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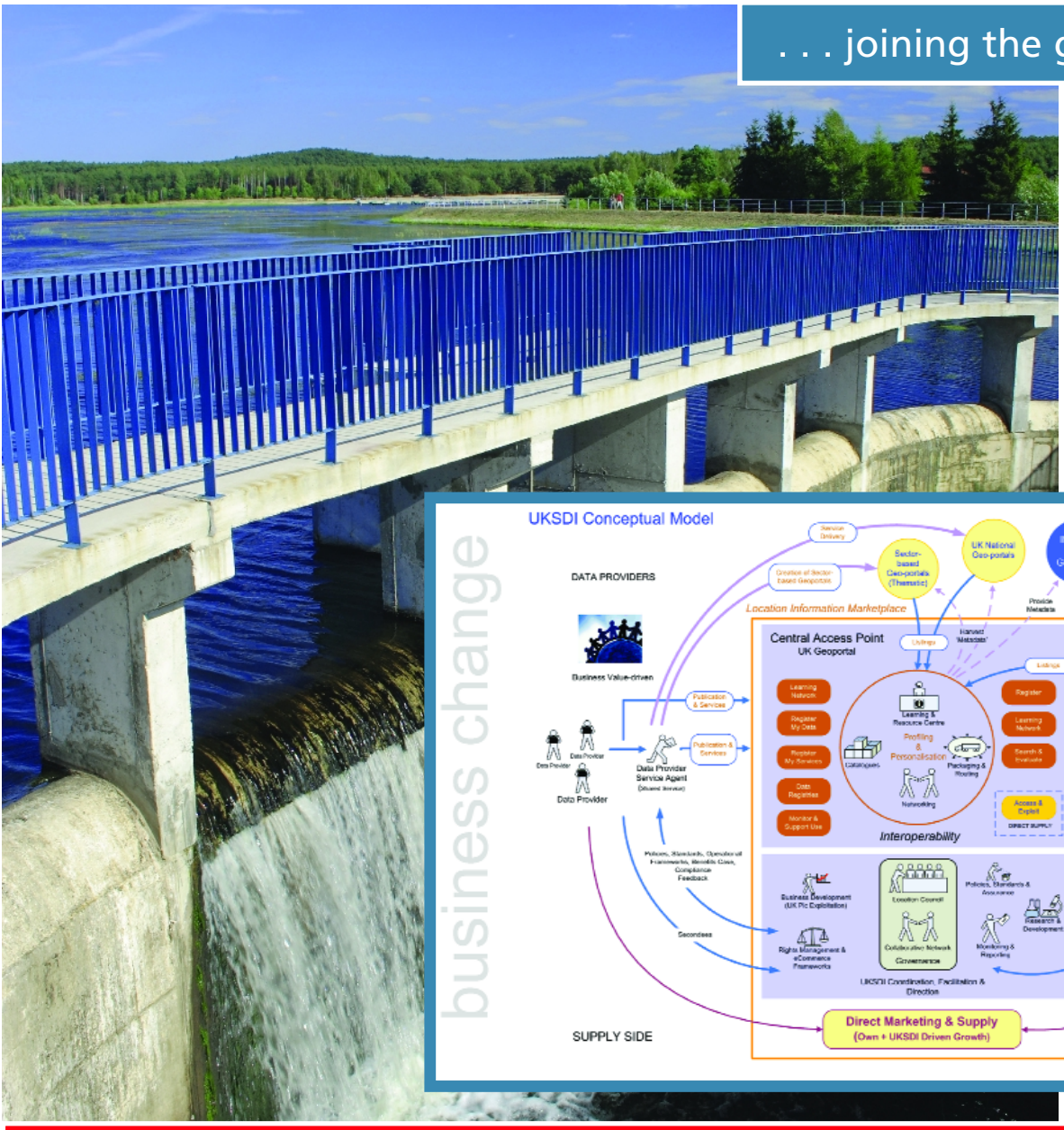
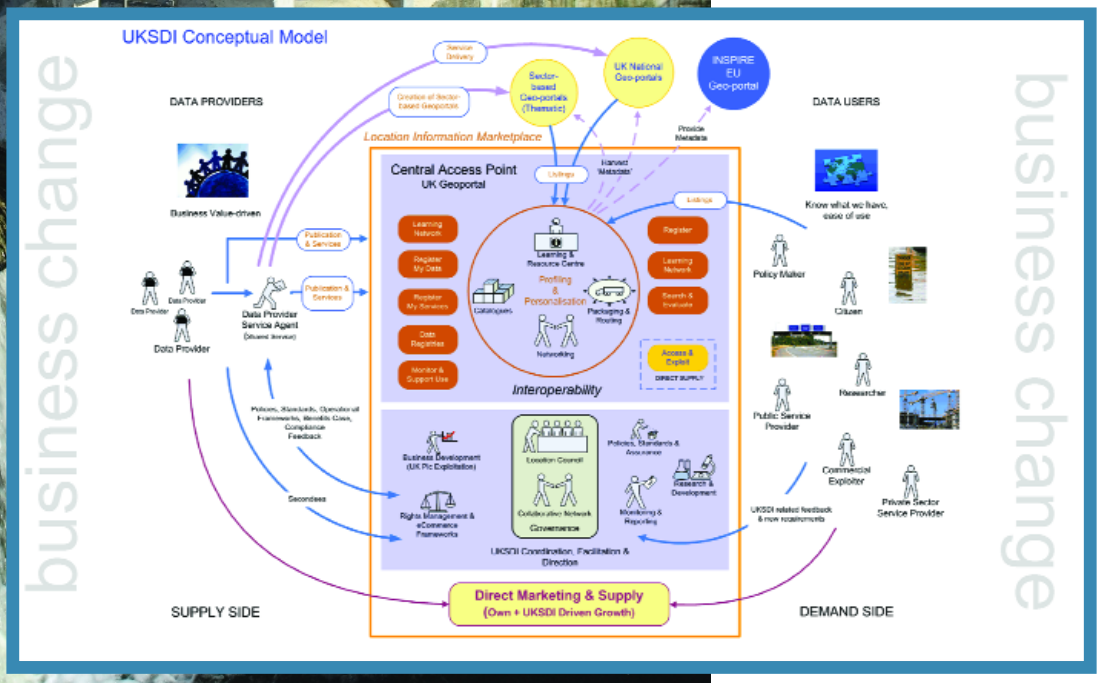
. . . joining the geography jigsaw





Seasonal greenshoots or a sustainable future for UK GI?

NSDI: framework or a battleground?

Open systems architecture

Open Source: creeping up the agenda

OS's new strategy. Time to be more positive?

Testing datasets for INSPIRE

Seamless integration the Autodesk way

plus News | People | Products & Services | GiSPro's columnists | Blogging the blogs

SDI's: elevating policy

Since 2005 digital mapping has been opened up to the mainstream by Google and others.

LOOKING BACK at the history of the geospatial industry the authors are old enough to recall heated debates about the relative merits of the raster and vector approaches to representing geographic data. And while these debates raged many other discrete geospatially relevant technologies were developing, in areas such as imaging, communications, search and analysis. The result was that users would spend hours struggling with data to make it compatible for use with the multiple specialist tools for data analysis and application.

Only in the last few years have we started to emerge from that world into a future of broad-spectrum interoperability. Standards first started to address data interoperability and then services that can be chained using business process management software. Clients can find servers and invoke operations as if the clients and servers were functions or subroutines in a standalone software system. This was the original vision of the Open Geospatial Consortium (OGC), a vision that has been increasingly realised through the work of OGC members building open interfaces and encodings in a well-documented and highly disciplined consensus process.

This vision fed the concept of "National Spatial Data Infrastructures" (NSDI). Originally constrained to focus on issues of data, metadata, clearing houses and data coordination, spatial data infrastructure policy makers began tracking the emerging concepts of interoperable information processing and embraced the vision of pervasive web-based environments for the collaborative development and use of geospatial information and services.

Agencies are coordinating SDI worldwide In the EU, in response to the INSPIRE Directive, scores of agencies are now in the process of coordinating their SDI activities. In Canada, GeoConnections, a national partnership programme led by Natural Resources Canada, provides guidance and motivation for partnering agencies at all levels of government to join the web-based Canadian NSDI. In the US, the Federal Geographic Data Committee (FGDC), an inter-agency committee presently under the supervision of the Executive Office of Management and Budget (OMB), promotes the coordinated development and interoperability of geospatial data on a national basis, administering both the National Map and Geospatial One-Stop. In Australia and New Zealand, the inter-governmental council (ANZLIC) is responsible for the coordination of spatial information management, working with other agencies such as Geoscience Australia, to provide a range of national fundamental datasets and to manage the gateway to the Australia Spatial Data Directory (ASDD).

As interoperability becomes a reality, and as increasingly diverse data sources can be merged and operated on in a synergistic manner, we are beginning to see an explosion of innovation in geospatial services. This interoperability both influences, and is influenced by:

- **the convergence between formally discrete technologies such as data collection technologies and sensor webs,**
- **mobile broadband communications,**
- **spatial search and visualisation.**

National Spatial Data Infrastructures – co-ordinating framework or battleground for the management of geospatial data?

The world is experiencing significant and largely unplanned change due to the rapid evolution of geoprocessing. It may have major and potentially very negative consequences unless addressed. The authors argue that we need to elevate NSDI to the highest level of policy development in government.

> ***". . . we are beginning to see an explosion of innovation in geospatial services."***

The SDI programmes of many countries benefit from the rich possibilities that accompany this explosion of innovation. It has become straightforward, for example, for city employees to access and update street furniture data via their mobile phone or PDA. Open web services innovations bring other benefits, such as preservation of the value of both legacy systems and newly purchased systems and the increasing ability to integrate components from diverse vendors.

Many SDI stakeholders are encouraged by the progress of intra- and inter-governmental interoperability of institutional geo-data and services. Data and processing services on distributed servers can be found through distributed catalogues of metadata. Local data can be kept up to date by those most familiar with the data and current data can be accessed from anywhere and "rolled up" with data from other localities. Decision makers who value productivity and service to the public have much to be pleased about. In fact it seems that we

may finally be close to realising the SDI vision.

Too fast to handle? But are things changing too fast for the agencies responsible for NSDI themselves?

It is pleasing to see innovative growth and "bottom-up" initiatives from industry and NGO's that cut across the institutional domains that have traditionally characterised SDI. It is exciting to observe the accelerated pace of SDI development enabled by the many novel and productive connections made possible through the use of standard interfaces and encodings that we and our colleagues have created.

But we must also understand that the pace of technological change brings challenges. Not only academics, but commercial and public sector policy planners must recognise their responsibility to carefully examine the rapidly evolving interplay of technology and market forces. We are experiencing significant and largely unplanned change due to the rapid evolution of geoprocessing. The pace and nature of this change significantly affects society's ability to assimilate new capabilities and practices efficiently into the market process. This will have major and potentially very negative consequences unless addressed.

Fast development and converging technologies can be, and frequently are, disruptive technologies. If the disruption were only "creative destruction" of slower-moving technology providers, it would be of limited concern. But creative destruction can also apply to the efficiency and integrity of government programmes and policies. The problem is more complicated than workers adjusting to new business processes or recasting of job descriptions to fit new "geo-enabled" workflows.

In 2005, Google, Microsoft and Yahoo! all released free web mapping applications, with free APIs, that opened up digital mapping to mainstream Internet users. In general, users can't modify the maps, but they can overlay locations of things that have street addresses or GPS coordinates. Considering the accuracy and liability issues that surround such data products, what, we might ask, would be the consequences were these companies to be asked to provide increasingly comprehensive and economically attractive data services to municipalities and regional planners in an unregulated market?

Could maps for all replace government agencies? Or, alternatively, consider the bottom-up initiatives such as OpenStreetMap, whose map database grows and improves through the efforts of thousands of volunteers. What if the quality and currency of this data began to exceed the quality and currency of government-provided data? It is not inconceivable that novel methods designed to work for "the average person" could be so successful that, issues of relative accuracy notwithstanding, they might in other ways significantly alter the plans and programmes of government agencies.

Also, the potential clash of new paradigms involves questions of data ownership, licensing, pricing, cost-recovery and impact on traditional power structures, personal privacy, and even national security. Until recently government maps were often considered to be classified documents, and in some countries this continues to be the case. Yet comprehensive high resolution images and street level views of facilities such as, for example, the MI5 and MI6 buildings in London are readily available to users on-line. The social, political and legal implications of the use of these data sources are only now being explored.

When an application can acquire data from multiple repositories in real-time and process the data sources in multiple ways via complex optional service process chains then, in the absence of regulatory and certification processes, where does legal liability lie in the event of an error and consequent financial loss or human tragedy? And, when similar data is available from a plethora of licensed and open Internet sources how does one determine whether data and application outputs are in any way governed by licensing arrangements?

Given the economic, organisational, legislative and political importance of NSDIs and intra-governmental programmes such as INSPIRE, what should be done to ensure that currently divergent "top-down" and "bottom-up" approaches to geoprocessing become mutually reinforcing? The legal and liability issues alone are enough to emphasise the need for such a development.

Unless we address such issues we may find that many hundreds of millions of pounds/euros/dollars are expended on multi-year initiatives that are superseded or marginalised by the time they reach fruition.

The way forward in research? Both NSDI and commercial developments that bring geospatial data and services to the general public are at an early enough stage of evolution that collaboration can be mutually beneficial and produce synergy and convergence rather than schism and conflict. This will require vision and strong leadership; it must involve not only Government but industry and academia. The current developments in NSDI are positive and to be lauded, as are initiatives such as the establishment of a Location Council by the UK Government.

But governments must be innovative and far-sighted enough to acknowledge that developments will not follow smooth ten-year plans and that policy and plans must be constructed in a manner that will be agile and flexible enough to accommodate an inevitable sequence of disruptive technological developments.

Government cannot continue to follow a path that is separate and discrete from the bottom-up entrepreneurial revolution in the generation and use of location-based data for mass consumer applications. Governments must play a part in that revolution by

What if the quality and currency of this data began to exceed the quality and currency of government-provided data?

supporting research, developing consensus and defining their role on behalf of the public they serve.

Government and industry fund research; it is in the interest of both to encourage academia to expand geomatics research agendas and curricula to address these questions. Existing standards, now widely implemented in products, are solving longstanding problems of data sharing and data discovery. Now the focus will increasingly be on innovation to use this platform in new and exciting ways to meet social needs, create wealth, increase the security of nations and their citizens and address the many environmental challenges that face this planet.

We need to aggressively develop our understanding of how to model features, phenomena and relationships in time and space as computation and bandwidth constraints diminish, as real-time access to thousands of constantly updated data sources and services becomes practical, and as web-accessible sensor nets proliferate.

> ***Geospatial data is. . . a very powerful data type with value in almost all aspects of government...***

The way forward in government NSDI efforts have historically developed out of the needs of national mapping agencies and natural resource agencies. Geospatial data is, however, a very powerful data type with value in almost all aspects of government, and accordingly NSDI must be an effective government-wide responsibility.

The progress of geospatial technology has far outpaced the progress of laws and policies that address liability, privacy, national security and intellectual property rights (IPR) in spatial data. The issues involved are complicated and their resolution is required in advance of events, some of which may otherwise have tragic consequences in law enforcement, civil protection, emergency response or the consumption of location services. We need to elevate NSDI to the highest level of policy development if we are to adequately deal with the rapidly advancing progress in geospatial information and technology. NSDI is too important to be left in the hands of the geospatial community alone!

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