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**TECHNOLOGY INNOVATION FOR ACCESS TO NATURAL RESOURCES INFORMATION:
THE SOUTH AFRICAN INTEGRATED SPATIAL INFORMATION SYSTEM (SA-ISIS)**

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Introduction

1. South Africa holds a wealth of data, information and interpretive tools that have been gathered, created and used by government and parastatals for decades. Its access and use by decision makers at all levels has been cumbersome, hampered by a conservative policy framework in the past. New legislation promulgated since the 1994 democratic elections has seen a rapid move toward an open and enabling environment for access to information and the development of tools and technologies to interrogate databases and interpret information. The focus of these efforts has been to enhance decision-making in government and provide access to the public within a framework of open democracy.

2. This paper highlights progress to date of innovative technologies that provide access to, and use of natural resource information to South African decision-makers. While primarily an information access mechanism for government decision makers, SA-ISIS will be accessible to the wider public *via* the Internet and at levels determined by the owners of the system's information and tools. Barriers to successful implementation and use are noted in this paper, and models for long-term sustainability and commercialisation of SA-ISIS are suggested.

What is innovative about SA-ISIS?

3. Innovation can loosely be defined as “mind to market” – converting ideas into reality, and capitalising on the commercial potential in a competitive market of products and services. South Africa instituted the Innovation Fund to support research and development (R & D) that would be aligned with National imperatives while simultaneously capturing the commercial potential of such projects. SA-ISIS, as a

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research and development project, is designed to provide proof of concept and implementation of technologies to support government decision-making. SA-ISIS embodies the concept of a DeSS – a Development Support System. This concept goes beyond the now-familiar decision support system (DSS) in that access to multiple DSSs will be made available, that both spatial and non-spatial data, information and technologies will be accessible within the context of South Africa's development.

4. Technology innovations that have been entrenched in SA-ISIS include:

- a. Access to data, information and tools *via* the Internet
- b. Decision-making “audit” tracking
- c. On-line training modules in natural resource management principles
- d. Intuitive multi-criteria decision making technology
- e. Market-driven information-based products and services
- f. Flexible information formatting to ensure access to non-Internet users
- g. Flexible technology architecture to allow easy inclusion of new technologies

5. As a research and development project, SA-ISIS is made up of three principal institutes: the Agriculture Research Council's Institute for Soil, Climate and Water, the CSIR (formerly known as the Council for Scientific and Industrial Research), and the University of Pretoria, acting in a legally binding research consortium. Each principal institute is responsible for the R&D contributions of their sub-consortium partners, resulting in a project that has in excess of 30 participants. SA-ISIS as an entity does not own, nor hold databases. All existing data, information, and tools reside with the original owners (mostly government and government-funded institutions) and are accessed according to the consent parameters of the owners. Flexibility and incentive to make data and information accessible are vital to the success of SA-ISIS. Issues of maintenance and validity of the databases, information and interpretive tools therefore rest with the owners. SA-ISIS partners have a five-year jurisdiction over new technology and innovations created with the current research grant. Should any consortium partner fail to capitalise on the technologies developed under the Innovation Fund, all rights revert to the Department for their use and exploitation. Under the terms of the research grant, a negotiated royalty must be paid to the Innovation Fund as a means of perpetuating the Innovation Fund pool.

6. Value-addition and continued access to data and information held by government and institutions is a key activity of SA-ISIS and a cornerstone of long-term sustainability. The principles driving the long-term sustainability of SA-ISIS beyond a government funded R&D project are straightforward: natural resource-based information has value, and this value is perceived differently by different segments of society. The degree of access as well as the packaging of the same reservoir of data and information provides the opportunity for SA-ISIS to deliver knowledge-based products and services to a wide market base in addition to the primary “client” i.e. government.

What is the current scope and functionality of SA-ISIS?

7. SA-ISIS provides access to natural resource-based databases, information, and tools in three areas:

- agriculture (SA-ISIS Agriculture),
- biodiversity (SA-ISIS Biodiversity) and
- the coastal and marine zones (SA-ISIS Coastal & Marine).

Within each of these functional areas, the relevant national government departments have prescribed the priorities for access and the development of interpretive tools. For agriculture, the National Department of Agriculture has undertaken a lengthy (>7 years) consultative process that has culminated in the development of the Agriculture Geographic Information System (AGIS). Aspects of AGIS have been funded under the auspices of SA-ISIS to ensure technical compatibility with the biodiversity and coastal and marine systems, and access to the enormous agricultural datasets and suite of tools. AGIS is designed to be used by agricultural decision-makers from national policy to the level of the individual farmer. It is a very

comprehensive and all-encompassing system. As a GIS, the agriculture component is heavily biased toward the provision of geospatial data and decision support from a geospatial perspective.

8. The coastal and marine component of SA-ISIS is focussed on the provision of interrogative and interpretive tools within the framework of the decision-making process used in government. The concept of a “workbench” or suite of tools and technologies to access and interpret data for specific purposes forms the core of the coastal and marine groups’ efforts. Specifically, SA-ISIS Coastal & Marine addresses the needs articulated in the White Paper on Sustainable Coastal Development in South Africa to provide an information and decision-support system to assist coastal managers and stakeholders at local, provincial and national levels. In addition, a key component of SA-ISIS Coastal & Marine is a suite of State of the Environment Indicators that will support the requirement to monitor the state of the coast and the effectiveness of coastal management and policy implementation.

9. Two functional requirements were necessary for the coastal and marine managers within national government:

- (1) that the decision-making process be captured and archived to be used for scenario development, management training and dispute resolution, and
- (2) that the decision support system provide on-line access to coastal and marine management principles so that government staff entrusted with decision-making would be able to have regular and updated best practises knowledge at their fingertips.

Multi-criteria decision making (MCDM) technologies have been designed to enhance the functionality of SA-ISIS Coastal & Marine to capture and facilitate the human dimension of the decision-making process. A series of Best Practices Modules on Integrated Coastal Area Management have been completed and are already available on-line.

10. Additional rapid assessment technologies have been piloted within the coastal and marine component of SA-ISIS. Near real-time digital video imagery technology has been incorporated to assist in the State of the Environment Indicator component for managing changes in the shoreline and nearshore zones of the coast. When incorporated into the coastal GIS, this allows for rapid assessment of change of state in the coastline that may be due to unauthorised development or over harvesting of resources such as mussel beds, and in assisting in the assessment of visible water quality changes due to runoff, effluent management and disasters such as oil spills. Protocols for the rapid incorporation of satellite imagery into existing decision support systems are also being developed for the coastal and marine component.

11. The biodiversity component of SA-ISIS illustrates a different focus and set of functionality than either the agriculture or coastal and marine components. The core function of SA-ISIS Biodiversity is to extract, format, assimilate and present the vast sources of biodiversity data held in museums and institutions across the country, and make this information easily accessible to all and for multiple purposes. Access to universities and schools is a key feature of the biodiversity group. The biodiversity information is assembled within a GIS and value-added functionality is provided in the packaging and processing of information for target user groups. The National Bird Atlas is an example of this; it is currently on-line and functional, and plans for commercialising this component of SA-ISIS are well under way.

What are the barriers to success of SA-ISIS?

12. The most critical barrier to success of SA-ISIS as a tool for assisting with better government decision-making is government itself. While South Africa has newly enacted legislation governing access to information (the Open Democracy Bill), there is little clarity among government departments over who has preferential jurisdiction over which databases, their maintenance and accuracy, and the terms by which sister departments can access each other’s databases. Government departments often charge each other for access to data that has already been collected, formatted and maintained with state funds. This has created tension

between departments and frustration from the public's point of view, as well as forming significant barriers for SA-ISIS in terms of:

- a. Selecting base datasets upon which interrogative and interpretive tools will run;
- b. Negotiating access conditions;
- c. Ensuring regular updating and maintenance;
- d. Ensuring due recognition is given to owners within the Internet environment of SA-ISIS;
- e. Addressing duplication of activities within pockets of government;
- f. Ensuring complementarity of information access initiatives funded by international agencies within government;
- g. Maintaining harmonious relationships with multiple departments and in the face of regular (and too often) rapid government staff turnover.

13. Additional barriers lie largely at the level of the user. As SA-ISIS is intended to assist government decision-making, it will only be used if there is a compelling reason (or set of reasons) to in fact, use it. Human nature is such that many excellent technological innovations are rarely used as intended by the system designers unless they are required to, and provided the user interface is intuitive and interactive (from a help and training point of view). Technologically, the latter barriers can be addressed with sensitivity to the intended user groups. The compelling reason for government decision-makers to use a technology such as SA-ISIS is being addressed and facilitated at the highest level through imperatives such as the Presidential Lead Projects. These projects are national in scope, highly integrated among departments, require access to a vast array of data and information, and necessitate the use of multiple interrogative and interpretive tools.

14. An example currently under discussion is the Integrated Rural Development Strategy (IRDS), for which SA-ISIS is seen to be able to play an instrumental role in providing access to information from wherever in government the information may reside. High level discussions and buy-in at the level of Ministers and their senior staff have begun; the IRDS sits within the Office of the Presidency and as such, carries significant weight in selecting how the various national departments will deliver their part of the rural development strategy. This level of interest in SA-ISIS is viewed a positive reinforcement for its use in government.

15. Long terms sustainability of SA-ISIS is expected by government. Models to ensure "life after Innovation funds" are currently being considered. Broadly speaking, SA-ISIS has two paths: incorporation as a stand-alone legal and financial entity, or association with government as an interdepartmental agency or parastatal institution. There are numerous advantages and disadvantages to each model that are being debated however, the urgency to choose is in itself a barrier. Current SA-ISIS funding will cease as from 31 December 2001 and, although the primary technology concepts and implementation will have been completed, SA-ISIS will by no means have all possible technological functionality or ubiquitous access to all natural resource-based information within South Africa. Alternative sources of funds (be they commercial, government or international) will be required to expand the scope of SA-ISIS.

Next steps

16. SA-ISIS is in a rapid phase of technical system integration among the three principal components. ARC IMS has been selected as the base technology for accessing and serving map objects from SA-ISIS. All relevant geospatial components of SA-ISIS are being configured to be served in the ARC IMS environment. Metadata standards have been instituted across the consortium and exceed those specified by South Africa's National Spatial Information Framework. A new system of "metadata" for interpretive tools and technologies - analogous to that for databases - is currently being developed. Models for the most efficient configuration of database access are currently being evaluated in order to configure the necessary servers, access protocols and firewalls of the participating institutions. Individual system components (for example, the State of the Environment Indicators, near real time digital video and satellite imagery) are in the process of being validated and configured to ensure compatibility of the interrogative and interpretive tools with the system architecture and with the datasets that these tools need to access.

17. The SA-ISIS Steering Committee is actively assessing various models for converting SA-ISIS from a research grant-funded project to a stand-alone, legal entity. Options for commercialising technologies developed in SA-ISIS are constantly being explored and tested. At present, the Integrated Coastal Area Management best practices module is available as an on-line training module; it is being considered as a University course offering that will have accreditation at South African Universities. The National Bird Atlas will soon have commercial products available by e-commerce; these include month-by-month bird lists extracted by area of interest that can be obtained from SA-ISIS on a fee payment basis.

18. On-line testing of SA-ISIS with selected user groups is scheduled for the final quarter of 2000.

19. Discussions with senior government representatives continue in order to secure acceptance for the use of SA-ISIS as one of the primary access to information mechanisms within government. Proposals have been tendered to expand the scope and functionality for SA-ISIS specifically in respect of supporting the Presidential Lead Project on integrated rural development.

20. A proposal has been prepared to assess the appropriateness of Think Tools[®] technology as a strategic decision-making functionality accessible through SA-ISIS.

Future developments for access to natural resource-based information in South Africa

21. The innovations piloted through SA-ISIS are intended to prove technological concepts and expand the current paradigms of accessing information within the realm of government decision making. There are many excellent information-based systems currently in use, or under development within South Africa. SA-ISIS is not intended to compete with any of these existing systems or initiatives; it is designed to act in a complementary manner and enhance both the access to and use of the enormous investments into GIS, DSS and basic IT within government. Comprehensive and integrated decision-making support to government cannot be made through a pilot R&D project alone, nor will it occur simply because new technologies become available. Barriers at the level of government bureaucracy and that of an individual's technology and systems adoption are critical to overcome and often fall beyond the ambit of R&D professionals. Only through positive internal government support mechanism, designing a system that is easy of use, providing relevant tools and technologies and adding value to information-based products and services will endeavours such as SA-ISIS succeed.

22. When the commercial value of natural resource-based data and interpretive tools is realised, then the opportunity for economic spin-off in the world of e-business will parallel and exceed that which we have become familiar with in the current Internet environment. South Africa strives to become an information society and operate in the knowledge economy; creating value-based services and products to access existing environmental information is a critical step in this direction.