



# GIS

## Professional

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# future cities

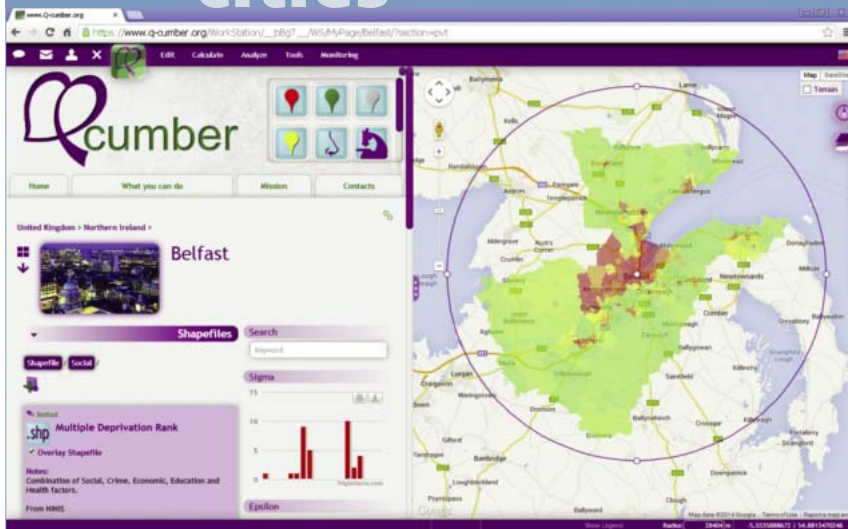


Figure 1 – QCumber Smart City showing a custom-shaded choropleth: a ranking of regions within Belfast by a combined measure of deprivation.

CITIES ARE VITAL to the future global economy. One third of the UK's population lives in the country's ten largest urban areas and cities are the engine of economic growth. However, cities are struggling with changes in population and demographics and pressure

and smart phone networks enabling the data platforms to realise their full potential and enabling fast input of new data by the public.

**Crowd-sourcing and social media** Crowd-sourcing has become a major source of data assets in its own right, from Wikipedia to OpenStreetMap and Q-Cumber. Government organisations are now sponsoring the collection of crowd-sourced data. The European Environment Agency's "Eye On Earth" is a good example, combining traditional datasets with crowd-sourced data submitted directly through the data platform. QCumber Smart City combines two powerful trends in city data: open city data and crowd-sourcing. This innovation increases feedback and communication between the city authorities and the citizen, providing new channels for those authorities, elected representatives and the public to communicate on the key issues confronting modern cities.

Crowd-sourcing intrinsically brings the challenge of managing spam and other abuse. We are building on the lessons learnt with QCumber in Italy, where it is being used by thousands of users to report environmental problems in a number of

## Unleashing city data

CERC and Algebra are prototyping QCumber Smart City, an open city data platform with crowd-sourcing, which is being funded by the Technology Strategy Board (TSB) under their Future City Solutions competition "Data Challenge". QCumber Smart City uses interactive map presentations and combines public data with crowd-sourced data. Open APIs (Application Programming Interfaces) provide the potential to support a thriving ecosystem of third-party apps and services based on phones, websites, smart devices and social media, leveraging direct access to data through the APIs. **Mark Jackson** and **Giuseppe Magro** discuss the challenge of creating this open city management platform.

on key resources. Over time there will be a large market for innovative approaches to creating efficient, attractive and resilient cities. The TSB's Future Cities Programme is designed to support UK firms in developing products and services for this market, with demonstrator projects to show what can be achieved by innovative use of the tools and techniques available today. The "Data Challenge" competition is to prototype a solution for a city management platform that can connect the disparate datasets and data sources to be found within a city, using a non-proprietary, generic and open API.

It is an opportune time for the development of such a system. Historically, cities have owned rich datasets. However, the data has been "hidden" in isolated silos so the value of the data has been unavailable to the public and often also to the city authorities, particularly if the city has multi-tier governance. Increasingly cities are opening their data and empowering businesses and the public to create additional value from these assets. However, it is only very recently that cities are becoming "super-connected" with fast broadband, dense wifi

Italian cities. Technical measures can reduce abuse – for example, it is important to disallow anonymous content by requiring users to provide an email address when they register on the system. However, it is likely that some degree of manual moderation will always be necessary.

**Supporting third-party apps** Traditional city data platforms often simply offer a searchable catalogue, which provides data files for download and links to external data APIs. QCumber Smart City provides rich APIs to support third-party smart phone apps, websites, smart devices or other services, allowing them to read and update data. QCumber Smart City will support both external apps and embedded apps, which appear within the platform itself, in a similar way to third-party apps within Facebook.

There are unlimited possibilities for third-party apps and services. One example is a "loyalty" app enabling the public to recognise and applaud traders or others who make a difference within the city, while accruing and

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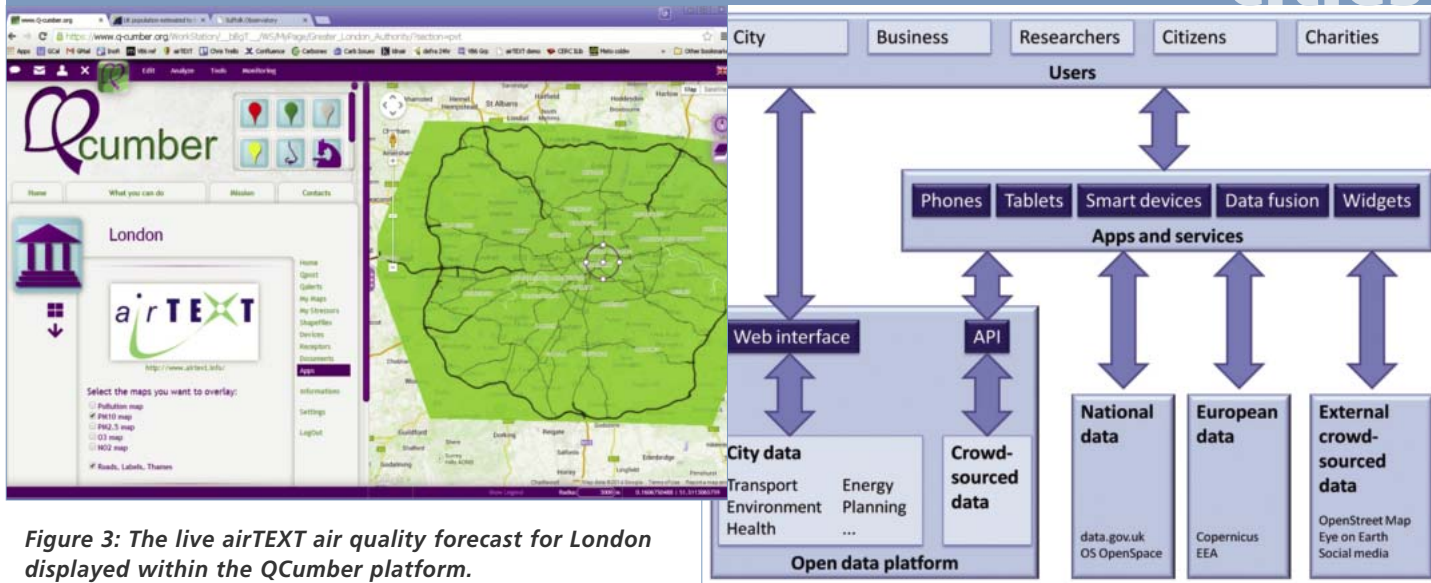


Figure 3: The live airTEXT air quality forecast for London displayed within the Qcumber platform.

redeeming points that can be exchanged for local goods or services. Others include advanced health and air quality forecasts integrating live traffic information, micro-simulation of traffic emissions, crowd-sourced data and emissions measurements, and integrated tools to combine traffic, health, population and environmental data with scientific modelling to estimate health impacts through air quality and noise (see figure 2).

**Open standards** Data and APIs sometimes lack standardisation, presenting an obstacle to third-party developers seeking to exploit them to develop apps and services.

In our view, the geospatial community is in a strong position to support this movement towards open standards, since it has a rich set of well-established and proven open standards (see table below). The work of the Open Geospatial Consortium (OGC) is an excellent example of this. The OGC API standards such as WMS, WFS and CSW allow data federation, catalogue queries, querying and updating of data, and also dynamic combination of maps from different sources in 'mash-up' displays. As well as the OGC standards, there are more lightweight APIs, such as GeoJSON, which are often preferred for use in phone app development and smart devices.

There is a need for harmonisation of the

standardisation efforts from different communities. For example, the TSB project OpenIoT, an effort to improve interoperability in the Internet of Things, has developed Hypercat, a standard for metadata about APIs (services). It is to be hoped that the two communities can collaborate to prevent the development of multiple diverging standards covering the same topic area.

There are an increasing number of exciting real-time services freely available through open APIs, from free live rain radar satellite imagery from the Met Office Datapoint service through WMTS, to hygiene ratings for restaurants and other food businesses from the Food Standards Agency.

**Prototype platforms for test-bed cities** We are liaising with local authorities from the five cities who have volunteered to participate in the TSB Data Challenge: Belfast, Birmingham, Cambridge, Ipswich and London. These test-bed cities are well aware of the potential benefits and are primed to participate in developing, deploying and testing new solutions. Prototype data platforms have been developed for each of the five cities. Over one hundred datasets have been included from thirty data providers, representing international, national and city-specific data from governmental, academic, business and the public

Figure 2: The Qcumber Smart City open data platform with advanced APIs to support third-party apps and services.

API Standard	Description	Sponsor
<b>GeoJSON</b>	A simple, widely-used standard format for APIs with geographical data.	geojson.org
<b>WMS and WMTS</b>	Web Map Service and Web Map Tile Service. Widely-used standards for map imagery.	OGC
<b>CSW</b>	Catalogue Service for the Web is a widely-used standard for metadata for data and services. The UK has adopted CSW for data.gov.uk.	OGC
<b>Hypercat</b>	A standard for metadata about APIs, which was initially developed by the TSB project OpenIoT.	openiot.org



Figure 4 – Prototype apps showing live air quality forecasts and live satellite rain radar images.



(crowd-sourced data). We have created a custom data hierarchy for each city.

We have also developed prototype apps. For example, we have embedded the airTEXT forecasts within QCumber Smart City. airTEXT ([www.airtext.info](http://www.airtext.info)) is a free air pollution alert service for London, delivered via SMS, email, voicemail and smartphone apps, operated by CERC on behalf of the GLA and the London boroughs. The WMS API has been used to embed the live airTEXT forecasts in QCumber. This required some technical development since Google Maps does not have native support for WMS. See figure 3.

We have also developed prototype smart phone and tablet apps that link to the QCumber platform, showing the potential for live air quality forecasts and live satellite rain radar imagery. See figure 4.

The prototypes have been demonstrated to local authority representatives from the five cities through workshops and site visits. Their feedback and support has been vital in shaping the project. The city representatives have welcomed the potential of the QCumber Smart City platform. For example, **Paul Clift**, a

principal environmental health officer at Islington and chair of the airTEXT consortium, said “there is huge potential to use crowd-sourced information and engage with the public in this way to ensure people become involved and take greater ownership of environmental matters.”

**The future of QCumber Smart City** We are developing proposals to enhance QCumber Smart City, install it publicly for a test-bed city, and create apps and services that will demonstrate the possibilities of the platform and foster the app ecosystem. These solutions will be shaped with the partner city, analysing decisions to be made by the authorities that can be supported with innovative data use as well as different user needs (managers, assessors, citizens, app developers).

For further information, please contact Mark Jackson at [mark.jackson@cerc.co.uk](mailto:mark.jackson@cerc.co.uk).

• This article is based on work commissioned by the Technology Strategy Board (TSB). The views expressed are those of the authors and not necessarily those of the TSB.



#### About the authors

Mark Jackson is a Principal Consultant at CERC specialising in software development on projects such as the airTEXT forecasts and the CARBONES geoportal.



Giuseppe Magro is an environmental consultant at Algebra s.r.l. specialising in impact and risk assessment and dynamic computational GIS. Giuseppe developed the QCumber platform: [www.q-cumber.org](http://www.q-cumber.org).

### Cambridge Environmental Research Consultants (CERC)

Established in 1985 with the aim of making use of new developments in environmental research from Cambridge University and elsewhere for practical purposes, CERC is an SME (small and medium enterprise) with over 20 high level technical consultants. The company has two technical directors at the forefront of their fields: Professor Julian Hunt, FRS, chairman, and Dr. David Carruthers, managing and technical director. The company is located opposite King's College in the centre of Cambridge.

### Algebra s.r.l.

Founded in 2008 with the mission to devise new methodologies and advanced software tools for Impact and Risk Assessment, Algebra works in cooperation with several universities and institutions. The company developed Dynamic Computational GIS (DCGIS), an integrated GIS-based language and methodology for analysing and evaluating impacts, and environmental and health risks in multi-scale contexts, compliant with specific EPA, ASTM, WHO, EEA guidelines. In 2012, Algebra launched QCumber ([www.Q-Cumber.org](http://www.Q-Cumber.org)), the world wide Geo-Social Platform for environmental participation, integrating institutional and crowd-sourced data on Google Maps. The system is being adopted by several cities to provide web services to citizens, planners and environmental consultants. In 2012, QCumber was selected as one of the most significant projects at the “StartUp Games” during the Olympic Games of London 2012. Algebra's offices are in Desenzano del Garda, Italy.

For more information, contact:



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