Sustaining High Quality Scientific Measurements in Sudan

Mohammed Ali
Scientific and Technology Solutions Ltd, UK

Abstract: Scientific measurement data plays an important role in all areas of human activity. The quality of associated measurement results needs to be assured and demonstrated in order for them to be accepted as part of the decision making process. By addressing and improving the quality and comparability of analytical measurements made in Sudan, the country can compete effectively in a global market, which is demanding universally assured products and services. This paper addresses the requirements, capabilities, tools and challenges in sustaining high quality scientific measurements in Sudan.

1 Introduction

Sudan's development and economic prosperity depends on the ability to put science at the heart of national development. Science, research and technology are the backbone of the modern knowledge economy. They are essential components of economic and social development and also crucial for solving problems affecting the developing world such as health care, environment, energy, safe drinking water and food supplies.

Scientific measurements are a basic input to decisions made in many areas of human activity. In particular, physical, chemical and biological measurements are used for estimating the quality and fitness for purpose of traded goods such as food, pharmaceutical products, environmental monitoring, chemical and biological products. For these reasons, well developed nations spend up to 6% of their gross national product on measurements and measurement related operations. The quality (*valid, accurate and reliable*) associated with measurement results needs to be assured and demonstrated in order to be accepted as part of the decision making process.

The term 'quality of analytical measurement results' encompasses, among other things, comparability of analytical results, their accuracy, repeatability/reproducibility, metrological traceability, and measurement uncertainty. There are many challenges facing us today like demand for better measurement techniques, from DNA profiling to nanoscale characterization, continuous development and validation of new methodologies, biotechnology and genetics, non–food crops, pharmaceutical, environmental forensics, nanotechnology and high throughput technologies. Some analytes need to be measured at extremely low concentration over a wide polarity range, in complex matrices, and frequently there is little or no information on the sample. Analytical techniques have improved dramatically over the past 10 years in terms of sensitivity, selectivity, state–of art instrumentation, quality assurance and quality control, data collection, interpretation and management.

To achieve valid, globally acceptable and comparable scientific results, there are basic tools which are used by accredited laboratories to assure and demonstrate the quality of their measurement results, and these include the following:

- Use of standardized methods for sampling and analysis,
- Proper (traceable) calibration of measurement instruments,
- Routine (documented) quality control practices, and
- Regular participation in interlaboratory comparison and proficiency tests.

(*You need to be absolutely sure that the laboratory carrying out analytical measurement has competent staff, facilities and track record to produce valid and accurate data and results consistently*)

How do we improve the quality and comparability of scientific measurements in Sudan in order to improve competitiveness and support regulatory needs? To answer this question, basic and advanced tools and measurement capabilities need to be addressed. There are five main areas need to look at:

2 Chemical Metrology and Analytical Process

This consists of an integrated set of projects, developing the methods, capabilities and facilities to provide quality data and results that are, traceable to internationally recognized standards. With the globalization of trade and the international mutual recognition of accreditation to ISO 17025:2005, traceable measurements are becoming increasingly important. Regular participation in a proficiency testing scheme provides independent verification of the analytical competence of a laboratory and shows a commitment to the maintenance and improvement of performance. It demonstrates to the public, customers, accreditation bodies, regulators, and management that analytical procedures are under control and gives analysts the confidence that the service which they provide will stand up to internal and external scrutiny.

I was recently in Sudan and witnessed first hand the problems facing users of analytical instrumentation. Difficulties in maintenance support, inconsistent electrical and water supplies, and harsh environments are just some factors that combine to make the management of sophisticated equipment very difficult (e.g., ICP, hyphenated techniques with information rich detection - GC-MS, GC-LC-MS/MS, FTMS etc). Making scientific tools available in such situations necessitates a fundamental analysis of the technical requirements, which can lead to novel adaptations of equipment, the use of alternative techniques, simplification of protocols and reliance on skill innovation. By breaking down technology and reconstituting it on site, one can often achieve what at first seemed impossible, finding simpler ways of performing experiments in the process. The key, however, is to understand the principles behind the technique, as well as its limitations.

3 Knowledge transfer

Technology alone is not the only solution, but it is a clever combination of transferring, processing, integrating and implementing the measurement tools. There should be an emphasis on partnership between developed countries and Sudan, but simply transferring knowledge and technology is not enough to help Sudan build its own measurement capabilities. Such effort must be tied to national and local needs in order to create sustainable (and self promoting) measurement culture. Existing technologies can be adapted where necessary and new technologies can be invented when required, but the key to scientific measurement success resides in human resources.

The emphasis must therefore be on the training and knowledge transfer process, and on establishing long lasting, sustainable partnerships. To achieve this goal, the transfer of technology and knowledge must be carried out beyond workshops, seminars and short training courses (locally or abroad). For this, long term technical, scientific and material support is necessary, as is access to electronic communication, e-learning and resources, and partnerships with local institutions and with more international bodies. True international partnerships require a huge investment of time from all parties, but are correspondingly massively rewarding.

As a Sudanese citizen myself and a member SATS Limited, a technical services company, I am very keen to help promote and improve technical education by encouraging discussion via our website/blog which is freely available to anyone interested in sharing scientific/technical discussion.

4 Scientific Equipment Policies

The acquisition, use and management of scientific equipment needs to be addressed seriously. It is argued that scientific progress in Africa is held back by, among other things, due to the dilapidated state of scientific equipment in laboratories and other research facilities. When making bids for funds to purchase scientific equipment, government and institutions may consider them as invaluable assets for the success of an institution's activities in bringing about development. However, the acquisition, use and management of these assets can be fraught with problems (for example; management, calibration and preventative maintenance), which compromise the quality and quantity of the desired output. To maintain and sustain high quality measurements there should be robust equipment policy (e.g., equipment selection, standardization, installation, user training, maintenance training and documentation).

5 Partnership between Academia and Industry

I strongly believe that Sudan will only compete globally if there is an effective co-ordination between academia and industry. Industry–University links are currently not very strong in the country and collaboration needs to be improved. The Industrial sector innovates much better than the public sector because their organizations are more fluid and open to change. There is currently a need to ensure that universities are producing graduates with the skills to walk straight into research or industrial positions. Science students would benefit greatly from spending a sandwich year in industry. The government should provide the schemes and strategic planning, and industry should provide the opportunities, skills and training for a rewarding and sustainable career and technology innovation.

6 Government and Regulatory Bodies

The weakness of scientific measurement tools and capabilities represent a serious competitive disadvantage for national industry. In order to coordinate all scientific and technological activities, geared towards national needs, and to promote, develop and integrate measurement science in the national development process, a very ambitious but essential objective, government should have considerable political influence and power over all the shareholders involved with measurement quality. At present, there is low quality awareness in the country, poor funding and insuf-

ficient technical and management skills, and lack of accreditation to international standards for measuring and testing. The government should be active in promoting quality awareness between the private and public sectors.

7 Conclusion

High quality analytical measurements play an increasingly important role in many of world economies. International trade is currently driven by reliable analytical measurements and accreditation to internationally recognized standards. The fact is that barriers to trade exist and are still growing between developed and developing economies. One reason for this is the standardization and application of very rigorous quality requirements in the scientific measurement processes. Obtaining high quality data depends on the maintenance of a recognized quality system, which includes detailed equipment calibration procedures, training requirements, and documentation of methods and control data processing and reporting; internal quality control procedures and management involvement. Quality measurement data means more competitiveness, more efficient discovery and development of drugs, more certain control of the environment, food and drinking water and also better communication with regulators. The principle of reliable, accurate, and sound measurements needs to be integrated into our every day activity.

During my visit to Sudan I met with people involved in technical work within many and varied technical disciplines - involving quality, petroleum, health care, nuclear medicine, construction, water and much more - people with great enthusiasm and ability, with a wish to improve their knowledge to further the progress for them, their families and Sudan as a whole, I'm therefore confident that this is a challenge that Sudan is capable of meeting.

References

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Science & Technology., Issue 01, A PSCA International Ltd Publication 2008.