

Making Infrastructure Development Location Intelligent

Jason CLARK and Ben SOMERVILLE, Australia

Key words: GIS, spatial, location intelligence, infrastructure, construction

SUMMARY

In today's economic climate, infrastructure planning and development needs to be on time and on budget. The need to service the demand for maximum return on investment is creating tough competition in the marketplace, forcing companies to look at smarter ways to deliver all stages of a project, from construction assessment, planning and design through to project execution.

With more than 80 percent of all business information containing a location component, the use of location as an anchor for project management and information flow is a logical choice. Geographic Information Systems (GIS) allows us to view, understand, question, interpret, and visualise this business data in many ways to reveal relationships, patterns, and trends.

This paper will explore the emergence of GIS as a valued tool in the infrastructure and construction industries for its ability to address four broad business issues - data management, planning and analysis, field force enablement and situational awareness – and how leading construction, mining and services provider Thiess are using GIS to great advantage.

Making Infrastructure Development Location Intelligent

Jason CLARK and Ben SOMERVILLE, Australia

1. INTRODUCTION

While CAD has been a design tool of the construction and infrastructure trades for many years, a growing number of infrastructure organisations are now adding smarter spatial solutions to manage, visualise, and analyse the large volumes of data involved in a construction or infrastructure project.

GIS is becoming an increasingly valued tool in the infrastructure and construction industries for its ability to address four broad business issues: data management, planning and analysis, field force enablement and situational awareness. The ability of GIS to extend on visualisation, and deliver integration, analysis and modelling capabilities is driving the construction and infrastructure industry to include location intelligence as a valuable part of their information management platform.

Companies such as Thiess, a construction, mining and services provider, are achieving noticeable return on investment from applying location intelligence to infrastructure and construction projects, benefiting from better and more informed decision making that ultimately helps the bottom line of any project.

Thiess is leading the way in the infrastructure industry, and has come a long way since implementing GIS only five years ago. The introduction of GIS has delivered Thiess with the location intelligence to not only help deliver their projects on time and on budget, but to also help monitor and protect natural resources and improve environmental and community outcomes. The insight delivered by location intelligence is delivering significant benefits to Thiess, with a 7.5% reduction in project costs achieved through efficiency gains delivered by the implementation of smart spatial solutions.

2. WHY GIS IS BECOMING A TECHNOLOGY OF CHOICE

In these uncertain economic times, organisations are continually assessing new ways to improve the bottom line. Infrastructure and development projects are under more pressure to be delivered within acceptable economic and time constraints. Tough competition in the marketplace is forcing companies to evaluate technology that supports construction assessment, planning, design and execution.

To secure bids in the economic slow-down, construction companies are under pressure to present an up-front proposal that offers credible in-depth data from day one. It is vital to both the bidding firm, and also the commissioning company, that the former can accurately map

information to ensure that the project deliverables are achievable with the return well defined. For example, existing features in and around a proposed development site can be modelled in conjunction with the future impact of the project to create a visual forecast ensuring environmental imperitives are met.

GIS allows companies serving the infrastructure industry to view, understand, question, interpret, and visualise multiple data sets in many ways to reveal relationships, patterns, and trends. It is the discovery and forward knowledge of these relationships, patterns and trends that give business's a competitive advantage during the bid process.

2.1 The difference between GIS and CAD

With more than 80 per cent of all business information containing a geographic component, the use of location as an anchor for project management and information flow is a logical option. As the mainstay technology of choice, Computer Aided Design (CAD) has successfully given users computer mapping functionality for many years. However, although it has been extended with some limited "GIS-like" features, it is still deeply rooted in the three-dimensional drawing functionality that the software was originally designed to deliver.

The difference between GIS and CAD is the way that the map data is stored in the computer. A GIS handles data in a single seamless database, while CAD stores drawing files that share a common coordinate system, but are physically disjointed. The ability to analyse multiple data sets in one view is critical to understanding how seemingly unconnected information is, in fact, interrelated. This helps to ensure all eventualities are documented before they occur, helping to manage projects.

While CAD is still a useful tool for project design, a growing number of infrastructure organisations are now recognising the benefits of GIS. The use of GIS within construction and infrastructure projects is expanding rapidly as organisations begin to want more than just paper maps and three-dimensional information. By unlocking the location component of a project's data, a GIS can deliver detailed location intelligence.

Sophisticated Geographic Information Systems can go beyond CAD to show the relationships between different features such as existing transport and utility infrastructure above and below ground, local community requirements and various technical data from consultants working on the construction project. Users can manage, visualise, and analyse the large volumes of data, delivering location intelligence that ultimately leads to a better bottom line.

3. THE USE OF LOCATION INTELLIGENCE ACROSS A PROJECT'S LIFECYCLE

The benefits that GIS offers to construction companies for evaluating the viability and profitability of a project in the pre-planning stage are clear. Location intelligence can be used

beyond the initial phases to support all elements of a project cycle, from research and the initial concept through to the construction, management and evaluation of the project.

All large infrastructure and construction projects experience a continual stream of incoming data that must be documented and evaluated in the context of the whole development. As an industry that typically has a large range of stakeholders involved in any one project, data can relate to a broad spectrum of areas such as design, survey information, the environment, community feedback and planning.

GIS can act as a portal for all of this information, giving infrastructure companies the ability to disseminate it easily and quickly. Furthermore, this level of visibility can assist in workforce planning and human capital management across the project, enabling companies to allocate the most efficient level of resource to a particular element of the project.

3.1 Situational awareness to inform planning and execution

GIS quickly incorporates and analyses many types of information and images for site analysis. Highly accurate results are displayed geographically which gives a visual representation of multiple project variables. This provides an insight into connections and relationships between data that influences the project outcomes.

For example, the base map can include zoning and city designations, environmental protection areas, aerial photos, and topographic and soil maps. Overlays of relevant data such as population growth, commercial activity, and traffic flow combine to paint a meaningful picture of a site's opportunities and constraints.

3.2 Data management to deliver streamlined workflows

Using GIS to streamline project activities from field data collection to project management ensures that all of the customer, inventory, network, purchasing and maintenance data is connected. By using GIS to enhance a project's workflow, data accuracy is significantly increased, with project staff able to easily share data and conduct analysis on this information.

Throughout a project, infrastructure companies can provide its customers with very accurate and feature-rich products in any format they wish. This is becoming important, as most government agencies have adopted GIS technology and many require a format that is compatible with their software.

3.3. Data integration for in-depth planning and analysis

Construction and infrastructure projects contain wide variety of information sources. These can include project schedules, CAD drawings, satellite images and project documents. Using GIS enables a company to integrate multiple data sets into one view. This level of interpretation creates a valuable business tool that allows a deeper understanding of the construction project.

Companies such as Thies, a construction, mining and services provider, are increasingly turning to GIS to host the myriad of location-based and textual data produced by large projects.

3.4 Field force enablement

With large infrastructure projects often encompassing a number of work sites, having access to project information, regardless of a worker's location, is integral to achieving optimal efficiency. Mobile location intelligence solutions enable GIS to be taken into the field as digital maps on compact, mobile computers, providing field access to enterprise geographic information. This enables organisations to add real-time information to their database and applications, speeding up analysis, display, and decision making by using up-to-date, more accurate spatial data.

4. CASE STUDY – THIESS JOHN HOLLAND – AIRPORT LINK PROJECT

The \$4.8 billion Airport Link, Northern Busway (Windsor to Kedron) and Airport Roundabout Upgrade is Australia's largest ever infrastructure project. Airport Link will comprise 5.1km dual tunnels (one northbound and one southbound) up to 50m underground, connecting the Clem 7 Tunnel, Inner City Bypass and local road network at Bowen Hills to the northern arterials of Gympie Road and Stafford Road at Kedron, and east to Sandgate Road and the East West Arterial leading to the airport.

On completion in 2012, Airport Link will be the first major motorway linking Brisbane city to the northern suburbs and airport precinct, avoiding up to 18 sets of traffic lights and catering for 95,000 motorists a day.

Thies John Holland Services will operate and maintain Airport Link during the 45-year concession period.

4.1 GIS use in the initial planning stages of this project

GIS was used extensively during the tender phase of the project and played a critical role in conveying to the client the Joint Ventures project methodology and it was used during the planning stages of the project to identify and communicate the complex nature of such a large infrastructure project in an established urban area including environmental constraints, service locations, construction areas, property inspections and resumption scheduling, traffic and safety planning, community consultation and construction site layouts.

An early cost saving was achieved by using GIS to identify property owners by legal address by integrating a simple spatial search with a subscription service to ensure that no vanity addresses were present or corner addresses missed and ensure that the current property owners were consulted.

4.2 GIS improves the overall operational awareness for this massive project

Thies have taken a GIS Centric approach in delivering GIS services due to the complexity and number of different stakeholders on the project. Using this perspective the GIS Team have worked closely with the contrasting project teams to ensure that accurate and relevant

detailed information is available at all project staff fingertips. Additional to this the GIS Team support all aspects of Design and Construction through a close working relationship with teams involved in negotiations with stakeholders, service providers and utility owners.

Project management have been engaged throughout this process and have identified GIS as a tool to provide a spatial dashboard to present planned against actual progress of contrasting activities on the project. This is in stark contrast to the traditional reporting methodologies in construction projects of this magnitude.

Senior managers have also been impressed with the visualization capability with particular interest in the linking of spatial and non spatial information across the disparate systems that exist on the project.

Thiess have implemented an ArcGIS Server environment with FLEX API which offers a project wide solution at an investment level and staffing requirement where project directors could identify at an early stage the benefits and contributions of GIS to a predominantly construction project. A key outcome to date has been that project staff recognize the value and integrity of GIS and have adopted the Web GIS services as the resource for day to day inquiries replacing the previous experience of using free mapping services available over the internet.

4.3 Expected return on investment for your geographic information system

\$1 million GIS budget for 4 years (length of the project) includes personnel, software and hardware.

Returns on this project have quickly been identified through innovative and progressive thinking of the GIS team and provision of services and training to contrasting office and field staff. Over the life of the project the accumulated savings are anticipated to represent a benefit to cost ratio of 4:1. This does not take into account the savings that can be recognized by implementing Machine Guidance and logistical planning through the technology. GIS has been engaged in many ways which are difficult to cost but provide a clear and distinct advantage over traditional methods of information discovery and presentation.

Real cost savings are around operation and construction activity particularly as a preliminary step in permit approvals and identification of pre construction utilities and services, provision of information to external verifiers and asset owners, time to complete submissions and reports where location is paramount and through life of project access to document management system information through a GIS interface.

4.4 Future GIS developments on the horizon

Thiess have adopted a GIS Centric approach on our construction projects where the capability to support contrasting databases, project teams and contractual obligations is leveraged through a simple single interface. Those that require the absolute detail and staff wanting to do a simple query are all serviced through a rigorous and innovative GIS strategy. Building on

this core capacity is the development of an integrated asset management system designed around the data integrity, workflows and management functions of ESRI GIS. This will provide the organization the capability to plan and manage all the project assets through the visual display capabilities of ArcGIS including the management of incoming work requests, distribution of tasks, reporting of work completed and forecasting maintenance works. Additional to this the entire O&M register will be linked to the asset to ensure the maintenance program has full access to relevant documentation. This capability will deliver the contractual requirement to cover the maintenance program for the first 12 months after completion and during the rolling handover to project stakeholders.

Another fundamental development is the provision of location intelligence through the integration of Primavera with the project GIS capabilities. This has facilitated the project wide delivery of up to the minute content by location to ensure that decisions are made on the most current and relevant project plans or activities on site. Development of this to date has exposed GIS to a new level of management where area managers and coordinators anticipate integrating GIS products in the weekly and monthly report submissions to senior management and project directors as a way of demonstrating the planned versus actual progress in a simple and easy to comprehend GIS derived product.

Future developments on the project include the delivery of live feeds from hardware located on site. This is made possible through trends in the market for Survey and plant to have instrumentation designed with GIS as a defined data management tool. This will also feed into the Web GIS service to visually represent and track defined tasks in the construction and handover process.

5. CONCLUSION

The ability of GIS to deliver integration, analysis and modelling capabilities under one solution is driving the construction and infrastructure industry to consider location intelligence as a valuable part of their information management platform. Companies such as Thiess are achieving noticeable return on investment from applying location intelligence to infrastructure and construction projects. GIS ultimately helps construction businesses to maintain a competitive advantage in the bidding phase and achieve accurate and timely project delivery – a winning combination, particularly in the current economy.

CONTACTS

Mr Jason Clark
Thiess Pty Ltd
Level 5, Thiess Centre
179 Grey Street
South Bank QLD 4101
AUSTRALIA
Tel. +61 7 3002 9850
Fax + 61 7 3002 9769
Email: jdclark@thiess.com.au
Web site: www.thiess.com.au

Mr Ben Somerville
ESRI Australia
Level 3, 111 Elizabeth Street
Brisbane QLD 4000
AUSTRALIA
Tel. +61 7 3218 4100
Fax + 61 7 3211 1310
Email: location-intelligence@esriaustralia.com.au
Web site: www.esriaustralia.com.au