# AN INNOVATIVE SYSTEM OF SCIENCE AND TECHNOLOGY MODEL: USE OF STATISTICAL METHODS, SURVEY AND INFORMATION NETWORK

**Siraj Osman Omer**[1]
Agricultural Research Corporation (ARC), Sudan

**Abstract**

*Purpose:* The purpose of this paper is to build an innovative system of science and technology model using statistical methods, survey and information networks to support government strategies.

*Design/methodology/approach:* The approach concentrates the application of statistical methods, surveys and networks under strict conditions of confidentiality and quality of knowledge management.

*Findings:* This system represents more than the name "innovative", but is a shift in framework used for understanding how to integrate science and technology in order to achieve sustainable development.

*Practical implications:* Statistical tools play a vital role in change, innovation and planning for a sustainable future. The implications of systems could be relevant in the patterns of interaction and communication among firms, universities, and other regular parts of the statistical information of science and technology concerning the need for data on research and innovation. Other potential uses include the assessment and evaluation of input and output of science, touching on different network members and furnishing key indicators for science and technology. In addition, trends and policy-relevant analysis are potential uses, focusing mainly on research and development (R&D) and innovation.

International Journal of
Sudan Research
Vol. 2 No. 2, 2012



[1] Siraj Osman Omer, Experimental Design and Analysis Unit (EDAU), Agricultural Research Corporation (ARC), P. O. Box 126, Wad Medani, SUDAN, Email: sirajstat@yahoo.com

*Social implications:* The establishment of this system with its three components will save time and effort in the decision-making process, based on statistical knowledge. The system will be the essence of the management and understanding of the nature and sources of economic growth.

**Keywords:** S&T, Statistical method, Survey design and network.

## INTRODUCTION

Science and technology activities are major drivers of productivity and economic growth. The harnessing of science and technology as forces for sustainable development depends on processes that will ensure the involvement of all appropriate scientific input and expertise in problem identification and response. Excellent statistics are required, and with policy-makers and implementers, includes full participation by experts with local knowledge in developing countries. Experience of surveying the activities of innovation has grown through the system in many countries, including the community innovation system (Gault, 2008). These include the qualifying of existing variables to make the resulting measures more comparable.

In 2005, African ministers began to develop the consolidated plan of action of science, technology and innovation indicators to provide a roadmap for the improvement of scientific and technological infrastructure, including the development of indictors of statistics, surveys and networks. This plays an important role in developing countries in contributing to the development of indicators to maintain the importance of common concepts, definitions and methodologies (Gault, 2008). The science-technology-innovation system is one that is continuously and rapidly evolving. The dramatic growth over the last twenty years in the use of science, technology and innovations (STI) that were important in the last century may no longer be so relevant today, and indeed may even be misleading (Freeman, 2007).

The growing interest in public accountability, information technology and statistical science is an indicator to support the evaluation of science and technology. In Sudan, it is important to study the role of statistics as a part of the dynamic transformation of the global economy, policy perspective, agriculture, energy, trade, sustainable development and climate change, which are all linked to make science, technology and innovation work effectively (Siraj, 2010). The ongoing education, programme development, and learning collaboration for science and technology to work effectively are strategies to help refine and develop an institutional technology curriculum document reflecting the values and interests of the various actors (Brett *et al.*, 2009). The first meeting of the intergovernmental committee on African science, technology and innovation indicators (ASTII) was held in Maputo in September 2007. The recommendations of the meeting held as a part of the third African

ministerial Council on Science and Technology (AMCOST) which took place in Mombasa, Kenya in November 2007, identified topics common to all countries collecting R&D data which could contribute to the next revision of the manual (Ellis, 2008).

In statistical methods and survey methodologies, the launch of new science and technology initiatives are opportunities to establish indicator programmers that should tell the story of their success and their social and economic impacts. At a time when agriculture, energy, environment, science and technology and trade policy are inextricably linked, ministers responsible for these areas have never been in greater need of indicators to support evidence-based policy. Statistical indicators on science, technology and innovation (STI) have tried to achieve a wide variety of social and economic objectives in which business competition is increasingly based on innovation. STI indicators today become an essential ingredient in research on the modes of operation of the science-technology-innovation sub-system itself, and its relationship with the wider social system. Therefore, statistics indictors and surveys are good agents for producing sustainability in sufficient quantities and are governmental tools used to monitor and evaluate the performance of development programmers to inform both planning and decision-making. In this respect, statistics are effective and efficient guides for resource allocation, the design of interventions, progress monitoring, and reporting on outcomes (Arshad, 2003).

## JUSTIFICATION OF STUDY

The most important problem is the management and development of large amounts information concerning science and technology in the future. Availability of large sets of data will allow exploitation of the construction of decision support systems, which may play a significant role in improving the quality of STI effectiveness in Sudan.

Science and technology have vast amounts of knowledge contents; various methods have been used to attempt to overcome problems and gain access to enough information. Integral involvement is required to overcome these problems, including survey design and statistical indictors, networks and other methods to measure trends and evaluate S&T. Furthermore, information systems are often lacking in longitudinal surveys with highly spaced interviews and good sources. In the coming years, the types of survey data, statistical indictors and data networks

have the potential to produce the best methodological breakthrough in making effective STI work. Therefore, the objective of this study is to design model data related to science and technology issues via the following:

- Advance the methodology in quantitative data and statistical indictors in order to develop better tools for monitoring, evaluating and reporting on the impact of research and development.
- Provide more robust answers for processing social and economics questions.

## DATA SCIENCE AND TECHNOLOGY MODEL (DSTM)

The DST system model is important in order to identify the entities involved in science, technology and innovation. These entities are discussed and compared in three main areas, namely, survey design, statistical analysis and information networks. The model has three divisions: management, planning and research. There are quite a number of data technologies in networks, including research institutions, polytechnics, public and private training institutions (e.g. the Agricultural Research Corporation, the Animal Resources Research and Technology Corporation, the National Centre for Research, the Industrial Research and Earth Science Institute, the Economics and Social Research Institute, the National Centre Laboratory and the Metrological Authority). However, the focus of this model will be on the statistics of the technical information of S&T in the Sudan.

## RESULTS AND DISCUSSION

### Conceptual framework for innovative system of science and technology model

The following system of data of ST model is designed by the author as a result of previous studies of science and technology systems involving new visions of data technology, with such data miming applied statistics and statistical innovation.

This system aims to identify the entities involved in survey designs, statistical methods and information networks. The data model has three divisions: planning, management and research, as a framework of data science and technology in networks.

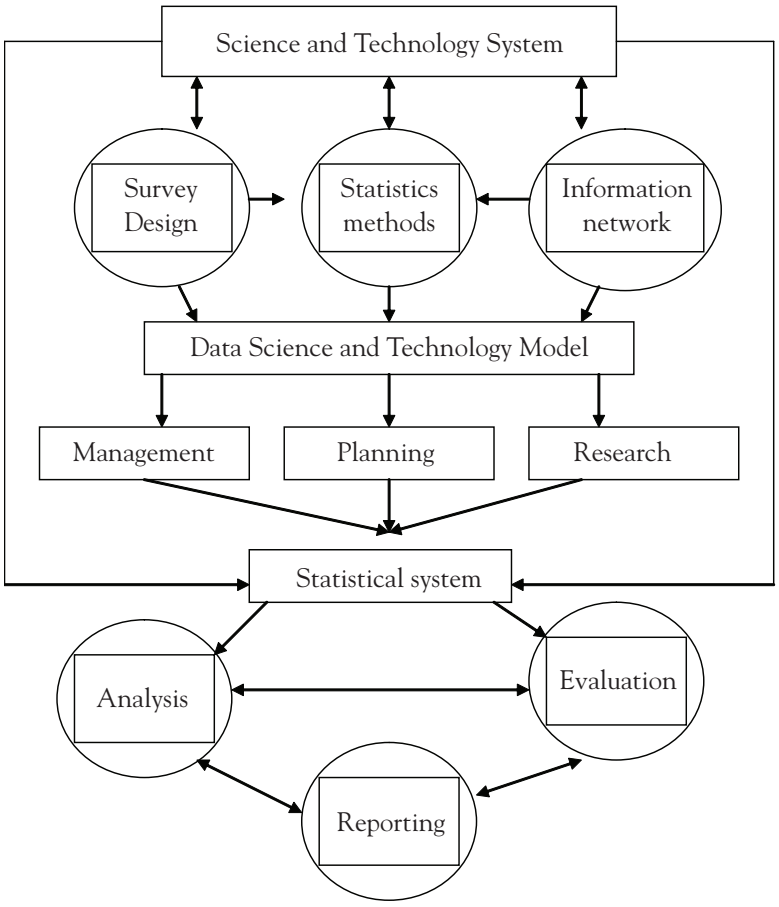


**Figure 1.** Diagram of innovative system of science and technology model

This model will develop an understanding of the analysis and evaluation of S&T outputs, which play a significant role in communicating our own ideas in relation to current scientific issues and technological development. It develops administration skills and creativity through the survey design and network of a range of products. The major part of the model is the provision of ST statistical system services. The involvement of statistical methods and surveys in this regard produces a large pool of statistical indictors and trends relating to research affairs, such as agricultural statistics, social and economics data, development and implementation of S&T and industrial surveys, computerization database and many others.

## SURVEY DESIGN

Survey designs are used to gather information. A survey is a big investment for good design and appropriate analysis. A well designed questionnaire is vital to ensure that the information collected is accurate, unbiased and contains the most important information needed to address research issue (Besag *et al.*, 2002). Conducting and managing surveys encompasses the complete survey process across different implementation methodologies. There are two basic methods for conducting a survey: self-administered and interviewer administered. Self-administered surveys include mail, web and other written surveys. Interviewer-administered surveys include telephone and in-person surveys (Tranmer, 1999). The survey design will operate automatically in all research institutions under a network system.

## SURVEYS FOR MEASURING CHANGE

Many surveys should be carried out to deal with the target in time. The need to measure change typically leads to three very different approaches for administering bills or statements (Michael *et al.*, 2009).

## DOUBLE CROSS–SECTIONAL SURVEYS

Two similar surveys are conducted, one before the intervention or policy change and one after it. Different samples are used for the two surveys. This type of survey is usually more expensive (Michael *et al.*, 2009).

## ST QUESTIONNAIRES

This questionnaire is part of a survey network (designed automatically) and statistical information evaluates the working conditions of S&T, which will administrate and publish the results of the questionnaire quarterly.

## STATISTICAL METHODS

The general aim of statistical methods is to improve the quality of collection, production and analysis of S&T data. The statistical method encompasses the following areas:

- General survey design and estimation in survey sampling
- Descriptive statistics, such as measures of central dispersion (mean and standard deviation), frequency counts, cross tabulation, regression and correlation analysis and percentages
- Multivariate analysis techniques, such as conjoint analysis, cluster analysis, modelling and perceptual mapping and quality control.
- Small area estimation and regression
- Time series and seasonal adjustment
- Disclosure control
- Statistical standards and metadata

Statistical methods are concerned with the twin aspect of design surveys and drawing valid inferences using various statistical techniques/ methods. The art of drawing valid conclusions depends on the method of data collection and analysis, which depend upon choice and the appropriate statistical procedure to support existing knowledge, fill information gaps or develop new methods. The correct study design management, data collection and analysis are required to obtain statistically sound results (Tindall, 2004).

The Statistical Package for Social Science (SPSS) process is a complete solution for survey research from designing surveys and collecting data to analysing and distributing results. SPSS allows the researcher to build the survey, collect data and analyze results easily. The management includes the performance of large datasets, including data entry, access to data sources and planning. Overall model-building performance and networks are improved, resulting in better, more confident decisions about tomorrow, today and in the future. The research will improve the entire survey process from designing to publishing the results.

## THE ANALYSIS OF S&T

The analysis of the STI data needed to populate statistics and to construct indictors requires concepts and definitions that are acceptable to the international community regarding both measurement and interpretation of data. There is a need for cooperation to facilitate

the standardization and use of databases and facilitate access to micro data holdings for research institutions. This is one of the subjects of interests in science and technology. There is also an analytical role for case studies in trends of R&D, which raise new research questions. In summary, analysis is needed to create information from data and knowledge of STI. This is especially important in a rapidly changing world (de Wolf, 2002).

## INFORMATION TECHNOLOGY

The information network establishment creates databases and presents them through the internet and the design and development of required computer systems. Informatics knowledge is promoted within the data technology, providing standards for applying information statistical systems and presenting scientific data (Siraj, 2010).

## DATA NETWORK

The measuring of linkage is fundamental to the understanding of the dynamics of S&T systems (Park and Moon, 2008). However, monitor linkages requires coordination across measurement programmes. In contrast, a linkage measure is a formal agreement that is classified between the different research institutions and universities in all the fields of science and technology, and is part of the ministry of science and technology (MST) Sudan.

## MONITORING AND EVALUATION OF SCIENCE AND TECHNOLOGY

Most importantly, the statistical system will be used for monitoring progress in terms of validity, reliability and timeliness of the statistics produced (Noyons *et al.*, 2002). The system is the essence for the efficiency of the National Statistical System. There are some important factors in planning and managing the S&T system, namely, the benefits of monitoring and evaluation. The benefit is the expected end result of any impact of the S&T system; another benefit would be to ensure the sufficient supply of a skilled workforce to the labour industry. In addition, the system is responsible for setting the target for the S&T system environment that affects the desired benefit in the long run. The statistical system is still very unresponsive to data demands in science, technology and innovation (SSI, 2002).

## CONCLUSION

The use of the skills and knowledge of statistical methods, survey designs and information networks will develop science and technology in future work. The model will offer data for science- and technology-related problems as meaningful investigations through active involvement as well as the production of national teamwork and a platform for new scientific discoveries. The availability of this model of S&T is essential for any modern government's strategic planning and efficient operation. In order to make science and technology in our society more effective, work must be adhered to the framework of governmental rules and regulations. In this paper, we suggest some key elements in the development of the necessary new quality assessment, science communication and public policy processes. These include: new approaches for statistical methods, the data of S&T modeling, survey designs and analysis for the monitoring and evaluation of scientific advances and a reassessment of the forms and locations of the "centres of excellence" capable of contributing the knowledge and judgments needed for sustainability. The system represents more than the name "innovative", but is a shift in the framework used for understanding how to integrate science and technology in order to achieve sustainable development, and it can be exploited for the construction of decision support systems, which may change the quality of science and technology. The implication of systems could be in the patterns of interaction and communication among firms, universities, and other organisations as a regular part of the statistical information of science and technology concerning the need for data on research and innovation. The establishment of this system, with its three components, will save time and effort for decision-making processes based on statistical knowledge. The system will be the essence of the management and understanding of the nature and sources of economic growth. The statistical information of science and technology will be computing and development to support the DSTM as knowledge production sites (universities and research institutes). The project has positive indications for developing new methods to support data analysis and applications in science and technology working in Sudan, together with evaluating and reporting for public policy.

## THE OUTPUT OF THE SYSTEM

The system of the DSTM will develop quantitative research in the fields of statistics indictors, surveys, networks and economics in science and

technology through universities, research institutions and scientific agencies. The output of the system will also play an important role in our engagement strategy, using survey data and statistical methods for the analysis of R&D. Covariates include:

- General framework and trends in science, technology, and innovation.
- Enhancing collaboration and networking among innovating research institutions.
- Enhancing proper utilization tools of statistical methods, survey and information. networks of science and technology.
- Enhancing data analysis of ST to ensure that science and technology are working effectively.
- Developing data, analyses and indicators of the globalization of science, engineering and technology to gain a better understanding of the emerging global economy.
- Comprehensive and coherent training programmes to build capacity in science and technology.
- Developing innovative methodological techniques that can be used to address sustainable research issues.
- Performing measurements to provide ongoing monitoring and reporting of science and technology against pre-established goals.

The first overview of the enhancement of science and technology will be through the collection of complete information at a particular time point during the actual methodology. The field of data technology S&T is of great importance in the contemporary information society. The most important information includes agricultural statistics, statistics genetics and medical, agricultural production statistics, environmental statistics, social and agricultural economics data, the development and implementation of agricultural, science and agricultural industry surveys, computerization database and information technology development. The potential of system uses include the assessment and evolution of the input and output of science, touching on different network members, furnishing key indicators for science and technology, and policy-relevant analysis, focusing mainly on research and development (R&D) and innovation.

**ACKNOWLEDGMENTS**

The author would like to thank all those who reviewed this paper, especially Professor Hassan Omer Kannan and Mr AbdeLGadir, M. Abdellah, the National Insect Collection, the Crop Protection Research Centre, ARC, and Wad Medani, Sudan, for their insightful and valuable recommendations.

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## ABOUT THE AUTHOR

**Mr Siraj O. Omer** is a biometrician working at the Experiment Design and Statistical Analysis Unit in the Agricultural Research Corporation (ARC), Wad Medani, Sudan. He studied applied statistics in Sudan, and has an MSc in statistics in collaboration with the International Centre for Agricultural Research in the Dry Area (ICARDA), Aleppo, Syria. He has worked in the Computer and Biometrics Services Unit (CBSU) (ICARDA), Aleppo Syria, and has conducted statistical analyses for more than 65 MSc and PhD studies in different aspects of agricultural research and related fields. His research and publications are focused on applied statistics, biometry and agricultural statistics, focusing on development in statistical science.