Using GIS for Asset Management in Trinidad and Tobago

by Bheshem Ramlal[1]

Abstract: In the last two decades, Trinidad and Tobago has invested significantly in the development of infrastructure across the country. New buildings to house schools, libraries, health centers, police stations, government offices and sporting facilities have been constructed. Additionally, roads and bridges have been rebuilt and new utility lines added. It is envisaged that even more will be added to the existing infrastructure in the next few years. A major problem that faces the country at present is the lack of effective tools for managing and maintaining these national assets. Although there have been some attempts at developing systems for that purpose, these have not been very successfully utilised. A nascent technology that may be employed in asset management and maintenance is Geographic Information Systems (GIS). GIS may be used in conjunction with several other technologies to provide effective solutions. This paper reviews existing applications of GIS for this purpose and proposes strategies for the development of GIS for asset management in Trinidad and Tobago. The limitations and benefits of using GIS for asset management are also discussed.

Keywords: Geographic Information Systems, asset management

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Introduction

Investment in infrastructure development in Trinidad and Tobago (T&T) consumes a very significant percentage of the national budget. In fact, in the last few years several hundred million dollars have been spent on roads, schools, libraries, heath centers, police stations, government offices and sporting facilities. Additionally, many state enterprises have laid new water lines, gas pipelines, and electricity lines. Other agencies have purchased new vehicles and equipment for use in carrying out their mandates. Since it is unlikely that the infrastructure may be easily replaceable, there is a need to ensure that these assets of the state are used effectively and properly managed and maintained.

Traditionally, the asset management approach used in Trinidad and Tobago was a reactive one. That is, rather than undertaking preventive and regular maintenance of assets, repairs are only carried out when a problem arises. This has led to major disruption in service on many occasions leading to high repair costs and losses for both the supplier and customer. This has created a perception by customers of most agencies being disorganised and inefficient and has left many customers dissatisfied with the reliability and quality of service received. It has also led to continued losses by many state agencies and a burden on the treasury and taxpayers.

Over the last few years, there has been a move towards more proactive approaches to asset management. Many agencies have started undertaking systematic maintenance works on their infrastructure. In addition, government has formed separate companies to manage some of the country's assets, for example vehicle and building management companies. However, no state agency is presently employing asset management systems that incorporate spatial information technologies. This makes the

present approaches very limited in scope. This paper discusses the use of Geographic Information Systems (GIS) in asset management with reference to managing public assets in T&T. Recommendations are forwarded on how best to implement GIS-based asset management systems in local state agencies.

Why Asset Management?

Asset management is the collection, processing, analysis and maintenance of extensive information about various types of assets such as equipment, facilities and other resources to plan work to be executed to maintain these assets at an operational level in the most cost-effective fashion possible (Lemer, 1998). In terms of public-works infrastructure, asset management is the process of keeping track of and deploying the public's capital. The priority of asset management in this context is making decisions about the effective and efficient development, use, maintenance, repair, and retirement or replacement of utility lines, highways, street furniture, and other public infrastructure (Lemer, 1998). The goal of asset management therefore is to achieve the best possible return on the investments made by the public in infrastructural development. While this may not be the view of many, it is an essential ingredient if the objectives of asset management are to be met.

Components of an Asset Management System

An asset management system comprises several components to facilitate the collection, processing, analysis and maintenance of data. Figure 1 highlights the major components that are required for an asset management system. While all the components of the asset

management system presented are important for the effective functioning of the system, focus is placed on the data collection and analysis of the components.

A major component of any successful management system is an effective data collection and analysis strategy. It is only with the recent advent of computer hardware and software that allowed the development of spatial databases and GIS analysis tools that makes it possible to provide a complete inventory of existing infrastructure. The capability to collect detailed information allows effective asset management.

(Insert Figure 1 about here)

Figure 1. Conceptual structure of an asset management system

Using GIS in Asset Management

According to Longley *et al*. (2001), geographic information systems handle locational data. These are information systems of hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modeling and display of spatially referenced data for solving complex planning and management problems.

GIS comprises five major components: spatial data, software, hardware, personnel and organisation (Longley *et al*., 2001). Spatial data represents the most expensive component, amounting to as much as eighty percent of the total cost of GIS development. Software comprises the programs and tools to handle the spatial data. There are many packages available for this purpose. Hardware comprises the various devices needed to input, process, store, analyse and output the spatial data. These include computer processors, digitizers, scanners, printers, storage devices, and network servers and

connectors. Well-trained personnel are needed to provide the technical and other support needed to design, develop, and manage the GIS and to provide analysis support to users. The organisation provides the context in which the GIS will exist. The goals and objectives of the organisation will determine the design of the GIS to be implemented. Detailed discussions on GIS may be found in Berhansen (1998), Burrough and McDonnell (1998), DeMers (1997), and Longley *et al*. (2001).

Many public assets are spatially distributed over the landscape. Spatial data about these assets may be captured and input into GIS. Table 1 depicts a list of the major assets that may be handled in a GIS environment. Along with the spatial data, extensive detail on these assets may be incorporated into the database. The resulting data sets will provide an appropriate infrastructure for asset management.

(Insert Table 1 about here)

Table 1. A list of the public assets in a GIS environment

Although GIS is a nascent technology, it has been successfully used in various aspects of asset management. In North America and Europe, GIS in asset management is becoming a standard approach. Several applications can be seen on the websites of ESRI (2004) and Intergraph (2004), for example. Many researchers have described approaches for designing and developing asset management systems based on GIS (Brun *et al*., 1999; Lemer 1998; Lubeley and Bishop, 2001; Peng and Tsou, 2003; Schurle *et al*., 1998; Theirren, 1996; Vanier, 2001; Vanier and Danylo, 1998).

Benefits and Limitations of GIS

A well-designed asset management system with a comprehensive database can provide information for the lifecycle of an asset, that is, coverage of the asset's design, construction, repair, reconstruction or replacement may be tracked. In fact, an asset management system can provide several benefits including the provision of data to predict asset performance, keep track of estimated and actual costs for various assets, assist in the management of maintenance activities, generate reports on maintenance activities, assist in maximising existing budgets and the preparation of future budgets; and provide appropriate information in the case of disasters. Asset management systems also help in creating a better image for the organisation by improving the communication between it and customers. The improvements in asset management lead to greater safety and reduce the organisation's exposure to liability and criticism (Greene, 2001; Lang, 1999; O'Looney, 2000).

GIS on its own is not sufficient to provide all the tools and support necessary to create an effective asset management system (Lemer, 1998). Additional software tools need to be integrated to create an effective system. This may be both expensive and technically challenging and may require expensive expertise to design and develop the system. Another major hurdle may be the cost of collecting and inputting the spatial and descriptive data to the asset management system. These costs may be very high depending on the types of assets that are being mapped. The time taken to input data may also extend to many years, leading to a possible loss of funding because benefits are not immediately realised by the organisation.

GIS Applications in Asset Management in T&T

A recent survey was conducted of government and private sector agencies in T&T to determine the level of implementation and use of GIS and other strategies for asset management and decision support. The results suggest a minimal use of this technology in asset management. Table 2 summarises the key survey findings of local agencies in the country. Out of these 42 agencies surveyed, only 17 had GIS software and hardware available within the agency. Although several agencies indicated a need to implement GIS, few knew how soon this was likely to happen. A total of four agencies used GIS for limited levels of asset management in Trinidad and Tobago. These include the Water and Sewerage Authority (WASA), The Petroleum Company of Trinidad and Tobago (PETROTRIN), The Port of Spain City Corporation, and the Police Service.

(Insert Table 2 about here)

Table 2. Key survey findings of local agencies on GIS application in asset management

WASA is the first state agency in Trinidad and Tobago to implement GIS using a comprehensive design approach. The agency compiled spatial data sets of its infrastructure including waterlines, sewer lines, sewer covers, booster stations, valves, water wells, water and sewerage treatment facilities, reservoirs, and service connections. In addition, locations of customers, roads, rivers, watersheds, and land use have been mapped. While the graphic data coverage is extensive, the attribute data are limited to a few items. This reduces the usefulness of the database. In fact, while WASA has a

comprehensive spatial data set of its assets, there has been limited application of this resource for asset management (Ramkissoon, 2004). The agency has gotten into the business of selling spatial data rather than using the data as part of an integrated asset management system.

PETROTRIN has implemented a GIS-based Well Information System (WIS) as part of a larger plan to implement enterprise-wide GIS to manage all assets of the company. The WIS however, is at the pilot stage and full implementation is yet to be completed. The extent to which this system has been applied to asset management cannot be evaluated at this stage (Thompson, 2003).

The Port of Spain City Corporation has initiated the development of a GIS for managing the public assets of the City that are vested in the corporation. This includes roads, fire hydrants, sidewalks, public squares, land and building properties, signposts, and drains. So far, the properties database has been developed and assessment and other relevant information has been added. This will allow the city to manage the collection of property taxes from landowners. Additional data are yet to be acquired and input to create a fully functional system (Yuk Low, 2003).

Recently, the Police Service has implemented the E999 Rapid Response System that included the use of GIS technology. As part of the system, vehicle tracking and navigation tools were purchased for implementation with the system. To implement the tracking and navigation component of the system, a digital road network needed to be developed. While the graphic component of the network was compiled, street names and addresses were not included. The full benefits of the system are therefore yet to be realised (Martin, 2003).

The above review suggests that the use of GIS for asset management in T&T is very limited. In fact, GIS applications in general are at their infancy. There are many reasons for this situation. The major hurdles in implementing and utilising GIS in asset management include: 1) the unavailability of comprehensive spatial datasets of the asset base for most public infrastructure; 2) a lack of trained GIS professionals and technical support personnel; 3) a lack of GIS and other asset management software systems; and 4) a lack of awareness of the benefits of GIS application in asset management by a majority of the stakeholders. These are compounded by the absence of data quality and metadata standards for spatial data, as well as no national policy for the sharing or sale of spatial data. This necessitates greater efforts and much work for successful implementation of GIS for asset management in the country.

Conclusions

GIS-based asset management systems would only be implemented if stakeholders, especially asset managers, become aware that this technology is appropriate and beneficial to their organisations. This may be accomplished through workshops, seminars and training programs. Moreover, incentives for personnel to pursue additional training in this area are needed. At the same time, the national agencies need to initiate steps to undertake inventories and mapping of all infrastructure assets in T&T. A national council for spatial data management needs to be formed to guide the development of appropriate policies and standards for spatial data. In addition, resources need to be allocated to ensure the successful completion of this effort. This requires government intervention to provide the funding as well as the leadership needed.

GIS has been successfully integrated into asset management in many agencies in other parts of the world. While GIS technology is being used in T&T, it is yet to be successfully applied in asset management. This requires significant investments in data collection, software acquisition, and training. The introduction of asset management systems in public agencies has the potential of significantly improving the quality of services delivered to consumers. However, state funding remains key to making this a reality.

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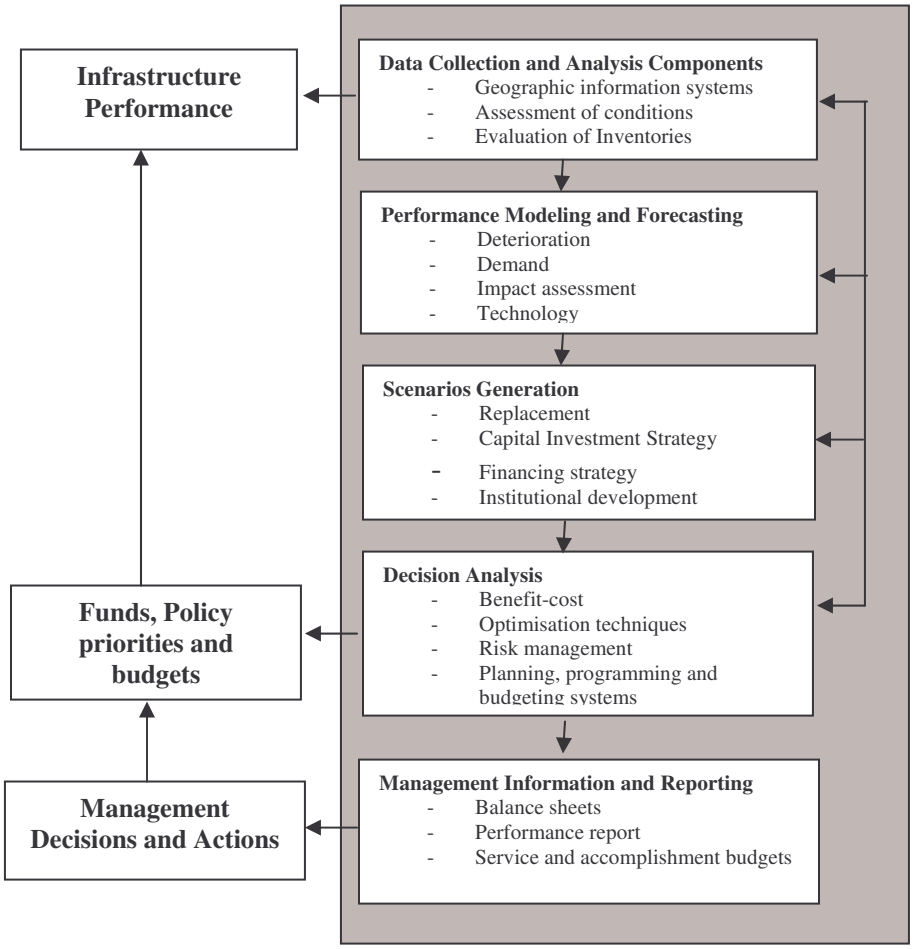

Figure 1. Conceptual structure of an asset management system
Sources: Adapted from Lemer (1998)

Table 1. A list of the public assets in a GIS environment

Major Assets	Examples
Street Assets:	Benches, street lights, traffic signals, signposts, garbage cans, fire hydrants, bus stops, bridges, overpasses and underpasses, tunnels, culverts, and guardrails.
Pipeline Network:	Water supply system, gas pipeline, oil pipeline, and steam pipelines.
Drainage Network:	Rivers and canals.
Utility Network:	Electricity, cable, telephone, and computer cables.
Transport Network:	Railways, roadways, rivers, airways, and shipping.
Fleet Assets:	Garbage trucks, ambulances, police vehicles, fire tenders, transport vehicles, construction equipment, and other vehicles.
Building Assets:	Government offices, public buildings, educational buildings, public safety buildings, historic buildings, and sporting facilities.
Other public assets:	Beach facilities, religious facilities, monitoring stations, water and sewerage treatment plants, water wells, springs, reservoirs, dams, parks and playground equipment, trees, and car parks.

Table 2. Key survey findings of local agencies on GIS application in asset management

Names of Agencies	Sections	GIS Usage
Tobago House of Assembly	Infrastructure and Public Utilities	No
Tobago House of Assembly	Statelands Land Management	No
Tobago House of Assembly	Finance and Planning	No
The University of the West Indies	Department of Surveying and Land Information	Yes, Educational, Property Information System
Ministry of Agriculture, Land and Marine Resources	Land Administration	Yes, Land Management
Central Statistical Office	GIS	Yes, Socio-economic data
Water and Sewerage Authority	GIS	Yes, Asset information
Registrar General's Department		No
Valuation Division		No
Petrotrin	Surveys and Cartography	Yes, Pipeline
National Gas Company	Drafting	No
Environmental Management Agency	Environmental Resources Management	No
TSTT	Engineering Services and Planning	No
T&TEC	Engineering Services and Planning	No
National Housing Authority	Drawing Office	No
POS City Corporation	City Engineer's Department	Yes, Some asset management
Fire Services Division		No
Elections and Boundaries Commission		No
Ministry of Works and Transport	Highways Division Road Planning	No
Ministry of Works and Transport	Drainage Division	No
TIDCO		No
Police Service of Trinidad and Tobago	Modus Operandi	Yes, Vehicle Navigation
Ministry of Energy and Energy Industries		Yes, Project basis
TATIL		No
Institute of Marine Affairs	IT	Yes, Project basis
National Emergency Management Authority		Yes, Software installed but not in use
Solid Waste Management Company		No
National Library Information Service	IT	No
T&T Regiment		Yes
MALMR	Soils	Yes, Databases
MALMR	Land and Water Resources Division	Yes, Watershed Analysis
Town and Country Planning Division		Project basis
TTPOST		No
Hindu Credit Union		No
CLICO		Yes
RBTT Bank Limited		No
First Citizen Bank		No
HiLo Food Stores		No
Ministry of Education		Yes, SEMP
Tunapuna/Piarco Regional Corporation		No
AGRICOLA		No
Home Construction Limited (HCL)	Estate Management Section	Yes, Estate Management