Geographical Information System, a tool for better spatial planning. A new perspective

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1. Abstract

Traditional spatial planning approaches and tools have proven inadequate to guide urban development in a context of rapid urbanization and in the face of new urban challenges especially in local authorities. In most developing countries, traditional plans have proven to be not only rigid and outdated, but also unable to reflect and address the interests of most stakeholders. Their implementation and enforcement often requires resources and capacities far beyond what is available within local institutions and among urban residents, particularly the poor. On the other hand over the time, spatial planning has faced the issue of credible data collection approaches and techniques. Spatial planning typically involves multiple stakeholders. To solve any specific planning problem, those stakeholders collaborate to produce spatial data which is capable to meet demands. On the other hand, geography as a utilization of geographical techniques and tools for personal and the public purposes, combines techniques of cartography and GIS to be used by both experts and the public.This paper presents a conceptual framework to helps us better understand our world so we can meet spatial planning challenges. By applying what we know of science and GIS to what we do not know, we can get to what we really need to know - how to enhance quality of life and achieve a better future. These issues are spatial in nature and require spatial tools and spatial thinking. Creating and applying GIS tools and knowledge allow us to integrate geographic intelligence into how we think and behave. To that end, GIS can govern our relationship with the environment as well as help us perceive intricate relationships that otherwise we would never be able to understand.

Keywords: GIS, *Planning, Traditional planning, Spatial Planning,*

2. Introduction:

Ever since computers were first developed in the mid 20^{th} century, planners saw an immediate use for them in not only organizing large quantities of data about the city but also in the analysis of that data, the construction of simulation models of how cities functioned, and in forecasting the future form of cities. All these ideas were put in place in the 1950s and 1960s mainly in North America and there were even moves to automate the city planning process itself by formulating models that could generate idealized plans based on data pertaining to the current situation as well as to the specification of future goals(Harris, 1989).

This technology began with main frame machines where most techniques were operated offline but with increasing networking of computers and miniaturization down to minicomputers along with the parallel development of personal computers, much of this activity came online(Batty *et al*.,2009).

The convergence of communications and computing which has occurred in the last twenty years with the development of the internet and its graphical interface in the form of the World Wide Web has moved many of these functions into networked environments. The prospect now exists for all stages of the planning process and its interfacing to the public at large to become accessible online (Ibid: 2).

By 1990s, various computational techniques that were being developed in urban planning were being heavily influenced by three related developments. First geographic information systems (GIS) technologies which represented the fusion of spatial database technology with computer cartographies, were being ported from minicomputers to PCs, second various forecasting techniques were being developed on PCs using standardized software such as spreadsheets, and third, this great potpourri of technologies was being fashioned together in what Britton Harris (1989) called 'planning support systems' (PSS) in his seminal article. Since then much of this technology has begun to move online with PSS being used not only for strategic planning but also for more routine uses in the control of development and also plan implementation. There are now so many developments that in a short article like this one, we cannot do justice to the hundreds of potential applications in urban planning (Batty, 2009:2). What the modern computing environment has opened up is the prospect that any kind of application can be fashioned in any kind of software and that any kinds of software can be plugged into any other. Forecasting models, traffic models, GIS and so on can be interfaced with one another with no one software necessarily dominating the other. The prospect now also exists of planners being able to draw on data and software which is configured and operated on remote sites such is the present connectivity and power of the internet.

3. Planning

Planning, in general, is considered as an iterative process of problem definition, collecting and processing of complex information, exploration of potential designs and evaluations of these designs according to set objectives, such as sustainability and enhanced quality of life for citizens(James *et al.*, 2004). Pressures on the planning system to deliver more and better services with fewer resources have come from:

- *Increased statutory requirements;*
- *Community strategies and discretionary, well-being powers;*
- *Regeneration – urban and rural – economic, social and environmental;*
- *Sustainability;*
- *More inclusive consultation;*
- *Better access to information, statutory registers and guidance;*
- *Higher public expectations – transparency and accountability;*
- *Loss of skilled and experienced staff; and*
- *Initiative overload – lack of clear leadership and vision (Gill, 2002:9).*

4. Information system and spatial panning

Proper and effective planning generally involves close monitoring of development growth, plans review as well as policy appraisal which calls for comprehensive information concerning the past, present and future(Shiffer,1992). As spatial representation is critical to environmental problem solving, the attribute data related to the problems or issues to be addressed need to be translated into spatial manifestation to ease the process of analysis and decision making (Yaakup *et al*., 2009). Apparently, data and information that need to be analyzed will be coming from various sources either in the primary or secondary forms. Information system can serve as the eyes and ears to development planning and monitoring process. It provides for the monitoring and surveillance of compliance with planning regulations and it serves as an early warning system with regard to sources of friction, imbalances, shortfalls and failures in the process of planning and management (Yaakup *et al.*, 1997). As suggested in Table 1, computers were assumed to play an important role in this task by collecting and storing the required data, proving systems models that could describe the present and project the future, and helping unambiguously to identify the best plan from the range of available alternatives (Harris and Batty,1993; Brail, 2001).

Table 1: Evolving Views of Planning and Information Technology

1960s	System Optimisation	'Planning as applied sciences' Information technology viewed as providing the information needed for a value-and politically neutral process of "rational" planning
1970s	Politics	'Planning as politics' Information technology seen as inherently political, reinforcing existing structure of influence, hiding political choices, and transforming the policy-making process
1980s	Discourse	'Planning as communication' Information technology and the content of planners technical analyses are seen as often less important than the ways in which planners transmit this information to others
1990s	Intelligence	'Planning as reasoning together' Information technology seen as providing the information infrastructure that facilitates social interaction, interpersonal communication, and debate that attempts to achieve collective goals and deal with common concerns

Source: R.K. Brail and R.E Klosterman (eds), 2001. *Planning Support Systems*

Although computers have been applied in urban planning almost since their inception, only recently with the development of graphics, distributed processing, and network communications has software emerged that can now be used routinely and effectively. At the basis of these developments are geographic information systems (GIS) but gradually, these are being adapted to the kind of decision and management functions that lie at the heart of the spatial planning process (Batty and Densham, 1996).

2. GIS & Spatial Planning

The evolution of sciences and technology has affected the change of planning decision method. Planning support system (PSS) and decision support system (DSS) are among tools for achieving planning quality in optimum development (Yaakup, 2006). They combine traditional tools for urban and regional planning with other technologies such as expert system (Han and Kim, 1989), decision support aids such as multi-attribute utility theory (Lee and Hopkins, 1995), hyper media systems (Shiffer, 1992), and group decision support systems (Armstrong, 1993; Finaly and Marples, 1992). However, GIS still remain as the core of these systems. The use of GIS as a major component of the planning support system is significant due to the need for frequent organization and updating of relevant spatial information concerning planning and development. GIS which come as a complete package with the capability in capturing, storing, updating, manipulating, analyzing and displaying of all forms of geographically referenced information, has proven to be an appropriate tool for spatial planning and monitoring (Ibid). An important GIS capability is in handling both digital cartographic data and the associated databases of attribute information for map features. Another main driving mechanism of any GIS is the ability to inter-relate data sets. Since the relative positions of different map features across geographical space can also be performed. The innovative technology can support planning and decision making by offering relatively quick response on analytical questions and monitoring issues. Some of the important functions include the ability to retrieve information rapidly and efficiently scenarios and to evaluate alternative solutions generated by modeling procedures. Expanding urbanization and population prompt planners and policy makers to look for a better understanding of the problems we face and ways to meaningfully address these issues.

For example, planners engage in a plethora of activities, but their work generally reflects the tension among three main competing interests: equity, economy and the environment, also known as the "three Es." Regardless of their specialty, planners pay a great deal of attention to the notion of sustainability, which encapsulates these three key elements. With this in mind, planners and community developers are in constant search of tools that can balance these often-conflicting interests as well as enhance their ability to make informed decisions that promote collaborative public participation processes and eventually, good urban form(Shiffer,1992). Planners and policy makers are keen to strike the right balance between these three factors. In practice, however, this is easier said than done because one of these aspects usually dominates, causing property, development, or resource conflicts. This creates a problem best known as reactive planning, which often results in precipitous action with disastrous results. This troubling side of planning and policy making is indicative of the need to rely on new tools and approaches to change the way we think, plan and - most importantly - envision our future. With GIS, we can create new approaches that help us understand the relationship between man and the environment. This calls for more integrated tools that build a holistic and comprehensive approach to resolving new emerged spatial planning problems.

3. Traditional practical applications of GIS in planning

6-1. Planning for people;

Traditional practical applications of GIS in planning can be referred to as "planning for people," where planners do the work and make decisions on behalf of the community (Abukhater, 2005*)*. This includes asset and facility management and planning for natural and man-made disasters before they happen and mitigating impacts after they occur - for example, modeling areas that are most vulnerable to wildfire to predict where a fire is most likely to happen and preparing to minimize its impact. By using GIS-based, multiple-criteria evaluation (MCE) and applying numerous factors that were consolidated into these criteria, planners can weigh and combine these factors into one layer, showing areas of high wildfire vulnerability. Knowing the population at risk enables planners to determine where to allocate and locate resources most effectively. By integrating geographic data with geoprocessing, modeling and visualization tools, we can evaluate the impact of human activities and land-use changes on the built environment. For example, GIS can be used to evaluate different land-use scenarios based on environmental implications. Adding particular land uses to an existing land-use plan will likely show increased amounts of impervious coverage, which in turn can cause a great deal of runoff and flooding that damage the environment. Using GIS, planners can compare and contrast two scenarios of land-use changes to determine which one is more environmentally friendly and promotes low-impactdevelopment.
GIS is also used in economic development, in site selection and suitability analysis, and for finding the right sites to locate new businesses and grow existing ones. Within economic development, GIS is used to support the emerging trend of economic gardening, a new way to foster local and regional economic growth by nurturing existing small businesses in the community.Additionally, planners are deploying GIS to encourage smart growth and promote green and lean cities, sustainable development initiatives, and effective growth management. For example, GIS can be used to determine the best locations for low-density residential development by employing a set of criteria and assigning different weights and values to each individual factor. These weights can reflect whether we are concerned more with protecting the environment or with economic development goals.

4. New practical applications of GIS in planning

7-1. PlanningwithPeople;

GIS can also be used to promote a more collaborative and engaging way of planning - planning with people (Nazri *et al*., 2006). In the context of land-use planning, planners try to determine where we are now, where we want to be in the future, and how we get there. To accomplish desired future conditions with the people, planning is an ongoing process, rather than a product. While creating the plan, planners should seek bidirectional community input to make sure that the process is collaborative and transparent. But how can planners do that? They can follow an emerging trend, spatial planning, in which has three components or levels of implementation:

1. **Inform** the impacted and interested stakeholders, including the public, by disseminating information and maps through online GIS.
2. **Involve** the public by getting its feedback on proposed projects and land-use changes. This is enabled by crowd sourcing (also referred to as capturing volunteered geographic information), where citizens act as sensors and a source of geographic information.
3. **Empower** the public to make informed decisions about existing and new development (*Abukhater, 2005)*.

5. Conclusion:

Using GIS as a collaborative platform empowers both decision makers and the broader community by exploiting the Web as a platform to deliver geoservices, often enabled by cloud computing capabilities and open data sharing policies.

People are using social media to communicate every day and express things that are important to them, so why not leverage social media to empower citizens to make decisions regarding what should and should not happen in their communities? Planning 2.0 incorporates online GIS and social media to support collaborative planning and ongoing public participation. This combination enhances government transparency and accountability by creating a societal infrastructure for human interaction.

What makes spatial planning with GIS an effective and efficient way to achieve a future that we all desire? The answer lies in the ability to visualize development that helps us understand the places in which we live. We can modify development patterns and view results on the fly, and we can show the different impacts of new developments and study the spatial morphology of the urban fabric in two- and three-dimensional environments. Modeling capabilities allow us to apply cutting-edge technology to conservation, economic development and land-use planning and policy making.

Today, GIS technology is advancing rapidly, providing many new capabilities and innovations in spatial planning. This growing technology provides a platform for more efficient and effective planning and decision making - not only mapping and visualization but also modeling, spatial analysis, data management, Web services and mobile solutions. GIS is being used everywhere to help us solve real problems and confront new challenges.

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