AFRICAN RENAISSANCE: TOWARDS THE DEVELOPMENT OF A SPATIAL INFORMATION SYSTEM FOR SOCIO-ECONOMIC DEVELOPMENT IN AFRICA

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ABSTRACT

The society in which you live has a significant influence on the type of information that you require to address particular socio-economic, development or environmental issues. For example, the apartheid policy in South Africa resulted in the concentration of black people in small regions in the country where there was little employment opportunity, limited investment in development and this resulted in the excessive exploitation of natural resources. Indicators covering these particular factors must be considered in the development of the information system for purposes of reconstruction and development in South Africa. It is also imperative that three factors are considered, namely, what policy at a national, continental or global level provides the framework in which particular information must be gathered, what international best practices exists and what theory should be considered in the development of the system. Having gone through such an exercise an appropriate spatial information model can be developed in deciding on what information is required for the development of the information system to address a particular problem in the society.

This paper will explore the philosophical issues associated with the development of the spatial information system and will focus on its application to the context of an African Renaissance. Examples of spatial information systems developed in South Africa will be discussed.

1. INTRODUCTION

To bring about the African Renaissance requires the development of a comprehensive information system for all countries on the continent at both the national and sub-national levels. This information is needed to address development issues as well as encourage investment by the private sector. It is only through an understanding of where there are very poor communities from a human development, socio-economic and service access perspective that African countries will be able to encourage international agencies to provide funding for development and begin to address socio-economic disparities on the continent. The identification of priority areas for funding will require collaboration by

African countries to ensure that the truly needy areas of the continent receive the suppor that they need. The ability to development such a system requires commitment from al African countries to work together and to allocate sufficient financial and institutiona resources.

Once this information is available, African countries will have to work together an possibly set aside their own national interests to ensure that those countries that ar identified as being the poorest and the most needy are assisted in accessing internationa funding and bringing about reconstruction and development. Only through this approacl will Africa be able to slowly lift the standards of living of its entire people to a level tha makes it a continent to be reckoned with internationally. Ideally, other information tha makes Africa unique in terms of its natural resources, different cultures, mineral wealth wilderness landscapes, scenic beauty and economic opportunities must be made availabl to encourage economic investment. International businesses want to grow into Africa, bu too often they are afraid to do so as they are unable to get sufficient information especially in a spatial context at a localized level, to enable them to decide whethe sufficiently large markets exists and whether it is a viable investment. Information that i required in this regard is often related to demographics, socio-economics an infrastructure of the country, such as the per capita income, disposable income, Gros Geographic Product, education skill base and road and airport infrastructure.

To maximize the return on investment in a country also requires an understanding o people's perceptions, risks of investment (e.g. wars, crime, political instability) an communication mediums (e.g. radio coverage). To introduce products or services to i country also requires an understanding of consumer patterns and buying behaviour of th different cultural groups. It is felt that the development of an information system fo Africa will create the foundation for the African Renaissance. However, it is not just i simple case of gathering information for all African countries at different scales nor is i simply about the continent coming together to develop such a system. If anything it i about gathering information within a framework that is underpinned by a common goa set out in some form of policy or protocol by the leaders of this continent. This i required to ensure that the correct information is collected and that the whole proces remains sustainable.

It is also about the gathering of core data sets based on an understanding of scientifi theory on development and international best practice. Martin (1991) goes further ii saying that the "best foundation" for the development of especially a socio-economii information system is by having a "clear theoretical understanding". Whether core dat sets are gathered to address issues of development or foreign investment, the use of th economic model of supply and demand forms a useful foundation of the informatioi system. It is also important to recognize that there are other secondary data sets tha might not directly influence development or foreign investment, but are needed to get i holistic picture of what is happening throughout the continent. Prime examples o secondary data sets are crime, environment, education, health, labour forces and socia welfare. This paper focuses on a philosophical dissertation of what is required to develoj a spatial information system that can be used to support an African Renaissance

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Examples of spatial information systems developed in South Africa and used to underpin its development will be referred to.

2. THE IMPORTANCE OF SPATIAL INFORMATION SYSTEMS

Although spatial information has been used in Africa for decades, it has been used mainly in the environmental and mineral exploration fields. It has not been as extensively used as it should have been in the socio-economic environment considering that many of the environmental problems that Africa face are because of social issues such as poverty. If one looks at the history of Geographical Information Systems (GIS)[1] use in first world countries (e.g. United States and Canada) one sees that it was initially applied in the environmental field because environmental issues were the concern of countries at tha stage. Information was also readily available from topocadastral maps and remote sensing images.

The next area that GIS was used in was in the public utilities environment mainly to automate the production of plans, manage services and infrastructure and develop a digital topocadastral base for countries. It was only decades later that GIS began to be used more and more in the socio-economic environment with the emergence of desktop GIS technology and the availability of large population data sets (Martin, 1991). The application of GIS technology to the business sector began in earnest only in the early 1990's with GIS technology becoming easier to use and more data sets becoming available, especially census information. Although several years behind first world countries, GIS has developed along similar lines in South Africa.

The initial use of the technology was in the environmental field, especially in water management, which is one of the main environmental issues facing South Africa. Soon thereafter, the larger metropolitan areas and municipalities saw the value of GIS for managing their information and infrastructure. With the capturing of the 1991 census information at an enumerator area[2] level into GIS for the whole of South Africa in the mid 1990's, the foundation was laid for the use of GIS in the socio-economic field. Since then the entrance of GIS into the business sector has been quite strong but it is still in its infancy if one considers how few companies are using the technology.

When examining countries in Africa one can see that, the largest and most common use of GIS is still in the environmental field. This is somewhat reflected in the fact tha AfricaGIS conferences have up until now focused mainly on environmental issues. Only recently, has GIS been used in the public utilities environment and for the capture of socio-economic information in some African countries. The true use of GIS for socio economic analysis for development or its use to encourage private sector investment in

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[1] A definition of GIS is "a computer based information system that enables the capture, modelling manipulation, retrieval, analysis and presentation of geographically referenced data" (Worboys, 1995) GIS is the technology that is used to capture, view and analyze spatial information.

[2] An enumerator area is the smallest area used in censuses to collect information on the population. In the South African situation, the enumerator area has usually between 180 – 250 households in it.

still to happen. This will occur when census information at an enumerator area leve becomes available in African countries. It will also occur when African leaders accept th fact that information, especially spatial information, is required to bring about the Africai Renaissance. Furthermore, it is necessary that they place sufficient emphasis on thei countries allocating enough resources to integrate this information into GIS. However, i must again be emphasized that this should be done within a spatial informatioi framework that is founded on policies and strategies of the continent and its individua countries.

There are many reasons why GIS is so important. One of them is because it immediatel; gives decision-makers an understanding of the geographic location of countries that ar(the most under developed and has the greatest need for international assistance. Mor(importantly, GIS easily shows socio-economic and development inequalities at a nationa as well as at a sub-national level, such as the magisterial districts of South Africa. It als(provides an understanding of the geographical dimensions and the relationships that exis between spatial features at these different levels. Probably one of the most importan functions of a spatial information system is to enable the integration of databases fron different sources and scales (Rich, 1993). The integration of information allow appropriate indicators to be developed (e.g. per capita funding for development).

According to Landis (1993), one of the most useful functions of spatial information o GIS is the production of thematic maps. Over the last year, South Africa has seen ; marked increase in the use of mapped information in decision making. However, evei before 2000 there was a steady increase in the use of mapping for decision making. It al started with the general elections of 1994 where the Independent Electoral Commissioi (IEC) in South Africa identified the need to use spatial information to demarcate thei voting districts and wards. GIS technology enabled them to demarcate areas of sufficien population size for the voting stations to handle over a short period. It also used GIS t(disseminate information to voters about the location of their voting station.

This process also formed the catalyst for the 1996 census in South Africa to be capture(accurately into GIS at an enumerator area level. Since then, spatial information has beei identified for use in South Africa's integrated rural development initiative, provision o universal access in the telecommunications and postal industries, human resourc(development strategy and labour market system. The overlaying of different layers o spatial information is another function that enables people to gain an understanding of th(spatial relationship between features and enables information from one layer to b(integrated with another. A good example of this is the overlaying of census informatioi with satellite imagery to show where areas of environmental degradation occur in relatioi to where populations with different socio-economic characteristics reside. Informatioi from point locations (e.g. crime incidence, schools, health facilities, developmen projects, social surveys, etc) can also be overlaid to get a better understanding of ; particular area. More recently, the use of geospatial formulas and hyperlinking ha enabled users to model the relationship between layers of spatial information to creat(new layers of information.

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Not only is the collection of relevant spatial information for countries in Africa a challenge but so to is the effective use of the information and technology. Research ha recently shown that very few people are effectively able to use spatial information fo problem solving. Therefore, the conclusion that has been drawn from this is that fo spatial information to be used for decision-making will require facilitation by specialist with knowledge of the relevant spatial information and GIS technology. This requires th development of this expertise in countries throughout Africa, especially in the use o socio-economic information in GIS. Decision support systems, especially usin interactive web mapping technology, needs to be further developed and the challenge o making spatial information readily available and easy to use needs to be addressed.

3. THE BUILDING BLOCKS OF THE AFRICAN RENAISSANCE THE DEVELOPMENT OF A SPATIAL INFORMATION FRAMEWORK

The development of a spatial information system for the African Renaissance must occu within a framework. The purpose of the framework is to focus attention on objectives tha have been set for Africa through the signing of protocols and the implementing o specific strategies so that the necessary spatial information for decision-making can b identified. Another function of the framework is to develop an integrated approach t planning and analysis (UNEP, 1999). Manning (1992) suggests that without having theoretical framework within which an information system is developed, the necessar connectivity between the data sets and components of the information system cannot b achieved resulting in the system not optimally being used.

The importance of developing a framework is internationally recognized and many hav been developed. For example, the Africa Information Society Initiative (AISI) is a action framework to build information and communication infrastructure in Africa whil the United Nation's Development Assistance Framework (UNDAF) is to coordinat development funds. More specifically, the intention of the AISI framework is to develo institutional, human, information and technology resources for use in the building up a information society in Africa. It is felt that this will help Africa in acceleratin development plans, stimulating growth, assisting with the planning of services an infrastructure and, ultimately, bringing about an improvement of the standard of living o all Africa's people. Although many frameworks exist there is opportunity to build ont these or develop new ones that focus specifically on spatial information to achieve th African Renaissance.

Theory on sustainable and economic development provides a more in-depth perspectiv of what information may be required to successful achieve the African Renaissance. Th framework also creates the foundation for the development, management and use of th spatial information. An area that still requires much research is the development of culture where spatial information and GIS is effectively used in creating developmen plans for the continent and individual countries. Ultimately, the spatial informatio should be used for strategic planning purposes on the continent. Out of this exercis should be the refining of protocols and strategies to achieve the African Renaissance.

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Consequently, it is suggested that the framework should have five interrelated influencing spheres. These are the societal, policy, theoretical, strategic and fundamental information spheres as is illustrated in Figure 1 below.
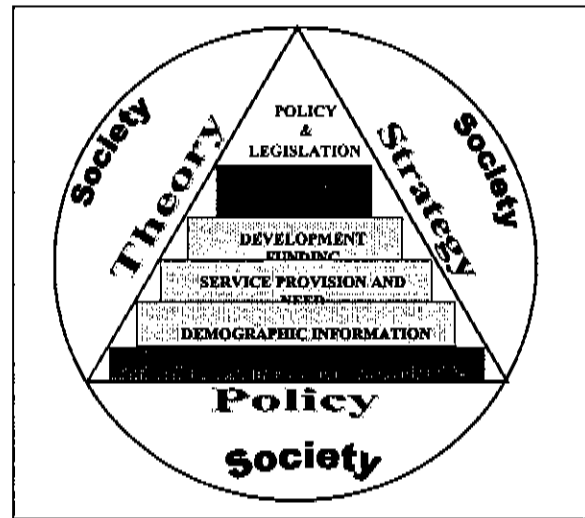

Figure 1: Spatial information framework for the African Renaissance

3.1 A socio-economic, political and environmental perspective of Africa

The socio-economic, political and environmental character of Africa is both unique and very complex. These unique features are a consequence of the many historical (e.g colonization), political and natural factors that have moulded the African landscape Present estimates of the African population show that the continent has 818 million people and it is increasing at a rate of 2.4% per annum (Population Reference Bureau 2001). Although Africa has one of the highest population growth rates it remains one of the more under populated continents in the world. HIV/Aids is expected to have a severe impact on the population in Africa and will result ultimately in a decline of the fertility and population growth rates (UNEP, 1999). It is estimated that there are over 24.5 million people on the African continent who were infected with the HIV virus in 2000 and that (000 people will die of Aids and another 11 000 will be infected each day (Brown, 2000) Of the development regions in Africa, the Southern African Development Community (SADC) is impacted the most with 12.8 million people being infected.

Of all the social problems faced in Africa, poverty is suggested to be the overriding priority. However, it is felt that unemployment and HIV/Aids are probably the more important issues on the African continent. Poverty does not happen on its own, but i

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caused by several factors including environmental degradation and the inability of peopl
to secure employment. This is often related to the economic situation, education of th
labour force and the availability of jobs. Unemployed people are more at risk of bein
infected with HIV and becoming impoverished and, thereby, continuing the vicious circl
of human depravation. Africa is also the only continent where poverty is expected t
increase in the next century. Therefore, economic growth, job creation and povert
reduction remain the primary challenges for Africa (UNEP, 1999). Part of the problem i
the $300 billion debt burden that many African countries are presently bearing (79% o
the debt comes from sub-Saharan countries), which seriously hampers economic an
social development on the continent but which is beginning to be taken seriously by th
international community (Colgan, 2001).

Another issue that characterizes many African countries is the under provision of basi
services and infrastructure, such as water, sanitation, electricity, telephones, education
health and roads. To improve access and the quality of services and infrastructur
requires an understanding of what is the status quo at a national and sub-national level
This requires information on the size of the population as well as the availability of thes
basic services and infrastructure. Migration across national borders and within countrie
is a factor that is now being recognized as having a major impact on government
planning for the provision of basic services and infrastructure. By looking at the pe
capita access to basic services gives a better understanding of the under provision withi
and between African countries. An initiative is presently on the go in SADC to map th
access to services and infrastructure at a sub-national level (i.e. district). Another part o
the project will look at whether SADC countries have population statistics from thei
census available at a localized level. This is required to provide information for decision
making in terms of both development and encourage private sector investment in th
region.

According to the Global Environment Outlook 2000 report (UNEP, 1999) competitio
for resources and declining opportunities are the causes of the political instability, civi
unrest and military conflicts that are presently occurring in Africa. Other factors that ca
be cited in contributing towards these problems are inter-sectoral power struggles
inequality amongst social groups and unequal access to political power. A consequenc
of these conflicts and wars are the displacement of millions of people to neighbourin
countries and the growth of large refuge populations. To overcome these conflicts an
bring about peace, it is necessary to instill democratic principles, sustain economi
growth and ensure an equitable income distribution.

Since time immemorial, many different regimes and conflicts have molded the politica
landscape of Africa. The two that have had the greatest impact in recent African histor
and that come so readily to mind is the slave trade in 1700's and 1800's and th
colonization of the continent in the 1880's. The slave trade saw the forced removal o
more than 22 million people from all regions in the continent. This resulted in th
significant destabilization of certain areas and in some instances the total disintegration o
societies. Following the suppression of slavery, the Berlin Conference of 1884-85 pave
the way for imperialism in Africa with nearly all the continent under the control o

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European countries. The independence of Ghana in 1957 saw the start of political powe
being given back to the people of the continent (Carlisle, 1999). During this same perioc
many African countries where still not controlled by the indigenous peoples of Africa
The transfer of political power back to the African people has continued up until the earl:
1990's with South Africa being one of the most recent, when the first truly democrati(
government was elected in 1994.

Colonialism left many countries in Africa under developed, with weak governments an(
unable to economically sustain themselves. This remains the case in many Africai
countries even today. The postcolonial period saw a dependence of African countries o1
their colonial masters for funding, which is where a lot of the debt burden of Africa cai
be traced. During this postcolonial period, a strong nationalism developed as well a
social classes. This led to the rise of many dictatorships in the 1970's that continued th(
political, economic and social exploitations of the previous colonial powers. The ne
effect of all of this, is that it entrenched a vicious cycle of economic decline, reduce(
capacity and poor governance in most of Africa. It is only in the last two decades tha
there has been a strong movement towards implementing democratic governmen
systems, which has in itself resulted in much conflict and destruction of nations on th(
continent. However, great hope is placed in the modern leaders of Africa to take th(
continent and its people into the 21st century. Under the framework of an Africai
Renaissance, initiatives such as the Millennium Partnership for the African Recover;
Programme (MAP) and the New Partnership for Africa's Development (NEPAD) hav(
blossomed and gained the support of the international community.

From an environmental perspective, Africa has seen a steady decline in the terrestrial
freshwater and marine biospheres over the last century. Research has shown that this i
predominantly a consequence of people being dependent on their natural resources t(
ensure their survival. This survival became especially entrenched in the postcolonial an(
dictatorship periods during the 1950's and 1970's. The social inequalities and the lack o
access to basic services meant that the people were forced to exploit whatever resource
were available. Consequently, African countries were forced to address th(
environmental problems that they were faced with so that the people could survive.

If we knew then more about sustainable development as what we know now the focu
would probably have been on addressing the social problems that are often the drivin;
forces of environmental change. The environmental challenges for Africa are many an(
diverse within the different regions of the continent. Those that are on the priority lis
include environmental degradation, loss of biodiversity, access to water, water scarcity
deforestation and desertification. Poverty is seen to be both a cause and a consequence o
these environmental problems. However, it is again argued that unemployment and a lacl
of access to basic services are probably the driving forces of both poverty an(
environmental degradation.

The above gives one a better understanding of socio-economic, political an(
environmental characteristics of Africa and, therefore, what information is required fo
the development of the spatial information system. For this information to b(

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environmental management in Africa. 2" AfricaGIS conference. Nairobi, Kenya.

forthcoming and for it to be placed in a GIS format before further analysis can be done will require the collaboration of all countries in Africa. Who will undertake this analysi will still have to be decided on. However, it would have to be recognized researcl institutions from the different regions of Africa that have a knowledge of this informatioı and its use in a spatial context.

3.2 A theoretical framework for developing a spatia information system

Many different theoretical constructs exist that can be used to define what information i required to optimally bring about the African Renaissance. The importance of usinį theories as part of the foundation in developing the spatial information system is that i attempts to make sense of the complexity which occurs in society and its delves into th depths and pulls out important nuances that need to be considered. The intention of thi section is not to go into a detailed exposé of different theories but it is important ti highlight two theories that probably have great significance to the future development o Africa. These theories are the economic and sustainable development theories.

It is also important to mention at this point that there is probably the need for thi development of new economic development theories that consider the unique socio economic, political and environmental character of Africa. This is instead of just applyinį economic development theories that were developed from a first world perspective anɩ do not necessarily take into consideration the distinctive features of economies in Africa However, these new theories can be built on the many theories that have already beeı formulated throughout the world. The socio-economic, political and environmenta differences that occur between African countries also means that a country specifiı analysis is required to make decisions about the most appropriate strategies to implemen for economic development that in turn contribute to the development of the continent.

Economic development if simply defined can be described as the analysis of economiı progress of countries, which takes into consideration sociological, anthropological historical, political and even ideological factors. By economic progress, it mainly mean economic growth. Although economic progress also takes into consideration institutiona development, capital formation (both physical and human), savings, trade and incomı distribution. Early theorists argued that government involvement is a critical componen of economic development whether it is in planning, construction of services anɩ infrastructure or managing the demand of the population. The focus of government iı terms of human capital would be on providing education, health facilities and populatioı development. Part of population development would be the alleviating of poverty unemployment and inequalities that exist in the society. With the environmental crisi surfacing in the 1980's the importance of sustainable development came to the forı (Centre for Policy Analysis, 2001).

More recently, scholars have suggested that the involvement of government has thwarteı economic development. This is because the huge government bureaucracies and statı regulations have made developing economies inefficient, have suffocated privatı

investment and controlled pricing. This has resulted in the drive for privatization of state assets (e.g. telecommunications, energy, transport) and has seen the emergence o government agencies to act as regulators of these industries. This is largely the accepted norm now, but the debate still rages on as to whether this is the best approach to follow especially in African countries where there is such a need for job creation and the addressing of inequalities. Economic development theory has over the decades changed quite dramatically as different scholars have added to the knowledge on the subject. Wha is presented here is a summary of the main points on economic development.

Sustainable development can be defined as the improving of economic efficiency protection and restoration of the environment and the enhancing of the social well being of people (IISD, 1995). What one can see from this is that sustainable development is a continuation of the principals of economic development but with more emphasis on the social well being of people and the introduction of the environment as a majo component. The IISD further argues that sustainable development is an integrated proces for decision-making that requires information for it to be accomplished. Inherent in the idea of sustainable development is aspects such as democratic values, communit participation, international collaboration, strong leadership and that it is a long-term solution. Agenda 21 is the foundational document of sustainable development and set out a global action plan to address issues such as air quality, resource use, and poverty.

One of the principles of sustainable development is to be proactive in identifying existing problems or preventing new problems before they start. Another principle is that the ful cost of using resources (e.g. water, land, forests) must be taken into consideration to ensure that they are not over exploited (IISD, 1995). The idea behind this principle is tha market forces are better able to ensure sustainable development and use of the world' resources than are government institutions. This particular issue is still open to mucl debate considering the effects that globalization has had especially on Third Work countries. Sustainable development is an integrated approach and, therefore, informatioi from a variety of different sources is required. Consequently, much effort has been pu into the development of sustainable development indicators. Jesinghaus (1999) in hi work on developing indicators for the European Union showed through his "informatioi iceberg" that initially there is the development of a plethora of indicators that ar eventually dwindled down to a core set of 3-5 indicators. In addition, there is the development of new composite indicators that provide a more useable and better overal perspective of sustainable development issues. Part of the process of developing indicators is the identification of international benchmarks or targets, which will be discussed in more detail in a later section.

3.3 A policy framework for the African Renaissance

There are many global and African conventions; resolutions, protocols and strategies tha Africa has committed to and which could be used as the policy framework to develop the spatial information system. However, the New Partnership for Africa's Developmen (NEPAD), previously known as the New Africa Initiative (NAI), will be used as the "policy" framework in this paper, because it is an idea that originated in Africa and the

leaders of this continent developed it. It has also received much support from the international community and is the hope that Africa searches for in uplifting the standard of living of its entire people. It is the foundation upon which Africa wants to develop the continent, encourage international investment and participate fully in the global economy. It is also a new initiative that can be used to show why the development of a framework is so important in the development of a spatial information system.

The immediate thought that one has when reading through the NEPAD document is that for the objectives and goals to be accomplished requires extensive information for all African countries to understand their present socio-economic, political and environmental situations. Only then can strategies be implemented and targets sets to achieve the goal of NEPAD. It addition, it will not be sufficient to obtain the information only at a national level but also at a sub-national level (e.g. district), and in some instances even at a lower level, so that disparities within countries can be shown and the most needy areas in Africa identified. What also comes to mind is that much work is required in the development of the spatial information system to provide the necessary information for decision-making so that the goals that are set in NEPAD can be achieved by the year 2015. The planning and development of the spatial information system needs to be done in the immediate short term so that strategies for achieving goals set out in NEPAD can be implemented as soon as possible.

The primary intention of NEPAD is to eradicate poverty, to put Africa on a sustainable development path, to address the underdevelopment found throughout the continent and to ensure that Africa is accepted as an integral part of the globalizing world. Although globalization has seen the continued exploitation of Africa's resource wealth the intention of embracing globalization is to manage Africa's integration and to ensure that the benefits of globalization, such as economic prosperity and poverty reduction, are turned into benefits for the continent. It is recognized that similar continental programmes have been implemented in the past and these have failed. It is suggested that this is a result of leadership in Africa not wanting to take ownership of the process mainly because it occurred at a time when the self-interest of African nations under different political regimes suited them better. Now there is a new set of circumstances with the wide spread democratization of African states and the influence of globalization that is acting as an imperative for NEPAD to succeed.

To succeed with NEPAD requires the driving of the process by African leaders as part of a consultative and participative process involving all African nations as well as the people of the continent. If African countries are unable to collaborate and bring forth a common front then the intentions of NEPAD will never be achieved. A solid foundation must be set for NEPAD to succeed and these factors include having stability in all countries on the continent, which means that the present wars and political conflicts have to be addressed. Democracy is felt to be the founding principle to ensure human rights and accountability of the government to the people. Good governance in terms of economic, financial, judicial and development policies is a necessity. It is also accepted that the capacity of African nations needs to be developed through education and training programmes to ensure that the necessary skills exist to implement NEPAD effectively.

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For NEPAD to be accomplished many things need to be done. Therefore, the priority sectors that have been identified are:

(i)   Provision and maintenance of services and infrastructure (e.g. roads, electricity water, sanitation, police, formal housing);
(ii)   Providing information and communications technology (e.g. radio, television telephones, cellular networks, internet connections and hubs);
(iii)   Provision of education and health services and the development of skills;
(iv)   Effective agricultural programmes; and
(v)   Develop of local and international export markets.

Funding from a variety of different sources will be required for the implementation o NEPAD. This includes generating revenue through taxation in each of the Africai countries; encourage savings by government as well as the people, increasing the flov and efficient use of international funding and by encouraging investment in Africa by th private sector. Efficient financial policies will have to put in place to make sure tha revenue generated by African countries is used as efficiently as possible. One of th major obstacles that African leaders are presently addressing with the internationa community is the obtaining of debt relief. These are all required if NEPAD is to achiev the goals that have been set.

These goals are to be achieved by the year 2015 and include:

(i)   Generating an average gross domestic product (GDP) growth rate of above 7% pe annum;
(ii)   To reduce the proportion of people living in extreme poverty by half;
(iii)   Enroll all children of school age in primary schools;
(iv)   Eliminating gender disparities in the enrolment in primary and secondary education;
(v)   To reduce infant and child mortality ratios by two-thirds;
(vi)   To reduce maternal mortality ratios by three-quarters;
(vii)   To provide access for all who need reproductive health services;
(viii) To implement national strategies for sustainable development by 2005, so as t reverse the loss of environmental resources.

What the above brings to the fore is the amount of information required to have ai understanding of what the situation is in all the countries of Africa. This information i needed to identify priority areas and for this to be achieved requires the use of spatia information at a sub-national level so that the true disparities are reflected an appropriate projects or programmes implemented. The monitoring of progress at : country, regional and continental level also requires information. The development o indicators to ensure a universal understanding of what the situation is and what needs t be accomplished is an imperative. A later section will provide a more detailed descriptioi of the information that is needed considering the social, political and environmenta character of Africa, the theories of economic and sustainable development and the need identified in the New Partnership for Africa's Development.

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3.4 International best practice

Throughout the world and Africa, many best practices can be considered in the development of a spatial information system to inform the African Renaissance. One o the most important is a consideration of the institutional framework within which i should be developed. Two models are often followed. The first is the development of the spatial information system by different agencies followed by the development of a framework in which the efforts of government are coordinated and managed. This i largely the approach that has been followed in South Africa where many different institutions have independently gathered spatial information that they have identified a being important through varies means. Only recently has the South African government implemented the National Spatial Information Framework (NSIF) and policies such a the Spatial Information Bill to coordinate the spatial information industry in South Africa.

Some of the major problems with this approach are that it entrenches the idea that the information collected by the independent agencies belongs to them and that they can control access through regulations and costing. Another problem is that without effective coordination there is limited standardization resulting in layers of information no overlaying with each other accurately. Advantages of this approach is that the ingenuit of institutions enables the development of information systems that often go beyond the minimum requirements and it is usually implemented much quicker. The second model i the development of the institutional framework before the information needs are identified and a unified approach by institutions is followed to collect the spatia information. It is understood that great success has been achieved with this approach in West African countries. It is likely that this approach suffers from bureaucrati regulations but the spatial information emanating from this approach often meets the needs of decision-makers better and is much more standardized.

Other aspects to consider in terms of best practice are the source of information, precision and accuracy, map projections, scale and resolution, metadata, spatial and attribut database design, choice of data formats, archiving and dissemination (Gillings and Wise 1998). The challenge that we have in Africa is that socio-economic, political and environmental information is not always readily available. One just has to look at censu information for African countries and one immediately sees that although censuses have been undertaken it is not normally in a spatial context and if it is, then it is usually not a a localized level. In addition, critical information on service and infrastructural needs and provision is not readily available. Therefore, innovative techniques such as the use o satellite imagery, social surveys and modelling techniques must be used to get access to this information. The Internet has become a powerful source of information on countrie in Africa. It is just a pity that institutions outside of Africa are always the source of thi information. The use of expert opinion is also a way that information can be obtained and linked to spatial layers at a national or sub-national level.

The emphasis on spatial information having a high precision is a good practice. However it usually comes at the expense of spatial information taking a long time to capture and

being very costly. The precision of spatial information in terms of town planning is ver; important but it is argued that it is not that important when using it for strategic plannin; purposes at a sub-national level. To meet the needs of NEPAD will require the spatia information to be collected in the immediate short term so that especially socio-economi and political information can be linked to administrative boundaries at a sub-nationa level. Another principle that should be followed is to collect information at the correc spatial resolution. It is usually the case that if you are wanting to know the extent o poverty in a country it is usually better to collect the information at one or two level below the national scale (i.e. provincial, district). Disparities in poverty can then b understood at a more localized level so that appropriate intervention programmes can b implemented. Another advantage of collecting information at the sub-national level i that the information can allows be aggregated to the national level but not visa versa.

The introduction of web interactive mapping to the world market has revolutionized th ability to disseminate spatial information. Although the wide use of this technology t make comprehensive country or continent specific information available, is still in it infancy. Further developments that are presently taking place around the use of wel interactive mapping are the creation of decision support systems. These systems conver web interactive mapping from being just a technology, for viewing and analyzing spatia information into a system that not only empowers people to use it but also gives detaile information on topics relating to the spatial information. Web interactive mapping for th dissemination of spatial information is a best practice but it must be kept in mind that th use and analysis of spatial information by people often has to be facilitated by GIS user.

4. SPATIAL INFORMATION MODEL FOR THE AFRICAN RENAISSANCE

The essence of the spatial information model (Figure 2) is the identification of core an secondary data sets that are needed for the development of the spatial information systen that can be used for decision making in the New Partnership for Africa's Development The three core data sets that are considered as being imperative are the socio-economic service need and provision, and the development funding. The socio-economic dat; includes socio-demographic (e.g. population, literacy, unemployment, Humar Development Index) and economic (e.g. poverty, GGP) information. The service nee and provision information provides an understanding of what proportion of th population has access to basic services and infrastructure and, thereby, enables decisio makers to calculate what proportion of the population still needs to be provided witl these basic services.

This information includes water, sanitation, electricity, formal housing, telephone policing, health, education, roads and postal services. Many international fundin; agencies also feel that access to financial institutions should also be considered a basi need. The development funding data set contains information on how much money i already being budgeted and spent on services and infrastructure. This informatio provides an understanding of the proportion of funds going to the different types o services and infrastructure and whether the African governments are spending their fund

efficiently. It should also give an understanding of the amount of funds being generated from internal revenue, that being donated by international agencies and the amount being invested by private companies.
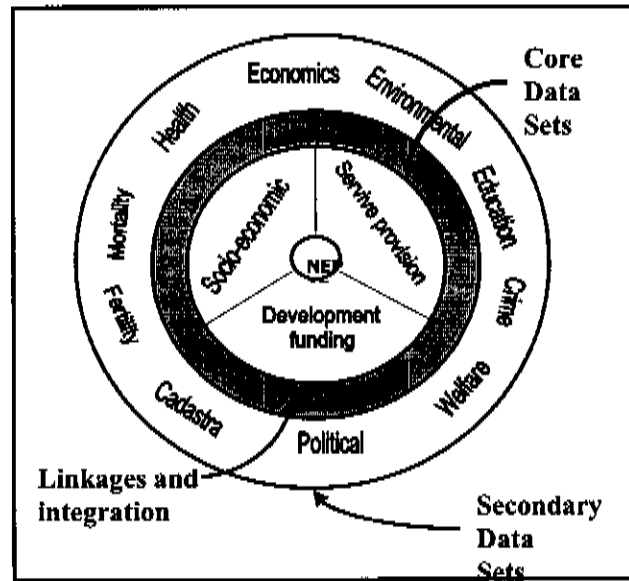

Figure 2: Spatial information model for the African Renaissance

From this core set, financial models can be generated to predict the extent of funding required to meet the objectives of NEPAD and the basic needs of people in Africa Although the core data sets provide most of the information needed to address issue associated with NEPAD, other secondary data sets are also required. The secondary data sets are needed to provide the context or a holistic picture of the situation in Africa. In addition, the secondary data sets form linkages with the core data sets that necessitate that they are fully integrated and results in enhancing the overall use of the spatial information model (Chorley, 1988). These data sets include spatial information on economics politics, environment, health, education, mortality/fertility, crime, welfare, NGO's/CBO' and cadastra.

It may be argued that some of these data sets, for example environmental information could be considered part of the core data sets, especially as Africa has many environmental problems and seems to be endowed with much information on the environment. However, with the emphasis being on economic and sustainable development, it is necessary to focus on those data sets that form the foundation of the development process and that emanate from the spatial information framework discussed earlier, especially NEPAD. It must also be realised that it is not possible to gather all of the information for immediate use in decision-making and, therefore, the core data set

should be collected first. Nevertheless, it must be emphasized that the secondary data are still very important, especially to gain a holistic perspective of what the development situation is in Africa.

This might sound all good and well but it is a huge challenge if one considers that through a consultative process with African countries there needs to the acceptance in principle of the development of a spatial information framework and model. The necessary national institutions that will coordinate it on the behalf of Africa must also be identified or a single organization identified that is to represent the interests of all African nations. Concerted efforts will then have to be made by national institutions to gather the information that has been identified. The problem often here is that these institutions do not have the necessary funds to undertake this work and, therefore, funding will have to be obtained from national budgets or from donor agencies. The lesson to be learnt from other research in the information field is that the development of the spatial information system for Africa will only happen if it is a conscious and deliberate decision made by all of its leaders (de Man, 1988). This will require strong leadership from the African nations.

4.1 The core data sets

4.1.1 Socio-economic information

The socio-economic information, is broadly perceived both locally and internationally to be the most important data set for planning purposes and should be the first to be developed (Chorley, 1988). A thorough understanding of the population distribution of a country and other socio-economic characteristics (e.g. poverty, GGP, per capita income literacy, population density) are imperative to address the needs of communities (Figure 3). Socio-economic information is primarily accessible from censuses conducted usually every five or ten years by African countries. More recently, because of conflicts on the continent and the cost of conducting censuses, censuses might not have been undertaken in quite a while and this might remain the case into the future. Therefore, other innovative methods will have to be used, for example, the use of satellite imagery, aerial photography or social surveys.

Ideally, the approach to the development of the socio-economic databases is to capture the enumerator area boundaries used by the statistical agencies in each African country and to then link the census information at this level. An enumerator area is the area within which people will be enumerated by a census official and in terms of censuses in South Africa, this approximates 120-180 households. In developing any spatial database it is important to always try and access the information at the smallest building block possible. However, to provide socio-economic information for the NEPAD census information should be presented at the district level in each African state. Unfortunately for private sector investment in a country the presenting of the socio-economic information at a district level is not detailed enough and, therefore, census information will ultimately have to be captured at an enumerator area level as well.

Source: D.S., 1988, Africa Geospace : The development of a spatial information system for economic development in Africa, 2ⁿᵈ AfricaGIS conference, Nairobi, Kenya.

The enumerator area is one of the most important building blocks in any spatial information model because it provides up-to-date socio-economic information from the censuses on a regular basis. This information can then be aggregated to other spatial layers of information (e.g. suburbs, local authorities, health regions) to provide census statistics. It is used with most other data sets whether it is education, health, crime development, services provision or business applications for gaining a greater understanding of the socio-economic environment within which decisions are being made. Another important aspect is that many internationally recognised indicators are often a ratio of population (e.g. murders per 100 000 population) and, therefore, it is imperative that this important component of the core data sets is obtained.

4.1.2 Service need and provision

An understanding of what services and infrastructure people have access to is imperative for prioritizing areas for development funding and addressing the backlog that has arisen. In addition, this data set creates a benchmark against which governments can monitor their progress in developing greater equity in the access to services and infrastructure (Harris et al, 1995). The data set created for the South African situation was termed the Service Need and Provision database. The first component comprised of information on the social needs of communities at a magisterial district level. This included information on the total population, population density, employment, functional literacy, poverty dependency ratio and health.

Combining the ranked scores of social variables generated an index of social need. The second component of the database comprised of information on the provision of service and infrastructure. These included factors such as access to water, sanitation, electricity housing, policing, health, education, postal facilities, telecommunications, roads and retirement facilities. Information was obtained firstly and primarily, from existing databases, secondly, from service providers and only as a last resort, was new baseline information collected. This approach facilitated easy access to spatial information and reduced the duplication of effort and expenditure.

Combining the ranked scores of service and infrastructure variables also generated an index of service need. Finally, by combining the social and service need indices a composite social and service need index was created (Figure 4) which identifies areas within provinces and South Africa that are underdeveloped from both a social and service perspective. Districts that require intervention from government, in order to address the inequalities, are then easily located. Products that have emanated from this database are atlases for all nine provinces in South Africa that include maps, tabular data and commentaries by local experts on the different social and service variables. By disseminating these atlases to senior government officials, the mechanism of providing spatial information for decision-making is being implemented. This requires a commitment from the developers of the spatial data sets in terms of both man-hours and financial resources.

Schmidt, C.A., 2001. African Renaissance: The development of a spatial information system for disaster management in Africa. 2nd AfricaGIS conference, Nairobi, Kenya.

This type of information must be collected for all African countries and similar method to that used in South Africa can be used. An exercise is presently being undertaken in the SADC region. The idea is to collect the service need and provision information at the equivalent of a district level in all SADC member states. National partners will collect the spatial and attribute information from statistical agencies as well as government departments and service utility companies. The information will then be integrated into GIS before being disseminated via an integrated web mapping server and a published atlas. The information will also be archived at the SADC Regional Remote Sensing Unit (RRSU).

4.1.3 Development funding

To have an understanding of characteristics of the population and whether people have access to services and infrastructure is not enough when implementing the New Partnership for Africa's Development (NEPAD). An understanding of how much money is being spent by government departments and donor agencies in countries in Africa is also important. This is because it illustrates whether the high priority countries and districts within countries are being targeted. Having an understanding of the population profile, service access and the extent of expenditure on development projects provides the basis upon which further financial projections can be made to alleviate poverty and address the services and infrastructure backlog.

Development funding revolves around the gathering of information on the extent of expenditure by government departments (i.e. national and provincial), local authorities and donor agencies on development expenditure. Ideally, information should be collected at a project level so that a detailed understanding can be obtained of which communities are benefiting, what development activities are being implemented and what other benefits are being accrued to the community (e.g. number of jobs created, skill development). Once the location of the project has been defined, the information is aggregated to show the extent of expenditure in larger spatial units of analysis such as the district level. The district level is probably the most useful because it provides decision makers with an understanding at a localized level of disparities in a country and can also be used for macro planning purposes. It is also at this spatial level that other data sets can be integrated (e.g. demographics, financial, administration).

The development funding information has several important applications. Firstly, it can be used to determine whether countries that are considered "under developed" are being effectively targeted. The map in Figure 5 shows the extent of expenditure on development projects and can be compared to the map of poverty in South Africa (see Figure 3) to see whether the high poverty areas are being targeted. Secondly, whether the allocation of funds are equitable considering indices of service need and the population profile of African countries. This is best determined by looking at the per capita allocation of funds for development projects. Thirdly, whether areas are getting no financial allocation for development projects or there is the duplication of development funding for particular projects from different donor agencies. Lastly, comparisons of

Schwabe, C.A. 2001. *Understanding the development of a spatial information system for socio-economic development in Africa.* 5th AfricaGIS conference, Nairobi, Kenya

which types of projects are being funded and where there is the greatest service need wil indicate whether the allocation of funding is the most appropriate.

4.2 Secondary data sets

Not much detail will be provided on the secondary data sets presented in the spatia information model above. However, of the secondary data sets, environmenta information is probably the priority. This is because of the major environmental issue that Africa faces, whether it is land degradation in southern Africa or water scarcity ii northern Africa or loss of biodiversity in eastern Africa or deforestation in western an central Africa. It is these types of issues that have been the focus of attention o international agencies and African countries alike over the last couple of decades Consequently, a substantial amount of research has been done and information collecte on these and many other environmental issues. This has been especially the case with th implementation of national, regional and continental State of Environment (SoE) reports.
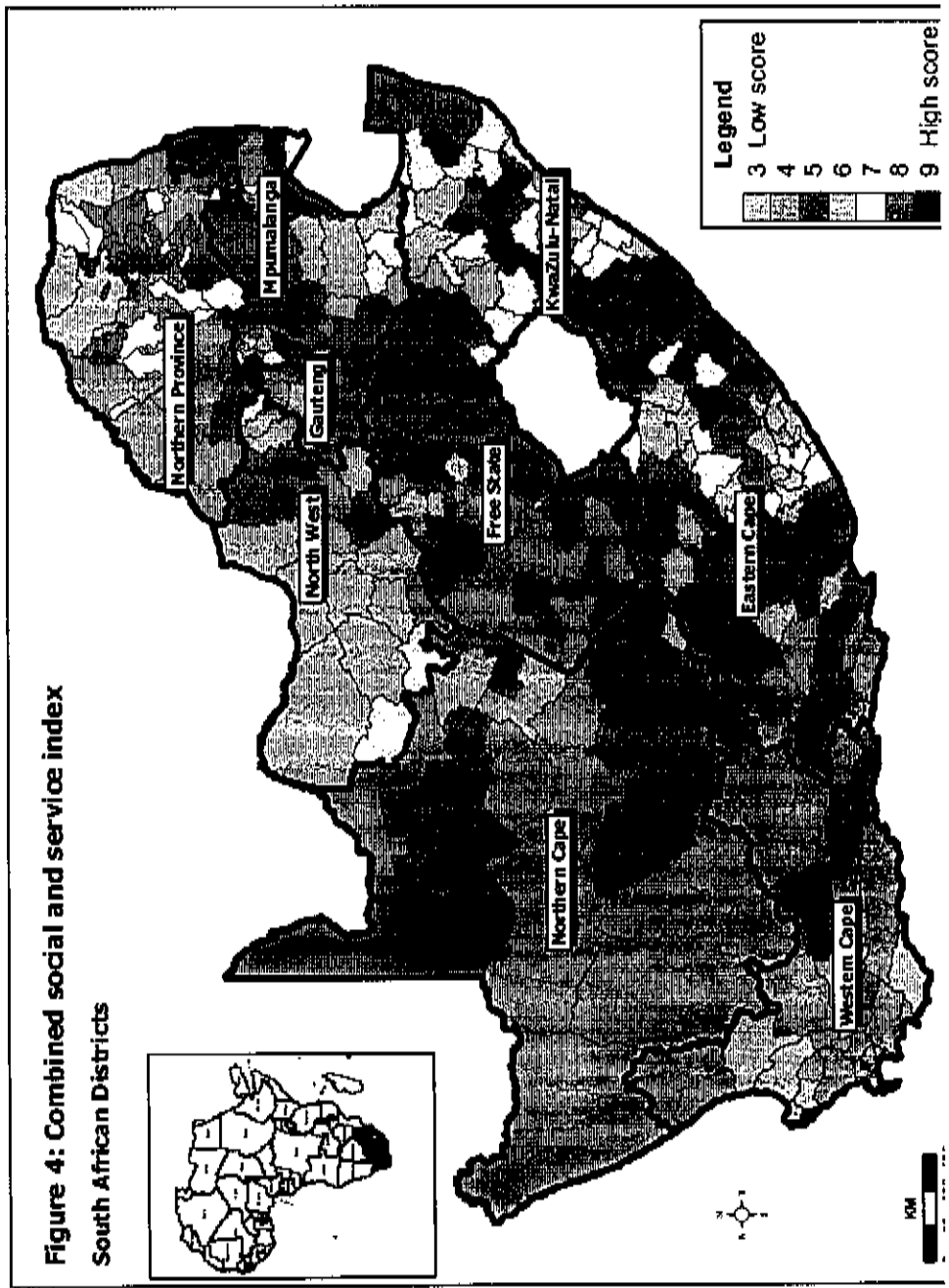
Although a lot has been done there is a lot more that still has to be done, especially i sustainable development is to be achieved in Africa. A lot can be learnt from the State o the Environment processes. This includes the development of indicators and th necessity, especially in Africa, for the development of unique and innovative methods fo measuring and monitoring the state of the environment. In the development of indicator the use of frameworks such as the State-Pressure-Impact-Response (SPIR) and Drivin force-Pressure-State-Impact-Response (DPSIR) approaches has gain much prominenc (UNEP, 1999). These frameworks are very useful in focusing ones attention o particular problems, whether they are environmental or poverty related, and identify th causes and government responses to these problems. More will be discussed on th development of indicators and the use of innovative methods for gathering spatia information in the next section.

5. USING THE ECONOMIC CONCEPT OF SUPPLY ANC DEMAND TO IDENTIFY SPATIAL INFORMATION NEEDS
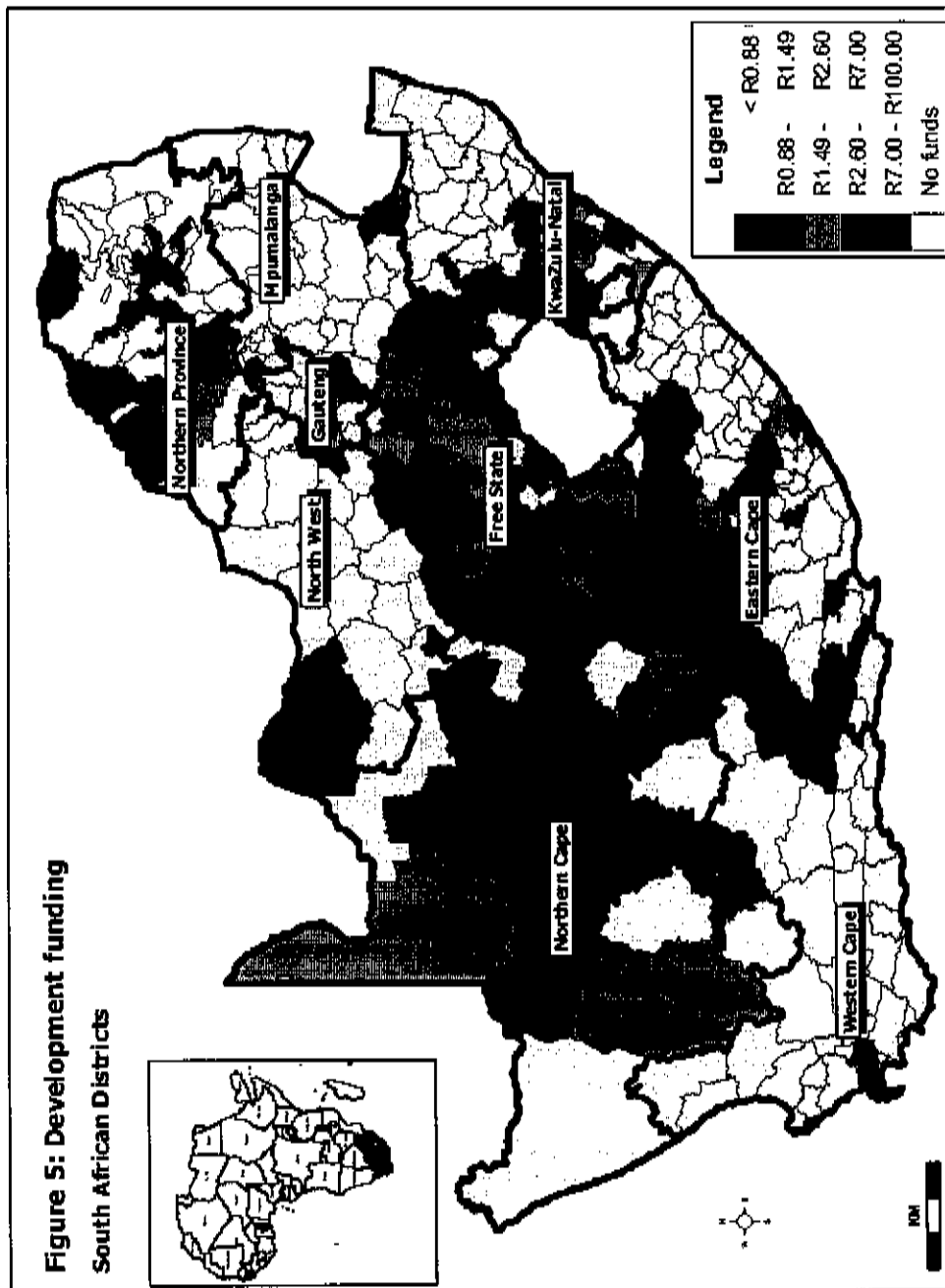
The economic concept of supply and demand is a very useful method to use ii identifying the spatial information needed to address a particular problem. In terms of th African Renaissance, the spatial information framework presented in a previous sectio identifies the New Partnership for Africa's Development (NEPAD) as a polic framework to focus on in identifying the way forward for economic and sustainabl development on the continent. Within the NEPAD several different long-term objective were identified (e.g. poverty eradication, economic growth) which can be focused on ii terms of supply and demand to identify the spatial information required. Once the critica variables are identified in terms of this economic concept, it is also important to defin the targets that should be set for these variables. These targets can use benchmark provided by international agencies or countries can develop national targets based on a understanding of the situation in that country and their capacity to address these issues For example, some of the NEPAD targets are:

Schmitz, C. M., 2001, *African Renaissance: The development of a spatial information system for sustainable economic development in Africa.* 5th AfricaGIS conference, Nairobi, Kenya

Figure 4: Combined social and service index

South African Districts

Legend

3	Low score
4	
5	
6	
7	
8	
9	High score

Northern Province

Mpumalanga

Gauteng

North West

Free State

KwaZulu-Natal

Northern Cape

Eastern Cape

Western Cape

KM

Figure 5: Development funding
South African Districts

Northern Province

Mpumalanga

Gauteng

North West

Free State

KwaZulu-Natal

Eastern Cape

Northern Cape

Western Cape

Legend

	< R0.88
R0.88 -	R1.49
R1.49 -	R2.60
R2.60 -	R7.00
R7.00 -	R100.00
	No funds

KM

- Gross domestic product above 7% per annum for the next 15 years;
- Have all children of school going age enrolled in school by 20015;
- Two lines per 100 people in 2005;

Through extensive research in the social sciences it has become apparent that in the development of spatial information systems that an understanding of people's opinion and perceptions must also be considered. An understanding of what people's concerns are and what would enable them to change their behaviour is of critical importance. A classic example of this is the approach that was used in Uganda to address the HIV/Aid problem in that country. The approach was to encourage people through the political and religious leaders to change their behaviour. This resulted in a marked decline in the prevalence of the disease in Uganda.

It is also important to understand how people want to be communicated with in relation to problems in society. The available communication mediums (e.g. radio, TV, newspapers, magazines) can be investigated to see which provides the best coverage in addressing a particular issue. More recently, the importance of indigenous knowledge about particular issues has come to the fore. Although this science is in its infancy, especially in a spatial context, it needs more research and its importance to the African Renaissance must not be underestimated. These types of information will enable the better use of spatial data for decision-making. Figure 6 also gives a list of the types of spatial information that is needed to address particular issues associated with the NEPAD. A more detailed list of information required to address the NEPAD is presented in Addendum 1.

		SUPPLY	DEMAND
TARGETS		• Provision of services and infrastructure (e.g. water, sanitation, electricity, housing, policing, health, education, telephones, roads, postal). • Allocation of funds for development of services and infrastructure • Allocation of poverty relief funds • Number of jobs created through public and private investments • Gross domestic product by sector	• Distribution of the population (i.e. size of the population) • Geodemographic classification • Extent of poverty (i.e. Gini coefficient, Poverty gap) • Extent of access to services and infrastructure • Extent of economic dependency and unemployment • Employment of women by sector
		OPINIONS AND PERCEPTIONS COMMUNICATION BEHAVIOUR INDIGENOUS KNOWLEDGE	

Figure 6: Supply and demand analysis of poverty.

Schwabe, C.A. (2001). African Renaissance: The development of a spatial information system for the sustainable development in Africa. 5th AfricaGIS conference, Nairobi, Kenya.

6. CONCLUSION

The intention of this paper was to stimulate thought on how to develop a spatial information system to bring about an African Renaissance. It is emphasized that there is a need to initially develop a spatial information framework (see Figure 1) that will guide ones philosophical thinking and the practical development of the spatial information system. The spatial information framework consists of several influencing spheres including an understanding of societal issues, policy as a foundation, theoretical constructs on economic and sustainable development, the consideration of international best practice in developing spatial information systems and defining what are the building blocks of such systems. To develop the spatial information system it is argued that there needs to be a culture within African governments of using spatial information for decision-making.

On this foundation, critical layers of spatial information are needed to bring about the African Renaissance. One of the most important layers of information is socio-economic data that is available from censuses conducted in African countries. An understanding of what proportion of the population has access to services and infrastructure is an important layer of information. In combination, these two layers of information enable one to gain an understanding of what the backlogs are in the provision of these services and infrastructure and provide an understanding of the extent of poverty in African countries. It is also important to know the extent of funds being allocated to service this backlog. Funds are usually forthcoming from internal revenue generation, development agencies and through private investment. These layers of spatial information are the core data sets defined in the spatial information model (see Figure 2) that are considered imperative to bring about an African Renaissance.

The New Partnership for Africa's Development (NEPAD) is the policy framework used to guide the development of the spatial information system. The theoretical constructs of economic and sustainable development are also used in guiding the formation of the spatial information system. An example of spatial information from South Africa that was developed within such a spatial information framework and model is presented to the reader. The economic concept of supply and demand is another mechanism that can aid in the identification of important variables within the core data sets. The model presented in this paper highlights the importance of also identifying the targets for each of the variables identified. Importance is placed on also having an understanding of people's perceptions, communication mediums, behavioural aspects and indigenous knowledge in the development of the most appropriate spatial information system.

Finally, it must be emphasized that the development of a spatial information system must be undertaken within a defined framework as has been presented in this paper. Many scholars emphasize this particular point. Martin (1991) states that the "best foundation" for the development of an information system is by having a "clear theoretical understanding". Manning (1992) goes further and says that without a theoretical framework within which an information system is developed, the necessary connectivity between the data sets and components of the information system cannot be achieved.

resulting in the system not optimally being used. For the African Renaissance to be achieved and for Africa to take ownership of its future there is a need for it to develop it own spatial information framework and systems.

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ADDENDUM 1

LIST OF INFORMATION REQUIREMENTS

FOR THE NEW PARTNERSHIP FOR AFRICA'S DEVELOPMENT

- Population with access to services and infrastructure (e.g. water, sanitation electricity, housing, policing, health, education, telephones, roads, postal)
- Reliability and quality of services and infrastructure
- Population with access to credit
- Number of jobs created
- Economic growth rate
- Extent of funding (i.e. government, ODA, private) allocated and spent on development
- Extent of international debt
- Democratic governments
- Distribution of natural resources
- Distribution of historical and archeological sites
- Dollar value of exports and imports
- Extent of trade deficit
- Gross domestic product (GDP) by sector
- Corruption index ranking of countries
- Access to information and communication technologies (ICT – internet connections)
- Distribution of transportation infrastructure (i.e. air, rail, road, border points)
- Quality of life index
- Political stability rating
- Extent of environmental degradation and desertification
- Extent of wetland conservation
- Percentage land lost to alien vegetation
- Percentage of land conserved as natural ecosystems or nature reserves or a transfrontier areas
- Quality of water rating
- Macroeconomic stability rating
- Fiscal and monetary policy rating
- Percentage population attending education and skills development institutions
- Gender equality
- Percentage land under agriculture and irrigation
- Competitive index ranking of countries
- Percentage population with access to medical practitioners
- Number of tertiary educated people
- Dollar value of national savings
- Dollar value of revenue per capita
- Percentage land under tenure systems

Sietchiping, R. A., 2001, *African Renaissance. The development of a spatial information system for research, sustainable development in Africa.* 5th AfricaGIS conference, Nairobi, Kenya

- Distribution of tourism services and infrastructure
- Percentage population with disease (e.g. malaria, TB, HIV/Aids)
- Percentage adult illiteracy
- Percentage school going population enrolment in primary and secondary education
- Percentage adult and infant mortality
- Population fertility rate
- Percentage educated by level
- Geodemographics and lifestyle segmentation
- Extent of international and national migration

Sehmate, C.A., 2001, *African Renaissance. The development of a spatial information system for sustainable development in Africa*, 5th AfricaGIS conference, Nairobi, Kenya