Spatially Enabled Society

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Key words: Land Administration, Spatial Data Infrastructures (SDIs), Spatial Enablement

SUMMARY

The term 'spatially enabled society' describes the emerging cultural and governance revolution offered by pervasive spatial information technologies and spatially equipped citizens. Spatially enabled societies make possible, amongst many other things, sustainable cities, GFC early warning systems, smarter delivery of housing, improved risk management, and better macroeconomic decision making. The concept is not about managing spatial information, it is about governing society spatially. Spatially enabled societies represent the realization of the promises offered by building spatial data infrastructures (SDIs) and reforming land administration systems. These building blocks, established over decades, make possible spatially enabled societies. Without tools for managing metadata, building complete national cadastres, modelling and integrating the 3rd dimension, and much other foundational work, spatially enabled societies cannot emerge. This paper explores the notion of spatially enabled societies further. Example applications are used in the discussion. The paper also demonstrates how, despite the grand possibilities of revolutionary spatial technologies and spatially aware citizens, existing infrastructures including SDIs and land administration system will still require an ongoing governance structure for spatially enabled societies to be maintained.

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1. INTRODUCTION

The term 'spatially enabled society' attempts to describe an emerging cultural and governance revolution: pervasive spatial information technologies and spatially equipped citizens are changing the way economies, people, and environments are managed and organized. Economic wealth, social stability and environmental protection can be facilitated through the development of spatial information products and services created by all levels of society including governments, the business sector, and citizens (Rajabifard *et al*, 2010).

The concept of the 'spatially enabled society' is still unformed. Emerging literature, practical examples, and international associations (e.g. FIG, GSDI) continue to provide hints as to key characteristics and features; however, a shared empirically tested view is still forming.

This paper aims to review current understandings of spatially enabled societies. The emergence of the concept is described, as are associated definitions. A number of examples are used to illustrate progress and developments. The paper then argues how, despite the grand possibilities of revolutionary spatial technologies and spatially aware citizens, existing infrastructures including SDIs and land administration system will still require an ongoing governance structure for spatially enabled societies to be maintained. Extracts from Rajabifard *et al* (2010), one of the most recent publications on spatially enabled societies, are used throughout the paper to inform the discussion.

2. THE EMERGENCE OF SPATIALLY ENABLED SOCIETIES

The high take-up of spatial information technology by organizations seeking better land management opportunities is well known. The growth was so spectacular that an entire new concept was designed to manage and coordinate the explosion. The spatial data infrastructure, SDI, was born and became a worldwide phenomenon. The power of the idea was demonstrated by their take-up and by efforts to build components of national systems. The development of spatial data infrastructures underpins the management of both spatial information and information organised according to location. SDIs are now tools of global significance. Over 100 countries actively work to construct a national SDI.

Following on from the government-driven SDI phenomenon, popularity of GIS amongst citizens jumped by orders of magnitude as capacity to handle, visualize, and analyze geographic information improved. The term 'spatially enabled society' emerged in the mid 2000s as new spatial technologies began pervading mainstream user groups: in-car navigation systems, GPS enabled mobile devices, and various digital globes (e.g. Google Earth) quickly

gained traction and popularity amongst the wider community. Williamson *et al* (2010b) described the underlying reason for the rapid uptake. The power of the visual over the verbal was highlighted: spatial information reduced the amount of information and organized it into "brain-ready" information. When people were spatially informed, the "map condensed thousands of spreadsheets" into a single view. Combined with the web environment, the communication of information amongst agencies and citizens could be vastly improved (Williamson *et al*, 2010b; Rajabifard *et al*, 2010). This new spatial pervasiveness led the research community to define the emerging cultural phenomenon as 'spatial enablement'.

In the literature, Williamson *et al* (2006) first describe spatially enabled societies as those 'where location and spatial information are regarded as common goods made available to citizens and businesses to encourage creativity and product development'. In this regard, the vast majority of the public were users, either knowingly or unknowingly, of spatial information. The daily business of people was implicitly connected to a location. Locations were presented in variety of ways such as address, maps, coordinates, landmarks, and increasingly 'places' (Rajabifard *et al*, 2010).

Van der Molen (2007) described spatially enabled societies as having two key characteristics. First, it related to decision-making. Spatial enablement was realized "when public administrators, the private sector and citizens (the actors in 'governance') decide on issues where the spatial component was one of the determinants for the decisions". In these cases they needed access to spatial information that was relevant and contributed in a meaningful way to the process of making that decision. Second, it related to information integration. Decisions seldom needed only one source of information, they tended to require information from many sources. Integration and sharing transformed single source data into meaningful information and services.

Wallace (2007) described spatial enablement as having two stages. The first involved utilizing imagery to answer simple questions visually such as 'Where am I?". Traditioanl non-spatial information and processes could be visualized spatially to allow for simple decisions about finances, health, education, and tax, amongst others. The second stage involved linking all data with a geocoded reference and re-engineering processes around the opportunities provided by spatial analysis and spatial decision-making. The link between activities, locations, times and people were key.

At application specific levels, Ezigbalike and Rajabifard (2009) regarded a service as spatially enabled if the service delivery process incorporated seamless access to all the information that a user of the service might need to make spatial or location-specific decisions associated with the service (Rajabifard *et al*, 2010). Additionally, they suggest that the user would be expected to know which datasets were required and to specifically request these and combine them. The onus was also on the service provider and system designers to ensure that relevant spatial information was integrated into any enquiry or request application.

Another recurring characteristic of spatial enablement was that existing spatial and land administration organizations needed to readjust their focus. Spatial tools and information

would no longer be sequestered in mapping agencies where they were originally created (Rajabifard *et al*, 2010). The previous focus of these organizations on 'managing spatial information' needed to shift to a focus on assisting society to manage itself spatially.

Williamson *et al* (2010b) recognized that 'spatially enabled society' was an evolving concept. However, the general requirements remained that location, place and other spatial information needed to be available to governments, citizens and businesses as a means of organizing their activities and information (Rajabifard *et al*, 2010). In-line with the mantra of social-informatics, spatial enablement was about more than just developing and using geographic information systems (GIS). It was a concept that permeated and changed the whole of government and society, drawing heavily upon the spatial data infrastructures within a jurisdiction (Williamson *et al*, 2010a).

Richer definitions of spatial enablement are also emerging. Rajabifard (2007) describes the range of activities and processes that should be created across jurisdictional levels. These include: an enabling platform comprising of institutional elements, a collaborative framework, a governance structure, legal controls, and technical tools for data sharing, and e-government and information sharing strategies; building on SDIs and related initiatives; using geocodes and "place" related information (such as a national geocoded street address files); re-engineering the institutions of government; legal frameworks to facilitate integration and management; activities on spatial data standards and interoperability; development of authoritative registers of key spatial information; research and development; and growth in capacity at societal, institutional and individual levels.

Steudler and Rajabifard (2010) also provide more depth. Key technical elements of spatially enabled ability are defined to include: rules for representing the real world situation; the existence of a legal framework; a reference between reality and the model; the ability to position objects correctly; representing situations correctly; acquiring the needed human resources and technical tools; having as much spatial information as needed; and delivering the appropriate area coverage.

In summary, descriptions of spatially enabled societies are still undeveloped and continue to evolve. Despite this inadequacy, there is firm agreement that spatially enabled societies are emerging and will continue to do so. Attention is now given to more practical examples of the spatially enabled society.

3. SPATIALLY ENABLED SOCIETIES IN PRACTICE

Various approaches for achieving spatial enablement in practice are evident: hierarchical systems, market mechanisms, or networked approaches provide examples. The relative merits of each approach is examined and assessed in works by Compvoets *et al* (2010), Vandenbroucke *et al* (2009), and Van der Molen (2007) amongst others.

Van der Molen (2007) argues that three key participants are evident in spatially enabled

societies: government, data supplier sectors, and society as a whole. The roles and contributions of these participants are described. Specifically, it is suggested that it is the responsibility of the government to facilitate the underlying spatial data infrastructure. The underlying reason here is to safeguard the availability and access of spatial information for greater society. Further, as the spatially enabled society evolves through interactions between participants, government should facilitate the legal and economic transactions relating to spatial information. With regard to data suppliers, they should bear the responsibility for organizing the availability and access to information and respond to the needs of society.

From another perspective, Crompvoets *et al* (2010) and Vandenbroucke *et al* (2009) argue that in reality, SDIs and accompanying spatially enabled communities are complex networks of datasets, information flows, and nodes. Hierarchical approaches to understanding and building SDIs have less utility in terms of assessing the success of SDIs and spatial enablement. The network approach allows for richer assessment of the SDI: density, distance, and centrality of the spatially enabled society or SDI components can be measured and consequently improved.

The debate continues as to whether hierarchical, market, or network approaches are best used for designing and assessing SDIs. Meanwhile, regardless of the underlying infrastructure, the number and types of spatially enabled applications continues to grow. For example, Eagleson (2007) describes how geographically referenced statistics can be used to monitor activity within an area: health, wealth, and population distributions can be collected, aggregated and analysed spatially. Spatially enabled data is becoming an increasingly critical resource for planning and decision making in disciplines including epidemiology, economics and environmental management. Analysts are being required to integrate growing numbers of information sources to feed into increasingly sophisticated applications (Rajabifard *et al*, 2010).

Spatial applications in realms once oblivious to the utility of spatial and mapped information are now evident. In Australia, the insurance and re-insurance industries in both the government and private sectors are developing spatial applications to manage risks and claims. Other emerging applications include tools for assessing, monitoring and achieving sustainable cities, smarter delivery of public housing, and improved macroeconomic decision-making (including taxation and management of monetary policy).

The Victorian Mapping and Address Service in Australia provides an example from the government sector. It helped to spatially enable employees in the Victorian Government. The system delivers operational efficiencies for standard work practices. It increased the accuracy and reliability of address information that was collected during standard business operations. It is important to note that in this case the majority of users had no spatial background. Moreover, it eliminated the need for specialised software, training or resources. The system was designed as a whole of Victorian Government web service and consequently costs associated with hosting and information maintenance were reduced (Davies, 2007; Rajabifard *et al*, 2010).

Cowen and Buhler (2010) provide another example of how spatial enablement could be utilized in the government realm. The proposed application here was a early warning systems for economic events such as the global financial crisis (GFC). Bennett *et al* (2011) provide a simple illustration of such an application in practice (Figure 2). Information from land administration systems, such as registry data relating to mortgages and ownership, could be spatially enabled and used to deliver a visual snapshot of the health of a nations property market.

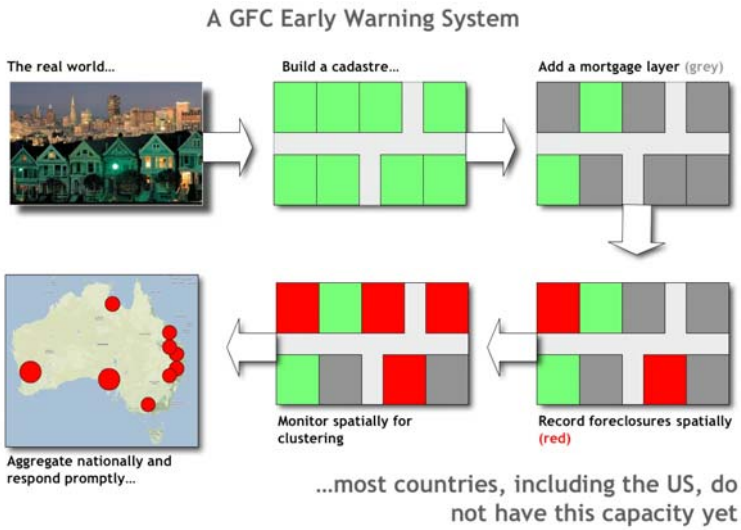

Figure 2. A spatially enabled GFC early warning system (Bennett et al, 2011)

Another example of spatial enablement in action is the use of Google Maps or Bing Maps to allow mash-up capacity to facilitate simple, and sometimes complex, service provision. There are many instances from the business and citizen sector using spatial mash-up technologies in providing user friendly services or organizing private and business activities (Rajabifard *et al*, 2010). Spatial systems now combine information from other services and convert queries into much more user-friendly results. For example, finding properties for sale is much more convenient by combining buyers' preferences and presenting final results in an easy to comprehend visual (map) format.

In summary, the number and range of spatial applications is growing exponentially within all sectors of society. While some aggregation in the numbers of applications will occur in the coming years, the quality of the applications, if not the associated data, will continue to improve. Not explicitly mentioned above is the rapid increase in volunteered geographic information (VGI) and associated applications. This swathe of non-authoritative spatial information is challenging traditional notions of SDIs (Jackson *et al*, 2010), but at the same time is expediting the delivery of spatial enablement across society. Attention is now given to other future directions and emerging challenges in the realm of spatial enablement.

4. FUTURE DIRECTIONS AND CHALLENGES

It is important to acknowledge that spatial enablement cannot emerge without supporting infrastructure. The understated, non-visible nature of this infrastructure often means it is taken for granted. In Australia for example, there is little public recognition of the complex governance and technical arrangements that enable a national geocoded address file to be delivered. Spatial enablement cannot hope to be achieved without some form of coordinated spatial data infrastructures (SDIs) and reformed land administration system. These building blocks, established over decades, make possible spatially enabled societies. Without tools for managing metadata, building complete national digital cadastres (DCDBs), modelling and integrating the 3rd dimension, and much other foundational work, spatially enabled societies could not emerge. The importance of promoting these building blocks is a challenge for the international spatial community. In particular the Global Spatial Data Infrastructure (GSDI) association and the International Federation of Surveyors (FIG) are undertaking work programs.

The GSDI Association developed its strategic plan 2009-2013 around issues related to spatial enablement. The betterment of society through spatial enablement is the key underlying goal of the plan. Importantly, both developed and developing countries are considered. The different opportunities that spatial enablement can deliver to the developing context needs sensible consideration. Key issues are cost and existing capacity. The GSDI Association will aim to create a promotional environment that can be utilized by stakeholders to assist with spatial enablement in their specific country contexts. The first attempt at realizing this notion was through the theme for the GSDI 12 World Conference in Singapore 2010 (which ran jointly with the United Nations sponsored Permanent Committee on GIS Infrastructure for Asia and the Pacific): 'Realizing Spatially Enabled Socieities'.

The FIG, through a special short-term task force as part of Commission 7, is also undertook work related to spatially enabled society. The aim was to develop a framework for jurisdictions to understand and embark on spatial enablement. The task force was established by the FIG Council and endorsed by the General Assembly in May 2009 in Eilat, Israel (Rajabifard *et al*, 2010). The task force is considered the importance of global economic, social and environmental issues and how spatial enablement could assist in managing these. These include: the UN Millennium development goals (eight objectives that focus on the eradication of poverty, which can strongly be related to land and ownership of land); Climate change and global warming; and Disaster management. A clear understanding of the requirements of spatial enablement is emerging: a precondition for spatial enablement is the modelling of reality (i.e. spatial enablement is best practice, when real world reality is modelled as closely as possible). The establishment of real world models requires modelling rules and tools. Indicators to measure spatial enablement include comprehensiveness, coverage, reliability and accuracy. A crucial element in dealing with global problems is the information about land ownership (i.e. a cadastre is crucial for establishing the link people to land) (Rajabifard *et al*, 2010).

Along with the need for awareness and maintenance of existing spatial infrastructures a

number of other challenges are evident. First, a long-term view is required: the development of a spatially enabled government and society is ongoing and multi-disciplinary. Jurisdictions will need to work together over the long-term if the vision is to become reality (Rajabifard *et al*, 2010). Overcoming the political and financial impediments to implementing long-term visions needs further consideration. Second, achieving spatial enablement also requires multi-disciplinary approaches to research and governance. A wide range of experiences and disciplines from surveying and mapping, land administration, GIS, information and communications technology, computer science, legal and public administration, economics and many more is required. The 'Spatialist' project run out of the University of Leuven in Belgium and sponsored by the Government of Flanders provides early clues as to how multi-disciplinary research can be undertaken in the realm of SDIs and how multi-view assessment approaches can be developed. Finally, there is a need to develop institutional practices to make existing and future technology more effective. Research has found that very few jurisdictions have developed a framework for establishing a spatial infrastructure that addresses comprehensively operational, organisational and legal issues (Rajabifard *et al*, 2010).

In summary, future directions associated with realizing spatially enabled socities should include a focus on creating awareness of the importance of maintaining existing spatial and land infrastructures, promoting a long-term approach across government, ensuring multi-disciplinary groups to work together with respect to SDI design, and developing comprehensive institutional practices for establishing spatial infrastructures.

5. CONCLUSIONS

New spatial technologies offer remarkable opportunities to organise information and reengineer business processes. This prevailing sense of potential is described as 'spatial enablement'. Descriptions of spatially enabled societies are still undeveloped and continue to evolve. Despite this inadequacy, there is firm agreement that spatially enabled societies are emerging and will continue to do so. The demand, number and range of ubiquitous spatial applications are growing exponentially within all sectors of society. The need to deliver sustainable development is now pressing. The global credit crisis and the spread of credit contagion originating in the sub-prime mortgage markets of the United States provides another example of where spatial technologies have a role to play. While some aggregation in the numbers of applications will occur in the coming years, the quality of the applications, if not the associated data, will continue to improve.

To achieve the benefits of spatial enablement, people who design and build systems need to set up the right foundations. Future directions associated with realizing spatially enabled societies will need to include a focus on creating awareness of the importance of maintaining existing spatial and land infrastructures. The modern challenge is to redesign the existing tools used to perform fundamental business processes in order to achieve much more relevant results across society. Other challenges include promoting a long-term approach across government, ensuring multi-disciplinary groups to work together with respect to SDI design, and developing comprehensive institutional practices for establishing spatial infrastructures.

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ACKNOWLEDGEMENTS

The authors, from The University of Melbourne, would like to acknowledge the support of the Australian Research Council, Land and Property Management Authority of New South Wales, Land Victoria, Landgate of Western Australia, and PSMA Australia Ltd. The authors would also like to acknowledge that parts of this paper are extracted and adapted from: Rajabifard, A., Crompvoets, J., Kalantari, M., and Kok, B., (Eds)(2010), Spatially Enabled Societies, Leuven University Press, Belgium. Where these extractions have taken place full citation is provided using: Rajabifard *et al* (2010). Finally, the authors would also like to acknowledge the support of colleagues at the Centre for SDIs and Land Administration at The University of Melbourne

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Title:
Spatially enabled society

Date:
2011

Citation:
Williamson, I., Rajabifard, A., Wallace, J., & Bennett, R. (2011). Spatially enabled society. In Bridging the Gap between Cultures (FIG Working Week 2011), Marrakech, Morocco.

Publication Status:
Published

Persistent Link:
http://hdl.handle.net/11343/32586

File Description:
Spatially enabled society