

## Software

### Geographic information systems



# On the map

Easier-to-use software and lower costs are leading more and more companies to realise the benefits of using geographic information systems. **Ben Sampson** looks at potential applications

The point where geography and engineering meet is hitherto unmapped territory. But the latest information technology has greatly improved upon the analogue printed maps of the 20th century and provides engineers with tremendous opportunities to optimise operations and products.

A geographic information system (GIS) is software that enables a person to read and use map data on a computer. Geographic information can include data about a location such as buildings, roads, railways, population density, height and flooding. The GIS allows the user to visualise and analyse that information. Insurance companies use GIS to predict flood patterns, retailers use it to plan the best places to locate new shops, and emergency services use it to plan the best places to leave vehicles so they can respond to incidents quickly.

According to the Ordnance Survey, GIS applications have evolved by combining advances in CAD and computer graphics technology to handle the map geometries, with spreadsheet and database software to handle the data about features in the maps. The first GIS is said to have been developed in 1960 for the Canadian government's land registry. The idea spread and by the end of the 1970s a number of commercial and open-

source GIS platforms were available. But it wasn't until the late 20th century that the technology really took off. Consolidation, standardisation and advances in computing power and the internet meant that more applications that used geospatial data could be made widely available.

Some of the leading CAD vendors that are familiar to engineers, such as Autodesk, Bentley and Dassault Systèmes, have GIS mapping software products. But US software company Esri is the market leader for GIS, with more than 300,000 customers in 131 countries, representing 43% of the market.

#### Spatial skills

Stuart Bonthron, managing director of the UK arm of the company, says organisations of all types are beginning to pay more attention to GIS and to use it to "spatially enable their enterprises". He says: "We can do things today thanks to technology we couldn't dream of doing a few years ago. We can share maps to the web, get content from thousands of people and deliver content back to them. We can personalise geographic information to help people do their job more effectively."

Bonthron says Esri's goal is to make its software more accessible to a wider audience of people by "consumerising" it – making it easier



to use and understand. According to Bonthron, most Esri customers use GIS in a couple of departments. Usually an information analyst uses it to gain insight, but he says there is value in spreading its use throughout other parts of a company, such as remote workers. "We need to connect up the field workers," he says.

#### Management made easier

GIS can be used to improve logistics management, and has been used by companies such as Crossrail. GIS can also be used in buildings so that engineers, architects and facilities staff can manage them more efficiently.

Several parts of industry are adopting GIS to support field technicians and engineers in their work. A recent example is how engineering firm Black & Veatch has used off-the-shelf Esri software in its work with power companies to "change the way they look at assets".

Following a series of explosions and fires in cable pits across London, UK Power Networks contracted Black & Veatch to identify, visit, inspect and develop mitigation measures for each of the 47,000 cable pits in London. Faced with this mammoth task, Black & Veatch engineers first prioritised sites according to risk by visually inspecting and assessing their condition, then prioritised by consequence to give each pit a high, medium and low rating.

Inspection required a visit from three technicians, guard rails, lifting equipment and a permit. Paul Hart, information management and analytics consultant at Black &

Veatch, says: "We found 20% of the assets no longer existed. They were buried or were out of date. We were wasting a lot of time."

Initially the firm used the traditional approach, producing 17,000 paper maps for 17,000 sites. The visits were allocated, and a technician would confirm if the pit was present. The data was entered into a system and a report produced. End to end, this involved 23 people.

Hart says: "We became Esri UK licensed partners, so we could trial things. I purchased a tablet and set up a beta. We moved to surveying the pits which were less risky and could be done quicker."

The remaining 30,000 pits were investigated using the new method, which involved mobile devices running mapping software and accessing through mobile internet. GPS ensured the worker was visiting the right pit. Forms could be filled in online and a photograph was taken.

Hart also set up an operations dashboard that monitored and displayed the activity of the technicians in the field minute by minute. The 30,000 were done in five-and-a-half weeks and took just 13 people. "The backroom side of things was almost completely eliminated," says Hart. "We don't do paper surveys at Black & Veatch any more. This has been the case study that has tipped the balance."

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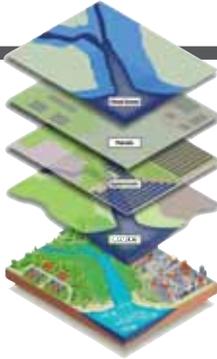
## SPOTLIGHT

## WATER WORKS

Another firm that has embraced the use of GIS is Severn Trent Water, which updates changes to its 4,500 field service technicians via a mobile app so they can instantly get the information and share it throughout the company. An example of its use of mapping technology was to install secure caps to 40,000

hydrants in its region, to combat illegal access to water, which can cause discoloration in the water supply.

Reports of discoloured water were overlaid with hydrant locations. This



allowed prioritisation of the roll-out. Technicians were given devices and apps that allowed them to instantly update information and upload photos. This avoided duplication and enabled tracking of the project via a live dashboard.

barrier to using GIS for everyday operations was the high cost. It was not unusual to see GIS implementations of around £200,000. Now they can be achieved for as little as £200, thanks to cheaper tablet computers and the low cost of data communications and storage. "A few years ago this cost money and required much more expertise," he says. "But the Esri platform can be used on the move out of the box.

Another key area for GIS is buildings and infrastructure, where architects and engineers have been quick to realise the benefits of integrating geographic information with other data. Bruno Moser from consultancy Foster and Partners says that GIS is integral to urban planning: "We believe infrastructure should be designed as carefully as buildings. We also build products in our industrial design practice driven by the same principles of simplicity and function.

"We take advantage of GIS throughout the design process," says Moser. "For instance in GIS topography and environmental planning and spatial configuration. GIS helps us to produce visuals of our design and ensure that our quantitative information is accurate and consistent.

"We also use it to study how cities will grow." For example, London's population

was 8.6 million in 2015, but by 2040 it is predicted to be more than 20 million. The remaining empty areas are designated green belt. Transport is linked to city development. The spatial patterns of population density and employment can predict how busy public transport will be during the rush hour. "Roads take up 60% of public space, but technology will change how we use this space. But the need for public transport in cities will not change. Analysing cities can tell us more about producing a more sustainable model," says Moser.

GIS software is moving forwards rapidly with the use of drones, big data, and 3D.

The use of point clouds enables more granularity in the data, but it's the use of drones that is having the largest impact. Unmanned aerial vehicles enable the cost-effective capture of images from new angles and positions, top down, angled or oblique view. Software developers are getting to grips with drone-to-map software, which is able to turn the captured images into 2D maps and 3D models.

Charles Kennelly, chief technology officer at Esri UK, says new services provided by the software are supported by the increased availability of data and the cloud. These services are produced by data

and its analysis and are provided through applications through the web and locally. Kennelly says: "Geographic information systems of record are where authoritative data is maintained and controlled. Systems of engagement are about social-type systems that are shared. We're not moving from one to the other, but they do in fact live next to each other. It's about unlocking GIS and giving it to more people."

#### Costs falling

Kennelly suggests that evidence for this is in the firm's online content. Web GIS is increasing exponentially, subscriptions have increased 30% in the last year and the number of maps being used has increased massively. "3D as an analysis tool is also becoming the norm," he says. "Spatial analysis has always been part of GIS, but our goal is to use big data to do that quicker and make it available to more people. The cost of imagery has plummeted and can be made available to more people. Cheap storage and streaming technology are allowing users to do more things with images.

"This is a golden age of GIS. We've never had so much opportunity to do more with the technology. You had to go out with lots of high-tech equipment, but now you can just use drones. That level of change is impressive and opens up lots of possibilities."

With one of the major historical drawbacks of GIS, high costs, coming down, combined with the internet and ease-of-use improvements, now is the time to look again at your geography credentials. An accomplished GIS user has to understand CAD, databases and geographic principles and, although challenging, the potential results are great. ■



# £200,000

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