FOUR: ENABLING g-GOVERNMENT IN THE GAUTENG CITY-REGION

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ABSTRACT
The term g-government, a subset of e-government, was first introduced in 2000 as the convergence of geographical information systems (GIS) and the Internet to create more effective government interaction with citizens. More recently, it has been revised to describe the combination of GIS and Web 2.0 technologies that can enhance government services and delivery. Most government data is spatially based and can be visualised and interpreted using a Web GIS mapping application, but this data is often not available to other government departments, or the general public, frustratingly so.

In South Africa, problems with accessing spatial data continue to exist. The Gauteng City-Region Observatory (GCRO) recognised that g-government remains a challenge within the Gauteng city-region (GCR), and in 2010 developed a GIS website for the GCRO and Gauteng Provincial Government. This article is presented in the context of the global shift to fully connected governments through technologies such as Government 2.0 and g-government. It provides a specific focus on the GCRO GIS website and how it enables g-government by providing local and provincial government with the spatial data and tools required to better understand the city-region, and to make informed decisions about future development in the city-region. The article also reviews Technology Acceptance Model (TAM) scores measured at the launch of the website. Finally, monthly website visits are examined. This confirms that local and provincial government are ready to utilise the g-government website.

KEYWORDS:
effective government, g-government, GIS, spatial data

BACKGROUND TO e-GOVERNMENT IN THE GAUTENG CITY-REGION

The Gauteng city-region (GCR) is an integrated cluster of cities, towns and urban nodes that together constitute the economic heartland of South Africa (Figure 1), accounting for 34% of national Gross Domestic Product (OECD, 2011). It is anchored by the three large metros of Johannesburg, Tshwane and Ekurhuleni, with a number of smaller urban centres that extend across the Gauteng Province to create an almost continuous urban agglomeration. The economic footprint of the GCR, however, extends beyond the border of Gauteng to include Rustenburg in the north-west, Potchefstroom and Klerksdorp in the south-west, Sasolburg in the south and Witbank, Middleburg and Secunda in the east. All of these centres are functionally integrated with the cities and towns of Gauteng and represent an extended GCR with a total population of 13 million that spills over into the three neighbouring provinces of North West, Free State and Mpumulanga.

The GCR is currently facing major socio-economic challenges. These include high unemployment rates (26.9% in Quarter 1, 2011), alarming levels of economic and spatial inequality and poverty (22.3% of households living in informal or traditional dwellings), persistent public housing backlogs and mounting environmental challenges such as rising water contamination and air pollution (OECD, 2011).

FIGURE 1: THE GAUTENG CITY-REGION (GCR)

Source: Wray, 2011

The GCRO was established in 2008 as a partnership between the Gauteng Provincial Government (GPG), the University of Johannesburg (UJ) and University of the Witwatersrand, Johannesburg (Wits). Local government is also represented on the GCRO board. Behind the motivation for setting up the GCRO is a vision for South Africa's economic heartland as a region that is competitive, spatially integrated, environmentally sustainable and socially inclusive. Better planning, management and cooperative government relies on improved data, information, analysis and reflective evaluation, which the GCRO seeks to provide.

A measure of success of the GCRO will be the provision of information such as the results from the 2009 Quality of Life survey,[1] in a usable format that is understood and used by government to develop future policies and programmes, as well as by the public to interact with the data or use it for their own purposes. GCRO recognised the need for g-government within the Gauteng city-region and a project was initiated at the start of 2010 to develop a Web 2.0 GIS mapping application to provide publicly accessible spatial data describing the GCR and to serve as a model for a g-government website.

1 The first Gauteng city-region-wide Quality of Life/customer satisfaction survey, completed in 2009, measures a wide range of issues such as levels of satisfaction with government services, poverty, socio-economic status, movement within the GCR and quality of life.

This article discusses the early introduction of g-government in South Africa in the context of a global shift to fully connected governments through technologies such as Government 2.0, g-government and opening access to government spatial data. The example of the GCRO GIS website will be considered in terms of how it enables g-government by providing both local and provincial government with the spatial data and tools required to better understand the GCR, and make informed decisions pertaining to future development. The website's initial acceptance, measured using a Technology Acceptance Model questionnaire, and subsequent usage is reviewed to provide an indication of the adoption of g-government applications by provincial and local governments governing the GCR.

DISCUSSION OF THE LITERATURE: THINKING GOVERNMENT 2.0

As the world advances towards an increasingly connected and spatially enabled Internet society, citizens and stakeholders are demanding that governments deliver more effective and efficient services as conventional governmental systems fail to address the current challenges of increasing globalisation, crime, poverty, pandemics and service delivery failure (Hughes, Macmillan & Medd, 2008). The post-apartheid phenomenon of violent service delivery protests in South Africa, with Gauteng as the most protest-afflicted province in 2010 (SABC, 2011), highlights the need for rapid improvements in service delivery, requiring new management tools. Governments need to respond to these new challenges and redefine how they manage and share information, make policies and deliver services. Hughes, MacMillan and Medd (2008) proclaim: "Change your world or the world will change you" in their report on the future of collaborative government and Web 2.0.

Web 2.0 is a second generation of web development and design technology, focusing on facilitating communication, information sharing, interoperability and collaboration on the Internet (Wikipedia contributors, 2009a). Web 2.0 is not just about new technologies such as blogs and wikis, it represents a shift in culture that views the Internet as a platform for deploying services, rather than merely as a source of information from static web pages (Hughes, Macmillan & Medd, 2008). Web 2.0 promotes the principles of sharing, collaboration and data integration on the Internet.

Internet users have embraced public Web 2.0 applications such as Flickr, MySpace, You Tube, Facebook and more recently the social networking and micro blogging application Twitter. The statistics are staggering, with over 500 million active users on Facebook (Facebook, 2010) and 190 million users tweeting 65 million times a day on Twitter (Schonfeld, 2010). Examples of Web 2.0 GIS websites include the commercial web mapping applications such as Google Maps, Microsoft Bing Maps, Google Earth, Yahoo Maps and Mapquest (Fu & Sun, 2011a). The use of these online map applications is also impressive with nearly a billion people having used Google Maps and at least 500 million having downloaded Google Earth (O'Doherty, 2010). Businesses and enterprises have similarly realised the advantages of Web 2.0. The 2009 McKinsey global survey reports that 69% of respondents' companies have gained measurable business benefits, such as more innovative products and services, more effective marketing, better access to knowledge, lower cost of doing business and higher revenues (McKinsey & Company, 2009). Companies are making use of social networking applications such as Facebook,

blogs and wikis to actively engage with customers and staff (Websense, 2008). Despite the recent recession, respondents also reported that they would continue to invest in Web 2.0 (McKinsey & Company, 2009).

When collaborative government, simply defined as working in conjunction with others (Wanna, 2008), is empowered by Web 2.0 technology, the result is referred to as Government 2.0. Government 2.0 is about leveraging the power of Internet-based Web 2.0 tools to change the way governments interact with society, share information and ultimately, achieve better outcomes for citizens (Hughes, Macmillan & Medd, 2008). g-Government relates to the use of electronic maps to improve Government 2.0. The value of GIS and spatial data to governments should be better understood, as much of government data is spatially based and is best visualised and interpreted using a Web GIS mapping application. For more than a decade, GIS remained a tool used only by GIS professionals, limiting the full potential of GIS as an analysis and problem solving tool (Pratt & Fu, 2011). Web 2.0 mapping applications such as Google Earth, however, have revolutionised public access to spatial data and GIS technology, forever altering public expectations of what is possible online. Governments need to meet these expectations by spatially enabling their data and systems with fresh innovative Web GIS mapping applications and opening access to their vast resources of data.

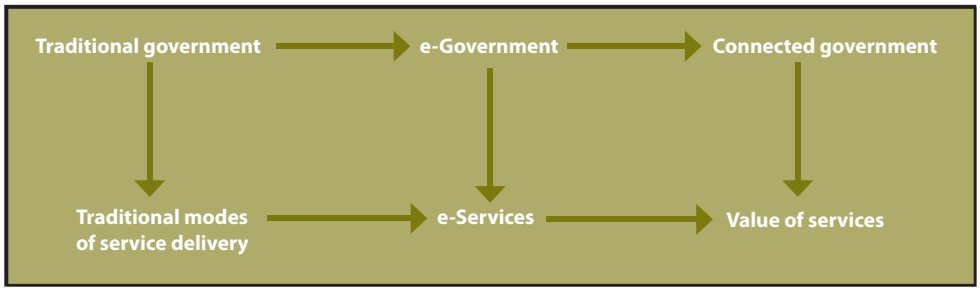
There are still many barriers to overcome as "constraints on access to data remain one of the greatest challenges to extending the use of Web GIS in government" (Pratt & Fu, 2011). Studies in Singapore have revealed that 83% of government departments required spatial data, but only 35% had access to the data and a mere 40% of spatial data was shared (Dasgupta, 2010a). A similar situation exists in South Africa, as Sharif (2009) has indicated there are still problems accessing government information, a concern that the Gauteng City-Region Observatory is attempting to address.

Governments around the world need to change the way they function and interact with society, or they will fail to overcome today's current challenges and will alienate their citizens (Hughes, Macmillan & Medd, 2008). This need has been primarily spurred by citizens around the world placing new demands on governments to reform the public sector (United Nations, 2008).

> *The days of governments at all levels – national, state/provincial or local – operating primarily as singular entities are over. Tomorrow's governments cannot deliver the policy outcomes that society expects if they continue to hold onto yesterday's monolithic-leadership model* (Hughes, Macmillan & Medd, 2008).

The evolving approach to public service delivery is illustrated in Figure 2 with an initial shift from traditional government and modes of delivery to e-government and e-services, to a new paradigm of a fully connected government committed to enhancing the value of services available for all citizens (United Nations, 2008).

FIGURE 2: EVOLVING APPROACH TO PUBLIC SERVICE DELIVERY



Source: United Nations, 2008

The first wave of e-government, which focused on "the use of information and communication technology to provide and improve government services, transactions and interactions with citizens, businesses and other arms of government" (Wikipedia contributors, 2009b), was a significant step forward with regard to interacting with and making information available to citizens. Web 2.0 is proposed as the latest technological initiative to assist in bringing governments closer to their citizens (Hui & Hayllar, 2010) and opening access to government data, ushering in a second wave of e-government.

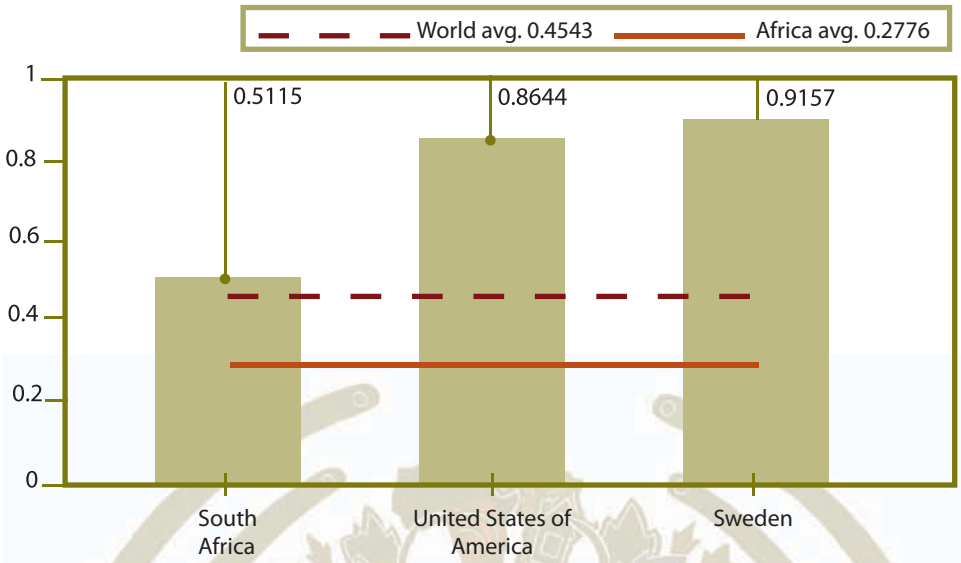
However, governments themselves have not been transformed and need to embrace a new networked model of government (Hughes, Macmillan & Medd, 2008). This need to transform, together with emerging Web 2.0 technologies, will facilitate a new form of collaboration to improve how governments function together with other governments, non-governmental organisations (NGOs), the private sector and citizens, to solve complex problems and enhance service delivery. Elements of Government 2.0 include collaboration, mashups, social networking, user generated content such as crowd sourcing and Volunteered Geographic Information[2], cloud computing and open systems (Evans, 2010).

The 2008 United Nations survey report of e-government readiness[3], which presents an assessment of e-government progress across the world, ranked South Africa 61 out of a total of 189 countries, with an e-readiness score of 0.5115 (United Nations, 2008). The survey was led by Sweden (0.9157) followed by Denmark, Norway and the United States. Africa as a region lagged far behind the world average of 0.4543, with a score of 0.2776 (Figure 3).

2 Volunteered Geographic Information (VGI), is defined by Goodchild (2007) as the creation of geographic information on the web by large numbers of private citizens.

3 The e-government readiness index is a composite index comprising the web measure index, the telecommunication infrastructure index and the human capital index, with the survey focusing mainly on the "government to citizen" (G to C) and "government to government" (G to G) aspects of e-government (United Nations, 2008).

FIGURE 3: 2008 E-READINESS COMPARISON



Source: United Nations, 2009

The E-Government Survey 2010: Leveraging e-government at a time of financial and economic crisis, concludes that "citizens are benefiting from more advanced e-service delivery, better access to information, more efficient government, management and improved interactions with governments, primarily as a result of increasing use by the public sector of information and communications technology" (United Nations, 2010). However, of concern is the decline of South Africa's ranking from 61 to 97 out of 184 countries, with an e-government development index[4] score of 0.4306, its lowest score since the first global e-government survey report was released in 2003. This 2010 index score, listed in Table 1, places South Africa fourth in the African region, behind Tunisia, Mauritius and Egypt.

The reason for South Africa's drastic drop in rankings is not given in the report, but may in part be due to significant changes to the survey instruments that were introduced, which focused more on how governments are using websites and portals to deliver public services and increase opportunities for their citizens to participate in decisionmaking (United Nations, 2010). The majority of the countries' rankings decreased slightly compared with the 2008 survey, but the report makes a pertinent point: "a drop in a country's ranking may serve as a reminder of the need to devote greater resources to improving online services and expanding access to telecommunication infrastructure" (United Nations, 2010). These pointers serve as important foci for the South African government in improving e-government services.

4 e-Government development index is a weighted average of three normalised scores on the most important dimensions of e-government, namely: scope and quality of online services, telecommunication connectivity, and human capacity (United Nations, 2010).

TABLE 1: 2010 UNITED NATIONS RANKING OF E-DEVELOPMENT IN AFRICA

		e-Government development index value		World e-government development ranking	
Rank	Country	2010	2008	2010	2008
1	Tunisia	0.4826	0.3458	66	124
2	Mauritius	0.4645	0.5086	77	63
3	Egypt	0.4518	0.4767	86	79
4	South Africa	0.4306	0.5115	97	61
5	Seychelles	0.4179	0.4942	104	69
6	Cape Verde	0.4054	0.4158	108	104
7	Libya	0.3799	0.3546	114	120
8	Botswana	0.3627	0.3647	117	118
9	Lesotho	0.3512	0.3805	121	114
10	Gabon	0.3420	0.3228	123	129
	World average	0.4406	0.4514		

Source: United Nations, 2010

At the 2008 Govtech conference, national government decisionmakers promised that the South African government would not be left behind and was working towards a Government 2.0 model with real time access to information for both government and its citizens (Du Toit, 2008). The R2.5 billion "Who am I" online project with smart identity cards, by the Department of Home Affairs, was listed as a prime example of a Government 2.0 project. However, previous failures of expensive government IT applications and projects, such as the R408 million eNaTIS project, which made headlines as a result of a number of system failures and shortcomings raised by the Auditor-General (Hoskin, 2008; SAPA, 2007), may influence government's willingness to adopt and invest in new applications and technology. The web as an information sharing tool is also restricted within some government spheres, with a number of local municipalities struggling to get broadband Internet access (Tate, 2005), a situation which has not changed significantly in recent years. e-Government and Government 2.0 remain a challenge in South Africa.

G-GOVERNMENT (WEB 2.0 GIS) AND OPEN ACCESS TO PUBLIC DATA

g-Government is defined as using the Internet and GIS to create more effective government (Thomas, 2001). The g-government definition has been recently updated by describing the use of GIS and new Web 2.0 technologies as g-government (Tickner, 2009). According to Dangermond, ESRI President, it is all about Web GIS extending the vision of e-government (Artz, 2009). Approximately 80% of government data is spatially based (Pratt & Fu, 2011) and can be best visualised and interpreted using a Web GIS mapping application. Tickner (2009) states that g-government can enhance the way governments connect with citizens by hosting map web portals to organise and display the vast government data resources.

As a key component of the Web 2.0 revolution, O'Reilly (2005) recognised that data would provide the competitive advantage in harnessing collective intelligence: "Data is the 'Intel Inside' of the next

generation of computer applications". Parsons (2010), a geospatial technologist at Google, expands this by stating that "there is a simple relationship between ease of access to information and economic activity". Although not as yet quantified, each new technological advance that resulted in more effective publication and distribution of information has generated massive economic activity by creating new markets and businesses (Parsons, 2010). O'Reilly quotes the example of the Apple iPhone that has attracted some 150 000 applications, but almost none of which were developed by Apple itself (Chafkin, 2010).

INTERNATIONAL EXAMPLES OF G-GOVERNMENT

The United States has been a strong supporter of g-government, where in 2000 the term "G-Gov" first appeared when then Vice President Gore realised its potential: "We have an unparalleled opportunity to turn a flood of raw data into understandable information about our society and planet" (Tickner, 2009). As compared to other parts of the world, where GIS adoption has been slow due to government data not being freely available, government data in the United States has been made freely available for a number of years, resulting in the widespread use of GIS and varied GIS applications (Ball, 2009). The MD iMap viewer utilised in the State of Maryland is just one example of a Web 2.0 mapping application which provides both government and public access to the State's enterprise GIS, by combining maps with government performance statistics and graphs in a rich Internet application (RIA) (ESRI, 2009). The initiative was recognised by President Obama during an address to the National Governors Association on 23 February, 2009: "Instead of passing the buck on accountability and efficiency, governors like Martin O'Malley and Governor Kaine have revolutionised performance management systems, showing the American people precisely how their governments are working for them" (ESRI, 2009).

Other countries are also beginning to realise the importance of g-government and open access to data. The United Kingdom's (UK) Ordnance Survey (OS), which traditionally charged for access to its data, launched the OS OpenData initiative on 1 April 2010. OS OpenData is an online portal providing free access to a range of GIS layers (Ordnance Survey, 2010a) and web map development tools such as the OS OpenSpace API (Application Programming Interface). The quote below, from Ordnance Survey Communities Secretary Denham, summarises the benefits of g-government and opening access to public data:

> "This shows the UK is at the cutting edge of a digital revolution. The move to free up public data encourages fresh thinking – people re-using information in different and more imaginative ways than may have originally been intended. A seemingly endless stream of new applications and websites continues to show the potential of combining information, creative vision and digital technology. Increasing access to Ordnance Survey data will attract a new wave of entrepreneurs and result in new solutions to old problems that will benefit us all. It will also drive a new industry, creating new jobs and driving future growth. The changes signal a wider cultural change in Government based on an assumption that information should be in the public domain unless there is a good reason not to – not the other way around. Greater openness, accountability and transparency in Government will give people greater choice and make it easier for individuals to get more directly involved in issues that matter to them" (Ordnance Survey, 2010a).

The UK government is further enhancing the use of government data through the "Show us a better way" website run on behalf of UK government by the Power of Information Taskforce (Power of Information Taskforce, 2010). The website promotes new and innovative uses of public government datasets, through a competition that funds good ideas of proposed applications to be built with public information, with examples such as crime mapping, fix my street and farm subsidy maps. Ordnance Survey has a specific GIS-based competition called GeoVation, innovation through geography, which aims to help "communities address their unmet needs through the application of geographic data, skills and expertise" (Ordnance Survey, 2010b). These are excellent examples of a true realisation of Government 2.0 and g-government, with citizen participation in uploading data and presenting ideas to the government, and government supporting and funding the use of government data and development of applications that meet the needs of communities.

G-GOVERNMENT IN THE SOUTH AFRICAN CONTEXT

South Africa has numerous spatial data policies and legislation in place, such as the Promotion of Access to Information Act (Act 2 of 2000) and Spatial Data Infrastructure (SDI) Act (Act 54 of 2003), that were designed to promote access to information. However, there are still problems accessing government or public sector information (PSI) in South Africa, such as:

- "Open availability of information.
- Lack of systematic approach to collect, manage and store the data.
- Institutional and socio-cultural barriers.
- Poor quality and quantity of data and information at municipal levels.
- Timeliness of information.
- Reliability of information (use of private external consultants and the difficulty to verify and trust the methodologies used in these reports).
- Lack of the culture of appreciating the value of PSI" (Sharif, 2009).

Clarke, Chief Director: National Geo-spatial Information in the Department of Rural Development and Land Affairs, argues that institutions continue to operate in silos with limited cooperation between key stakeholders (Dasgupta, 2010b). Sharif (2009) maintains that it is not the policies that are the problem, but rather the implementation of PSI policy. For example, it has taken seven years from the promulgation of the SDI Act to the formation and first meeting of the Committee for Spatial Information (CSI), a committee responsible for the successful implementation of South Africa's SDI and for ensuring that South Africa makes effective use of its geospatial data for the benefit of all its citizens (Van Zweiten, 2010).

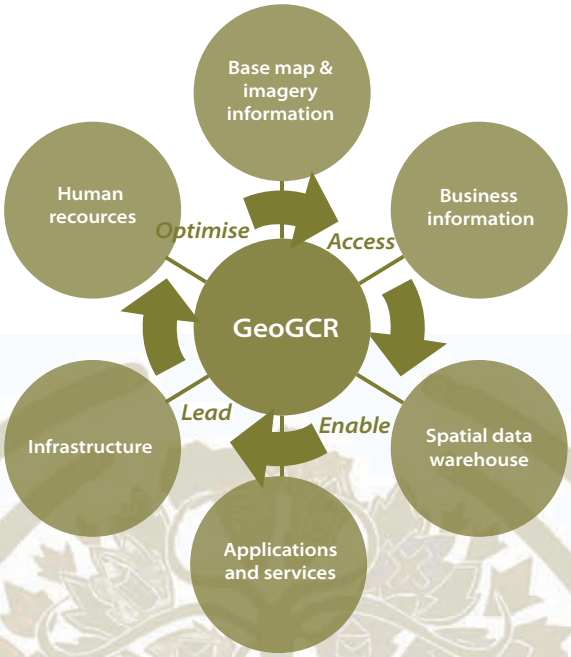
Many of the national base mapping layers such as 1:50 000 topographical layers and 1:10 000 orthophoto map series are freely available from the national mapping organisation, the Chief Directorate National Geo-spatial Information (CDNGI) (Vorster & Duesimi, 2010). However, access to the CDNGI data is obtained through manual requests and a copy of the data delivered on a DVD (Digital Versatile Disc) or hard drive. The CDNGI is attempting to rectify this by developing a multi-server environment to provide seamless direct access to all the CDNGI's spatial and related data through an Intranet/Internet web portal with Web Feature Services (WFS) and Web Map Services (WMS) (Vorster & Duesimi, 2010).

At a provincial level, data is not publicly accessible and it is often only available to other provincial or local departments through personal relationships. The Cape Urban Observatory (CUO) is working on a Memorandum of Understanding (MOU) between the Western Cape Provincial Government and the City of Cape Town (Cape Urban Observatory, 2009). "These negotiations aim to facilitate formal relations between the two organisations, reducing the reliance on personal relationships and providing a clear data sharing framework" (Cape Urban Observatory, 2009). Furthermore, improved integration of spatial data between national, provincial and local government in the Western Cape is being facilitated by the CUO through the development of a regional SDI (Smit, Makanga, Lance & De Vries, 2009).

Within the GCR, online access to spatial information in the GPG is limited and not publicly accessible via web mapping services. Furthermore, some GPG staff have expressed frustration with the lack of access to shared spatial information within the various Gauteng departments (Wray, 2009). The Gauteng Department of Economic Development (GDED) has recognised the need to fundamentally transform provincial information service delivery and launched an ambitious project in 2010 called the GeoGCR, or Geographic Information System for the Gauteng City-Region (GDED, 2008; Kekana, 2010). The project, depicted in Figure 4 aims to provide:

- Access – through the establishment of a single gateway to provincial geographic information.
- Enablement – by spatially enabling the public sector.
- Optimisation – by defining the legal, hardware and software requirements to make use of the latest mapping technologies.
- Leadership – by leading the way in public sector data and infrastructure provisioning and meeting the business needs of each stakeholder.

FIGURE 4: THE BUILDING BLOCKS OF THE GAUTENG GEOGCR



Source: Kekana, 2010

Web GIS applications are available at a municipal level within the larger metropolitan municipalities in the GCR. A study by Ogra and Singh (2011) assessed the geospatial readiness of Ekurhuleni, City of Johannesburg and City of Tshwane metropolitan municipalities in terms of "geospatial readiness of local governments in providing Web-enabled citizen centric services". The study concluded that the level of e-governance services are at differing levels of maturity within local government, with existing citizen access to basic information such as water supply, electricity and building plans, but with further scope for the integration of and access to citizen centric services such as solid waste management, emergency services, social and other community assets. Ogra and Singh (2011) also recommend that municipalities should strengthen their decisionmaking for better planning, governance and management, through geospatial analysis across various municipal services.

It is clear that in order to overcome the many policy implementation problems, to create effective public services and ensure open and easy accessibility to government data, a high level of coordination and collaboration is urgently required (Sharif, 2009). Some of the measures proposed by Sharif (2009) include: increasing the awareness about the importance of public sector information and implementing new follow-up, monitoring and evaluation methods and activities to ensure effective utilisation of public sector information. This is the role that the newly formed CSI has to fulfil in order to meet the geospatial needs of the country, and the GCRO has to fulfil to satisfy the g-government requirements for the GCR.

GCRO GIS WEBSITE DEVELOPMENT

There was an initial focus by the GCRO, in its first year of operation in 2009, to collect existing government base datasets and generate new datasets to be used to map and research the city-region. Various maps were prepared and made available as pdf/jpeg downloads on the GCRO website (www.gcro.ac.za). However, the GCRO recognised that in order to ensure that the GCR information was fully utilised, the GIS maps and data needed to be visualised in a dynamic interactive GIS website. This website would enable the users to have a better understanding of the GCR by providing base data and thematic layers offering different perspectives of the GCR, such as population distribution, poverty and the 2009 Quality of Life survey results as maps and dynamic graphs; and GIS analysis tools for the user to make better informed decisions and policies regarding the future development of the GCR.

The primary users of the application were identified as the main GCRO stakeholders, namely the GPG Planning Commission, GPG Office of the Premier, GPG Department of Economic Development, local government officials and other GCR government agencies. These users are responsible for planning the future development and direction of the GCR and are mostly high-ranking government officials with minimal mapping or GIS experience. Hence the need for a simple "Google Maps-like" Web GIS design. Public access was also a requirement to ensure open access to information about the GCR, through the Internet, to all GCR citizens.

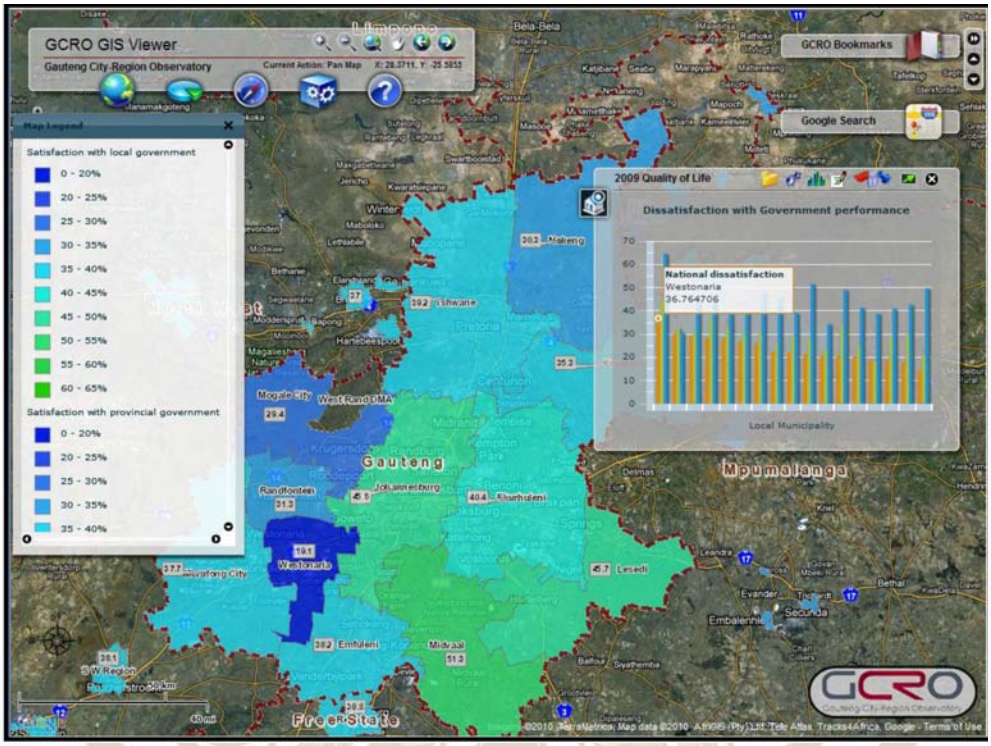
To obtain and maintain the latest data from the local and district municipalities and provincial governments constituting the GCR would require a devoted effort, given that data availability, accuracy and currency varies greatly across the different authorities. Many freely available mapping websites such as Google Maps offer more up-to-date imagery and base layers, such as streets, than the data available within government departments. GCRO recognised that online spatial datasets can provide a viable alternative to sourcing base datasets, including imagery and streets, and deliver seamless mapping coverage across a wide area. Web 2.0 technologies such as data mashups and APIs provide the tools to access these online datasets.

There are numerous sources of online base datasets: Google maps, Bing maps and ESRI online resources. Other sources include open data initiatives, such as OpenStreetMap, which offer free (licensed under the terms of the Creative Commons Attribution Share-Alike 2.0 licence) downloadable street datasets for the world (OpenStreetMap, 2009). Google Maps was found to offer the most up to date imagery and dynamic functionality such as Google street view, and was therefore selected to provide the base layers in the GCRO GIS website application.

With regard to the various GIS layers that had been assembled, the GIS data was divided into several themes that users could interact with individually, or overlay layers from different themes. Six themes were prepared for the first release of the viewer, namely: GCRO administrative layers, demographics, GCRO 2009 Quality of Life Survey, economic, spatial structure and transport data. The development of these data themes is an ongoing process as more GCR data becomes available or is generated from GIS data projects or analysis.

The GIS website, developed using ESRI software with the Adobe Flex API, is viewable in all the main Internet browsers (such as Internet Explorer, Safari, Firefox and Google Chrome), but does require the Adobe Flash Player plugin (version 9) to be installed. The website offers comprehensive base data and thematic layers covering the GCR, and is fast and easy to use, with a fun element of RIA popup windows and dynamic graphs. An example is provided in Figure 5 with the 2009 Quality of Life Survey "satisfaction with local government" layer shown on the map, and "dissatisfaction with government performance" drawn in the graph.

FIGURE 5: QUALITY OF LIFE (QOL) DYNAMIC THEME WITH GRAPH



Source: Wray, 2011

GCRO GIS WEBSITE LAUNCH AND SUBSEQUENT USAGE

The GIS website was formally launched by the Observatory on 1 September 2010, with launch sessions held over three days at the Wits School of Electrical and Information Engineering's computer lab. Each session focused on a different group of users, ie government GIS specialists, local government officials involved in planning, and provincial Heads of Department. After an introduction explaining the business need for the GIS website and development process, an interactive demonstration of the website was presented, with participants able to actively interact with the various tools and datasets using the engineering lab computers. Attendees then evaluated the website by completing an online questionnaire, designed to measure user acceptance of the new application, using the Technology Acceptance Model (TAM), the most widely employed model of IT adoption and use (Venkatesh & Bala, 2008).

In response to the question regarding website usage, the 38 respondents were unanimous in agreeing that they would utilise the website, with an average TAM score of 6.82 out of a possible 7 for behavioural intention to use. This is supported by comments from the questionnaire such as:

> *Our district does not have access or rather developed systems to access some geographical data, therefore this website will definitely help us access some of this information and improve the effectiveness in our tasks.*

In terms of usage, two thirds of the respondents (68.4%) replied that they would use the website on a daily or weekly basis, with the main use of the website identified as accessing GCR data (87%), followed by 71% of respondents intending to use the website to assist with planning. The overwhelmingly positive response is evident in the Wordle[5] graphic of launch questionnaire comments (Figure 6).

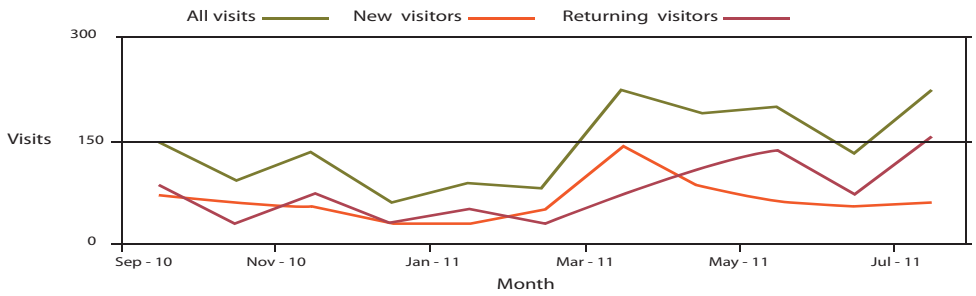
FIGURE 6: WORDLE GRAPHIC OF COMMENTS FROM THE LAUNCH QUESTIONNAIRE

Source: Wray, 2011

Actual usage of the website has been monitored with Google Analytics statistics, which captured a total of 1 571 visits to the GCRO GIS website over the period 1 September 2010 to 31 July 2011, with 55% logged as returning visitors, and 45% as new visitors. Figure 7 illustrates that usage peaked in March and July 2011 with an overall upward trend of usage, specifically with returning visitors. The data indicates continued new interest in the website, as well as regular returning users. However, it is good website practice to continually market or update the website with new data or tools to ensure continued interest, a process that GCRO is undertaking.

5 Wordle is a free online application for generating "word clouds" from text with greater prominence given to words that appear more frequently in the source text (Feinberg, 2009).

FIGURE 7: GCRO GIS WEBSITE TOTAL NUMBER OF VISITS PER MONTH



Source: GCRO, 2011, compiled from analysis of GIS website visits

A total of 1 350 of the visits (86%) were from South Africa, with 57% of the South African visits captured as returning visitors. Within South Africa, the website was mainly accessed from Gauteng, with 1 150 visits representing 85% of South African visits and 73% of the total visits.

An important acknowledgement of the website's success is an approach from the Gauteng Department of Agriculture and Rural Development (GDARD) to host an environmental theme on the GCRO website. Due to the lack of an external GIS website and restrictive IT policies that prevent external publishing of the department's GIS data, GDARD was limited in making environmental data available to the public. A Memorandum of Understanding was drafted to provide for cooperation on data sharing and web hosting in terms of a GCRO GIS website environmental theme. This new website theme enables government and public users to overlay and print GDARD layers with various Google Maps and GCRO GIS layers, thus providing access to and basic analysis of provincial environmental data. The website was recently commended by a public environmental non-profit organisation that utilised the environmental theme to visually present property development proposals in relation to the provincial environmental data, illustrating the benefits of g-government for ordinary citizens. The Gauteng Department of Sports, Arts, Culture and Recreation has also expressed an interest for GCRO to host the provincial sports data sets.

The Google Analytics statistics, responses from government employees who attended the launch, approaches by provincial government departments to host their department's data and examples of public usage of the site, confirm that the g-government website is being utilised by government to provide information and assist with planning and policymaking within the GCR; and by citizens to access spatial government information, with specific examples of citizen usage being visualising current environmental policy (including the GDARD layers) and planning for future development (with attention to the spatial structure theme layers, such as the urban development boundary). However, the true value of the GIS website is the easily integrated manner in which users can visualise, overlay and map different statistics and themes, made possible through Web GIS.

CONCLUSIONS

> *Harnessing the power of Web GIS will greatly benefit, or even determine, the future of many organisations* (Fu & Sun, 2011b).

Web 2.0 has revolutionised the Internet and the way we interact with information and people, by offering new ways to collaborate and communicate, and providing exciting new Web GIS applications and sources of online spatial data. This presents governments with an opportunity to evolve towards a new form of connected e-government with enhanced value of services for all citizens through Government 2.0. According to O'Reilly, one of the pioneers of Web 2.0, not only is Government 2.0 the future of technology, but the future of democracy (Chafkin, 2010).

This article has focused on g-government within the Gauteng city-region. By combining the use of GIS and Web 2.0 technologies, g-government uses Web GIS to promote collaboration within government and connect to its citizens through online maps and spatial data. South Africa, however, still faces many challenges with regard to g-government, with the United Nations e-government survey 2010 indicating a decline in South Africa's e-government development, thereby highlighting the need to devote greater resources to enhancing online services and increasing access to ICT infrastructure (United Nations, 2010).

There are still problems accessing government information (Sharif, 2009), with limited cooperation and institutions operating in silos (Dasgupta, 2010b). It is promising, however, that there are attempts to address these challenges with a number of Web GIS projects such as the CDNGI Intranet/Internet web mapping portal, the CUO's attempts to establish an MOU and regional SDI with Western Cape provincial and local governments, and the GeoGCR initiative to provide a single gateway to Gauteng's spatial information.

The GCRO recognised the need to provide online spatial information and GIS tools to develop a better understanding of the GCR, assist the GCR policymakers to make more informed decisions and open up public access to government datasets. This business need was met through the development of a g-government solution for the provincial and local government stakeholders within the GCR. It makes use of Web 2.0 technologies, such as data mashups, to integrate data from various sources. It is one of the first government GIS websites in South Africa to utilise open datasets such as Google Maps to provide the base data and tap into the Google Maps search engine to provide powerful searching capabilities.

The TAM questionnaire results from the website launch and website usage statistics from Google Analytics have confirmed that a Web 2.0 GIS g-government website site has been successfully developed for the GCRO and local and provincial government, by turning government data and GIS layers into dynamic interactive maps and graphs, easily accessible by both policymakers and citizens.

The g-government website has an important role within the city-region as the GCRO, GPG and Gauteng Planning Commission attempt to improve the way government connects with its

citizens and promote coordination between different departments within the Gauteng province and between the different spheres of local and provincial government. It is hoped that the g-government website will serve as a prototype for the GeoGCR plan that the GPG is embarking on. Furthermore, as the success of the GCR is of national importance, it is also anticipated that the website will be a vital tool for the newly constituted National Planning Commission, tasked with contributing towards the South African government's long-term plans and strategic vision through the production of high quality, evidence-based research (South African Government: The Presidency, 2010).

Further innovation is required for the extensive adoption of g-government. The next phase of website development will focus on upgrading to the latest version of the ESRI Flex viewer and providing the functionality, as requested by the launch questionnaire respondents, for users to incorporate their own data (in ESRI shapefile format or WMS) into this g-government application.

With the growing availability of mobile phone Web GIS applications, such as Google Maps for mobile and ESRI mobile phone APIs, and increasing numbers of mobile phone users accessing the Internet through smartphones, further research consideration should be given to the mobile platform for provision of g-government. Not only can information be served to mobile phone applications, but government employees and citizens can feed information back to government.

Mobile phones can be used as locational devices, serving as valuable sensory input to government information systems as Volunteered Geographic Information. The health-enabling mobile phone pilot project, Impilo Health in our Hands, launched in 2009, utilised the mobile phone user's location (as determined by the Impilo application) to provide access to health and welfare information from the HIV-911 database at a cost of just ZAR0.20 a call (AMREF South Africa, 2012). This inexpensive solution is an example of an interactive mobile service that governments should be developing to provide Government 2.0 services accessible by all communities including the poor.

According to Williamson (Dasgupta, 2010b), "The need is to manage information spatially and not manage spatial information". g-Government provides the technology to achieve this and the GCR governments and stakeholders have embraced the GCRO GIS website. Further research should provide insight into the tangible benefits and public use of g-government, to direct future g-government innovation.

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