Creating smarter communities

How geospatial technology is helping to
build better places to live and work

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SmartCitiesWorld

The road to smarter communities

Paul Clarke leads the Government team at Esri UK. He believes that for councils and public sector organisations to truly transform, the role of the citizen will need to change. And Geographic Information Systems have a huge part to play

Technology is a vital component of delivering smarter communities, but technology alone is not enough. Smart communities are born when people, place and technology come together to deliver outcomes that improve our places and the lives of those who live there.

Increasingly, citizens, businesses and public sector organisations are working together to make decisions. Government should no longer be seen as something that is

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'done' to people. Instead, citizens are playing an increasing role in achieving the aspirations of their communities through collaborative initiatives.

Geographic Information Systems (GIS) are providing the vital context to underpin and support decision-making, informing opinion and helping to test and shape policy, plans and the future. There are challenges ahead for everyone if we are to realise the vision of smart communities. And as global market leader in GIS, Esri recognises the role it must play.

Historically, Esri's products were used by specialists and analysts working alone. Over time these pioneers became more connected to colleagues. Now the web is connecting communities and stakeholders and making it possible for them to share geographic information. Recent innovations are further breaking down barriers between external organisations, stakeholders and citizens.

Esri has responded to this need by creating tools for non-expert users and the four case studies featured here show how such products are being adopted by organisations.

Esri's web technology has matured further to allow groups of people and organisations to securely share information and to do so in near real-time, which is essential if the public and private sectors, citizens and academia are to work in partnership.

This is helping to democratise data and our four Spotlight case studies are great examples of how empowering this can be for citizens and organisations alike. The case studies show, for example, how providing proactive access to more information reduces the number of Freedom of Information requests citizens need to make, and how technology allows citizens to collaborate with organisations by reporting issues, such as defective street lighting or the location of potholes, in geospatially intelligent ways that can be efficiently acted on.

In addition to collaboration, such technology is achieving major efficiency gains and saving both time and money, which in turn is allowing services to be redesigned and optimised, and enabling a channel shift to services that are online and available anywhere at any time.

At Esri, we see our role as providing the technology that helps customers achieve their strategic goals and outcomes. Make no mistake some of these are big goals, ranging from keeping people safe by optimising the deployment of police officers and identifying patterns of crime, to building more sustainable cities, reducing air pollution and optimising transport infrastructure.

Ultimately, Geographical Information Systems have the potential to be the enabler for happier, safer and healthier people and places. Many public and private sector organisations are already exploiting the technology but there is plenty of work still to be done. We look forward to playing our part to help realise the vision for the smarter communities of the future.

Paul Clarke leads the Government Team at Esri UK. He has worked with government organisations across the UK and the US, to help them harness the information in their data and to deliver improved services and outcomes for citizens for 20 years. Paul passionately believes that location is the vital context through which it is possible to visualise, analyse, share and understand information and use it to make our communities smarter.

Crossrail

GIS has been one of the building blocks of Europe's largest single infrastructure project and has helped the project stay on time and on budget

Crossrail encompasses 42km of tunnels, 10 new stations and the finished railway will comprise a route that runs through 41 stations from Reading and Heathrow in the West, through central London, and to Shenfield and Abbey Wood in the East. Tunnelling alone, which began in 2012, has presented engineering challenges on an unprecedented scale and the project as a whole has represented one of the largest single infrastructure investments the UK has ever undertaken.

GIS has been a key building block of the project and continues to be instrumental in ensuring Crossrail remains on time and on budget ahead of the first service being introduced between Paddington and Heathrow in May 2018. Completion of the new Elizabeth line is scheduled for December 2019. Behind the scenes, the Esri ArcGIS platform has and continues to be used to assist in managing hundreds of ongoing programmes of work and hundreds of thousands of assets with Crossrail using the full range of desktop, web, mobile and 3D GIS apps to do so.

Geospatial data from a variety of internal and external sources has been captured, stored and managed through a Central Enterprise Repository which has minimised both duplication and loss of information. It has provided visibility of the changing landscape of Crossrail throughout the various project phases and supported decision-making in a variety of areas. It has also underpinned the backbone of Building Information Modelling (BIM) principles that the technical

team follow. It is estimated that ArcGIS has improved the productivity of Crossrail's asset protection engineers by up to 80 per cent when reporting on claims.

Daniel Irwin, geospatial lead for Crossrail, sums up the value of the technology internally and externally succinctly by saying "ultimately, it saves people huge amounts of time trying to find the right information". "If something isn't geo-enabled, you can spend hours looking for it."

Crucially, the Esri technology has provided an invaluable tool to keep the public and stakeholders informed and engaged in the project. "GIS acts as a great starting point for people to get to the information they need, whether that is CAD drawings or models, defect surveys or utility reports. You can interact with a map about a specific location, such as a Crossrail station, and use links to go and find the information you need."

One of the best public facing examples of GIS is the 'Near you' feature which, as its name suggests, informs people about activity in their vicinity. "For example, during tunnelling, it updated them on where the boring machines were and where they would be in the next weeks and months," says Irwin. "The ability to share this information with the public has generated a lot of interest during the project, culminating in tens of thousands of visitors every month to Near You."

Internally, one of the major benefits of Esri's technology has been its easy integration with other systems and data. Irwin's
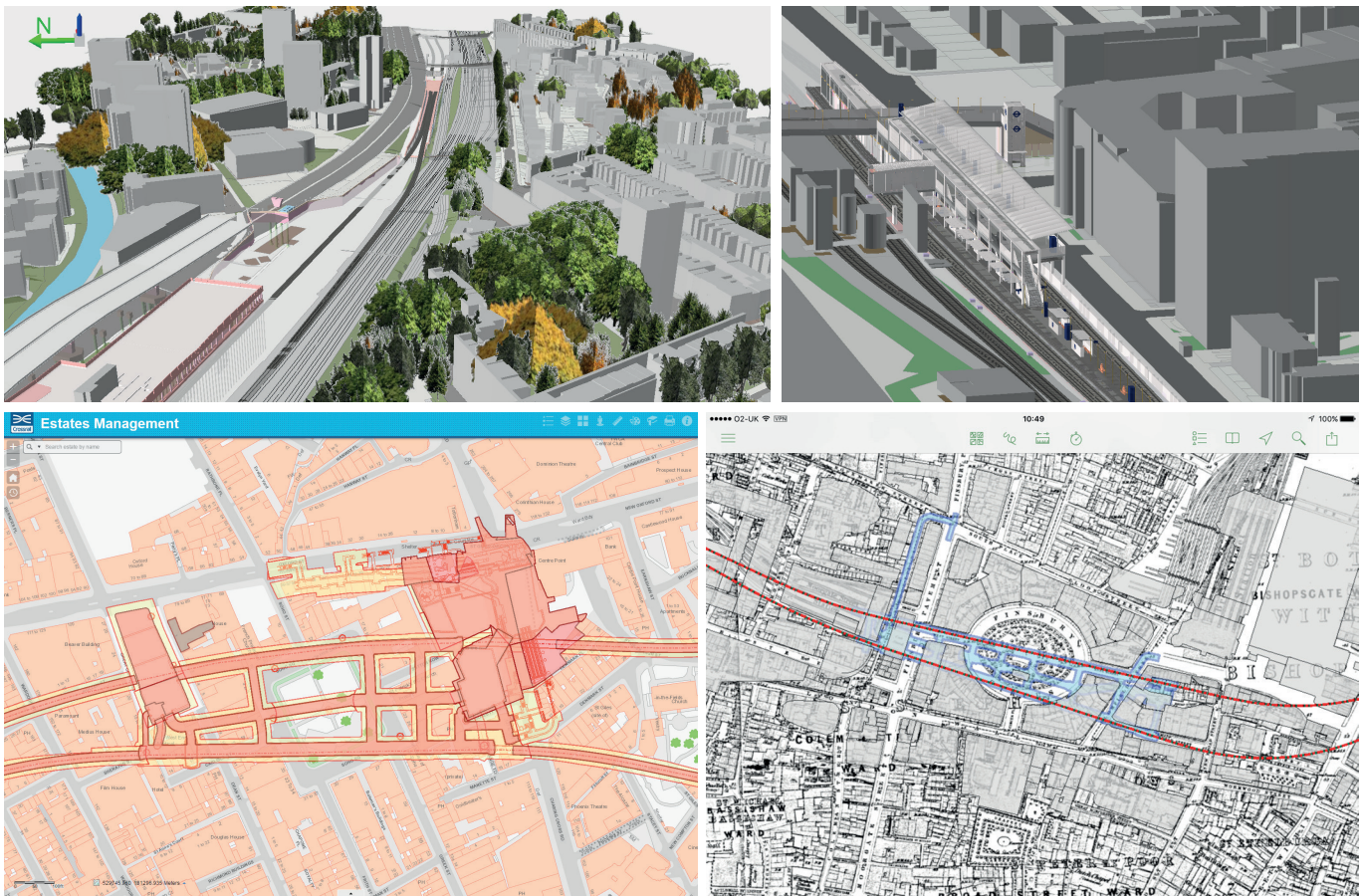
Top left: 3D view of Westbourne Park and Royal Oak, from the west looking east. Top right: 3D view of Custom House Station, looking west from the east). Bottom left: Overlay of works outline, final land acquisition boundaries and occupied estate at Tottenham Court Road. Bottom right: Overlay of Tottenham Court Road sub–surface footprint and track centreline against mapping from approximately 1862

The technology is smart, cutting edge and extremely powerful because it allows you to build things far more quickly. It needs to brought into infrastructure projects as early as possible

team worked closely with Crossrail's Land & Property function, which was responsible for managing one of the most complex compulsory purchase programmes undertaken by the UK.

"GIS gave us the ability to not only know where the land parcels to be procured and managed were but also where their boundaries were and what the timeframe around their usage was," says Irwin. "Temporal layers in GIS showed us who was occupying the land at any time. Land & Property calculated that if we hadn't got the system in place, they would have needed three times as many people so GIS transferred into a significant quantitative benefit."

Irwin says that putting CAD models into context using GIS provides significantly more intelligence to inform the design process. He believes that, in the future, GIS can't be brought into infrastructure projects early enough, citing

the relational database abilities behind the system as a key strength. "With a traditional database architecture, you have to explicitly define the relationship between objects but with spatial information that relationship is built in, it's implicit," he says. "So you might say 'here's my track alignment and find me all the buildings within 50m and it will do it without needing any relationship between the two objects being defined.

"That is a very powerful thing and people outside of GIS don't understand this as well as they should because it essentially means you can build things very quickly and can be agile with the data you have. It is a wider problem in the GIS world: people just see the map and don't see the intelligence behind it but this technology is database-driven, it's web-service driven, it's smart and very cutting edge."

For future construction and infrastructure projects, Irwin believes remote data collection in not just 2D form but also 3D will become increasingly important. "We are looking at ways to use point cloud, 3D photo meshes, 360-degree and other clever techniques to give a visualisation of location without having to go there. On top of that, we can extract and build our asset catalogue geospatially without conducting a survey. It can all be done remotely and then you just have to go out and do a sampling exercise to check it is all correct. I believe this is the way forward for asset and facilities management, especially in major infrastructure projects."

Glasgow City Council

As well as empowering citizens, GIS technology has spawned a new way of working at the council and is helping to embed a culture of data-driven decision-making as well as test policy

A 50-year vision for Glasgow revealed in 2012 that its citizens were already technology-literate and were keen to be engaged in the use of technology throughout the city. At the time, the city council also had one of the most popular Twitter feeds in the UK with 26,200 followers, a figure that continued to climb and today sits at more than 160,000. Their apparent appetite for digital services and information has been borne out by the interest in and take-up in use of the council's interactive mapping applications which are effectively an information tool to tell citizens 'what is happening and where'.

Built by the council's GIS team using Esri ArcGIS Online, the mapping applications are based on more than 150 spatial datasets and provide city-wide information on everything from parking and listed buildings to the nearest schools and gritting bins. Indeed, the Which School Catchment tool, which sits in its online Public Gallery, is a great example of using GIS technology to meet a pressing need. "It is one of the most popular datasets," says Iain Langlands, GIS and data manager at the council. "Its use peaks in school enrolment times during December, January and February. The feedback is extremely positive and parents like the idea of being able to view it online rather than go to the library or into our offices."

The list of public roads that the council is responsible for is another popular map and Langlands reports that Freedom of Information requests have been reduced significantly because so much of the information the public is seeking is online. "It helps us to deploy our resources so much more effectively," he says.

As in many organisations, GIS began as an internal tool but its potential to disseminate important information externally was quickly recognised and actioned by the GIS team. "The GIS community was too closed and was sitting on a mine of information that needed to be broadcast further," says Langlands, who adds that it has now progressed to become "the new way of working". The next challenge, he says, is to add more value and take it even further.

"The immediate priority is to embed a culture of data management and information management across more than just the council's GIS users so that we start to build a bank of robust and sustainable information. We need to change the culture so we aren't just collecting data for a particular purpose but to achieve broader corporate goals."

Indeed, the GIS team is playing a key part in shifting towards a culture of more data-driven decision-making which dovetails not just with current trends but also Glasgow's wider vision to become a smart city and its Glasgow Future City project.

The council is currently developing a corporate data strategy which goes beyond spatial data but one in which Esri technology will play a key part. "This exercise is helping to identify our strengths and where we need to improve so we know we are focusing on the right areas," says Langlands.

"In the longer term, we want to put some intelligence on the data and start working with the analytical capabilities that the Esri products offer. Then we can use it to test policy and develop strategy and really use the data the way it should be."

As well as having this broader vision in mind, the 10-strong GIS team remains focused on using GIS and data to improve public services and the citizen's quality of life. "One of the challenges for myself and colleagues who are entirely familiar with spatial data is to constantly take ourselves out of that world and go into consumer mode," says Langlands.

Citizens are already benefiting from more intelligent reporting forms which embed an interactive map. This means for example, that when it comes to letting the council know of a street light that isn't working, they can pick the precise lighting column on the map. "This also helps to create a very efficient workflow for us behind the scenes," says Langlands.

The team also know that the rise in mobile and tablet usage means it has to ensure its applications are optimised for the mobile environment. "Reporting dog fouling or potholes are often done through the mobile app," he says. "People like using mobile technology for engagement and we need to be considering this at all times."
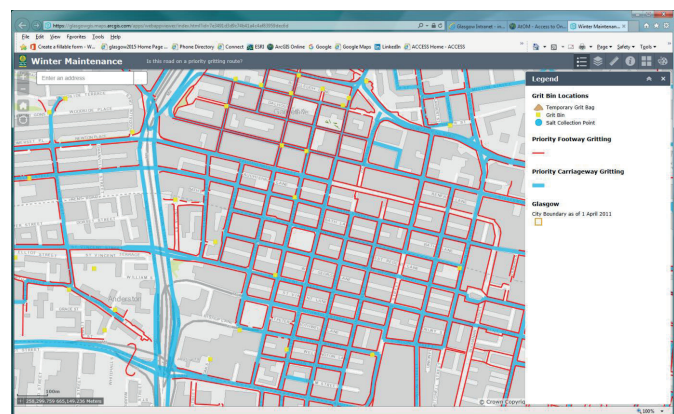
Winter maintenance map

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Leeds City Council

A major plan for the city and the timely arrival of Esri's ArcGIS Online tool provided the catalyst for a new way of doing public consultations

Public consultancy on the content of an emerging plan is a statutory requirement but also presents an opportunity for councils to engage with and, increasingly, empower their citizens.

With a stated ambition to become the "best city" in the UK, Leeds City Council knew there was a great deal riding on how it communicated its Site Allocation Plan, which set out how it would provide the future homes, development and jobs that the district needs. The plans followed on from the Core Strategy adopted in 2014 which identified 70,000 new homes were needed up to 2028.

An Esri user since 2001, the council was keen to introduce online mapping and the arrival of the ArcGIS Online tool proved timely for the consultation. "Obviously such a plan is of great interest to a lot of people across different sectors," explains Neil Webber, principal data officer for Policy and Plans at Leeds City Council. "It contains a large amount of complex information and we wanted to provide a way for the council to present it to the public and stakeholders in an engaging and easy-to-understand way."

The council's aim was not just to create an interactive online map but to establish a link to an online form for comments that fed into the back-office database. "It was jumping in at the deep end as we hadn't created a map like this before and wanted to establish this separate link."

Pop-up boxes on the map provided basic site information while hyperlinks took users to more in-depth, site specific details. Previously, if a member of the public or another individual wanted to find out more about the site, such as its sustainability appraisal, they would first have to find the site on the map and then search out the information in separate documents.

 "Because of the scale of Leeds and the scale of projects, this can mean mountains of paper," says Webber. "The map proved to be extremely empowering as it opened up a lot more information to a lot more people."

During the eight-week consultation, the map had 22,000 views and nearly 5,000 separate submissions were made via the online commenting system. Once processed, this represented more than a third of the total comments submitted (40,000) and massively reduced the administrative burden of hard copy and emailed comments.

"This was an impressive total and the map was the most popular method of representation," says Webber. "And the other benefit was that the information went straight into our back-office system. If 40,000 submissions come in as hard copy, that is a lot of transcribing. So it wasn't just about making the map but also establishing that key link to the back-office function."

The map was used for a subsequent stage of the consultation and Webber reports that it has generated interest in other parts of the council which are exploring GIS as a tool for consultation. Indeed, an online map is being used for consulting on the East Leeds Orbital Road project, a relief road which represents a huge extension to the urban area in East Leeds.

"Doing the original map has put us in the position of being able to increase our use of online mapping at a rapid pace which is bringing a raft of benefits such as increased transparency, engagement and accessibility."

Webber says that the ability to share spatial data by sending the URL of an online map is helping to show non-GIS users the possibilities of the technology. "Previously, you'd have to ask them to install a small piece of software but the ease with which you can share the URL is raising the awareness of GIS and I hope will encourage more people to exploit its use in the future," he says. "We've always felt it was under-used and we're trying to do something about that."

In the future, Webber believes GIS will be a key tool for helping councils to build trust with citizens and foster a culture of openness and transparency. "Councils can be accused of hiding stuff with impenetrable forests of information," he says. "But this enables them to demonstrate transparency because not only is all of the information out there but it can be found far more easily."

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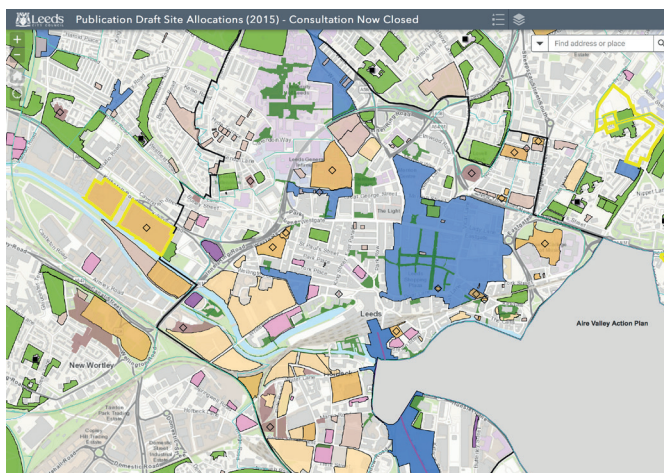
The map opened up a lot more information to many more people

GLA

London is set to see a huge population increase within the next 25 years. It is expected to rise 70,000 every year, reaching a total of 10.8 million by 2041. One of the proposals on Mayor Sadiq Khan's draft London Plan, which aims to shape how the UK capital's urban environment develops over the next 20-25 years, is to build affordable homes, especially in areas served by strong infrastructure.

One of the Greater London Authority's (GLA) priorities is to ensure there is sufficient infrastructure to support the population increase. Infrastructure delivery is complex and achieving it in the most efficient way is a challenge. The more informed utilities and other parties are at knowing what each other is doing – and planning to do – the more chance there is of delivering projects on time, on budget and with the least disruption to the smooth running of the city and people's lives.

To help utilities and other parties better coordinate with one another, GLA has developed the Infrastructure Mapping Application (IMA) using the Esri platform, with added specialised functionality on top that the GLA produced in consultation

The tool visualises data on future investment in infrastructure and development so that utilities and providers can plan around each other, share resources and labour where appropriate

with professional services firm, Arup. The tool visualises data on future investment in infrastructure and development so that utilities and providers can plan around each other, share resources and labour where appropriate, and avoid digging up the same hole, in the same place, twice. Because the GLA is a body with the public interest in mind, with a mission to make London a better place, utilities have felt comfortable sharing their data through the tool.

The data was also designed to help utilities assess their own existing infrastructure capacities in areas where growth is most likely to occur. As well as sourcing data from utility and other relevant parties involved in infrastructure projects, the IMA features development data based on planning applications and developers. The tool helps providers assess whether they will have the infrastructure in place to support new people, and if not, offers information that enables them to plan how they can increase their capacity, potentially even ahead of demand.

While the IMA is designed primarily for utility and infrastructure companies and the public sector (which sign a confidentiality agreement to access additional data), it also has a public-facing side to keep citizens abreast of developments. Version 2.0 of the tool was launched in

August and since then has had over 11,000 page views. The GLA reports that stakeholders are pleased with the new user interface and filtering tools and have offered suggestions for ongoing development.

The GLA team is working on version 3.0 of the IMA which will see the platform evolve from a visualisation tool to a more analytical one. Version 3.0 will enable the mapping tool to flag up opportunities for co-ordination and perform analysis on capacity with the intention to improve usefulness for the tool's main stakeholders and expand to additional user groups, as well.

The GLA also wants to further automate the sourcing of data through APIs and other machine-to-machine (M2M) connections to ensure the data is as up-to-date as it can be. In addition, it wants to expand the GLA's ability to collect development data direct from the local authorities. Currently, some development data comes from third-parties but it has an initiative in place with the London boroughs to collect more data direct from the source.

GLA is developing a concept for an Infrastructure and Development Coordination Unit because of the expected spike in infrastructure delivery and the IMA will be one of the underpinning technologies of its work, as well as a proactive tool to help inform decision-making.

The mapping tool is intended to be a common database for that unit and help identify projects and places that need co-ordination. This should help to drive efficiencies and reduce road and other disruption.
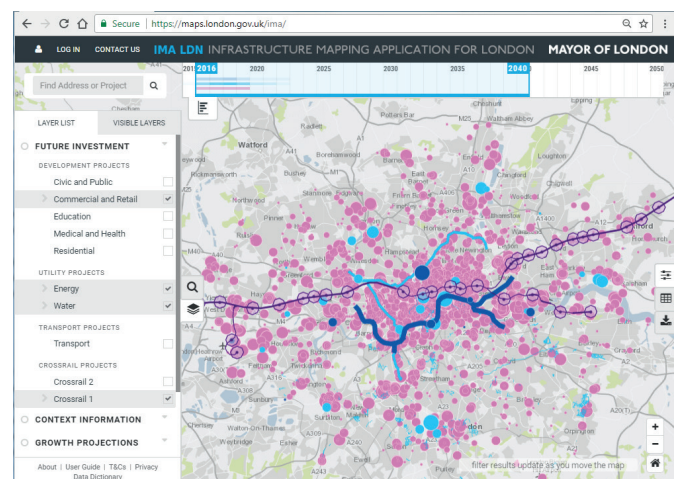
The Infrastructure Mapping Application

About Esri: bringing meaning to maps

Esri is the global market leader in geographic information systems (GIS), offering the most powerful mapping and spatial analytics technology available. Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today Esri software is deployed in more than 350,000 organisations including the world's largest cities and national governments, as well as colleges, schools and universities around the world.

Esri UK works with Central and Local Government across the UK, deploying advanced solutions for operational intelligence, digital transformation, IoT and analytics. It combines maps and data that enable governments to see the world in a smarter way, engage more effectively with citizens, identify cost savings and create communities that are safer, healthier and more liveable, sustainable, prosperous and well-run.