Multi-disciplinary City Management through Web-Based GIS

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Abstract

Urbanization continues to grow at a rapid pace. This is the first time ever in humanity's history that more people are living in cities rather than rural areas. With over 50% of the Global population urbanized. In Africa ~40% live in cities. As a result, city infrastructure is under huge pressure to cope with the growing demand. City governments need to implement more efficient and effective management procedures to counteract this growing demand and plan for future urbanization. Implementing a single geospatial platform can be used to create collaboration and coordination between all departments including public transport, water & sanitation, electricity and emergency planning. Intergraph's GeoMedia SmartClient (Web-based GIS) provides a superior planning, management and maintenance tool for the increased infrastructure demands evident in cities. It focuses on automated geographical workflows to enable city planners and department managers to implement infrastructure more efficiently and cost effectively, while ensuring collaboration between departments and efficient roll-out of project implementation. City government departments have unlimited access to this application allowing further department specific workflows to be derived thus enhancing information sharing and making all facets of city management smarter and simpler. This paper will aim to give an overview of this solution and how it can be implemented throughout city municipalities.

1. Introduction

Traditionally cities have operated as silos of productivity connected by a paper chain and management, where each Department has its own style of operation, dictated by its deliverables. In the early days of GIS and digital mapping, most cities' operational strategy was for a request to be placed with the mapping office for the production of a map to be used in Planning, Operations or Reporting. This would then require the person who requested the map to wait until their request reached the top of the pile. Similarly, when the status of an item changed, the relevant attribute would be updated in the GIS database (or other system) after the relevant data capturer was given the notification.

Many cities are, however, still underutilising their GIS data as a resource. In the past few years mapping applications on the internet and on mobile phones have become common and so this sort of interface is no longer a foreign concept of interest or fear but rather a tool that is being used more and more in everyday life.

GIS practitioners who have been in the industry for a few years have an idea of the financial

commitment required for a GIS. A closer look at the costs of hardware, software, data sourcing, human resources in terms of training and salaries makes this very apparent. Additionally, users get tied into maintenance, because the data is losing value as it ages. So it makes sense that city managers would like to let the GIS at least pay for itself rather than be a financial burden, or ideally even save the city money.

We introduce the use of GeoMedia SmartClient to do just that, if structured correctly to optimise the workflow of most every section in every department in your cities organisation; its scalability can pay for itself and save cities money.

2. Background

According to the Population Institute, the world's population reached 7 Billion in 2011 and is expected to reach 8 billion by 2024. At predicted fertility rates it will reach 9 billion by 2042 (Population Institute, 2014). The Population Institute is an international non-profit organisation with their head office in Washington DC that educates policymakers and the public about population. It also seeks to promote universal access to family planning information, education, and voluntary family planning services. They strive towards achieving a world population in balance with a healthy global environment and resource base.

Following current media reports we know that globally there are environmental issues effecting health, food security, ecology and such. We also know that much of the environmental issues have been caused by industrialisation which in turn has created cities as we know them today. According to a report compiled for the European Parliament (Manville C et al, 2014), the world's urban population is expected to double by 2050. By 2030, 60% of all people will live in cities, and the United Nations forecasts that in 2050, 70% of the world population will be living in urban environments.

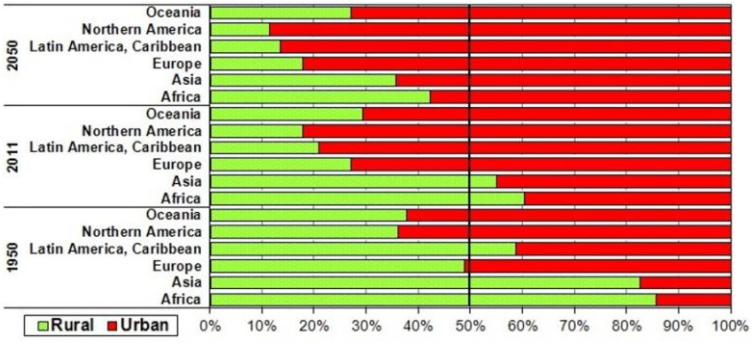

Figure 1. Urban and rural population by development regions (United Nations, 2011)

As South Africans we know that our towns and cities are under strain in part due to, a high rate of urbanisation. We also know that resources are limited. However this is not a situation wholly endemic to South Africa. Globally many cities are under strain due to urbanisation rate, population

growth and dwindling resources. Thus we can truthfully state that Urban Environments are under pressure and City Managers need to be smart with their allocation of resources. This cannot just be an optional operational choice; it is needed to tackle overcrowding, poverty, inequality, energy consumption, resource management and environmental issues.

3. Solution

3.1 City Managers Efforts Internationally

In recognition of this, the smart city movement was started. 'Smart City' is a concept and a collaboration of urban experts and thinkers, city government representatives and companies, sharing experiences and approaches to current urban challenges, transforming cities into smart, sustainable and more liveable places (Fira de Barcelona 2014). There is still no complete consensus on the definition of a 'Smart City', however there is much agreement. A smart city is enabled by the use of Information and Communication Technologies (ICT's) and is aimed at enhancing sustainability, quality of life and urban welfare. A smart city is a unified urban entity and does not have fragmented projects that result in over costly ventures (Abdoullaev A, 2014). A smart city does not just use smart technology, applications and systems; it plans, develops and manages as the unified entity. In a report compiled for the European Parliament (Manville C, 2014), the 6 proposed characteristics of a Smart city are:

- Smart Governance
- Smart Economy
- Smart Mobility
- Smart Environment
- Smart People
- Smart Living,

where each component is ICT enabled and linked as a unified urban entity. Regular Smart City Expos are being held. In November 2014, the Smart City Expo - World Congress - will be held in Barcelona. In March this year, the first Smart City Expo in an Asian city was held in Kyoto. Ms Pilar Conesa, Director of the Smart City Expo World Congress 2014 says that "Smart cities are a platform for Technology-led economic growth. Importantly, they are also an opportunity to demonstrate our commitment to making cities more sustainable and humane." (Conesa P, 2013)

To quote Denise Lee of Deloitte Africa which is the South African member firm of Deloitte Touche Tohmatsu Limited; "When compared to mature cities like London and New York, African cities can currently be considered to be behind the 'competitive' curve" as far as Smart Cities are concerned. She goes on to say that African cities can, through the successful adoption of the ideology and technology underpinning the Smart Cities concept, become globally competitive (Lee D, 2014). That it is through the adoption of suitable technologies and lessons learned from mature cities that the anticipated growth can be exponential in function, economy and social wellbeing. Johannesburg City Metro claims to be on track to become Africa's first Smart city (Johannesburg

2014).

Nationally we can say that city governments need to seek to implement the most efficient and effective management procedures to plan for and manage future and current urbanization with all its encompassing facets.

3.2 GeoMedia SmartClient

Geomatics practitioners know that a map says a thousand words. They might even be accused of being biased in our belief that they are the best tool for most planning and communication needs. With the advances in software and hardware, a web based GIS offers a platform that can be used to collaborate and coordinate between City Government Departments to provide a more efficient, operational and planning tool in the form of Software as a Service (SaaS).

The solution we believe to be the best available and that GDD offers is Intergraph's 'GeoMedia SmartClient' (GMSC) launched by Intergraph in 2012. Geomedia SmartClient SaaS offers you web-based geospatially enabled workflows allowing all the employees in your organisation to engage the power of the web and GIS within each Section, with built in Departmental workflows tailored to your cities advantage (task orientated and optimised). GMSC is ideally suited to city wide deployment where you have a single GMSC server installed with multiple workflows, where each is designed for a Section within each Department. Every employee and contractor of your city can have access to the specific Information and tools they need to do only their assigned task. This is crucial when one considers the volume of data housed in a typical city GIS. For example, the city of Zurich, the largest city in Switzerland has about 600 different layers in its system. This figure comes from Zurichs' Head of Geoinformatics Department, Mr René Müller (Intergraph 2013).

GeoMedia SmartClient is also a cornerstone to the increasing use of real time monitoring equipment which is one of the necessities in the development of a smart city. A working version of GeoMedia SmartClient can be accessed via the Hexagon Geospatial website at <http://smartclient.intergraph.at/GMSC/en/> where the user name and password are both 'GMSC'.

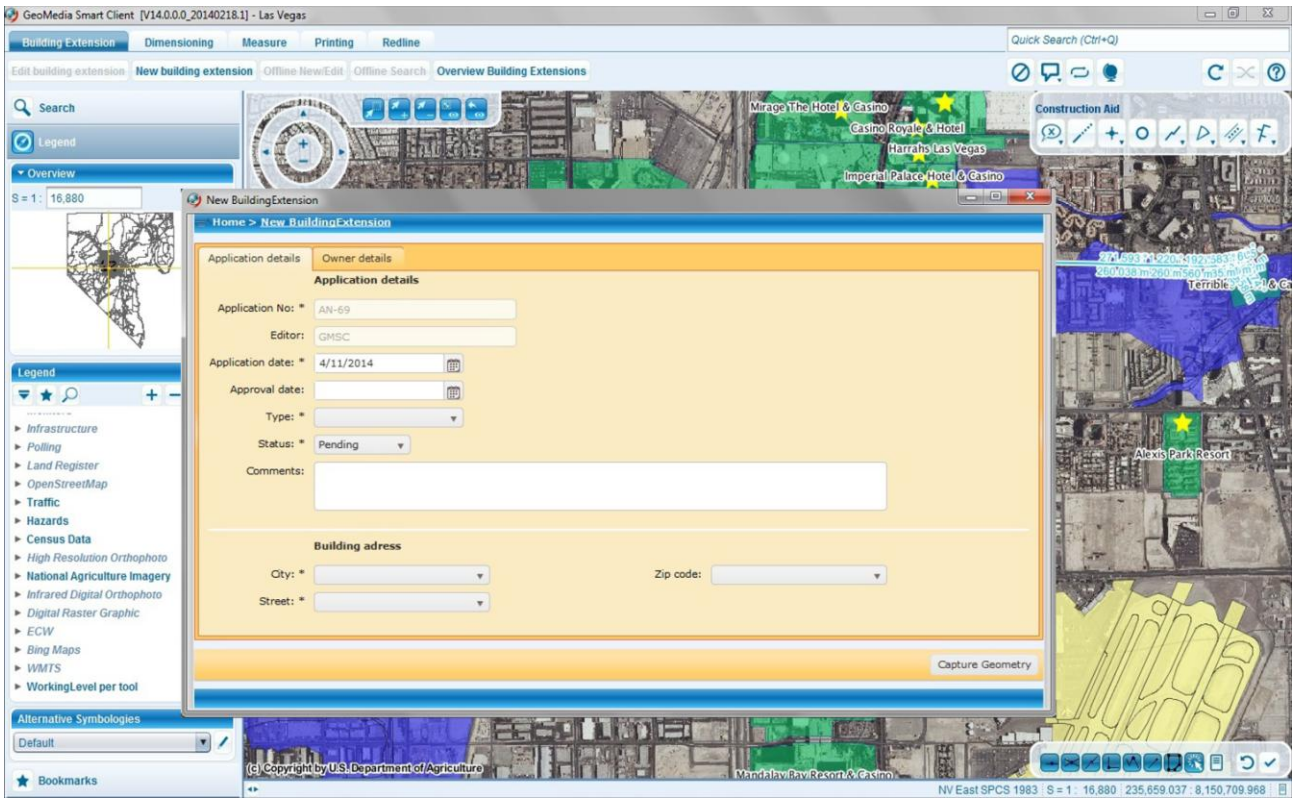

Figure 2. A screenshot from the Intergraph GeoMedia SmartClient Demo installation.

One can use GeoMedia SmartClient for workflows in anything from asset management to billing, electricity, guiding field crews, dealing with storm damage, issuing permits, building inspections, coordination of resources, planning, enhancing the running of infrastructure, dealing with public safety, health, parks, pollution monitoring, waterworks, sewage, tourism, street lights and zoning. All the while with coordinated data access, models, and workflows. Making it easier to use and hand over to junior engineers.

3.2.1 GMSC Technical specifications

One GeoMedia SmartClient licenced to a City is infinitely scalable with an uncapped amount of organisational users (Intergraph 2014).

Using XML based workflow and rules definition tools you can create role and departmental specific interface forms as well as GIS data validation and business rules to be enforced during data capture to prevent errors and speed up systems, procedures and processes.

- All modifications to the City data are made on the enterprise database.
- Data and workflow access is controlled on the server using administrative tools and user logins.
- Advanced editing tools are provided and can be customised to the individual user group workflow.
- Data may be cached on client machines thereby allowing faster displays and off-line work when connectivity is an issue. This is especially handy when mobile devices are used. Any java enabled mobile device can be used, this because the caching functionality requires Java.

- Native 64-bit and multicore enables parallel processing.
- Simple to support and install as everything is in one location.
- Attributes update live (when on-line) – so for example; if permits are being issued, one can track the progress and take action timeously with works orders or any such process. This can be especially useful in emergencies.
- GMSC can connect to ESRI Enterprise Geodatabases already in place and can be used with other enterprise Asset Management Systems.
- It also Connects to data warehouses like Oracle Spatial; Microsoft SQL Server; MS Access; MSTN Design Files; Shape Files; MS Excel; Autodesk DWG; OGC; Google; yahoo like BING Maps (Intergraph, 2014) and connects to GPS devices that stream NMEA0183 Sentences over a COM-Port (minimum sentences are RMC, GGA, GSA).
- Oracle or SQL server is required for storage of Administrator and metadata.

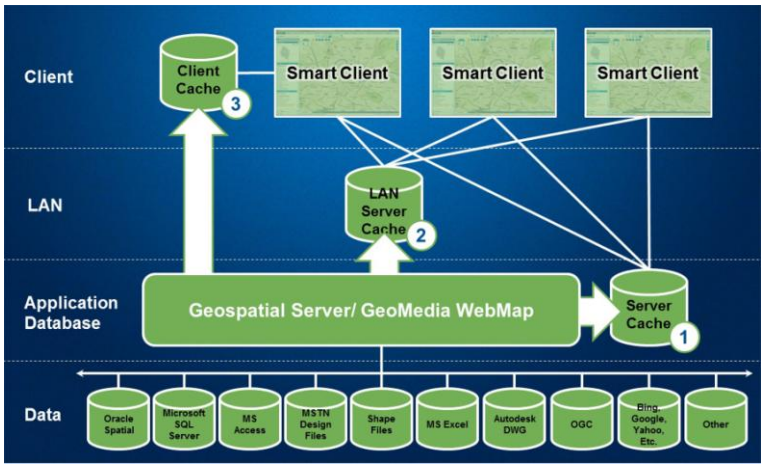

Figure 3. Illustration of connectivity

- If you already have a GeoMedia Installation, initial project setup can be assisted by exporting via the GeoMedia library.
- There is no fixed data model for GMSC so you can use Oracle Workspace Manager. Transaction control for data capturing or editing is handled with the WorkFlow Manager, so some level of services in required.
- GMSC also supports high resolution large format printing up to AO where predefined templates can be set up so all the user needs to do is define the area of interest and type in a few prompted values for items such as Title and Metadata in a legend (Schutzberg A, 2012).

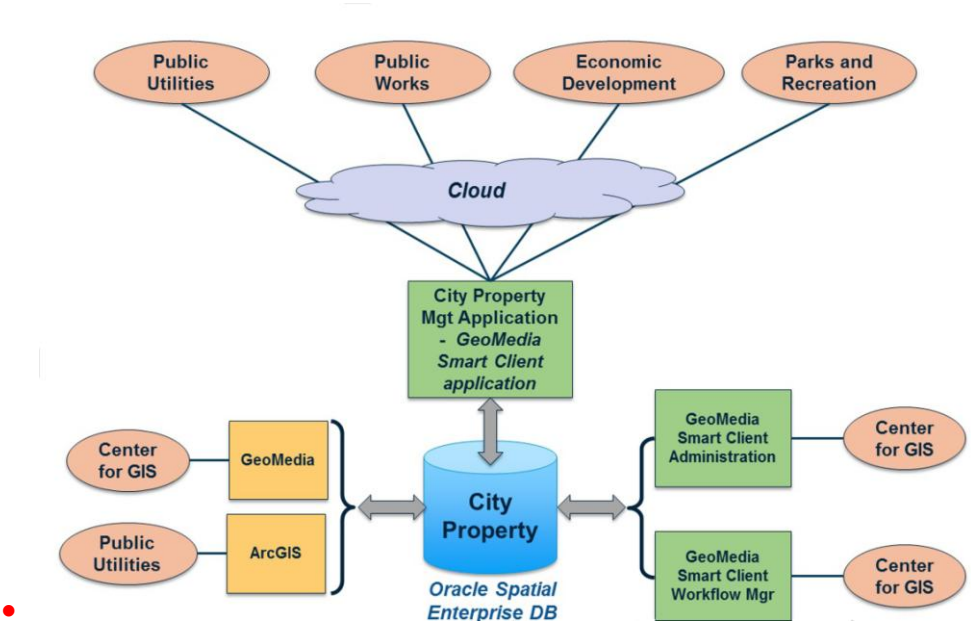

Figure 4. Working installation City System Architecture

3.2.2 GMSC Implementation effects

With GMSC implemented, all the non-GIS Departments in your multi-disciplinary operations would be using GIS to do their work, in a manner that is designed to optimize and streamline productivity. The same non-GIS Departments are directly feeding back attribute information (and planimetric if needs) to the GIS database, thereby reducing update time and costs.

The more users the city has, the cheaper it is and the more the city saves money. It improves staff collaboration and communication, and lowers the cost of ownership for managing assets. This means that cities can use their valuable and expensive GIS Databases and Geographical Information Warehouses in a manner which enhances the rest of the staff productivity without increasing the GIS Departments numbers. Rob Jessen, GIS Coordinator for the City of Virginia Beach in the USA has stated that they expect a savings of about a half a year's worth of work annually as a result of implementing GeoMedia SmartClient (Dredging today, 2013).

Some working implementations include (Intergraph, 2014):

- City of Düsseldorf, Germany
- City of Linz, Austria
- KRZN, Moers, Germany (43 Municipalities joined since 1971, with GMSC providing 250 workflows to 8000 clients)
- City of Virginia Beach, USA
- GISquadrat, Austria (This organization provides SaaS to over 450 municipalities supporting over 2,500 Intranet-user clients, providing GIS tools from simple address searches to complex analysis on environmental data, zoning plans, aerial photographs, line cadastral data and more)

3.3 A Broader Scope

We can see that GeoMedia SmartClient is ideally suited to an organisation such as a City, which is diverse, multifaceted and decentralised but cross linked due to operational geography. Where the geo-location is relatively widely distributed but at the same time confined, and the items of responsibility are all components of a working system where everyone benefits from seamless operations. Hence it takes no leap of the imagination to see that it can work for more than just cities. It is equally suited to Organisations that are more widely distributed such as Nation-wide Utilities and Infrastructure Management Companies.

Some working implementations include (Intergraph, 2014):

- Stuttgart SSB 'GeoTrAMS', Germany (German Rail Company)
- NavLog GmbH, Germany (Collaboration between Governmental Forestry and Industry)
- Agrarmarkt Austria (AMA) (controlling Agricultural EU payments)
- Aurora Energy, Australia

4. Conclusion

GeoMedia SmartClient offers cost saving software as a service with GIS enabled Workflow Solutions which streamline and unify non-GIS management and production activity chains. It is ideally positioned to be one of the building blocks to the creation of a 'Smart City'. The concept of which is to use Information and Communication Technologies to achieve a unified City organism more strongly positioned to achieve the symbiotic linkage of networks, people, businesses, technologies, infrastructures, consumption, energy and spaces. So GeoMedia SmartClient can make it easier to strengthen sustainability, quality of life and social and urban welfare.

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