

Anticipating the cultural aspects of sharing for SDI development

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ABSTRACT

The complexity of communications and relationships between sectors and agencies to achieve a common understanding of spatially related issues across a jurisdiction is paramount for any economy, management of the environment, social issues and security. On the other hand, the need to create multi-participant, decision-supported environments to address the issues of sustainable development and improving the quality of life creates a growing need to organise data across disciplines and organisations through different forms of spatial data infrastructure (SDI). This infrastructure is fundamentally a concept about facilitation and coordination of the exchange and sharing of spatial data between stakeholders from different jurisdictional levels in the spatial data community.

This paper reviews the role that human nature plays in any endeavour based on interaction and sharing makes cultural and social factors important to the acceptance of the SDI concept and its alignment with spatial industry objectives. Cultural aspects and social factors influence the complexity and dynamics of developing SDIs. Therefore, positioning to consider these aspects and factors are important elements in design and development of SDIs. Further, the importance of establishing a culture for sharing as well as understanding the dynamic partnerships necessary to support such a culture is highlighted. It is argued that by better understanding and promoting a culture for sharing spatial data, any level of SDI development can gain support from a wider community of both government and non-government data users and producers.

KEYWORDS: Culture, Sharing spatial data, Spatial Data Infrastructure (SDI), SDI Hierarchy, Social and cultural Factors

Introduction

The growing need to organise data across different disciplines and organisations has resulted in the concept of spatial data infrastructure (SDI). SDI is an initiative underpins the design, implementation and maintenance of mechanisms that facilitate the sharing, access and utilisation of spatial data across different communities to better achieve their objectives. With this in mind, many countries are developing SDIs to better manage and utilise their spatial data by taking a perspective that starts at a local level and proceeds through state, national and regional levels to the global level. This has resulted in the development of different forms of SDI at and between these levels and giving more attention to the SDI hierarchy which assist in decision making. However, many research still shows that the despite considerable interest and activities, the development of an effective and comprehensive SDIs are hampered by a lack of support from members of the communities and their willingness for cooperation and sharing spatial data which results in these initiatives remaining—in many cases—very much an innovative concept.

Based on this situation, this paper aims to address the minimisation of this problem based on the results of a case study and survey research on Regional SDI development in the Asia–Pacific region. It is proposed that this problem can be minimised by better understanding of the significance of human and community issues, as much as technical issues; increasing the level of awareness about the nature and value of SDIs; understanding the dynamic partnerships which are necessary to support a culture for sharing; and by identifying key factors that facilitate development based on the complexity of the interaction between social, economic and political issues.

To achieve this aim, the concept and nature of SDIs is reviewed in order to facilitate their development and progressive uptake and utilisation by different jurisdictions. The paper then reviews the role that human nature plays in any endeavour based on interaction and sharing which makes cultural and social factors important to the acceptance of the SDI concept and its alignment with spatial industry objectives. The argument here is that developing a successful SDI within a jurisdiction must be seen as a socio-technical, rather than a purely technical, exercise as the communities concerned are expecting to reap benefits from their investment in SDIs. Further, the importance of establishing a culture for sharing as well as understanding the dynamic partnerships necessary to support such a culture is highlighted. Finally, the paper discusses different SDI development issues follows by addressing three major classes of factors to facilitate the development of an SDI initiative. It is argued that by better understanding and promoting a culture for sharing spatial data, and the adoption and implementation of key factors, any level of SDI development can gain support from a wider community of both government and non-government data users and producers.

Spatial data infrastructure—nature and components

Spatial Data Infrastructure (SDI) is fundamentally a concept about facilitation and coordination of the exchange and sharing of spatial data between stakeholders from different political/administrative levels. In principle, SDIs underpin the design and development of mechanisms that facilitate the creation of multi-participant, decision-supported environments to address the issues of sustainable development and improving the quality of life. Therefore, SDI is whole about people and data in which people includes the data users and suppliers and any value-adding agents in between, who interact to drive the development of the SDI.

An SDI encompasses the policies, access networks and data handling facilities (based on the available technologies), standards, and human resources necessary for the effective collection, management, access, delivery and utilisation of spatial data for a specific jurisdiction or community. Within the context of SDI components, Georgiadou and Groot (2002) noted that there is a complex relationship between technological, institutional, organisational, human, and economic resources which interact with one another. Further, they argued that SDIs are the intermediate mechanisms underpinning the supply of jurisdictional public goods, due to the various components of SDIs that also exhibit public goods characteristics to a larger or lesser extent.

Viewing the SDIs components, Rajabifard *et al.* (2002a) suggested that different categories of components can be formed based on the different nature of their interactions within the SDI framework. Considering the important and fundamental role between people and data as one category, a second can be considered consisting of the main technological components: the access networks, policy and standards. The nature of both categories is very dynamic due to the changes occurring in communities (people) and their needs, as well as their ongoing requirement for different sets of data. Additionally, with the rapidity with which technology develops, the need for the mediation of rights, restrictions and responsibilities between people and data are also constantly subject to change. This suggests an integrated SDI cannot be composed of spatial data, value-added services and end-users alone, but instead involves other important issues regarding interoperability, policies and networks. According to this view, anyone wishing to access data must utilise the technological components.

Discussion of the SDI concept also initially focused on nations as an entity, while the last few years have seen more attention given to understanding the SDI hierarchy, which is made up of inter-connected SDIs at local, state or provincial, national, regional and global levels (Rajabifard *et al.*, 2000). In general the various levels in the SDI hierarchy are a function of scale with the local government and state level SDIs usually concerned with large and medium scale data, whereas National SDIs tend to be medium to small scale with regional and Global SDIs adopting the small scale for their activities. With an improved understanding of the SDI hierarchy has come

the challenge to improve the relationships between SDIs in different jurisdictions as well as between different spatial data initiatives.

The key to building successful SDIs is in the establishment of these relationships, especially through mutually beneficial partnerships, which are both inter- and intra-jurisdictional within the SDI hierarchy. This illustrates the existence of other form of relationships within the SDI hierarchy. In addition to the vertical relationships between different jurisdictional level of SDIs, there are also complex relationships between SDIs within a political/administrative level, at an horizontal level, which need to be realised as well. The vertical and the horizontal relationships within an SDI hierarchy are very complex, and this complexity is due to the dynamic, inter- and intra-jurisdictional nature of SDIs (Rajabifard *et al*, 2002b). In order to map these relationships and take the benefits of SDI hierarchy, it has been argued that any SDI practitioners need to understand the role of dynamic partnerships as they are essential to develop any SDI initiatives.

Partnerships are formed to create business consortia to develop specific data products or services for strategic users, by adopting a focused approach to SDI development. It is also important to identify and understand the human and community issues as they help to better define and arrange relationships through the partnerships concept.


Human and community issues

As discussed above, SDI is whole about sharing data and cooperation between different people within and across different disciplines in spatial data communities. It is essential that SDI practitioners to understand the significance of human and community issues as much as technical issues, as they determine and contribute to the success of SDI developments. Community issues determine the long running success of an SDI innovation. SDI, therefore, can no longer be regarded, or taught, primarily as just a technical matter. Developing a successful SDI initiative depends at least as much upon issues such as political support within the community, clarifying the business objectives which the SDI is expected to achieve, sustaining a culture of sharing, maintaining reliable financial support and enlisting the cooperation of all members of the community, as upon technical issues relating to spatial data access, networking, and standards. Therefore, developing a successful SDI within a jurisdictional level must be seen as a socio-technical, rather than a purely technical, exercise; the communities concerned are expecting to reap benefits from their investment in SDI in terms of improved corporate performances and cooperation.

For example, for improving the success rate of an SDI initiative the attention needs to be paid to understanding the community and organisational issues within which SDI is supposed to be developed. Campbell and Masser (1995) noted that the technological imperative leads us to believe that the adoption of new technology is inevitable and the sooner we adopt the new products the greater will be our advantage. Thus, like any new technology, any community which adopts SDI sooner, will experience greater advantages. In response to this recognition, Petch and Reeve (1999) believe a socio-technical viewpoint has increasingly been adopted with the definition of an information system being expanded to include not only the hardware and software, but also the people involved.

Socio-technical view is as relevant to the development of SDI initiatives, which suggests the need to focus on people, alongside technical and institutional components, in the definition and design of SDI initiatives. Based on this view, a shift is suggested from a techno-centric position to a socio-technical position within a spatial data community. By this adoption, the focus of practitioners will be more on 'people and technology' instead of just 'technology' (Table 1).

Table 1 From a techno-centric position to a socio-technical position

Spatial data community positions		Techno-centric view (<i>Focus on Technology</i>)	Socio-technical view (<i>People and Technology</i>)
Characteristics		Technology push Because it's possible Specified by technologist Static in nature	Demand pull Because it's needed Specified by users Dynamic in nature

Source: adopted from Petch and Reeve 1999.

According to Table 1, the shift from techno-centric to the socio-technical position would suggest practitioners to consider the *demand pull* instead of *technology push*, in the adoption of a new technology and technological initiative—like an SDI. In this type of community, users will specify the needs for a new technology. Also, the design characteristics of such a technology will be justified by user needs. However, in a techno-centric community, technology dictates the ability to use a new system. Technologists (rather than users) specify the adoption of such a system.

Another aspect is the difference between the nature of both communities. The socio-technical community is dynamic and this is due to the various disciplines and applications, commonly dealt with by people in this type of community. However, in a techno-centric community the nature is relatively constant due to the fact that advancement is driven by the technology push rather than demand pull. The dynamic nature of the socio-technical position within the broader society assists practitioners to better serve the growing diversity of users, and also makes society more reactive in meeting their needs.

As a result of the socio-technical environment, people become more interested to cooperate with each other and more willing to share their datasets. Therefore, these attitudes bring a unique culture—culture for sharing—for the community.

Culture for sharing information

All communities and societies have a culture—a system of shared meaning (Langdon and Marshall 1998). Similarly, any initiative or function, including the sharing of information, also has a specific culture which needs to be promoted to prepare the environment for developing/pursuing the specific activity. Whether that culture is weak or strong is important to both a coordinating agency and individual parties. Therefore, sharing knowledge and information requires a specific culture—a culture for sharing.

Culture is the integrated system of learned patterns of behaviour, ideas, and products characteristic of a society. It is also the ideas people have about their world. In this sense, culture is our mental map of our world and it is also a map for determining action and it becomes a guide for behaviour and decision making. Langdon and Marshall (1998) view the organisational culture as a shared system of beliefs and values, as evident in rituals, stories, myths and often a specialised language, that fosters a feeling of belonging. Cultural differences have persisted between countries at similar stages in industrialisation, and it has been suggested that national culture had a pervasive influence even upon institutional, productive and managerial structures that had formerly been cited as instrumental in international organisational convergence (Neal 1998). Along this line, many researchers also suggested that national cultural differences have an important impact upon the relationship between different countries within a region and their cooperation (Bartlett and Ghoshal 1990, Hennart 1989)

One common lesson propounded by all the researchers is that the relationship between culture and economy is an interdependent: a particular form of economy can only persist if it is sustained by a validating culture(s); on the other hand, a particular form of culture can only persist if its ideological and institutional needs are met by a particular form of economy. Further Neal (1998) reported that, managers find that they are unable to isolate the cultural factors in the diffusion of a new technology and therefore have real problems in trying to manage it. This is not surprising for in targeting national cultural orders, the complex social factors that are collapsed into the

notion of national culture go unaddressed. Cultural problems are the result of complex social dynamics at the interactive and institutional levels. Attempting to manage such problems by targeting transcendent cultural orders overlooks the reasons for these problems.

Influencing factors and issues for SDI development

There are a number of important factors and issues related to SDI development from conceptual, technical, socio-technical, political, institutional and financial perspectives. Therefore, the challenge of designing, building, implementing, and maintaining an SDI draws on many different disciplines and requires examination of such factors and issues.

It is noteworthy that influencing factors and issues involve in the design and the development of SDIs should be considered in the long term in order to achieve sustainable and ongoing development of SDIs. Therefore, in order to develop a functioning SDI efficiently in any jurisdiction, any SDI coordinating agency must manage the diversity of the issues within the community and the jurisdiction in order to gain the support necessary to meet their objectives. By identifying human and community factors as well as the technical factors within classes of potential users, therefore SDI coordinating agencies will be able to better define and develop their strategies to achieve their objectives. Identifying critical social factors and processes in the acquisition, implementation, and utilisation of a technology can facilitate the management of the diversity of the issues.

Having said that, the research conducted by authors, in Asia and the Pacific region, has identified three major classes of factors, which are influencing and contributing to the development of an SDI initiative. As illustrated in Figure 1, the three classes of factors are Environmental Factors, Capacity Factors, and SDI Organisation Factors.

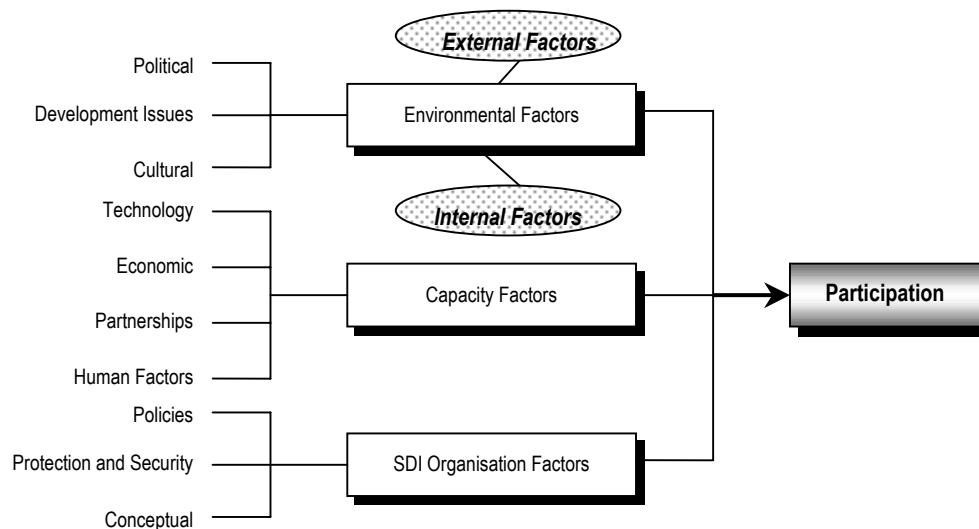


Figure 1 Factors influencing the development of SDIs

Based on this figure, and as Rajabifard *et al.* (2002b) argued, these three classes of factors together can effect on the participation rate for SDI development.

A) *Environmental Factors*: the environment by definition here means the overall structure within which the social system operates and this environment is characterised by internal and external factors. Therefore, the different characteristics of social systems, or communities, adopting the SDI concept can be attributed to a number of environmental factors, including the different cultures of the communities, political factors, and development issues. The external factors are those factors outside the border of the social system which affect, or could potentially affect, the performance of an organisation. These factors impinge more on management levels. The internal factors are those factors inside the border and affect both management and member levels. Therefore,

determining an appropriate social border for study and analysis of a social system is very important. Some examples of external factors are Globalisation (global market, global economics, other global initiatives); the GSDI initiative; and the global environment. In terms of internal factors, examples include the political climate; political structure and procedures; relationships with regional organisations; technological pressure; financial stability of each member nation; organisational structure of the coordinating agency; market pressure; and the degree of culture of data sharing.

B) Capacity Factors: it is generally accepted that capacity building as a concept is closely related to education, training and human resource development (HRD). This conventional concept has changed over recent years towards a broader and more holistic view, covering both institutional and country specific initiatives (Enemark and Williamson 2003). With this in mind, Capacity Factors are those that cover technology, economic factors, partnerships, and human factors and thus encompass technological capacity, human capacity, and financial capacity. Some examples of Capacity Factors are: the level of awareness of values of SDIs; the state of infrastructure and communications; technology pressures; the economic and financial stability of each member nation (including the ability to cover participation expenses); the necessity for long-term investment plans; regional market pressures (the state of regional markets and proximity to other markets); the availability of resources (lack of funding can be a stimulus for building partnerships, however, there should be a stable source of funding); and the continued building of business processes.

C) SDI Organisation Factors: there are a number of important factors and issues that are related to the way that an SDI is defined, designed and implemented. This mainly includes the factors and issues which can fall into each SDI core components, including technical and institutional issues such as access policies, access networks, data and standards, and the SDI conceptual model. Some examples of these factors are the suitability and degree of complexity of the SDI conceptual model; the availability of spatial data and metadata; the interoperability, integration and inter-flow of datasets from different parties (this has important implications for the ownership and control of information); access networks; and multiple trusted data sources (quality and the content of data).

There are also a number of other issues and challenges which have been identified and reported by Williamson *et al.* (2003) which do not fall into SDI components categories. These challenges and issues are reflected in global trends and which are impacting on the development of SDI models and which will continue to influence the evolution of the SDI concept. They are: expanding technologies market demand, changing business models, e-government and participatory democracy, and sustainable development. These issues crystallise the following challenges for SDI coordinating agencies: accelerated development of SDI-compliant fundamental datasets; defining the role of dataset sponsors and custodians in a distributed SDI model; defining the role of the private sector in designing, developing and using an SDI; jurisdictionally consistent data access and pricing policies; as well as monitoring and evaluating the objectives of SDI development and the relativity of their outcomes.

The factors and issues discussed above must all be taken into account as part of the interrelationship of SDI development at any level, from local to global, as these can no longer be considered in isolation. They have to be considered as part of the SDI hierarchy. However, there is still a need for descriptions to actually represent the discrepancies between the role and deliverables of an SDI and thus contribute to a simpler, but dynamic, understanding of the complexity of the SDI concept. To this end, Rajabifard *et al.* (2002b) suggested, that the roles of SDI have been pursued through two different approaches: product-based and process-based models, which contribute to the evolution, uptake and utilisation of the SDI concept in different ways. The main objective of product-based model is to link existing and potential databases of the respective jurisdictional levels of the community. Whilst, the objectives of the process-based model, are to provide better communication channels for the community for sharing and using data assets, instead of aiming toward the linkage of available databases.

Based on these two SDI development models and the factors and issues discussed here, it is possible to classify different levels of an SDI hierarchy, according to the roles played within different political/administration levels and their similarities to the organisational structure. This classification will help to simplify the understanding of the relationship between development models for SDI hierarchy levels.

Relationships between SDI hierarchy, factors and different models of SDI development

All the factors and issues and SDI development models listed above together influence the strategy chosen for SDI development and its effectiveness. How then does a state, country or region decide on the best SDI model to accommodate these issues recognising that they differ between jurisdictions and levels in the SDI hierarchy, as well as between developed and developing countries. As a result, some SDI development initiatives exhibit characteristics of different SDI development models, or of being in a transitional stage—developing a more process-based approach while having product-based origins. This has begun a process of looking beyond a single focus for strategic SDI development to the broader issues contributing to the context of any SDI initiative. Therefore, understanding of the relationships between different SDI jurisdictions, knowing more about SDI development issues and knowing about the potential and applicability of each SDI development model are important for effective SDI development and driving the flexibility required in the second generation of SDI development.

In order to facilitate understanding the relationship between development models for SDIs, an organisational classification of hierarchy levels enables the characterisation of their dominant organisational structure. The relevance of this approach is that each layer of the organisational structure has distinct information requirements and hence demands support from a specific SDI level. It is thus possible to classify different levels of an SDI hierarchy, according to the roles played within different jurisdictional levels and their similarities to the organisational structure (Figure 2).

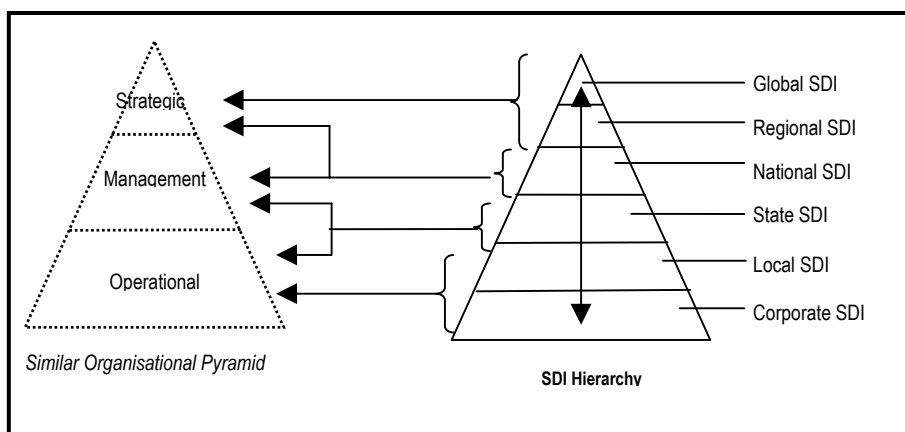


Figure 2 Relationships between SDI hierarchy and their similarities to the organisational structure

According to the above figure and based on the nature of SDIs, any multi-national SDI (regional or global), can be considered similar to the strategic tier of an organisational structure. Due to the important roles that a National SDI plays within an SDI hierarchy, an SDI at a national level can have characteristics of both managerial and strategic tiers. Similarly, state-level SDIs can emulate management or operational organisational tiers, or both due to the wide ranging responsibilities many have in a nation which is a federation of states. The local and corporate levels of an SDI hierarchy are similar to the operational tier of an organisational structure. Both management and operational tiers tend to adopt product-based models due to their key roles in data development. Only the strategic tier and nations with federal systems tend to adopt the process-based model of SDI development. The main reason multi-national and federated nations can benefit more from using a process-based model is that SDI participation at these levels of SDI hierarchy is voluntary.

Whatever SDI model is adopted, whether it is product or process based or is somewhere on the continuum between, the model which is best for the individual jurisdiction will need to consider all the complex issues and factors which are discussed above if an infrastructure is to be established which facilitates the ongoing development of the SDI concept.

Conclusion

Development of a spatial data infrastructure is a challenging task, as it requires identification and examination of a large number of factors and issues. Based on this, this paper discussed and presented the key factors and issues influencing the development of an SDI, which has been part of the outcome of ongoing research. The paper first reviewed the nature and the concept of SDIs, including the SDI hierarchy, which helped to build understanding about the importance of the relationships within different levels of SDI, to support the interactions and dynamic nature of partnerships of spatial data communities. Then, it discussed human and community issues which are important in long running success of an SDI initiative. As part of this discussion, two different types of communities are reviewed, and a shift from techno-centric to the socio-technical positions is highlighted. It is argued that the socio-technical community would suggest practitioners to consider the demand pull instead of technology push, in the adoption of a new technology and technological initiative—like an SDI. The paper then discussed the culture for sharing information followed by discussion on key factors and issues which are influencing the development of SDIs.

Finally, based on two SDI development models, the product and the process based, the paper presented a classification for different levels of SDI hierarchy, using the roles they played within different political/administration levels and their similarities to the organisational structure. This classification been introduced to simplify the understanding of the relationship between SDI hierarchy, factors and SDI development models. It is argued that the adoption and implementation of influencing factors and the selection of a proper model can assist the SDI coordinating agencies in such a way that they improve participation rate and speed up their progress in the development of the SDI initiative.

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