Facilitating Urban Planning and Management at Local Level Through the Development of SDI (Case Study of Lahore - Pakistan)

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Abstract

Role of urban planning and management at local level is becoming more and more crucial due to the dramatic increase in urban population and allied urban problems. However, absence of appropriate information and its limited sharing is one of the important factor affecting planners and decision makers' ability to deal with urban problems. Effective quality of life can not be achieved without appropriate spatial information. Realising importance of spatial information, developed countries have started to develop Spatial Data Infrastructure (SDI) for efficient information sharing. Developing countries like Pakistan & Iran should learn from their experience and develop SDI according to their own institutional, political and culture background. It is expected that improved information sharing and application through Local SDI can help experts in achieving better urban life through improved urban planning & management. This paper aims to explore the role of SDI in better urban planning and management through effective & efficient information integration and sharing.

Key words: Urban planning, Spatial Data Infrastructures, SDI design

1 INTRODUCTION

Urban proportion of the total world population has quadrupled in the last one century (UN, 2006). This rapid urbanization along with technological advancement and changing life styles have resulted in a number of urban problems like housing affordability, unemployment, traffic congestion, pollution, juvenile delinquency, increased crime, epidemic and environmental degradation etc asserting more pressure on urban planners and managers for better urban planning & management.

Planning is a future oriented activity and is a means for preparing for actions. It occurs through a process in which: (1) information is collected and analysed; (2) logical alternatives courses of actions are developed consistent with the goals of a constituency; and (3) a course of action is recommended (ASCE, 1986). Information collection, management and analysis about past trends and present issues are pre-requisite of good urban planning & management. The more information available about people's actual needs and preferences, the better planners are able to satisfy them (Dandekar, 1988). Mostly planners require data from secondary sources ranging from national to local level. But in many cases and specially in developing countries, this secondary information is not easily available in appropriate form reducing its utility (Edralin, 1986). Therefore, planners spend a greater portion of their time and resources on data sources identification, collection and management while little time is left for analysis and policy formulation (Arbeit, 1993). Same data is collected by various department multiple times and in some cases similar data is collected by different departments simultaneously. Present approach of ad-hoc-ism in data collection at municipal level by various departments causing duplication and wastage of resources needs to be revised. Information must be regarded as infrastructures and as local authorities can not afford to develop other infrastructure like water supply, sewerage etc again and again, than why is the case with information infrastructure (Carrera and Hoyt, 2006)? Currency of information is another issue as delay in information availability diminishes its values because ground realities changes very rapidly (Ouf, 2007). This lack of timely information in appropriate format is one of the major obstacles in effective urban planning and management (Cheema et al., 1993).

Above mentioned issues require coordinated efforts for information collection, management and sharing between different departments of national to local level. But this is not an easy job without proper institutional, technical, economic, legal and social framework and guidelines. From last two decades, efforts have started in developed countries to design such a model in the form of SDI based on dynamic, hierarchic and multi-disciplinary concept enabling sharing and accessibility of information to people through access networks, institutional policy and technical standards (Rajabifard et al., 2006). However, so far much of the work is conceptual and more efforts are required to develop a standard replicable model useful in reduced duplication of efforts, efficient information integration, sharing and ultimately informed decision making.

2 URBAN PLANNING

Complexity of urban problems creates the demand for a coordinated effort. Urban problems like housing adorability, traffic congestion, economy, crime, poor living conditions and degraded environment etc can not be solved in isolation without evaluating their relationship with other problems, and any isolated effort

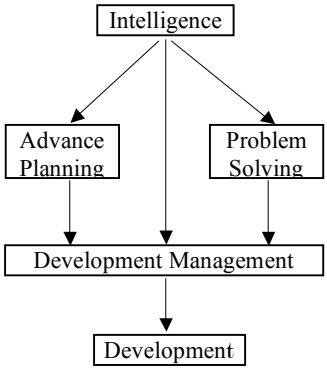
creates other problems. For example in 1960, big and tall buildings were erected to solve the housing problem in France, but after some time, new problems of delinquency and violence emerged in these buildings due to overcrowding (Laurini, 2001). Interdependence between various urban elements like housing, transportation, and job places etc demands for planning. At the same time, role of private market is increasing in physical development and different services and facilities are provided by different authorities at different times, therefore, a working environment can not be achieved without coordinated efforts in the light of a guided plan (Neutze, 1986).

2.1 Urban Planning Functions

Planning is exercised at different level of government from national to local level. However in most of the countries, general policies are made at national level where as detailed plans and strategies for urban growth and management are exercised at local level (ISoCaRP, 2005). Urban planning is considered to be serving four main functions as represented in figure 1 (Kaiser et al., 1995). These include

- Intelligence function
- Problem solving
- Advance Planning
- Development management

Figure 1: Local government planning functions (Kaiser et al., 1995)



Intelligence function involves collection, analysis and dissemination of information to stakeholders. Good planning and sound decision making relies on the quality of information available through intelligence function (Williams, 1968). Based on available information, problem is analysed. If it requires immediate attention, then problem solving approach is implemented. However, problem

solving approach is not a long term solution and for that reason, advance / long-term planning is exercised. It involves formulation of policy documents, development plans. In order to implement planning and development plans effectively, they need to be integrated with ordinances, capital improvement schemes and other government actions. This can help in managing development properly. To evaluate information sharing and its impact on planning and management of cities in developing countries, two case studies have been selected. First on is Lahore in Pakistan and the second is Tehran in Iran. However, this paper focuses mainly on the first case study i.e. metropolitan city of Lahore in Pakistan.

2.2 Case Study: Lahore - Pakistan

City of Lahore is a historical city and is ruled by different rules throughout the history. It was the largest city of Pakistan at the time of independence in 1947. According to 1998 census, Lahore is the 2nd largest city of Pakistan after Karachi with urban population of 5.1 million (Population Census Organisation, 2004) occupying an urban area of 343 sq KM (NESPAK, 2004). Magnificent mosques, gardens, palaces are some of the remaining symbols of Mogulas period who ruled Lahore for more than two centuries. However, many of these gardens, palaces were destroyed during subsequent rule of Sikh and only few are left today. Finally it came under British rule from 1849 until independence in 1947. Before this colonial period, Lahore was mainly confined to walled city. However, British developed new areas like civil lines and cantonments which were connected by a boulevard know as mall road. New administrative buildings like Governor's House, The High Court and General Post Office were developed which still have their presence on Lahore. But, most of this new development by British had little impact on the life of general public which were still living in their traditional houses (Qadeer, 1983).

Municipal Committee for Lahore was established in 1862 for the planning and management of Lahore city and its first municipal act was passed in 1911. During this period, small housing schemes were designed and implemented. As population was growing rapidly and one organisation was unable to control the city expansion, therefore, in 1936, another statutory body, Lahore Improvement Trust (LIT) was established. Soon after its establishment, LIT developed large housing schemes like Samanabad, Gulberg and Shadbagh. Later on, another large industrial township was developed on an area of 3,000 acre in the south at a distance of 15 KM from City (Population Census Organisation, 2004). However, even with the presence of two authorities, most of physical development of housing schemes was in a frog leap manner with little coordination. Therefore, in 1963-65, the Provincial Town Planning Department started efforts for the preparation of master plan. However, absence of appropriate information compelled the professionals to use out date base maps and collect other

necessary information again by spending large amount of time and resources. It took almost 10 years before master plan was ready for implementation. But till that moment, situation had changed drastically and this plan was of little use as a guide for planning and management (Hameed and Nadeem, 2007). Had the required information been available timely in an appropriate and up-to-date format, plan would have been ready much earlier with improved policies assisting professionals and decision makers in informed decision making rather than becoming a financial burden with little benefits.

After two years of master plan, LIT was transformed into Lahore Development Authority (LDA) in 1975 and its first major initiative was to prepare another structure plan for Lahore called Lahore Urban Development Traffic Study (LUDTS) with foreign assistance. For two decades, Metropolitan Corporation Lahore (MCL) and LDA had two different plans for their respective jurisdictions; MCL with its own Master plan and LDA with its own Structure plan. How a coordinated development can be achieved in the presence of two different development plans? Efforts for a single planning and development authority with mergence of LDA and MCL were made in 2001 during the implementation of devolution plan by new government, but it remained only a wishful thinking. Meanwhile Lahore Cantonment Board continued to develop Cantonment areas of Lahore without little coordination with LDA or MCL. Recently a new Master plan is prepared by private consultants and adopted both by LDA and MCL (NESPAK, 2004).

After it establishment in 1975, LDA continued to develop housing schemes like Allama Iqbal Town, Johar town, Jubilee town etc whereas MCL was mainly confined to the maintenance of its old stock of small housing schemes. Most of the planning and development information about these small housing schemes is never integrated. Base maps are rarely updated and in certain areas, it is hard to identify the location of building and streets on old base maps. For some areas, even the base maps have been lost due to poor maintenance. In this situation, development control is a real tough job and effects in the form of encroachments, illegal construction and haphazard developments are clearly visible throughout the city (Qadeer, 1983). On the other side, even though detailed maps of newly developed housing schemes like Johar Town by LDA are available, there are a lot of plot ownership frauds. Recently 2200 double entries were found in the official record of LDA for Johar Town (Qtidar, 2008). Situation of schemes developed by private entrepreneurs is even more alarming as cases have been explored where a large plan was prepared against only a small portion of land and scheme only exists in documents. According to recent news, LDA started a crackdown against 103 illegal housing schemes in Lahore (*Dawn*, 25 May 2008, p.17). In majority of these schemes, people have purchases plots without any verification from concerned authorities as no appropriate verification system exist and people are the ultimate effete as actual owner or developer of housing

schemes have disappeared. It is not easy to verify the property ownership even for LDA developed schemes e.g. Johar town. It is Government responsibility to restore the people confidence in property ownership and provide measure for safeguarding people from such frauds. Absence of appropriate cadastral information is also effecting Government financially and administratively.

Today, most of spatial information and particularly cadastre is in the form of outdated paper maps vulnerable to corruption, destruction and inaccuracy. It is difficult to share information available in paper format. Presently some departments are in effort of preparing GIS according to their own requirement but even this can not be easily integrated due to varying standard, technical specifications, contents and currency factors. All these and other factors are affecting urban planning, development and informed decision making. Master plan failure is one such case and other problems like illegal construction, ownership frauds, corruption, encroachments and slum developments etc are common in Lahore. Realizing the importance of spatial information, Government of Pakistan (2001) made it mandatory for every local council to prepare GIS based land information system within three years. But so far, local authorities with limited skills and resources have not made any remarkable progress especially in the absence of any guidelines or models. Recently, as part of urban sector reform project in collaboration with World Bank, Urban Unit within in Planning and development department has started to develop detailed base map of Lahore city along with other four major cities in Punjab. But due to little coordination with other departments and incorporation of their demands, the output may have limited applications. In 2007, Government of Punjab province has started a project in coordination with World Bank for land record (cadastral) management with an estimated cost of US$ 50 million (World Bank, 2007). Even this project focuses on one aspect of spatial information. Whereas planners and decision makers demand diverse type of current spatial information form various departments of national to local level in an appropriate format. Information availability and sharing issues particular in case of Lahore and generally in developing countries are summarised below:

- A large group of people are ignorant of the availability of spatial information.
- Absence of metadata affects discovery and understanding information contents
- Integration of information from different levels with varying scales, standards and contents is problematic reducing information utility.
- Absence of appropriate spatial information and its knowledge is causing duplication and wastage of resources and time leading to uninformed decision making.
- Collection of similar information delays the project and in many cases rapid changes in ground realities reduce the effectiveness of plan and difficult to implement.

- Certain information can not be collected later on like weather and decision makers have to rely on estimates and judgements.
- No proper guidelines or models are available to local authorities for information sharing.

These are not the problems in developing countries alone; rather many developed countries also face these issues especially with a federal system of governance from national to local level. Therefore, efforts should be made to explore some universal model for effective and efficient information integration and sharing between different levels of governance.

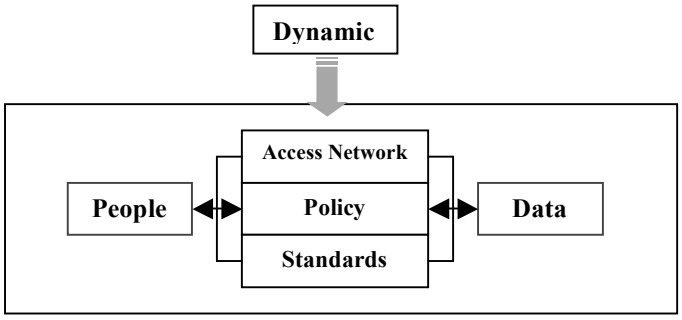
2.3 Opportunities

Modern Information and Communication Technologies (ICT) like computers are good tools for information management and sharing. Planners started to use main frame computers for forecasting and modelling in land-use and transportation studies from late 1950s and 1960s (Creighton et al., 1959, Harris, 1965). During the same time period, computers were also used for mapping successfully and first GIS i.e. Canadian Geographic Information System, was developed in 1960s. However, GIS was not common in urban planning department till late 1980s due to the higher cost of computer (So et al., 2000). At this time, importance of spatial information management and sharing was realized and concept of Spatial Data Infrastructure started to develop in early 1990s (Coleman and McLaughlin, 1998). In USA, National government took the initiative for National Spatial Data Infrastructure (NSDI), where as in Australia, Australian Land Information Council coordinated the efforts which was later on renamed as Australia New Zealand Land Information Council (ANZLIC) with the participation of New Zealand. Other countries which initiated similar activities include Canada, United Kingdom, Netherland, Portugal, Qatar, Japan, Korea, Malaysia and Indonesia (Masser, 1999).

3 SPATIAL DATA INFRASTRUCTURE (SDI)

SDI remained an evolving concept perceived differently even by the innovators, and therefore, it was defined by its components in different ways with little concept of integration and multi-level SDI (Chan et al., 2001). For example, Coleman & McLaughlin (1998) defines components of SDI as sources of spatial data, database and metadata, data networks, technology, institutional arrangement, policies and standards and end-users. Rajabifard (2002) describes

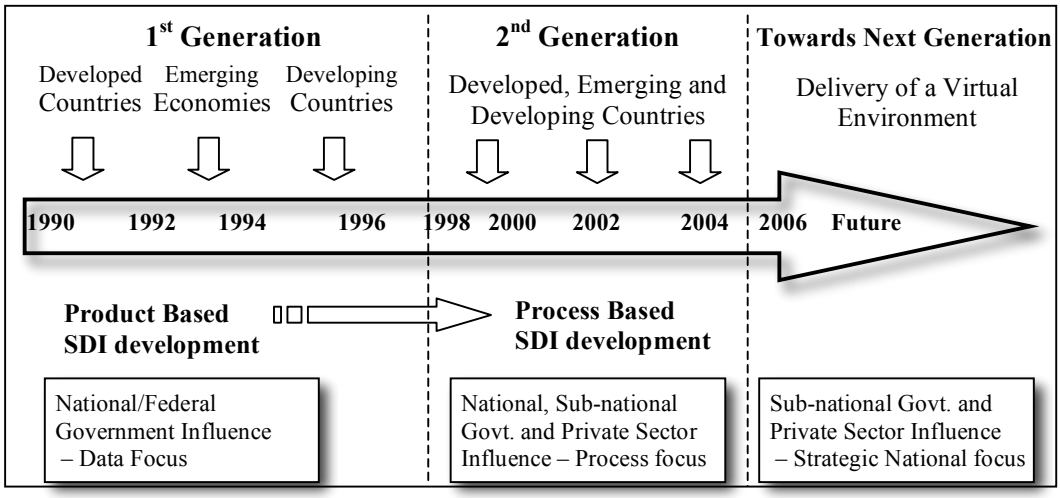
Figure 2: Nature and relations between SDI components (Rajabifard et al., 2002)



SDI as an enabling platform based on dynamic, hierarchical concept with the aim of facilitating and coordinating the exchange and sharing of spatial information between different stakeholders and include data, people, standards, policy and access network. It enables users to save resources, time and efforts by avoiding duplication of efforts related with information collection, maintenance and integration (Chan et al., 2001). SDI needs to be developed at different levels with hierarchy concept allowing both horizontal and vertical integration (Rajabifard et al., 2000). These varying levels differ in their scale, application, type of data etc.

SDI being an evolving concept is perceived and practiced differently throughout the world (Rajabifard et al., 2006). Initially the concept of information linking was promoted with concept of product based model. These SDIs were referred as first generation of SDI. From 2000 onward, focus shifted to second generation SDI with process based model with objective to provide improved communication system enabling the community for sharing and using the information (Rajabifard et al., 2002). More recently, emphasis is shifting from information sharing to information application in decision making through the design and development of required services. It lead to a new concept of next generation of SDI (Rajabifard et al., 2006). This continuum of SDI over time from product base to process base leading to the development of virtual environment is presented in figure 3.

Figure 3: Continuum of SDI Development (Rajabifard et al., 2006)



Due to the evolving nature of SDI, professional in urban planning and management are unable to realise its full potential in decision making especially in the absence of a standard model. Therefore, SDI design is explored to highlight the benefits.

3.1 SDI Design

SDI needs to incorporate the needs of all stakeholders making the design of SDI a multidimensional and complex job. Therefore, Commission on Spatial Data Standards of the International Cartographic Association (ICA) presented a general SDI design. As the information is collected, managed by different department at different places, therefore various recent model in the filed of distributing computing were analysed and finally Reference Model of Open Distributing Computing (RM-ODP) was selected (Cooper et al., 2005). This model has the flexibility of emphasizing different aspects of design in different viewpoints. A viewpoint is a subdivision of the specification of a complete system with some particular area of concern. RM-ODP is explained into five different viewpoint listed below (Farooqui et al., 1995).

- Enterprise viewpoint
- Information viewpoint
- Computation viewpoint
- Engineering viewpoint
- Technology viewpoint

These separate viewpoints are not completely independent of each other; rather some key items are related with each other. Each viewpoint has its own importance, but as the objective of SDI is improved sharing and application of information, therefore information viewpoint attains more importance. Author's Professional background of urban planning helpful in better understanding of information/services requirements of planners is very useful in the designing of information viewpoint explored in next section. With the development of 2nd generation of SDI, emphasis is shifting form simple sharing of data towards more advanced level of provision of services. Therefore Service Oriented Architecture (SOA) approach will be applied for the design of SDI.

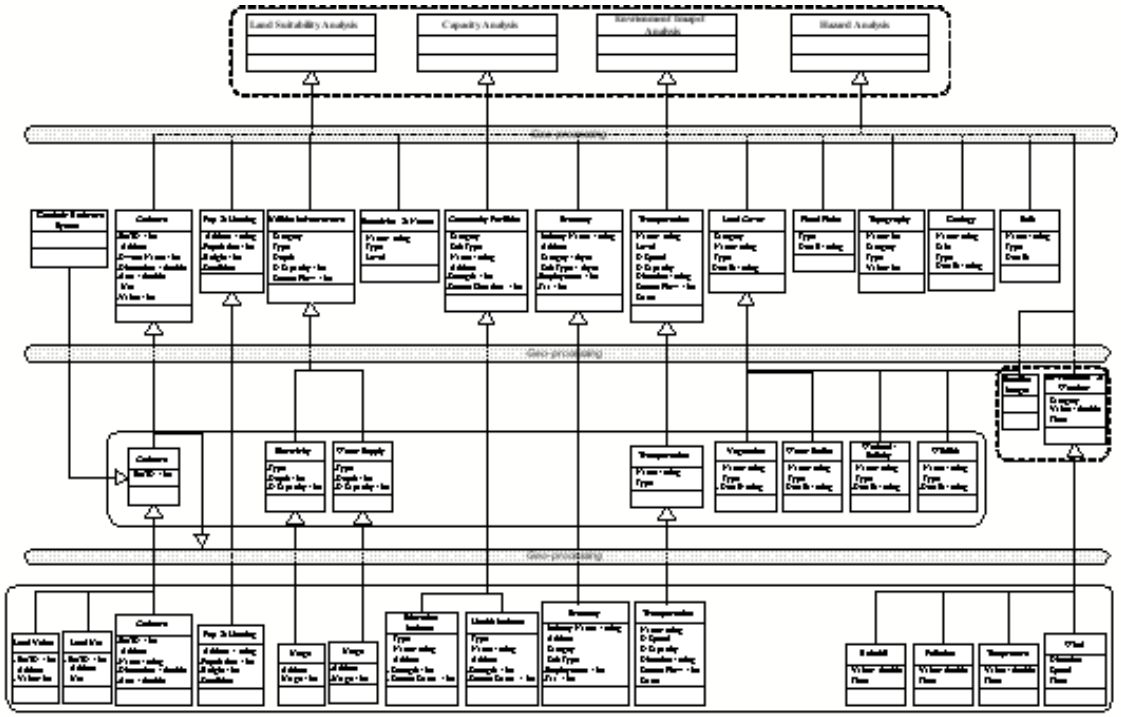
3.2 SDI information viewpoint

As urban planning is perceived and exercised differently throughout the world, therefore, it is not any easy job to precisely define their requirements (Edralin, 1986). However, some of the common information requirements can be categorised as land (cadastre, topography), population & housing, transportation, economy, environment, habitat (vegetation and wildlife), utilities, community facilities and services etc (Kaiser et al., 1995, Edralin, 1986, Williams, 1968). This viewpoint starts from the bottom with basic dataset available in different departments and ends at the top with advanced levels of services generated through geo-processing of information. ICA Commission on Spatial Data

Standards has divided available data into four main categories of vector, raster, alphanumeric and multimedia (Cooper et al., 2005). But to make it simple and easy to understand, we have focused only on first three categories of data.

Data is available in printed or digital format. In case of Alphanumeric, it can be converted into digital format using simple database software with important attributes defined in viewpoint. Whereas maps can be digitized manually or through automatic procedure using same geodetic reference system and incorporating required attributes. Satellite images or other interpolated data in raster format are expected to be in digital format.

Figure4: Information Viewpoint of SDI from urban planning perspective



Cadastral data comprises maps and registers. Maps describe the relative geometry and location whereas register include ownership, use and other valuable information. To integrate both datasets, a standard reference ID will be included in map as well as in register. This reference ID can be based on some serial number or coordinates of central point of cadastre. As different departments may be responsible for collection and management of information about land use and value, therefore, separate register for land-use and value can

exist. All these register will include standard reference ID and address beside other useful information. Address will be used to locate land parcel on ground as it may not be feasible to identify parcel using standard Reference ID. However, at time, address may be refined by different authorities and it may be difficult to integrate information, therefore, standard reference ID will form the basis of integration of cadastre. After incorporating register information and vector maps, standard cadastral information can be generated by geo-processing. A standard geo-coded address file can be generated for geo-coding other alphanumeric information from different departments on address basis.

Data about population, housing, community facilities, economy etc can be geo-processed for overlay on other maps for better understanding and analysis. Only education and health facilities are highlighted under community facilities but these will include all other community facilities like post offices, libraries, police station etc. Information about utilities infrastructure is critical to evaluate capacity analysis for new development. Normally this information is hard to obtain using traditional system. But geo-coding monthly usage of each utility service at parcel level and than geo-processing it with available network can assist us to find current status of their usage and future requirements. Data about weather like rainfall, temperature, wind and pollution is monitored at certain location and then interpolated for analysis. Standard geo-processing based on a uniform reference system and interpolation technique makes it really valuable. Otherwise different reference system and varying interpolation techniques means different users will be using different information. Standard image processing techniques can be used to explore land covers information from satellite images.

Once required information is available, next step will be the development of services facilitating planners and decision makers for informed decision making. Some of the most common services or analyses are land suitability analysis, capacity analysis, environment impact analysis and hazard analysis. Land suitability analysis will be performed by evaluating feasibility of land for development by analysis topography, soils and geology information along with availability of infrastructure, related services and nature of land cover. Maps showing range of land from most-suitable to less-suitable for development can be generated and displayed in three dimensional to better communicate this information to decision makers and pubic enabling them informed decision making. Similarly hazard analysis can be performed by geo-processing land information, environment, transportation, flood plains with population and housing information. Local authorities can better identify critical areas vulnerable to disaster and necessary measures can be taken to reduce the impact of disasters. Even in worst case scenario, authorities can better identify affected areas, estimate the damage and devise improved strategy for recovery.

Capacity analysis is another very useful service for evaluating the capacity of natural resources like pollution absorbing capacity of environment, availability of drinking water as well as that of man made resources like transportation , utility services network. This information can be used for framing future growth strategies at city level. At neighbourhood level, planners can estimate the demand of new development against system capacity and in certain cases, efforts for capacity increase can be started in advance for important locations. These are only few examples of different services, which are outcome of local SDI. Many more services can be developed as availability of up-to-date and interoperable information continues to increase.

Other important components like metadata and services for discovery and retrieval in the form of geo-portal are part of the whole system. This viewpoint highlight the effectiveness of SDI in better information sharing and its application for the development of many critical services required by planners and decision makers for informed decision making.

3.3 SDI implementation

Implementation of SDI at varying level is a tough job due to varying cultural, social, institutional and economic scenarios. Sometime, decision makers and politicians in developing countries perceive SDI as a financial burden without realising its long-term and widespread effects on economy. More awareness about the economic benefits of SDI initiative for decision makers and politicians is required to convince them for the development of SDI. Successful examples like INSPIRE are useful where estimated economic benefits of 770-1150 m€ are far greater than the estimated cost of 93-138 m€ per year for a period of 10 years (European Commission, 2006). Economic benefits are even bigger in countries like US where spatial information is available either free or on dissemination cost. Prosperity effects are maximized when data are sold at marginal cost. Estimated benefits of 750 billion $ are much higher than investment value of 19 billion $ (Weiss, 2002). As Cost recovery is not the best approach for maximizing the economic value of public-sector information to society, therefore, ddeveloping countries should aim for free information to exploit maximum benefits.

Once decision makers realise the benefits of information sharing and its application, they will support the implementation of SDI and other changes like institutional development and legal issues can be resolved with ease.

4 CONCLUSIONS & RECOMMENDATIONS

As urban planners rely heavily on diverse type of information from different departments at varying level of Government, therefore, it becomes problematic to manage, share, integrate and effectively utilise available informing. SDI an as

enabling platform with vertical and horizontal integration of spatial information offer very good opportunity. Designing of local SDI on the modern concept of distributing computing like SOA and its implementation will not only improve information sharing and application but also it will help urban planners and decision makers to spend more time and resources on improved policy making and urban planning. Some of the most common services required by planners and decision makers at local level are explained in this paper as information viewpoint of local SDI. These services can be utilized by professionals in other fields as well without any need of data collection and integration efforts. Coordinated efforts between stakeholders will ensure development of comprehensive SDI satisfying requirement of each partner. Availability of information in appropriate format like three and four dimensions will not only increase public participation and transparency, but will also increase business opportunities. It will save precious time and resources of planners and facilitate them in better planning and management. Therefore, it is recommended that planners in developing countries should benefit from the research in developed countries and start efforts to design and implement SDI for informed decision making. Based on the experience of developed countries like USA & Europe, it is recommended that information should be available free of cost or at minimum disseminate cost to exploit its full potential.

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