Student : Syed Munawer
Student Id: 210283
Instructor : *Dr Baqer Al-Ramadan*
Department : CRP
College : CED, KFUPM

Computer Aided Planning - 507

The role of Computers and the Internet in Urban Planning : An overview of Developments and Innovations.

Term Paper

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Chapter 1: Introduction.

This paper attempts to explore the uses and the developments that have revolutionized the use of computers and the Internet in the planning process. Planners use computers to record and analyze information and to prepare reports and recommendations. Computer databases, spreadsheets, and analytical techniques are widely used to project costs and forecast future trends in employment, housing, transportation, or population. Computerized geographic information systems enable planners to map areas and overlay maps with geographic variables, such as population density, as well as to combine and manipulate geographic information to produce alternative plans for land use or development.

In short, computers, which were once thought of as being mere instruments for a better understanding for science, are rapidly becoming part of the infrastructure itself. Computers are being employed not only to understand cities but also to operate and control them.

The combination of technologies such as GIS, impact assessments and Virtual reality have made possible for the planner simulations of his designs so that he can envisage the outcomes of his proposals at a fraction of the cost of actually implementing them and sometimes endlessly awaiting results and feedback. Thus it is very evident that Internet and computers have innumerable applications for the planner

Aims and Objectives:

The aim of this study is to review and assess the tools, which Planners have always sought to enhance their analytical, problem-solving, and decision-making capability (Mandelbaum, 1996). From the late 1950s planners started to develop and use computerized models, planning information systems and decision support systems to improve performance (Brail 1987; Klosterman 1990). The study will try to establish future direction that planning tools are bound to lead the planning process into.

Approach:

The approach for the study will be mainly, reviews of relevant literature and studies. An attempt to arrive at a comprehensive view of the current trends in computer applications in planning will be made.

Chapter 2: History of computers in planning.

Computing devices have been used in public planning for almost 100 years. Hermann Hollerith invented the punched card machine at the turn of the century for the US Population Census, and this eventually led to the formation of the world's largest computer company, IBM. Once the digital computer was developed half a century later, applications in public planning and management became widespread. By the mid-1950s, population and transportation data were being processed by computers and these were quickly followed by various simulation modelling efforts. By the late 1960s, urban data management systems were being widely used by public agencies for a number of management and strategic planning functions (Michel Batty & Paul J Densham Jan 1996).

Brail, Richard K. in *Microcomputers in Urban Planning and Management,* cite Kindleberger’s findings of his studies aimed at use of microcomputers by local government planning agencies during the 1960’s and 70’s. Kindleberger’s finding stated that in spite of vigorous activity and innovations in computing for planning were not very effective. Similar studies by Kreamer, Dutton and Northup in 1981 and by Laudon in 1974 point to the fact that computers did not radically affect the structure of decision making which is central to the activity of planning. During this period computers did play an important role in planning in tasks such as the development of large-scale transportation and land-use models (Brail, Richard K., 1987).

In the last decade, applications of computers in planning have changed dramatically. The centralized top-down approach based on remote, large-scale, database computing has been replaced by a decentralized computing style in which graphical display of urban data is now the focus (Michel Batty & Paul J Densham Jan1996).

Current efforts are on to integrate different applications to combine the strengths of each in an effort to develop a comprehensive tool for Planners.

Chapter 3: GIS, CAD & Planning:

GIS: GIS, is the abbreviation for Geographic Information System, which is a modern, cutting edge technology helping planners in their tasks. It usually is made up of a special set of software that incorporates the powerful computing abilities of computers with extensive databases to organize, manipulate and present information in planning. This involves correlating spatial relationships and facts and figures.

GIS made its appearance as a tool in the late 60's and early 70's when computers became more powerful. The first GIS system was put together by Jack Dangermond, the president of ESRI (Environmental Systems Research Institute), and some of his for the US census department. The technology became widespread in the 80's, with GIS systems being ported to Unix, Solaris, IRIX, and other development platforms. ARC/Info was and still is a leading package with numerous geographic data processing functions. In 1991 ESRI made GIS easily accessible with the release of ArcView for the Windows PC. It was the first GIS with a modern graphical interface, but it's functionality was limited to viewing data. The ArcView 3.2 and future releases feature a powerful programming language and basic editing and data creation functions. (Michael Batty & Paul J. Densham January 1996)

GIS stores its data in "layers". Each layer represents a different distinct geographic feature. Every feature in a layer, such as a street, stream or building, has a corresponding set of data in a table. A table is essentially a spreadsheet that links values in the table to a geographic feature. GIS has built-in topological algorithms. At the intersections of two lines, a "node" is placed and the node stores information about the lines that pass through it.

GIS is now used in countless applications, urban planning uses are predicting revenue income based on zoning changes, and for predicting growth into new city annexes based on surrounding data. Planners employ geographic information technologies in many aspects of the planning process, including: data collection and storage, data analysis and presentation, plan and/or policy-making, communication with the public and decision makers, and plan and/or policy implementation and administration (Michael Batty & Paul J. Densham January 1996).

A survey of planning agencies in the US revealed that GIS with its power and flexibility is the preferable tool used in conjunction with the thematic mapping technologies. These are largely used to support administrative activities such as permit-tracking and zoning review and many of these institutions share their system and parts of their data with public works and other departments (S P French, L L Wiggins, 1990).

Most of the analytic input to planning is descriptive in nature and GIS helps by its visualization, data management and spatial modelling capabilities (C J Webster, 1993). Over a period of its inception and development GIS is becoming more flexible. Webster contends that to make GIS more flexible and accessible to data-manipulation environments, conceptualization of the role of GIS is needed in prescriptive tasks. There is a need for collaboration between fields as diverse as management and decision sciences (procedural theory), social sciences (substantive theory) and information science (technological theory) in an effort to develop a useful GIS based planning support system (C J Webster, 1994).

In his evaluation of the impacts of GIS technology Budic rightly asserts that assessment and feedback are essential for better adaptation of GIS technologies for urban planning, this evaluation points to the future direction that GIS technology is bound to take wherein there will be a need for a critical look at purposes, values, and meanings imbued in the GIS and their adaptation in the design of such systems (Z Nevodi'c-Budi'c, 1998).

Similar contention is derived from Zorica Nedovic (1999), where the writer attributes limited value of GIS technology for predictive analysis, crucial for understanding the consequences resulting from future planning actions.

GI-based tools are useful for understanding physical and environmental processes, the socio-economic dynamics are still hard to model and/or simulate. The on-going developments of customized GI and other tools only partially respond to analytical, design, administrative, communicative, and decision-making support. An integration of these attributes into a functional planning support system and their customization to suit various planning agencies is needed (Zorica Nedovic, 1999).

CAD: Conventionally Planners and architects relied upon 2d drawings (plans, elevations) and whenever finances permitted, on perspectives, projections or scaled models for presenting their concepts. The uses of cad and visualization applications to generate computer models of urban environments help planners to solve immediate problems and to create an information base. Advances in technology such as virtual-reality, compact discs and interactive TV enhance the dynamic quality of CAD for public involvement. Levy, to stress the role of CAD in planning, cites case studies of Geneva Lake front design and Cochrale where, controlling rapid growth was the concern of the citizens. He contends that CAD plays an important role as an instrument of visualization and as an agent of data organization. The role of CAD to visualize urban form plays an important role for greater participation from all participants in the planning process (RM Levy, 1995).

Software developers are trying to bridge the gap between CAD and GIS at the desktop level. CAD manufacturers have added database-management functionality to programs and GIS developers have added three-dimensional projection faculties to their applications. Major CAD vendors are working to introduce programs that combine the best of both. Autodesk World, by Autodesk is an attempt to integrate CAD, GIS and database technology into a single environment within which users can create, edit, and query geographic-based data from any source file format - without conversion.

Similarly, Bentley has developed " geoengineering," an integration of CAD and GIS. The company's MicroStation Geographics is a GIS-enhanced CAD product that relies on a translator called MicroStation GeoExchange to import data. Geographics allows MicroStation CAD and GIS files to merge, and preserves their intelligence in the new linked package. GIS makes it possible to manage and visualize the spatial properties of data. When combined with modeling and navigation capabilities, visualization through GIS can bring a new level of intelligence to urban simulations. (Architecturemag, 2000, Hybrid CAD and GIS applications help Architects and Planners predict the impact of their work, 1998).

It is evident that the contemporary scene with respect to urban planning, may be dominated by smaller, finer scale applications at the level of urban design, the increasing development of 3-d GIS capability, and the use of urban remote sensing for data capture and generation, are a pointer to this. Many such applications are being developed around the world like, European Science Foundation's GISDATA, US National Science Foundation's National Center for Geographic Information and Analysis (NCGIA) program, and CASA at the University of London. The integration of diverse software and methods to develop effective planning tools for complex urban processes seems to be the direction for the future (Michael Batty & Paul J. Densham, January 1996).

Chapter 4: DSS, ESS & Planning:

Planners in their tasks often encounter huge amount of data and numerous regulations and guidelines from a variety of sources and hence have to rely on expertise and assistance of planning models and analytical methods.

In the 1990's three types of DSS have been developed, traditional ones with database, mapping capabilities and rudimentary models, the improvement over these typically had a model base of spatial statistics, location-allocation models, etc. and sometimes planning methods such as the multi-criteria evaluation methods. The third perhaps the most interesting of the developments is the attempt to develop DSS's and a GIS hybrid (H Timmermans, 1994).

Instances occur when there is dearth of expertise and this calls for a computer based KBS or expert system, which can store and retrieve required data. Many KBS have been in use but are often employed in uncertainty since planning involves complicated, uncertain and subjective situations. As one of the solutions for this dilemma, AGO Yeh and Xshi have proposed a case based PSS, (AGO Yeh and Xshi, 1999)

Most existing KBS are usually rule based (if – then syntax) or model based (knowledge is represented by causal models). But most planning problems need creativity and expertise , these attributes of an experienced and adroit planner are difficult to translate as inputs for a KBS. The new technology of CBR refers to particular concepts and its corresponding techniques in KBS. It works in a way analogous to a human brain, which is to search for a solution form memory in order to solve familiar problem that had been previously encountered. CBS store knowledge as concrete instances rather than general rules or models. Some of their salient features include the visibility of reasoning process to the users, participation of users in inference process, similar cases and solutions presented to the user, exceptional cases presented to make the user aware, and real cases which are more easily digested. The computer finally aides in the visualization, evaluation and adaptation. AGO Yeh and Xshi have developed a hybrid of GIS and CBS, which provides the system capability to deal with special data and relationships (AGO Yeh and Xshi, 1999). Currently, SDSS are a conceptual framework rather than an implemented strategy and some systems approach a partial implementation of its concepts. Several implementations of GIS in forestry have been described as SDSS but do not satisfy the requirements of one (unit-59, lecture notes, State University of New York at Buffalo).

An example of a system is smart draw which provides support for construction process of FAST (function analysis system technique) diagram for the systematically formulated complex problems. The author of smart draw contends that the use of fast diagram can improve problem formulation and for making the diagramming procedure easier (RV George, 1995).

With the increase in computation prowess, the traditional tools for analysis, projecting future conditions and modeling of spatial interaction have combined with new tools such as expert systems and artificial neural networks. The point in question is elucidated in an editorial by Klostermann (Klostermann, 1999), by pointing to the work of Harris (1990) that contends the importance of public participation and collaborative planning; another reference is to Hopkins who points to the incorporation of GMS (geographic modeling system) in a PSS. The editorial further highlights the phenomenon that is to be the future orientation, the integration of tools and techniques to develop comprehensive systems (Klostermann, 1999). A similar effort is seen in the combination of software packages; Delphi, Arcview, an expert system and paradox to support project execution (Edamura and Tsuchida, 1999).

Chapter 5: Internet, Cyberspace & planning:

The enormous growth in the field of communications technologies in the recent past has provided new and improvised means of communication. Internet is the most revolutionary of these technological advances. Internet was started in the US of A as a military intelligence endeavor in the 1960's but emerged as a global phenomena very recently[1]. Internet consists of networks of computers, these complex networks like the World Wide Web is termed as "CYBERSPACE".

The term "cyberspace" was coined by Gibson in his fictional novel "Nueromancer" (Gibson 1984) . This network (space) is dynamic and expanding at a phenomenal rate with innumerable computers and information being added to it every day, but it still remains a finite entity. Cyberspace is characterized by an amalgam of two technologies, the internet discussed above, and virtual reality-which can be defined as a technique of making a non-existent or virtual condition seem real to an observer by stimulating his senses, this is achieved by graphic simulations of events and their causes. The term cyberspace itself is deceptive as the 'space' exists only as a virtual entity, rather than the familiar notion of space in conventional terms.

There are some salient features and uses of the cyber space that are uncommon with traditional means of communication. Perhaps the most important and revolutionary aspect of cyberspace is its ability to transmit information through this non-space almost instantly. Thus it links people, computers and sources of information irrespective of their geographical location on the globe. This innovation has become so popular and easy to use that it is largely being employed not only by academicians and researchers but also by the common man for easy and uninhibited access to information. Further it is increasingly being employed in commerce and entertainment.

Cyberspace offers the unique opportunity of experiencing the products of virtual reality such as simulations, games walking through a town or flying through it, all these making our sensory reception very realistic and the simulations themselves may cost a fraction of what the actual building of the depicted environment may cost in the real world.

Users can explore Internet, using a number of available, web browsing softwares. Initially exploration of the net was mostly text oriented, a person could browse information posted on a web page, the browsing tools help to navigate within the web page and also to access information on pages linked to the page being explored.

With advancement the exploration of the web became more interesting with a combination of textual matter as well as pictures (usually static/stationary). The latest feature in exploring cyberspace is 3d simulations using virtual reality where the person can explore the cyber world and perceive in formation using most of his senses and not just his intellect. The user can now assume an avatar or incarnation in the cyber world to exchange information with other users and to explore the cyber world.

However there are certain drawbacks in terms of challenges to the end user of this immensely popular world of information and opportunity. First is the inevitable use of the computer, the user needs to be familiar with the navigation and all the tools and jargon associated with it, but these are becoming user friendly by the day. Second is the ability to stay on course and get the necessary information the user is trying to locate because the cyberspace is so flooded with information that it is very easy for the user to be overwhelmed and get lost in a maze of information which one enters through the innumerable links encountered in this abyss.

Yet another challenge posed by the net is the time it affords to an individual to assimilate knowledge or information since cyberspace has overcome the geographical barriers, information is updated and outdated in the same breath. This is contrary to the conventional modes of information decimation where there was ample time to relate to information, assimilate and react to it.

Cyberspace has thrown open a number of avenues to enhance the process of ‘Urban Planning’. Other than the planner himself, the process involves a number of players who need to be informed or educated and involved. Cyberspace has assured easy access to information about the planning process for all those affected by it.

Cyber space provides ample opportunity to the planner in his arduous task of consensus building, which is very essential for successful planning. The comprehension of information has never been easier, this can be seen as illustrations, in a number of web pages developed by city councils, wherein planning proposals are simulated as virtual reality models. These models are most helpful for informing the lay citizen of the different impacts the proposal may have on their environment and interests.

Another aspect of planning that is the participation of the beneficiary or the end-user in the planning process, has received tremendous boost. With the emergence of simulations of proposals, where the end user can not only air his concern but also see the effect of his viewpoint or suggestion. This is exemplified by a no of sites wherein users can go to extent of displacing objects in a model and instantly view the effects of their action on the comprehensive model, which helps them to visualize and better appreciate the planning process.

The combination of technologies such as GIS, impact assessments and Virtual reality have made possible for the planner simulations of his designs so that he can envisage the outcomes of his proposals at a fraction of the cost of actually implementing them and sometimes endlessly awaiting results and feedback. The planner can effectively communicate and exchange ideas views and critique with his peers across the globe irrespective of the barriers, geographical, political or social. Thus a planner can be updated about the latest developments in the field of planning and technology, to help him stay abreast of the latest.

Chapter 6: Conclusion:

It is very evident that Internet and computers have innumerable applications for the planner and the combinations of technologies across technical barriers holds much promise in aiding the planner in his arduous task of shaping societies. The evolution to Internet GIS can be a critical component in the development of virtual cities that will allow urban planners and urban designers to visualize and model the complexity of the built environment in networked virtual reality. (Andy Smith, Martin Dodge and Simon Doyle, Visual Communication in Urban Planning and Urban Design).

Lately there have been efforts to simulate urban processes to aid the endeavor of planning. Most models are an evolution from the earliest transportation and land-use models. The application of mathematical concepts like the fractal geometry and cellular automata to simulate urban processes is a step in this direction. The journal "Environment and Planning: b" became the platform for the proponents of most of these models. CA based models became more attractive due to their non-reference to equilibrium in their construction. This is evident from the numerous CA based models that were developed like, DUEM (Dynamic Urban Evolution Model), a very general CA-based urban growth and land use modelling environment (Xie 1996). But most models seem to be intended more as frameworks for the urban CA ideal, rather than as operational urban models. Though the cellular automata and related non-linear dynamic models of city growth and evolution include some urban processes, they elude the quest for a highly accurate model to draw very general conclusions, since they do not explicitly relate urban spatial structure to urban social or economic processes. We can see efforts to overcome these shortcomings in the work of Sullivan where he proposes a graph-CA to simulate dynamic spatial systems(David O Sullivan, 2000, ch-12 pgs 278-290).

There is agreement among the proponents of CA models, that these do not fulfill the need for a killer application for urban simulation and the recent symposium of researchers at CASA, that there is lot more to be done in this direction (Paul M Torrens and David O Sullivan, 2001).

The future direction for this stream of computer applications needs contribution from people involved in the computation for the use of new forms of computer and networks, new digital sources and the internet (M Batty, COMPUTERS FOR PLANNING: PLANNING FOR COMPUTERS)

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