matters. While the market failure perspective focuses on lack of incentives to invest in innovation ..., the system failure perspective points to the creation of opportunities and capabilities in co-operative fashion. Firms remain the key actors in the innovation process but their knowledge generating capabilities are generally enhanced by their being embedded in a wider context of knowledge generating organizations".¹³

There are other reasons why STI policy matters. STI policy is critical for guiding the use of scientific and technical knowledge in the search for solutions to various societal challenges such as climate change and loss of biological diversity. In order to make informed choices about courses of action, or even inaction, policy-makers need to be guided how to solicit and use scientific and technical advice in and for policy-making.

The context and character of STI policy-making are changing rapidly due to forces such as globalisation, rapid scientific and technological development, the emergence and growth of civil society, the increasing role of the private sector in economic governance, and various geopolitical changes. Globalisation and the related regionalisation of economies are changing the locus of STI

¹⁰ Ziman, J. (2000). *Real Science: What it is, and What it Means*. Cambridge: Cambridge University Press, p. 74.

¹¹ Metcalfe, J.S. (2000). *Science, Technology and Innovation Policy in Developing Economies*. Economic and Social Research Council (ESRC) Centre for Research on Innovation and Competition, University of Manchester.

¹² Also see Guena, A. et. al. (eds) (2003). *Science and Innovation: Rethinking the Rationales for Funding and Governance*. Cheltenham, UK: Edward Elgar Publishing, for detailed discussions on market failure and the rationale for public funding of R&D.

¹³ Metcalfe, J.S. (2000). *Science, Technology and Innovation Policy in Developing Economies*. Economic and Social Research Council (ESRC) Centre for Research on Innovation and Competition, University of Manchester, p. 20.



policy-making. STI policy-making is increasingly *becoming regional and international*. This does not mean that national STI policy-making is being displaced. There are STI policy issues that used to be largely or exclusively dealt with at national level that are now being addressed at regional and/or international levels, and there are also issues that continue to be the preoccupation of national STI policy-making.

The opening up and integration of economies—phenomena of globalisation—are also changing the landscape of STI policy-making. Countries or nation-states can no longer formulate and implement STI policies that focus only on domestic economic goals. STI policies have to be based on principles of economic interdependence among countries. This relates to such issues as the protection of intellectual property, foreign direct investment and trade.

Another major change in the context of STI policy-making relates to the increasing participation and influence of non-state actors, particularly civil society and the private sector. Geopolitical changes and political democratisation across the world have opened up public policy-making to greater scrutiny by non-governmental organisations, think tanks, private companies and even development partners. Government departments and/or ministries of science and technology do not have exclusive control of policy processes or even related events, and cannot easily exclude non-state organisations from such processes or events. Non-governmental organisations, the private sector and other non-state actors are increasingly becoming major sources of STI information for policy, and many are actively involved in science for policy as well as in the formulation and implementation of policies for STI. The number of actors with various or diverse vested interests in STI policy-making processes has increased, making the management of the processes more complex. National governments require capacity to engage with non-state actors, including engagement in policy processes.

The participation of the private sector in STI policy-making is more critical today than ever before for a range of reasons. Firstly, the investment by the private sector in R&D in areas such as biomedicine and pharmaceuticals, agriculture, mining and ICT surpasses that of government in many countries of the world, particularly in industrialised and middle-income countries. In South Africa, for example, the private sector accounts for at least 50 per cent of total national expenditure on R&D.¹⁴ The private sector also undertakes in-house R&D and technology development activities as the source or owner of innovations, and holds a large share of the world's patents. The private sector plays an important role in a country's choice of R&D, procurement and diffusion of technologies, and is thus one of the loci of STI policy-making. Governments need to design mechanisms for public–private cooperation or partnerships.

STI policy-making is also becoming increasingly complex and is dependent on access to, and the use of, sophisticated knowledge and empirical data. Expert institutions and individuals thus have to play a greater role than before in policy-making processes. Government departments or ministries require capacity to identify and engage relevant skilled individuals and expert institutions.

¹⁴ Department of Science and Technology, Republic of South Africa (2011), "Enhancing the National System of Innovation to support growth and development: A strategy to increase R&D investment in South Africa", p. 10

STI policy converges with numerous other policies such as those on the environment, agriculture, transport, defence, industry and health. This means that many non-STI institutions have to become involved in policy-making on STI issues, and STI policy institutions have to be involved in a wide range of other policy regimes. This makes STI policy-making even more complex.

2.3 Capacity for STI policy-making

The creation and use of policy capacity are critical to a country's ability to govern STI, particularly during these times of rapid scientific advances and technological development. Governments require the capacity to anticipate changes and adjust their STI policies accordingly, and to use science and technology for better decision-making. Capacity is also required to adjust implicit policies in the face of advances in science and technology.

What constitutes capacity for STI policy-making? It is advisable to begin understanding what 'capacity' means, because the concept or term is used so often that its precise meaning tends to be taken for granted. Sometimes people use the term 'capacity' interchangeably with 'capability', but these two concepts do not mean the same thing. 'Capacity' is the ability of an individual, institution, country and/or society as a whole to identify and solve a problem or problems, while 'capability' is just the existence of potential. Capacity is when the potential—capability—is harnessed and used to formulate, evaluate, monitor and implement STI policy. It involves identifying real socio-economic, environmental and other problems and then structuring them into 'policy problems', or defining their policy underpinnings. This involves research and analysis of the causes of real-world problems and the identification of options to address those problems. STI policy capacity also entails the ability to organise and manage processes of decision-making on STI issues and the use of STI for public policy.

STI policy capacity has three interrelated components: skills, institutions and overall socio-economic and economic context. Skills, as the first component, are embodied in people who are trained and experienced, and who are used to conduct STI policy research and analysis, and to organise and manage policy-making processes. Such skills are multidisciplinary and generally require adequate conceptual understanding of STI and related broader issues of development.

Institutions, as the second component, are critical elements or components of STI policy capacity. They are the main vehicles for mobilising, creating, nurturing and using skills or expertise for STI policy research and analysis. Institutions are used to design and manage STI policy processes, including the formulation, monitoring, evaluation and implementation of specific policies. They possess, or are expected to possess, such infrastructure as funds and libraries. Institutions are the legitimate loci of STI policy-making. Individuals cannot in their personal capacities claim authority for national STI policy-making. It is not the mere existence of the agencies or organisations that constitute the institutional component of capacity that is important, but the way in which each of the agencies or organisations is configured within a country to create the necessary space for the creation,



mobilisation and utilisation of skills and other resources. Intra-institutional or agency articulation is, thus, an important factor to consider in the assessment of STI policy capacity.

The third component of STI policy capacity is the overall context in which the skills and institutions evolve and are utilised. The context comprises the overall economic, political and socio-cultural conditions, the national physical infrastructure, inter-institutional and inter-organisational articulation (how and whether institutions or agencies in a country communicate), the nature and adequacy of other policy regimes (non-STI policies, legislation and administrative measures), the way in which these policy regimes are implemented, and whether they are enforced on the basis of agreed or set benchmarks.

Building STI policy capacity involves creating, mobilising, utilising, enhancing or upgrading, and converting skills and expertise, institutions and contexts. Skills are mobilised in various ways, including networking among individuals, and can be enhanced through training. Institutional strengthening involves providing organisations with more resources—human, financial and infrastructural. It also entails giving organisations increased authority and autonomy to experiment and function. In the case of STI policy institutions, this might entail enhancing an organisation's legislative powers to conduct research, and to coordinate and convene policy-making processes.

STI policy-making is multidisciplinary in nature. That is, it requires the convergence of expertise or skills from a wide range of natural, physical and social sciences. It is not the preserve of one profession or group of professionals. STI policy-making depends on engineers, lawyers, economists, biologists, political scientists, sociologists and other professional groups. However, nowadays people may be trained in policy sciences, and some may specialise in STI policy. People trained in STI policy are expected to appreciate the multidisciplinary nature of policy-making and to have the capacity to mobilise the diversity of expertise and disciplines to participate in policy processes.

3. METHODOLOGY

This assessment of Africa's STI policy capacity needs and priorities was conducted largely by using secondary, published material, reports of governments, development partners' agencies and recent studies on STI in Africa. A short questionnaire was developed and administered to collect data and information from government departments. Telephone and e-mail interviews were conducted. In eastern and southern Africa, officials from Botswana, Burundi, Kenya, Rwanda, Mozambique, Uganda, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe were interviewed. For West, Central and North Africa, a questionnaire was distributed to relevant departments or ministries responsible for STI.



4. OVERVIEW OF STI POLICY-MAKING IN AFRICA¹⁵

4.1 Historical antecedents

STI policy-making in Africa has its roots in the colonial era. In many African countries, colonialists instituted various institutions for STI policy-making. STI policy-making was largely linked to changes or reforms taking place in specific sectors such as agriculture and mining. There were no coherent STI policy regimes or comprehensive policy documents. In many cases, STI policies were formulated for the colonies from the colonists' home countries. Agricultural R&D policies in British colonies were largely extensions of Britain's own policies. The colonies did not have institutions dedicated to STI policy. There were no ministries of science and technology. STI policy-making was scattered across the institutional terrain. The emphasis was generally on policies for R&D and agricultural technology diffusion.

Public policy-making during the colonial period was highly centralised and sectorial. Local participation and input were limited. There were no local African institutions engaged in research to generate evidence for policy. Colonial governments often used the police and administrative officers to gather information on and evidence from local situations. Policy-making was confused with public administration.¹⁶

Africa's STI policy-making has a pronounced colonial legacy. Most countries have kept the structures of, and approaches to, policy-making that they inherited from the colonial era. Although things are beginning to change, it is taking a long time for many African countries to modernise their policies and policy-making systems, possibly due to the overall political and economic governance in the countries. Many African countries do not have organised processes and institutions for STI policy-making. STI policy is generally not treated as part of overall national economic and political governance.

The first major attempts at formulating explicit science and technology (S&T) policies in post-colonial Africa can be traced to the 1970s and 1980s. These were largely efforts by UNESCO to assist some sub-Saharan African countries to put in place S&T policies and related institutions for policy formulation and implementation. UNESCO assisted some countries, including Ethiopia, Kenya, Uganda, Tanzania, Zambia, Malawi, Zimbabwe, Nigeria, Ghana and many others, to formulate S&T policies. In many cases, policy instruments took the form of legislation—science and technology acts

¹⁵ This section is based on Mugabe, J. (forthcoming). *Science, Technology and Innovation Policy-Making in Africa: Institutions, Practices and Experiences*.

¹⁶ Steedman, D.W. (1991). 'The internalization of the policymaking process', in *The Long-Term Perspective of Sub-Saharan Africa*, Vol. 2. Washington, DC: World Bank.

of parliament.

Related to S&T legislation, UNESCO supported the countries to establish institutions for S&T policy. In Kenya, Uganda, Zambia and Tanzania, commissions or councils were established. UNESCO also encouraged countries to create ministries of science and technology, and in some countries ministries of education, science and technology were created. The first drawback was that these efforts focused largely on R&D and technology development, with hardly any emphasis on innovation and innovation policies. Secondly, most of the S&T policies and related legislation that were put in place focused more on the structural than on the programmatic aspects of STI policy formulation and implementation. Structures for S&T policy were established, but they generally did not have programmes in place or a clear focus on STI policy processes. Indeed, efforts during the 1970s and 1980s generated agencies, many of which are statements of intent and of the aspiration to embrace science and technology. What they left behind are institutional structures with cognition of bygone times that are incapable of responding to the emerging global political economy and associated technological advances. Moreover, these policies are divorced from the poverty-eradication agendas and developing economy policies of many of the countries.

The past decade has witnessed growing attention in many African countries to formulating and/or reviewing their S&T policies. Some of the countries that do not have explicit innovation policy instruments have embarked on developing such regimes. In their efforts to review, reform or formulate STI policies, African governments are discovering that expertise for STI policy is in very short supply in Africa. Most of the countries do not have expertise and programmes for STI policy research and related capacity-building programmes.

On the whole, African countries have differentiated STI policy needs and capacities. It is thus crucial that any capacity-building programme be based on a clear understanding of the STI needs of the continent as a whole, as well as the particular needs of individual countries or groups of countries. Capacity-building programmes should also take an anticipatory approach by having a clear focus on future STI policy issues that the countries are likely to confront.

4.2 Design and governance of STI policy-making

Although African countries have different economic and political histories as well as different public policy-making systems, there are many similarities in their approaches to STI policy. Firstly, most of the countries do not have well-established and dynamic STI policy processes. STI policy formulation is organised through isolated events characterised by discontinuity. Policy gestation, which refers to the period from the time when a government sets out to review and/or formulate policy to when a policy is adopted, is relatively long in most African countries. Moreover, STI policy-making tends to be isolated from economic, social, technological, political and environmental issues, or these issues are considered separately at different times.



Public awareness of STI issues and related national policy-making agendas and events is very low. In some countries, departments of science and technology initiate and complete STI policy-formulation without any public engagement or even media attention or reference. They are not participatory and do not engage with stakeholders. The interests and technological needs of rural populations are rarely taken into account properly in technology policy-making. In fact, it is difficult to determine the central locus of technology policy formulation in most African countries. The existence of institutes, departments or ministries of science and technology does not necessarily show where the policies are formulated and implemented. On the whole, the STI policies of many African countries lack public ownership.

Most African countries do not have explicit innovation policies. They still focus on S&T policies, which are often narrowly defined around R&D funding and the setting of scientific research priorities. While the term or concept of 'innovation' is used increasingly in policy statements in many places, there is little evidence of innovation policy measures being instituted or promoted. This is probably because there is limited conceptual understanding of what constitutes innovation and the kinds of policy measures that countries need to use in order to promote both technological and institutional innovation.¹⁷

There has also been concern that many of the S&T policies, particularly those for R&D, tend to be imposed on African governments by international development partners and institutions. This is mainly because many African governments are not adequately prepared or resourced to set the agenda for STI policy processes. They are also not well resourced to manage the processes. There is overreliance on external funding that often comes with consultants. The limited participation in policy processes may generate resentment towards STI policies and their implementation.

Concern regarding African ownership of public policy is not peculiar to STI issues or the STI policy domain as a whole. In a study of public policy-making in sub-Saharan Africa, Steedman (1990) observed that: "Policies have often been imposed by development partners with the leverage accorded by a crisis; given a lack of economic data and analysis within government, development partners have at times been forced to make rapid appraisals and to suggest measures on the basis of their own understanding of the situation. In many cases, such policies risk having little chance of success over the long run, based as they are on analyses carried out by foreign agencies with little local involvement in their production or commitment to their implementation."¹⁸

One of the reasons why the gestation period for policy is so long is the absence of endogenous capacity within institutions and countries to manage policy processes. In many countries, ministries of science and technology lack capacity (including human resources, finances, physical infrastructure and organisational arrangements) to set STI policy agendas, procure evidence, and engage with

17 Mugabe, J. (2009). *Knowledge and Innovation for Africa's Development: Priorities, Policies and Programmes*. A study prepared for the World Bank Institute, Washington, DC.

18 Steedman, D.W. (1991). 'The internalization of the policymaking process', in *The Long-Term Perspective of Sub-Saharan Africa*, Vol. 2. Washington, DC: World Bank, p. 6.

various stakeholders, including other government ministries.

4.3 Sources of expertise and policy ideas

African governments depend on a very narrow range of sources of STI policy expertise, information and advice. They often depend on consultants, who often accompany donor funding for short-term STI policy projects. There are few independent or non-governmental institutions for STI policy in Africa. Those that do exist include the African Technology Policy Studies Network (ATPS), which has created national chapters in at least 15 African countries and networked with some of the leading researchers in STI policy. The ATPS and the very few other STI networks that exist in Africa are not adequately endowed to conduct serious policy research and analysis comparable with institutions with similar remits in the USA, Europe and Asia. Africa does not have strong institutions that generate empirical evidence for STI policy-making.

UNESCO is instrumental in providing policy expertise to African governments to review and/or reform their STI policy regimes. UNESCO hires international consultants and makes their expertise available to governments, and has supported Namibia, Malawi, Swaziland and Lesotho in reviewing their STI policies. The World Bank has also been a source of expertise and has been assisted by external expertise for STI review processes in Mozambique, Uganda and Rwanda.

On the whole, most African governments rely on external consultants for STI policy review and analysis. There is limited policy analysis capacity or capability within ministries of science and technology. This may account for the slow pace of STI policy development. Indeed, progress in STI policy-making in Africa countries has been rather modest and has not kept pace with other areas of social, political, technological and economic change. Most African countries lack the institutional infrastructure and expertise required for policy-making on R&D, for technology transfer and innovation, and for building consensus among experts, decision-makers and members of the research community on R&D and innovation policy issues. In order to accelerate STI policy formulation and implementation, there is a need to invest in the training and re-training of policy-makers, particularly the middle cadre in the civil service or government.



5. STI POLICY CAPACITY NEEDS AND PRIORITIES

5.1 Overview of capacity needs and priorities

This study has been undertaken to provide an indicative assessment of the nature of the capacity needs of African countries. It is not a comprehensive or in-depth survey of specific needs in quantitative terms. The study identifies skills sets or areas, and the kinds of institutional capacities that African governments require in order to effectively manage STI policy-making.

The first capacity challenge that many African governments face is the *lack of information on available expertise*. There are no databases of experts on STI policy. It is not easy to know what STI policy analysis expertise is available in each country's institutions or in regional research organisations. This makes it difficult for government officials to procure expertise for policy analysis and review. In this situation, addressing the need for capacity building would entail identifying, profiling and mobilising the available expertise. Networks such as the ATPS can be used to identify and mobilise the available STI policy expertise for easy access and use by African governments.

The second capacity need relates to limited awareness, or sometimes a lack of awareness altogether, among policy-makers of new and emerging STI issues. Many policy-makers and technical staff in ministries or departments of science and technology in most African countries do not keep abreast of, or informed about, new and emerging issues in STI policy. They are generally not conversant with concepts such as innovation, technical change or public policy, and have limited awareness of issues related to intellectual property protection, technology prospecting, the role of foreign direct investment in building national technological capabilities, technological catch-up and leapfrogging, and many others.

The third capacity need is for skills and experience in STI policy analysis. Most African ministries and/or departments responsible for STI policy-making are not staffed with relevant research and analytical skills. In most African countries, STI policy analysis expertise is not well recognised and sought after, in that ministries and/or departments do not invest in training, or support training, in STI policy. Many of the officials involved in or responsible for drafting policy documents are not well versed or trained in STI policies and have no experience in evidence-based policy making.

Institutional infrastructure for STI policy research, analysis and public policy-making is generally weak in most countries. African ministries and/or departments of science and technology, as well as other departments such as trade and industry involved in STI policy-making, lack capacity in terms of informational resource needs. They do not have libraries of STI policy material, or access to such

libraries. In many ministries and departments, officials do not have access to the latest relevant information on STI-related issues or policy.

Ministries and departments responsible for STI policy tend to operate in isolation from the other policy agencies of government and have weak links to academic institutions and the private sector. They are also not linked to international think tanks in policy research, not even to the few African think tanks that exist. As such, they are not able to easily access empirical material and ideas for STI policy-making.

5.2 Skills and personnel needs

To get an indicative assessment of the skills needs of African countries, three related questions were posed to the interviewees:

- Does your country have individuals who are trained in STI policy analysis?
- Does your ministry or department have an adequate number of staff or personnel involved in STI policy analysis and formulation?
- What are the specific skills or personnel development priorities of your country and/or ministry?

These questions were answered by 22 officials from 18 countries. The following table synthesises the empirical information obtained from the interviews.

Country	Does your country have individuals who are trained in STI policy analysis?	Does your ministry or department have an adequate number of staff or personnel involved in STI policy analysis and formulation?	What are the specific skills or personnel development priorities of your country and/or ministry?
Botswana	No information on STI policy expertise in the country.	No in-house STI policy research expertise in the Ministry of Infrastructure, Science and Technology.	No clear assessment of skills needs, but the Ministry of Infrastructure, Science and Technology is encouraging personnel to go for training in South Africa, the USA and Europe.
Burkina Faso	No information on STI policy expertise in the country.	No in-house expertise in STI policy analysis.	Not determined.
Burundi	No information on STI policy expertise in the country.	The Ministry of Higher Education and Scientific Research is new and understaffed. No skilled people in the STI directorate.	Not determined.
Egypt	Yes, there are individuals trained in STI policy analysis	There is expertise in STI policy analysis	Not determined



Country	Does your country have individuals who are trained in STI policy analysis?	Does your ministry or department have an adequate number of staff or personnel involved in STI policy analysis and formulation?	What are the specific skills or personnel development priorities of your country and/or ministry?
Gabon	Some academics have skills in STI policy analysis.	No STI policy researchers and analysts in the Ministry of National Education, Higher Education, Technical Training and Scientific Research.	Not determined
Kenya	Yes. There are in some institutes such as the African Centre for Technology Studies (ACTS), ATPS, University of Nairobi, and the Ministry of Higher Education, Science and Technology (MHEST).	No STI policy research and analysis being done in the MHEST, but there have been a number of relevant studies by universities, ATPS, ACTS, UNESCO and the United Nations Conference on Trade and Development (UNCTAD)	Not determined
Niger	No information on STI policy expertise in the country.	No in-house expertise in STI policy analysis.	
Nigeria	The country has citizens who are trained and experienced in STI policy research and analysis. Most of these are at national universities and in research bodies such as the Nigerian Chapter of the ATPS.	The Federal Ministry of Science and Technology (FMST) does not have adequate in-house staff trained in STI policy analysis, but relies on experts from universities, the ATPS and other institutions for STI policy advice.	Specific STI policy capacity needs include training in STI policy analysis, technology planning, STI statistics, and data analysis and policy research on new and emerging technologies.
Tunisia	Not enough	Not enough	Priorities are not defined but STI capacity building is much needed
Republic of Congo	No information on STI policy expertise in the country.	No in-house expertise in STI policy analysis.	Not determined.
Rwanda	No information on STI policy expertise in the country.	No STI research and analysis in the Directorate of Science, Technology and Innovation in the Ministry of Education.	Not determined.
Senegal	There are individuals at the Senegalese Academy of Science and the universities who are trained and experienced in STI policy analysis.	No policy research and analysis in the Ministry of Higher Education and Research, and few staff engaged with STI policy.	The priorities are training in STI data collection, and the development of STI policy documents and action plans.

Country	Does your country have individuals who are trained in STI policy analysis?	Does your ministry or department have an adequate number of staff or personnel involved in STI policy analysis and formulation?	What are the specific skills or personnel development priorities of your country and/or ministry?
South Africa	There are a growing number of individuals trained in and/or working on STI policy issues at universities (Witwatersrand, Cape Town, Pretoria, Tshwane and Stellenbosch), the Human Sciences Research Council (HSRC) and other research institutes.	Some of the universities and the HSRC conduct STI policy research. The National Advisory Council on Innovation (NACI) commissions studies on STI. The Department of Science and Technology (DST) also commissions consultants to conduct policy analysis on specific issues.	Although the specific STI policy capacity needs have not really been determined, the DST is funding some of its staff to do masters and PhD degrees in STI policy.
Swaziland	No information on STI policy expertise in the country.	No analysis and research on STI issues is being conducted by national institutions.	Not determined.
Tanzania	There are individuals trained in STI policy based at the University of Dar es Salaam and some NGOs.	The government relies on academics at national universities, consultants and researchers from NGOs to undertake policy analysis. No institutionalised STI policy research and analysis within government.	Not determined.
The Gambia	No information on STI policy expertise in the country.	No in-house expertise in STI policy analysis.	Not determined.
Uganda	Some of the staff of the National Council for Science and Technology have attended short courses on STI policy. There may be academics who are specialised in STI policy.	No STI policy research and analysis is being done in the National Council for Science and Technology, but there have been a number of relevant studies by universities, UNCTAD and the World Bank.	Not determined.
Zambia	No information on STI policy expertise in the country.	No analysis and research on STI issues.	Not determined.
Zimbabwe	It was not possible to determine whether the Ministry of Science and Technology has personnel trained in STI policy analysis. However, there are individuals in the country's universities with experience in STI policy.	The Ministry of Science and Technology does not have adequate in-house skilled staff to conduct STI policy analysis.	Not determined.



5.3 Organisational capacity needs

In the face-to-face and email interviews conducted in South Africa, Botswana, Rwanda, Uganda, Senegal and Kenya, interviewees were asked:

- What are the main national institutions responsible for STI policy formulation?
- Is there a central department or ministry that coordinates STI policy activities in the country?
- How well are STI policy activities coordinated in your country, or what are the challenges to coordinating STI policy activities in your country?
- What are the specific capacity needs to improve the coordination of STI policy formulation and implementation in your country?

In the six countries, there are departments, councils or even full ministries specifically established for STI policy formulation and implementation activities. However, there are other departments or ministries that are also engaged in various aspects of STI policy formulation and implementation. In South Africa, the DST is the government's main agency for STI policy activities. It is supposed to provide overall leadership for STI policy formulation and implementation. The DST is also expected to coordinate STI policy activities in the country. Key departments engaged in STI policy activities include the departments of Trade and Industry (the dti), Health (DoH), Agriculture, Forestry and Fisheries (DAFF), Environmental Affairs (DEA), Water Affairs (DWA) and Mineral Resources (DMR). These departments spearhead STI policies that focus on sectorial issues, while the DST is responsible for the overall STI policy regime or framework. However, the DST has not demonstrated its capacity to coordinate STI policy activities across sectors. There is limited organisational coordination for STI policy-making in the country.

A recent ministerial review of South Africa's institutional landscape for STI concluded that the country lacks a coherent organisational set-up to formulate and implement policies for growing a dynamic national system of innovation. The review notes: "South Africa has achieved only very limited horizontal and vertical coherence and integration of purpose and effort between the various agencies of the NSI."¹⁹ Other reviews (for example, OECD 2007²⁰) have also identified the weak coordination of agencies and STI policy activities as a major barrier to the development of research and innovation systems in South Africa.

The challenges of ensuring the coordination of STI policy activities are also experienced by Botswana, Rwanda, Uganda, Senegal and Kenya.²¹ As in South Africa, there are multiple loci of STI policy activities, and agencies for coordinating the activities have not been particularly successful, or lack organisational capacity. In the case of Kenya, the locus for coordinating STI policy formulation and implementation is diffused between the National Council for Science and Technology (NCST),

¹⁹ DST (2012), Report of the Ministerial Review Committee on South Africa's National System of Innovation. Department of Science and Technology, South Africa.

²⁰ OECD (Organisation for Economic Cooperation and Development) (2007). OECD Review of Innovation Policy: South Africa 2007. Paris: OECD.

²¹ For a detailed discussion of institutional challenges to STI policy formulation and implementation, see Mugabe, J. (forthcoming). Science, Technology and Innovation Policy-Making in Africa: Institutions, Practices and Experiences.

a statutory body established by legislation, and the Ministry of Higher Education, Science and Technology (MHEST). According to one interviewee, “the slow pace of adopting a new STI policy and enacting the National Science, Technology and Innovation Bill is a manifestation of turf wars between the NCST and the Ministry. The Bill has been in preparation for many years. There is some resistance to getting it enacted into law, because it seeks to create an independent commission for S&T outside the Ministry.”

The government of Rwanda has launched a process of reviewing its research and innovation system, including institutional arrangements for STI policy formulation and implementation. The review was conducted by a consultant supported by UNESCO between June and October 2012. It seeks to identify ways of strengthening organisational capacities and institutional arrangements for R&D and STI policy in the country.

5.4 Budgetary considerations

To determine whether the countries allocate resources to STI policy activities, interviewees were asked: “Is there a specific budget dedicated for STI policy formulation in your country?” Most of the interviewees noted that their countries do not have dedicated budgets for STI policy activities. They stated that funding for STI policy events and processes, such as workshops and assessment of national S&T systems, is often from external development partners with minimal financial inputs from national governments. Nigeria and South Africa were reported to have budgets for STI policy activities, including policy formulation and implementation. Nigeria has an annual budget of about US\$500,000 dedicated to STI policy. It was not possible to establish the exact budgetary allocation to STI policy activities in South Africa, although substantial funds are channelled through the National Advisory Council on Innovation (NACI), the Academy of Science of South Africa (ASSAf), the Human Sciences Research Council (HSRC) and other policy research institutes.

5.5 Infrastructural and information capacity needs

To determine some of the infrastructural and informational capacity needs of the countries, interviewees were asked the following two questions:

- Does your institution or your country’s STI ministry or department have a library or access to documents on STI policy?
- What are the specific infrastructure needs of your country to effectively engage with STI policy formulation, implementation, monitoring and evaluation?

Interviewees from only two of the 20 countries that participated in this assessment, namely Nigeria and South Africa, noted that their countries have libraries with documentation on STI policy issues. Interviewees from Kenya noted that the NCST and the MHEST have resource centres or libraries on general development issues, without a specific focus on STI policy. The other countries do not have libraries or resource centres with STI policy literature or documentation. However, some of the



interviewees noted that with improved ICT infrastructure, particularly access to the internet, they are able to access STI policy literature from websites of institutions such as UNESCO.

Regarding information needs, several interviewees identified the need for guidelines on innovation and innovation policy as a major priority. They noted that, unlike the situation with respect to R&D, they do not have guidelines and tools to determine innovation activities and design appropriate policy measures. One interviewee from South Africa stated that while he has access to considerable literature on innovation, innovation systems and innovation policy, he is not really able to use it to propose a clear national innovation policy for his country.

Inadequate information on, and limited understanding of, innovation are common capacity challenges for most African countries. The South African Ministerial Review Committee on the National System of Innovation concluded that the concepts of innovation and innovation systems are not well understood by policy-makers in the country: “The concept of a national system of innovation has as yet gained limited currency, both in the extent to which it is understood as something wider than traditional R&D activities, and in the extent to which it has been fully absorbed into the strategies of key actors ... there is far less understanding of the notion of innovation—in all its dimensions, including technical, economic and social.”²²

A review of the STI policy documents of most African countries shows that the countries do not have a clear understanding of what constitutes ‘innovation’ and ‘national systems of innovation’. There is a tendency to equate innovation with, or reduce it to, R&D, and to treat national systems of innovation simply as comprising R&D institutes and related funding mechanisms. For example, South Africa’s Ten-Year Innovation Plan, adopted in 2007/08, does not define what the government considers to be innovation. The basis for the Plan is the country’s challenge to turn the outputs of R&D into products, processes and services, but the Plan still focuses largely on measures for increasing scientific outputs. It does not make an explicit transition to innovation policies. This is precisely the point made in the recent report of the Ministerial Review Committee.

Kenya’s Science, Technology and Innovation Policy and Strategy (2008)²³ define innovation as “the practical application of creative ideas, which in many cases involves introduction of inventions into the marketplace. Two fundamental types of innovation are product and process innovation. Process innovations are changes that affect the methods of producing outputs. Product innovations are changes in actual outputs of the organisation. Competitive companies have to continually innovate to improve products and production processes.” It also defines a national innovation system in the following way: “the national system of innovation can be thought of as a set of functioning institutions, organisations and policies, which interact constructively in the pursuit of a common set of social and economic goals and objectives.” While the document lays out a clear conceptual framework for innovation policy, it is weak on specific innovation policy measures and ways of building a

²² Republic of South Africa, Department of Science and Technology (DST) (2012). Final Report of the Ministerial Review Committee on the Science, Technology and Innovation Landscape in South Africa. Pretoria: DST.

²³ Republic of Kenya, Ministry of Science and Technology. (2008). Science, Technology and Innovation Policy and Strategy. Nairobi: Republic of Kenya Ministry of Science and Technology

national innovation system. The Science, Technology and Innovation Policy and Strategy also places considerable emphasis on creating funding instruments, and pays less attention to specific ways of building institutions for technological innovation.

5.6 Leadership and contextual issues

Effective STI policy formulation and implementation depend on the executive and political leadership of countries. Each country requires leadership—at presidential, ministerial, parliamentary, political party and civil society levels—in order to organise and engage in STI policy processes. In most African countries, STI policy activities have been left to ministries or departments of science and technology, without having permanent secretaries as the main champions and leaders. In most African countries, national presidents and/or prime ministers have not been at the forefront of promoting STI policy formulation and implementation. We asked interviewees the following question: “Is your country’s presidency involved in promoting STI policy formulation and implementation?”

In Nigeria, the presidency has been directly involved in the recent national effort to review the old S&T policy and to design a modern STI policy. The president of Nigeria is actively engaged in chairing the National Research and Innovation Council (NRIC), which is a policy-making body. In Egypt, with the new presidency there is a presidential committee following continuously the S&T Policy. However, in most of the other countries that participated in this assessment, presidents and prime ministers seem to focus on supporting STI research and infrastructure projects, without actually engaging in overall STI policy processes. For example, in the Gambia the president is promoting the establishment of a national science park and a science academy. There are similar presidential initiatives in Uganda, Senegal, Niger and the Republic of Congo.

Parliamentary committees are important institutions for STI policy formulation and implementation. They play a critical role in agenda-setting, and policy formulation, implementation, monitoring and evaluation. Most African countries have parliamentary committees for STI. While some countries have parliamentary committees specifically dedicated to STI, many have integrated STI into portfolio committees for agriculture, health and the environment. Uganda, South Africa and Nigeria have parliamentary committees that are dedicated to STI. Uganda’s Parliamentary Standing Committee on Science and Technology is established under Article 90(2) of the Constitution of the Republic of Uganda and Rule No. 158(1) of the Rules of Procedure of the National Assembly. The committee has been active in reviewing the country’s S&T policies and designing a new STI policy regime.

South Africa’s national parliament has the Portfolio Committee on Science and Technology, established under Section 55(2) of the Constitution of the country. The portfolio committee has been actively involved in determining the budget of the Department of Science and Technology (DST), and was instrumental in the passing of legislation for the establishment of the Technology Innovation Agency (TIA), as well as laws on intellectual property protection. The DST involved the portfolio committee in designing the country’s Ten-Year Innovation Plan (2008–2018).



Kenya has a Parliamentary Committee on Education, Science and Technology that deals with STI policy issues. The parliamentary committee is actively involved in sectorial areas or issues of STI policy, such as the development of biosafety legislation. It lobbied the Ministry of Finance to establish an Endowment Fund for Innovation and Research in the 2007/08 fiscal budget. About US\$2.5 million was allocated to the fund.

In Egypt, both the 'Shoura' (lower parliament) and the House (parliament) have permanent parliamentary committees that cover Education, Science and Technology and oversight all the related activities.

Parliamentary committees on STI need to be strengthened to enable them to become actively engaged in STI policy activities. In most African countries, parliamentary committees do not research capacity or support for policy analysis, lack specific programmes and tend to work on an ad hoc basis, and do not have dedicated budgets, and many of their members do not have adequate understanding of the wide range of STI policy issues that the committees are expected to address.

Civil society organisations and think tanks for STI policy are nascent or almost non-existent in most African countries. Although there are civil society organisations (CSOs) that focus on sectorial STI policy issues such as biosafety, climate change, biodiversity and other aspects of environmental regulation, these institutions do not focus on or participate in the development of national STI policy regimes. For this assessment, we asked some of the interviewees to identify and list CSOs and think tanks that work on STI policy. The following think tanks were identified: the African Technology Policy Studies Network (ATPS) in Swaziland, Nigeria, Kenya, Tanzania and Uganda; the African Centre for Technology Studies (ACTS), the Advocates Coalition for Development and Environment (ACODE) in Uganda, the Misr El Kheir Foundation (MEK), an NGO in Egypt and the African Academy of Sciences (AAS). The Senegalese Academy of Science, the Kenyan National Academy of Science, the Ugandan Academy of Science, and the Academy of Science of South Africa were also identified as key players in national STI policy activities.

5.7 Synthesis of STI policy capacity priorities

To determine STI policy capacity priorities, interviewees were asked the following question: "What specific aspects of STI policy capacity building should AOSTI focus on in its programme of work?" The responses to the question can be clustered into three broad areas:

- Building, mobilising and making available expertise for STI policy formulation;
- Supporting countries to build infrastructure for STI data or statistics collection and use; and
- Supporting countries to build programmes for STI policy analysis and providing information to parliamentarians, decision-makers and civil society organisations.

All interviewees identified the training of government officials in ministries or departments of STI as a priority for building countries' capacity to engage in policy formulation and implementation. Of the 18 countries in which interviews were done, only Nigeria has a national STI policy training

programme. The Federal Ministry of Science and Technology (FMST) established the National Centre for Technology Management (NACETEM) to conduct research and training on STI policy issues. NACETEM collaborates with other national and international institutions, such as the African Institute for Science Policy and Innovation (AISPI) and the Nigerian Institute for Social and Economic Research (NISER) to develop and offer diploma and certificate training courses in technology policy.

Some African countries have individuals who are trained and/or experienced in STI policy research and analysis. These individuals are based at universities, policy research institutes, United Nations agencies and NGOs on the continent and abroad. In most African countries, departments or ministries do not know where the pool of expertise in STI policy resides, because there is no database of STI policy expertise. There is limited capacity to identify and access the expertise.

The need to build infrastructural capacity for STI data or statistics is also identified as one of the priorities that AOSTI should focus on. All the interviewees except those in South Africa identified STI data infrastructure as a priority. More specifically, the interviewees recommended that AOSTI should have a programme for supporting countries to build their capacity to collect and use STI statistics, including training government officials in good practice with respect to conducting STI surveys.

To build a broad-based constituency for STI policy activities and in particular the development of STI policy regimes, it is important to have programmes that raise the awareness of politicians and the public in general of the importance of having a national STI policy framework or regime. According to one interviewee from Botswana, “it is only when politicians and civil society in the country start to demand policies that promote research and innovation that we can get budgets for STI policy development and implementation.” In most countries, there is either weak and limited public demand for STI policy, or poor public articulation of demand for STI policy regimes.

STI policy formulation and implementation require financial resources. Indeed, no country can effectively manage STI policy activities without dedicated resources. Most African countries are unable to launch and manage STI policy processes, because they do not have dedicated budgets for such processes. Many of these countries rely on funding from external development partners to initiate activities for policy formulation. Often the STI policy processes are designed as short-term projects around the available funding levels. The main activities tend to be focused on the production of general reports on national S&T status, workshops to discuss these status reports, and the production of draft policy documents, which are often prepared by foreign consultants. The lack of domestic budgets for STI policy activities, including research and analysis, is often the reason for the long gestation periods for policy development, characterised by low levels of local input to policy activities and high levels of discontinuity.



6. CURRENT STI POLICY CAPACITY-BUILDING INITIATIVES IN AFRICA

6.1 University-based STI policy capacity building

There are a number of STI policy research and training activities in a few African universities and research institutes. However, there is no pan-African programme for STI policy capacity development. Some universities offer academic courses that cover issues of STI. Such academic courses are largely found in South African universities. For example, the University of the Witwatersrand in South Africa has STI policy-related courses covering health innovation, ICT and environmental policy. It also offers a Masters of Management in Public Policy. The Centre of Entrepreneurship and the Wits Business School, both at the University of the Witwatersrand, provide graduate training in entrepreneurship relevant to innovation policy and training in the strategic management of innovation.

The University of Pretoria in South Africa has the Graduate School of Technology Management (GSTM) and the Institute for Technological Innovation (ITI). The GSTM offers masters and PhD degree courses in technology risk management, technology forecasting and mapping, technological entrepreneurship, and project development and management. The courses are largely academic rather than policy focused. The ITI is mainly a research institute focusing on developing STI indicators.

Stellenbosch University in South Africa has the Centre for Research in Education, Science and Technology (CREST), which specialises in the sociology of science, bibliometrics, and R&D surveys. CREST has been instrumental in conducting S&T surveys for UNESCO and a number of other organisations. It also provides PhD research training in S&T policy studies.

6.2 Regional and international STI policy training programmes

There are a number of regional or Africa-based and international programmes for STI policy training. Regional programmes include the African Centre for Technology Studies (ACTS) Science and Technology Policy Institute and the course on STI policy, sponsored by UNESCO and the Southern African Development Community (SADC), to be offered by Tshwane University of Technology. The ACTS Science and Technology Policy Institute has offered courses that have focused mainly on technology and environmental policy. The courses covered areas such as biotechnology, biodiversity and health innovation policy. It has placed less emphasis on the theoretical and conceptual aspects of STI policy and policy-making.

The UNESCO-SADC STI policy training programme was launched in 2012. It is designed in

collaboration with the UK-based Manchester Business School. The focus of the programme is the review of existing S&T policy; analysis of S&T institutional strengths and weaknesses; analysis of international opportunities and threats; national innovation systems; policy consensus-building; policy formulation and implementation; policy research and international benchmarking, as well as international networking in S&T; policy sustainability and case studies; and international country comparisons in the field of S&T policy development.

Another STI policy capacity-building initiative is NEPAD's African Science, Technology and Innovation Indicators (ASTII).²⁴ ASTII was launched in 2007 to support African countries to build capacity to collect and use STI statistics for policy-making. The programme has organised and provided training to at least 50 government officials on various aspects of STI surveys and indicators.

The African Technology Policy Studies Network (ATPS) has activities that support independent African researchers to conduct studies on various aspects of STI. It has a network of researchers in 27 African countries. The ATPS has also organised activities and events to raise policy-makers' awareness and understanding of STI issues pertaining to health, water and climate change. In collaboration with UNESCO, the ATPS organised a training workshop on STI policy-making in 2011. The workshop focused on methodological approaches to STI policy review and formulation.

There are many international programmes to build capacity for STI policy that are relevant to the needs of African countries. It is not possible to profile all of them in a report such as this. The international initiatives are not academic programmes but are directly relevant to the needs of African policy-makers. They include Harvard University's Executive Programme on Science and Technology, Manchester University's Institute of Innovation Research²⁵ short courses on STI policy, and the UNU-MERIT programme on Design and Evaluation of Innovation Policy in Developing Countries (DEIP).

Harvard University's executive programme on STI policy is intended for high-level officials from government, academia, industry and civil society from developing countries. It focuses on the integration of science and technology into national development policy, with emphasis on the role of technology in development; the link between technological change and innovation; the roles of R&D institutions in improving national economic competitiveness; and the principles of and procedures for S&T advice.

UNU-MERIT's DEIP courses are targeted at senior and middle-level officials from science and technology, industry and other relevant ministries. The courses promote an innovation systems approach towards the analysis of innovation policy. They cover aspects such as the design of innovation policies, and techniques for the monitoring and evaluation of innovation policies.

Manchester University's Institute of Innovation Research short courses focus on the dynamics

²⁴ <http://www.nepadst.org/astii/index.shtml>

²⁵ Manchester University's Institute of Innovation Research was previously called the Policy Research in Engineering, Science and Technology (PREST).



of innovation and knowledge production, the impacts of globalisation on research and innovation activities, the importance of the local and regional contexts for research and innovation, the importance of demand in innovation, and policy evaluation and impact assessment.

6.3 Overall assessment

Most of the current initiatives on STI policy capacity building focus on *enhancing and/or building skills* in research and analysis. They do not address other capacity needs or priorities, such as the mobilisation of existing expertise; building political leadership and broad-based constituencies for STI policy; infrastructure for collecting STI statistics and their effective use; the allocation of financial resources for STI policy activities; or improving organisational arrangements for STI policy processes.

This assessment shows that the countries have very similar capacity needs and priorities. They have limited expertise to engage in STI policy development in general, and innovation policy-making in particular. With the support of UNESCO, many African countries have accumulated some experience and expertise in S&T policy development. They are able to undertake R&D surveys and design policies for R&D. However, they have very limited expertise in innovation policy. This makes it difficult for many countries to move from S&T policy regimes that focus mainly on R&D to STI policies.

A related issue is institutional or organisational arrangements for STI policy development. STI policy formulation and implementation in African countries tend to be spread across ministries of science and technology, trade and industry, health, agriculture, finance and planning, ICT and infrastructure, and many others. The ministries or departments of science and technology are generally not politically influential or technically capable of bringing together the various state and non-state stakeholders to engage in common national STI policy processes.

African countries have many STI policy capacity needs and priorities. It is important that AOSTI's programme for STI policy capacity focus on addressing some of the capacity priorities and areas where it will have comparative advantage. There are capacity-building priorities that should or must be addressed by national governments. These include the allocation of resources for STI policy activities such as research and analysis, policy formulation and implementation, as well as policy evaluation and monitoring. AOSTI should, upon request, support national governments in designing instruments for funding STI policy activities, but cannot be a source of funding for such initiatives.

7. RECOMMENDATIONS AND CONCLUSIONS

The formulation, implementation, monitoring and evaluation of STI policies will increasingly preoccupy African countries as they seek to integrate their economies into the global knowledge economy. Many countries will seek support to build capacity for STI policy activities. AOSTI has been established²⁶ by the African Union to help African countries to build capacity for STI policy-making and is now developing a comprehensive programme that will include STI policy capacity-building activities or initiatives. Based on this assessment, it is recommended that AOSTI should focus on the following:

- Mobilising and making available existing African and international expertise to support STI policy activities in Africa. Many departments and ministries of STI do not have access to information on the available STI policy expertise on the continent and abroad. AOSTI could be instrumental in supporting African governments to access and use the existing STI policy expertise by making information on STI policy experts available through an organised information system. AOSTI should design and manage a web-based database of experts in STI policy. The database should contain information on experts' educational background, research output, experience in STI policy research, and participation in national policy processes.
- Establishing a consortium for STI policy training. The assessment shows that there are a variety of STI policy training courses. Some of the courses are tailored for government officials in departments or ministries of S&T. The UNU-MERIT DEIP course is tailored to a specific country's needs and has been offered to Ethiopia, Senegal and Nigeria. The new UNESCO-SADC STI policy course focuses on S&T policy review and R&D indicators. AOSTI should consider establishing a platform or consortium to bring together the various institutions offering the courses in order to design and implement a single comprehensive programme for STI policy training. The programme would be spearheaded by AOSTI, but implemented by the consortium members as a partnership arrangement.
- Developing a virtual resource centre or unit for STI policy information. Almost all the countries that participated in this assessment identified the provision of STI policy information (with an emphasis on STI data and statistics and on concepts of innovation and systems of innovation) as a priority capacity-building need. This was identified as an area in which AOSTI could play an important role in supporting countries to have access to information and literature relevant

²⁶ **Assembly/AU/Dec.452(XX)**, Decision on the Creation of the African Observatory on Science, Technology and Innovation in the Republic of Equatorial Guinea – Doc. EX.CL/766(XX) , 2012
Assembly/AU/Dec.235(XII), Decision on the Proposal by the Government of the Republic of Equatorial Guinea to host the African Observatory of Science, Technology and Innovation – Doc. Assembly/AU/8(XII) Add.5, 2009



to STI policy formulation and implementation in Africa. AOSTI should consider establishing a well-structured policy-makers' web-based STI policy library. This would be a virtual centre or unit that is tailor-made to suit the information needs of African policy-makers.

- Developing a policy-makers' guide to innovation concepts and innovation policy formulation. This assessment has also shown that the concepts of innovation, systems of innovation and innovation policy are not well understood among most policy-makers. Current efforts at STI policy formulation thus seem to lack clear conceptual clarity. AOSTI should consider developing an accessible African policy-makers' guide, with examples of practices drawn from other parts of the world, covering definitions and applications of innovation concepts as well as guidelines for innovation policy formulation, implementation, monitoring and evaluation.

This assessment has shown that there is increasing interest in and effort at STI policy-making in Africa. Many countries are engaged in various activities to design modern STI policy regimes. However, most of the countries do not have the necessary capacities for STI policy formulation. The study recommends that AOSTI should address STI policy capacity building, with initial emphasis on mobilising existing expertise, developing an STI training programme that explicitly focuses on innovation policy, establishing an information centre on STI policy, and designing a policy-makers' guide on innovation concepts and STI policy.



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