Fundamental Research in Geographic Information and Analysis


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Spatial Technologies, Geographic Information, and the City

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http://www.ncgia.ucsb.edu/conf/BALTIMORE/opening.html

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A lot of people worked hard to make this conference possible. The contributions of the members of the steering committee - Ron Abler, Mike Batty, Ken Dueker, Susan Hanson, and Kingsley Haynes - were substantial at all stages and are gratefully acknowledged. Mike Batty, Ron Abler and Susan Hanson had been involved with this project since its inception as a potential NCGIA Research Initiative. Ron Abler also provided the first draft for the research agenda in this report that was put together by the three discussion groups.

I wish to thank LaNell Lucius, Sandi Glendinning, and Elan Sutton of the Santa Barbara NCGIA office for their hard work dealing with the logistics of the meeting. Chris Stebbins built a particularly attractive Web site for us. Despite a few minor glitches, the staff at the Lord Baltimore hotel helped make our stay enjoyable. Thanks also to Tim Foresman and Dana Hinzman of the University of Maryland, Baltimore County, for suggesting the Rusty Scupper for the conference dinner, and for other on-site help.

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THE BALTIMORE CONFERENCE

Background

The idea for this meeting originated in 1994 when Mike Batty and Helen Couclelis (both geographers with a background in planning and urban and regional modeling) decided to propose an NCGIA Research Initiative on the role of GIS in the cities of the information society. The Research Initiative, a structured set of meetings and other research-related activities focusing on a specific theme over a two-year period, is the main mechanism through which the NCGIA carries out its research agenda. In the past each Initiative has been directed by two or more co-leaders from NCGIA sites, supported by a steering committee also primarily drawn from NCGIA personnel. Batty and Couclelis put together a proposal for what was tentatively designated as Initiative 18 and submitted it to the NCGIA Board of Directors for review. While enthusiastic about the theme of the proposal, the Board (which at the time included Ron Abler and Susan Hanson as members) questioned the appropriateness of the Initiative formula for an enterprise of such breadth in scope. Indeed, all NCGIA Initiatives thus far had focused on well-defined, mostly technical topics; the only broadly formulated Initiative to this day (Initiative 19: "GIS and Society") was subsequently approved using a new, more open formula, i.e. with
co-leaders and a steering committee largely external to the NCGIA. Initiative 18 thus became the research conference entitled "Spatial Technologies, Geographic Information, and the City".

The term "spatial technologies" was defined by Couclelis (1994) as the complex of transportation, communication, and information technologies that together modify spatial relations:

"We need a collective name for all these technologies that modify spatial relations, because we need a new concept that will allow us to explore the new geography they generate together as an interdependent whole" (p. 143).

Thus spatial information technologies, of which GIS is arguably the most important example, is a subset of spatial technologies: geographic information systems both provide information about spatial relations, and contribute to the modification of these relations by affecting people’s spatial behavior in multiple ways. It is this peculiar role of GIS as both active cause and passive observation platform for the changes taking place in the city of the informational age that encouraged the NCGIA to include this broad topic of spatial technologies in its research agenda.

The Call for Papers (see APPENDIX A) circulated in December of 1995 solicited contributions in the following three areas:

- What changes in accessibility are brought about by spatial technologies affecting spatial interactions in cities?
- How do these changes affect different geographically or socially defined urban population groups?
- How can geographic information science and technology be used to help identify, measure, model, and plan for the impacts of changing spatial technology on the city?

Thus the intended focus of the conference was primarily on the changing conditions of urban accessibility under rapidly evolving spatial technologies, the impact of these changes on specific populations, and the contribution of geographic information science and technology in helping us deal with these changes and impacts. However, neither the research notes submitted, nor the discussions at the meeting, nor the research agenda that was proposed were limited to these questions. A number of participants were primarily interested in the question of access (especially by disadvantaged groups) to information technology in general, or to geographic information in particular. Others saw the societal threats of information technology, such as the issue of surveillance, as the most pressing question (the improper or unethical access to information, in a sense), along with the more general ones of spatial and social justice and power. Obviously this is a topic area of very broad import where people from substantially different research perspectives can fruitfully work together.

Figure 1 shows the thematic distribution of the papers (research notes) submitted by the conference participants relative to the three original questions of the Call: (A) Changes in urban accessibility; (B) Impacts on populations; and (C) Role for GIS. Some of the submissions focused on only one of the three questions, some connected two, and some all three. The research notes themselves are reproduced in this report as APPENDIX B.

**Figure 1** Distribution of the research notes across the three main conference themes

The meeting

The Baltimore meeting was planned as a small "research conference" or workshop along the lines of an NCGIA Initiative specialist meeting. The immediate goal was to formulate a tentative national research agenda in the
areas of concern to the conference. The research notes submitted by the participants had been circulated earlier and with the exception of keynote lectures by the members of the steering committee and T R Lakshmanan, no papers were presented at the meeting. The working sessions alternated between breakout group discussions and plenaries where the results of the group discussions were reported, examined and synthesized. The conference program is included in this report as APPENDIX C.

The initial breakout groups were assigned to the three "bullet" questions of the conference call roughly as shown in Figure 1. While group reshuffling from session to session was encouraged, most participants chose to remain with their original groups and continue discussing the same issues in more depth. As a result the discussions grew very intense and focused and by the last morning the participants were ready to present their views on what should constitute a national research agenda in the general area of spatial technologies, geographic information, and the city. The three group reports are reproduced below.

The future

Unlike an NCGIA Initiative specialist meeting, the Baltimore conference is not part of a sustained package of research activities of the NCGIA. However, interest in the general area covered by the conference is booming nationally and internationally. Several conferences and workshops on related themes were announced within the past couple of years. At the same time, several related major government initiatives were taken, and some landmark publications on the subject appeared. Prominent among these, but by no means unique, were the U.S. Congress’s report entitled "The Technological Reshaping of Metropolitan America" (OTA-ETI-643); the book "Telecommunications and the City" coauthored by one of our conference participants (Stephen Graham); and the joint NSF/ESF Transportation Workshop held 10/7/96 in Strasbourg, France. That growing interest in the urban impacts of spatial technologies bodes well for those seeking a new intellectually exciting area to do research in, along with funding possibilities to help carry out such research.

The NCGIA also plans to be part of these developments. At the time of writing NSF funding is expected for the next three-year phase of the Center, which will continue its activities around a new three-part research agenda, the third area of which is entitled "Geographies of the Information Society". The Baltimore conference and the tentative research agenda it produced will likely find a natural continuation within that environment.

References


TOWARDS A NATIONAL RESEARCH AGENDA: THE GROUP REPORTS

This section presents the edited versions of the three group reports presented on the last two plenary sessions of the Baltimore meeting, as these evolved following the general discussion and subsequent feedback to the editor. The groups were asked to define their special area of interest and provide a list of researchable questions within it, along with one or more suggestions for specific research projects addressing each question. The three-part report reflects a fairly strong consensus among those present.. Additional views on the research questions proposed and the themes of the meeting in general are reported in the next section.

Group A

The Measurement and Significance of Accessibility Changes
New research perspectives are required to study the effects of modern spatial technologies on urban areas, in particular the ongoing changes in accessibility conditions and their direct and indirect impacts, both short-term and long-term. New approaches to measuring and representing urban phenomena should facilitate shifts of focus from macro- to micro-scales of analysis, from static to dynamic views, from structures to processes, from material to electronic flows, and from space to space-time. Theoretical as well as empirical work is needed in these areas. Along with new definitions of distance, interaction, and accessibility we also urgently need studies on the questions outlined below. These should be undertaken for a number of different metropolitan areas, using comparable data and methods, cross-referencing existing data bases and generating new data from surveys and other sources. The creation of longitudinal data sets is particularly critical. These data bases should seek to include disaggregate data and should incorporate space-time diary studies on in-home as well as out-of-home activities. In some areas ethnographic research methods and data may be the most appropriate. Data collection should also include temporal coding for businesses and services (what goods and services are available when?). A literature review of work in cognate disciplines is also a high priority, to establish what is known and not known in each domain.

Priority Research Questions

A1 Explore/propose a typology appropriate for distinguishing different levels of accessibility among individuals, households, employment categories, and social and economic groups in time and space.

Relevant questions include:

- What are the parameters of accessibility in urban areas under expanding communication and information technologies?

- What geographic scales are appropriate for assessing accessibility conditions for different groups under changing spatial technologies?

- What qualitative accessibility differentials are produced by the new technologies among different urban population groups?

- Is there a useful operational distinction between accessibility (potential reach) and access (actual use)?

Categories could be derived from the literature. Existing surveys in Los Angeles, Portland, Seattle, and elsewhere could provide data for exploratory data analysis. However, in the interest of generalization, it is necessary to locally validate and appropriately cross-reference the results of similar surveys. Qualitative studies involving ethnographic methods may be needed to determine appropriate measures, especially those that incorporate access to goods, services, and places via information technologies (see also A7).  

Specific Project: Study of disparities in electronic accessibility: geocode origin/destination flows of electronic transaction data to examine patterns and distances; analyze these patterns in relation to area demographics/area type.

A2 We assume that the new technologies are encouraging a spreading of activity over time as well as space. What is the evolving relationship between work in space and work in time? How does this affect spatial structure?

Time-budget research should be undertaken to unpack the temporal dimension from data; it should attend specifically to the 'colonization of time’, i.e., the spreading of activity into the late evening and early morning
hours. The research should also focus on different age and gender groups and their activity patterns. Data collection should be sensitive to multitasking, i.e., the reality that people often are doing more than one thing at a time. European work (e.g., by K. Achshausen and D. Elterna) assembling historical data sets on activity patterns might be useful to US researchers.

Relevant questions include:

- Which traditional and new kinds of activities tend to spread over time and space with the help of spatial technologies?

- Which social and occupational groups are most affected by such spreading?

- In which parts of metropolitan areas (central cities, suburbs, exurbs...) is such spreading most manifest?

- Which urban patterns tend to facilitate/inhibit discontinuous activity patterns over time and space?

**Specific Project:** (1) Study the colonization of time in the capital markets industry: A number of people have to work at night, leading to more (support service) people having to also work at night. (2) Study systems using support from different time (and space) zones.

**A3 What has been the effect of the telephone on urban growth and spatial patterns?**

The telephone has been around a long time and in many respects its effects on human interaction have been comparable to those of the more recent communication and information technologies. Telephone infrastructure and use studies would help answer many of the questions about future patterns that have arisen at the meeting. We need microstudies of telephone penetration, in the developing as well as the developed world. (Good source: Claude Fisher’s ‘Calling America’).

Relevant questions include:

- In what respects are the spatial impacts of the telephone similar to/different than those of more recent communication and information technologies (fax, Internet...)

- What has been the relationship between telephone calls and trips in different settings (social, by socio-economic group; business and government, service provision)

- How has telephone infrastructure affected urban growth patterns in both the developed and the developing world?

- What is the evolving role of the telephone in the context of the other spreading spatial technologies?

**Specific Project:** Within specific metropolitan area(s), study place-to-place variations in telephone infrastructure at the micro level and personal access to the telephone: Find areas with little telephone penetration and compare with 'similar' areas with well-developed telephone infrastructure. Distinguish between availability and use.

**A4 What is the effect of mobile communications on urban growth, travel, and spatial patterns?** Does greater penetration contribute to greater dispersion activity and/or more efficient trip patterns?
Research should focus as much on the social market as on economic/business uses of mobile telephones and pagers, and on time series analyses. Disaggregate data on mobile communications have existed for over a decade and may be used to track locational changes for places of employment and households.

Relevant questions include:

- How are the spatio-temporal patterns of mobile communications different from those of fixed communications?
- In what percentage of such interactions are both ends of a communication mobile?
- How does use break down by occupational, socioeconomic, etc., class?
- In which parts of a metropolitan area, and which times of day, are such communications most heavily concentrated?
- What is the effect of pricing on the different categories of use and users?
- What are the patterns of penetration of non-telephone mobile communications (pagers, portable e-mail...)?
- How are such technologies impacting the activity spaces of people with disabilities?

**Specific Projects:** (1) Individual activity space analysis: map and explain relationship between mobile telephone use and extent of activity spaces for different age groups (e.g., children and teenagers); compare activity spaces for adopters and non-adopters; for city/suburban/exurban areas. (2) Map and explain relationship between mobile telephone use and driving/commuting behavior, especially in congested urban settings.

A5 To what extent is there substitution between travel and communications, and to what extent are they complementary or synergistic (and increase each other’s efficiency)?

Attend specifically to telecommuting within metropolitan regions over time. This is a specific aspect of the broader questions of technology and adaptation. A considerable literature on both telework and telecommuting exists (e.g., Nilliss, Salomon (?), Mokhtarian), going back to the 1970s. We need to determine what is known and not known about the topic. Research on this topic is amenable to investigation using participant-observer methods as well as aggregate analysis and simulation (e.g., the Stough/Paelinck simulation model).

Specific questions include:

- Why are people not making more use of telecommuting?
- How is people’s choice of a new home influenced by the possibility to telecommute?
- What differences in activity spaces are there between partial and total telecommuters/teleworkers?
- How are the effects of telework on urban and business organization different from (and more important than) those of telecommuting?
- What literature is there on neighborhood work centers? What have we learned?
- What measures matter for assessing urban impacts of telecommuting (and telework)?
- What are the effects of different levels of service (cost, bandwidth, reliability...) on the relation between travel
and telecommunications?

**Specific Projects:** (1) Set up a multi-university virtual seminar on this topic: a case of telework - the seminar can study itself!

(2) Correlate travel and information flows: compare work trip flows within urban areas at tract level with telecommunications traffic; compare business travel with Internet flows at intercity level.

(3) Develop a ZIP-level data base, to include: distance matrix, travel time matrix by mode, traffic flows by vehicle type and trip type, telecommunication flows by medium (phone, fax, Internet...).

**A6 How do changing conditions of employment alter patterns of individual behavior and affect urban spatial structure?**

Research addressing this question should attend to changes in temporal work ordering including flextime, shared jobs, shift work, and uncertainty of employment location; also to temporary workers and those with changing work locations (itinerant workers). Data on the proportion of the labor force and of various industries and occupations engaging in such work would be helpful. We also need micro-level studies of these workers to assess the impacts of the new work patterns on households and on the city. Some databases already exist (e.g., a Phoenix, AZ data set) that provide information on individual employee work start and stop times and weekly schedule choices, and can contribute greatly to this effort.

Relevant questions include:

- How are information technologies used to create flexibility in work patterns?
- Do urban areas with a strong informational base differ in their spatiotemporal work patterns from other areas?

**Specific Projects:** (1) Compare rush hour traffic in areas with and without a high percentage of information-based industries. (2) Compare spatiotemporal activity patterns for IT itinerants and blue-collar itinerants (e.g., roofers, plumbers): compare IT itinerants and more conventional white-collar itinerants such as visiting nurses and piano tuners. Study changes in the work patterns of traditional itinerants following the adoption of IT.

**A7 We need new measures of accessibility that capture both the distance-transcending effects of information technologies and the new dimensions of spatio-temporal diversity in human activities and roles.**

Traditional distance-based measures of accessibility are inadequate in their current forms for addressing the effects of technologies that transcend distance. Also, traditional measures have assumed that both the accessor and the accessed are fixed in space (and time). This is no longer true at a time when society appears to be moving more and more from place-based towards person-based activity patterns. The notion of role-group diversity may be relevant in this context. Space-time activity options across role groups display a range from low diversity (specialization or little variation in activities in time and space) to high diversity. To study and plan for the high-diversity role groups in particular, new definitions and measures of accessibility are needed.

Relevant questions include:

- How can traditional measures of accessibility be adapted to the new realities?
- What fundamentally new conceptualizations of accessibility would be practically useful?
- How could concepts of entropy and utility, or a Shannon-Weaver measure of diversity be applied to time-space activity data to help reveal the diversity spectrum in group roles?

**Specific projects:** (1) Expand traditional accessibility measures to include time and the effects of IT: Assume accessibility is a **relation** between person or group x and resource (person, group, good or service) y at time z. Then the XYZ matrix represents accessibility for a set of social groups X to a set of resources Y over a period of Z hours/days/weeks. (A difference with traditional measures is that neither X nor Y need to be fixed in space). The cells of the matrix can be vectors representing how accessible resource y is to group x at time z by each of a number of appropriate media (car, bus, telephone, pager, Internet...) Do pilot study with small number of groups and concrete set of resources.

(2) In specific urban areas where a significant amount of IT-based access takes place, compare the performance of a series of traditional place-based and individual-based measures of accessibility: are any of them satisfactory with or without modification?

**Group B**

**Unpacking Urban Social, Political, and Behavioral Impacts of Information and New Media**

Research in this realm should focus on relationships between information technologies and the restructuring of cities, with specific attention to in-home and out-of-home activities, highly portable information technologies, and space-creating technologies. Issues of social justice, ideology and power underlie many of these evolving relationships, and need to be closely examined next to the more visible structural and behavioral impacts.

**B1 What spatial, temporal, behavioral, social, economic, and political dimensions of these technological developments exist, and what are their implications for cities? Who benefits from these changes?**

Information technologies have the potential to restructure in-home and out-of-home activities (including work, shopping, recreation, and socializing) and in turn they may be changed themselves. Similarly, the electronic delivery of services has the potential to restructure public and private enterprises and household activities and to co-evolve with physical changes. (On the other hand, some media have been around for decades with few discernible effects on cities). Research on this topic should be merged with question B5 on the economic geographies of the information economy. Banks and health services should offer fertile ground for this kind of research. The iconography of such services should not be ignored; it reveals what traditional functions are being altered.

**Specific Projects:** (1) Study the impact of electronic banking (including ATM use and on-line services) on banking behavior of consumers (time, length, frequency, duration of trips to the bank; shifts in banking service use within households; choice of bank; effect on single-purpose and multi-purpose trips).

(2) Compare enterprises that do/do not use IT heavily. Examine how they make locational decisions; how has IT affected their real estate holdings. Need to examine multisite organizations for insights. (e.g., Bank of America).

**B2 What are the implications of highly portable information technologies for individuals and specific groups, for the separation of public and private realms, and for changes in the use of time and activity patterns?**

Wearable (highly portable) technologies are becoming more prevalent and could either liberate or constrain individuals. Investigating activity spaces in relation to highly portable technologies would be one way to begin. Relationships between portability and surveillance should not be neglected. (This topic should be subsumed
under a general Mobile Communications heading: see also question A4).

**Specific Project**: How do people use the mobile telephone? How dependent do people become on these phones? How does mobile telephone use affect spatial decisions and behavior? Study especially people with physical disabilities or other groups with constrained mobility.

**B3 What are the geographies of surveillance technologies in the city and how is this changing over time? What are the implications and consequences of these technologies?**

Emerging surveillance technologies offer promise for improved data acquisition and increased security, but they also raise questions about privacy, exclusion, and social control. This research could examine surveillance technologies in connection with highway networks and traffic flows, shopping malls, or gated communities.

**Specific Project**: Map closed-circuit television surveillance areas in cities and measure their effects on the behavior and well-being of both insiders and outsiders.

**B4 What consequences result from the commodification of information?**

Differential access to the information marketplace could exacerbate social (and eventually also locational) differences. Customizing information may provide efficient matches between consumer needs and wants and supply, but may also leave out those who cannot pay and lead to more social and political fragmentation. Marketing uses of information technology - especially consumer profiles and targeted advertising, may affect peoples lives, actions, identities, and perceptions of others. Social and spatial isolation can be measured and compared with increasing or decreasing commodification of information. Geodemographics research offers an entry point into these questions: one could begin by determining who is using ’pay-per’ services, and whether lack of access to such commercially provided services means lack of access to similar services altogether.

**Specific Project**: Document the roles of intermediaries that provide geographic information to community groups, and their effectiveness: what are the effects of the beliefs and ideologies of these intermediaries on outcomes?

**B5 What are the economic geographies of information technology industries? What is the spatial structure of cities whose primary economic base is information? What are the implications in terms of location, scale, and spatial distribution in such places?**

How do places emerge as information nodes? Where are they located? How do we measure ‘information intensity’ in an urban area? At what geographic scales is the phenomenon of an informational node most salient in its effects on people’s lives? How does spatial structure reflect these new functions, and how does the tradition-bound construction industry adapt to new needs? How are socioeconomic and demographic profiles different in these areas? How do unskilled, lower-income people fare in these areas?

**Specific Project**: For any of the questions above, determine critical measures and methods of study, and compare a range of information-based cities with others.

**B6 Who creates and controls information technology, and for whose benefit?**

What kinds of political and regulatory systems for the control of information technology exist, and what issues do they raise? What ideologies, discourses, biases, geographic representations, and metaphors are embedded in information technologies and in the institutions that implement them? How do these institutions vary with culture and country? How might institutions be restructured to create a more robust, just, and equitable means
of accessing and controlling information technologies within cities?

**Specific Project:** Measure the diversity and extent of information concerning services exchanged within specific social groups. Inventory some of the on-line services available to these groups and contrast publicly provided services with those offered by commercial networks such as CompuServe. What is the role of trust, personal contact, and word-of-mouth information in the adoption of on-line services by communities?

**B7 What methodological issues need to be addressed in designing research on spatial technologies and cities?**

What mix of quantitative and qualitative methods are appropriate for investigating spatial technologies and cities? What kinds of data are needed? How can they be collected or obtained, and by whom? What scales of analysis are appropriate for various research questions? What are the time frames of causes and effects? How can sequences of causes and effects (including nth-order effects) be exposed? How can comparative research be used? The absence of information on information flows hampers research: much is known about the flows of commodities, but virtually nothing about information flows: how can information flows be mapped? Can the World Wide Web be used to study its own functions and effects? What new research methods should be invented to help deal with the impacts of the new media?

Next to these methodological issues, there are deeper theoretical questions regarding the changing nature of spatiality and temporality in the informational city. There is a need to re-conceptualize urban space, time and process so as to deal with the phenomenon of ’community without propinquity’ and the ’death of distance’ already widely proclaimed by the media.

**Specific Project:** No specific project is proposed here as these are cross-cutting questions underlying many of the other projects mentioned.

**Group C**

**Operational Issues and Infrastructure Design Strategies**

**for Understanding Spatial Technology’s Roles**

**in Building Improved Urban Communities**

Discussion within Group C, which focused on the operational aspects of the issues raised at the conference, evolved in two parallel directions. The first was guided by the premise that a very decentralized information infrastructure was both desirable and possible; the group went on to propose some ideas about how a community-level spatial data infrastructure might be put together. The second focus of the group’s discussion was the broader question of how to develop tools to support the substantive research proposed by Groups A and B.

**C1 What is the appropriate level for a spatial data infrastructure from the public’s point of view, what needs should such an infrastructure meet, and what should be its characteristics?**

There is an urgent need to attend to spatial data infrastructure, but not at the level of the NSDI (National Spatial Data Infrastructure). Focus should be on the community level and in particular on community-based organizations (CBO’s) but not limited to them, nor limited to user-friendly access as the problem. The perspective of the users should be emphasized in a two-way framework in which communities contribute as well as receive relevant data using new kinds of flexible tools.

Relevant questions include:
- What kinds of data do communities need most, in what format, and for what purposes?

- What kinds of data can communities usefully contribute to a spatial data infrastructure primarily geared to community-level use?

- What are the most fruitful scales and perspectives for studies in this area: should urban systems, community-based organizations, government program evaluation, or human geography issues be emphasized?

- Do the Internet outreach schemes of libraries, schools, churches, social services, etc. have different requirements in terms of spatial data infrastructure? How can privacy, security, and credibility be addressed in each of these contexts?

- Uses of the information infrastructure involve problem formulation and interpretation and design as well as answers to specific queries: what are relevant research questions regarding language, visualization, tools, and networking suitable for different contexts and audiences?

- What neighborhood indicators would be most useful to communities for different purposes - how can we avoid such indicators being seen as too distilled an `us-versus-them’ view?

**Specific Project:** Within particular communities, examine how the three main kinds of functions of GIS as viewed from a non-technical user group’s perspective (information provision, problem analysis, and group communication) are used. (May be combined with project outlined under B6).

**C2 What novel system design principles need to be developed in order to provide the appropriate technical support to the requirements established under C1?**

It appears that current information systems are neither flexible nor decentralized enough to serve many local user needs. The market is unlikely to build and maintain the needed infrastructure. The notion of a simple, coherent, multipurpose, cadastre-type spatial data infrastructure is too narrow, inflexible, and hierarchical to be helpful. In the technical realm, new tools for data access and synthesis can play major roles in shortening the pipeline from raw data to analyses, answers, and cross-referencing. The notions of `user self-service’ and `just-in-time data access’ are proposed to address the need for timely, flexible data access using existing widely distributed databases.

Relevant questions include:

- What interoperability characteristics and metadata would facilitate user ‘self-service’ in that process?

- Can administrative and operational data and tools be applied to existing data to avoid costly, separate analytic data bases?

- What data models (e.g., dynamic segmentation) allow just-in-time cross-referencing? Can scales be chosen or tools be built to facilitate data aggregation and synthesis as needed?

- How can geographic information systems be better linked with recent developments in information technology, and in particular the Internet?

**Specific Project:** Within a particular community-level application, explore the idea of `user self-service’ or `just-in-time data access’, where users can synthesize the information needed on an ad hoc basis out of existing data bases. What are the patterns of behavior likely among users of such systems? What are the technical, administrative, and conceptual obstacles to implementing these ideas? What levels of data quality are required
for community uses, and what levels are technically possible under such highly decentralized conditions?

C3 A Framework to Support Research

Most research projects suggested by Groups A and B will require at some point GIS-based tools for analyzing spatial and temporal information. The group discussed a framework suggesting how different aspects of these research projects could be linked with GIS data models, functions and operations. Some of these already are available in current systems, but others will need to be substantially modified or designed from scratch. The framework proposed is a matrix with different aspects of GIS use (e.g., information provision, data modeling and analysis, graphic communication...) as the rows, and questions A1-B7 as the columns. Each cell of the matrix represents the GIS-related research issues that may need to be addressed in order to help implement the kind of research proposed in the substantive question. The matrix may thus be seen as a systematic tabulation of research topics in GIS relevant to the general question of spatial technologies and the city.

OVERARCHING THEMES

The general discussion that followed the presentation of the three group reports identified the following issues as being of very high priority for research.

- The need for new general measures of accessibility. These should take into account the fact that urban activities are becoming increasingly person-based as opposed to place-based, and increasingly distributed over both space and time.

- The need for data on information flows that are comparable in scope and quality to the data available on the movement of persons and goods in urban areas. Pricing effects on such flows should also be studied as for transport flows.

- The need to assess the role of spatial technologies in restructuring the geography and economy of cities: how is the economic geography of cities being rewritten under the combined effects of these technologies?

- The need to distinguish the effects of spatial technologies on the corporate and government sector from those on individuals and households.

- The need to empirically investigate the social and spatial disparities induced by new spatial technologies and information technologies.

- The need to fully integrate time as a fundamental dimension in research involving spatial technologies in urban settings.

- The desirability to reconceptualize cities as dynamic processes of flows, interactions and transactions, rather than as static mapped patterns.

- The need to carry out research on cross-cultural and cross-regional comparisons of the effects of spatial technologies on cities.

- The need to recognize that in the presence of exceedingly complex relationships, as are those involving spatial technologies and the city, second- and third-order effects may be as or more important than primary effects.

- The need for theoretical work advancing current conceptions of urban space and time in the light of the redefinition of spatial interaction through technologies that transcend distance.

- The need to clarify the hidden philosophical and ideological assumptions and biases underlying the
increasingly widespread production and adoption of electronic spatial technologies in particular, and their consequences for socio-spatial justice.

There was further general agreement that a comprehensive bibliography should be put together, perhaps as part of an ongoing virtual seminar to grow out of this meeting.

**PARTICIPANTS’ COMMENTS ON THE GROUP REPORTS**

The edited draft of the research agenda was circulated to the participants after the meeting and several responded with extensive comments. Most were suggestions of an editorial nature and were incorporated in the final draft reproduced here. Others were elaborations on issues briefly raised in the group reports, personal reflections on what was (or was not) accomplished, or opinions on what could have been done or said more effectively or differently. A couple make some fundamental points about cities, communication, access, and social justice. Because of their interest these comments are reported here verbatim, in alphabetical order by their authors’ name.

**Stuart Aitken**, on the social implications of information technologies (IT):

I have two points I’d like to add to the soup:

First, one theme that may be missing in your conclusion relates to surveillance and power structures around the control and abuse of IT. We kept coming back to this in Group B and although it is subsumed within a couple of the other themes, perhaps it warrant a place of its own. Here’s how I might word if it were to become an overarching theme:

"The need to critically analyze the ways that information technology is used to undermine spatial justice in the city."

Second, there was some discussion in Group B and in our general discussions (I know Mel Webber raised this several times) of the use of ethnographic methods to study the uses and abuses of IT. In the introductory paragraph of the report, you mention disaggregate data and space-time diaries should be included in "common data bases" but I’d like to see that taken a little further to include in-depth interviews and ethnographic data. The wealth of information garnered from these methods are not amenable to "measures of accessibility" (first overarching theme) but they have been found to be incredibly useful in unpacking social, cultural and power structures in urban settings. I notice in your report of A1 that discussion revolves around using qualitative methods to determine appropriate measures, but I think several of us at the conference believe that they have significant worth in and of themselves.

**Elizabeth Burns**, on data sets:

My few comments are offered in the spirit of clarification on discussion in Group A.

First, you note in the introductory paragraph the need for comparative studies using common databases that result from cross-referencing existing ones. Our discussions emphasized the value of longitudinal datasets. Existing data may include only recent information rather than studies done ten, twenty or more years ago when communications conditions were truly different. Existing datasets may be based on surveys conducted for specific purposes that did not require the complete in-home and out-of-home information we would like to examine. As an example, the Phoenix data covers individual employees, but has a relatively short time span beginning in 1990 with survey questions focused on the journey to work. Under question A6 you note how
research should attend to changes in temporal work. The Phoenix dataset can contribute some activity information on individual employee work start and stop times and weekly schedule choices. Perhaps our virtual seminar could include discussion that articulates the desirable common qualities of these existing databases and surveys and addresses ways to extract the maximum information from databases not designed for our purposes.

Amy Helling, on accessibility measures:

I am concerned with reinforcing the (obvious, but not emphasized in the current draft) point that measures of accessibility, to be valuable, must have (empirically demonstrable) relevance. The interest we express in more sophisticated measures is conditional upon being able to demonstrate that they are useful in prediction or explanation. In my work so far I have tried to use accessibility measures to predict residential density and, more recently, travel (number of trips and minutes spent in travel). The gravity measures I have experimented with are clearly able to do this, though they leave a lot of variation unexplained. Presumably any new variant would be worth pursuing if it did a better job, or perhaps did a better job for a subset of the population. Our narrative sometimes made it sound like constructing new measures was a worthwhile end in itself. I wouldn’t agree with that.

Incidentally, since our meeting, a colleague and I have decided to seek funds to expand our last summer’s telecommuting survey (over 300 responses in Atlanta) over time, questioning the same people who participated in the first survey one or more times in the future (depending on funding). This is the first step toward the conference’s expressed interest in a longitudinal look at telecommuting in a single metro area.

Kingsley Haynes, on the scope of the conference theme:

Particularly important is an assessment of how access to these technologies affect access to other economic and social opportunities - education, employment, retailing, information, cultural opportunities, and how this in turn affects class and social consciousness.

(On transport uses)

With information technologies real time control of urban/metro traffic flows is increasingly possible. However, the comparative statics point-to-point urban traffic flow forecasting models are no longer adequate for guidance on systems intervention in real time. Traffic flows are nonlinear, dynamic, self organizing feedback systems. What new models and data is needed to support such management activity even at the theoretical level is very unclear. Basic research is needed in this area. Further it is unclear - in a behavioral sense - how people will react to such information if it is supplied to them.

Don Janelle, on the discussions at the meeting

(On the "accessibility" discussions:)

Positive Outcomes:

Active accessibility researchers (e.g., Amy and Michael) and GIS scholars (Betsy) departed with new ideas on how to incorporate representations of information technologies in their measures and information systems. I had a distinct sense that the younger scholars (David, Lauren, Laxmi, Matt, and Yongmei) were excited by the proceedings and appreciated an opportunity to interact with senior researchers.

I was pleased that people took seriously the notions that accessibility measures and assessments of the effects of
information technologies should incorporate the temporal
conditions of employment and the timing of spaces. We never did discuss the formal map representation of
accessibility, but we had enough other things to focus on.

Controversy:

Ken Hillis mentioned a tension between those focused on empirical analysis and positivist science and those
concerned with critical analysis. Specific issues were empowerment and the commodification of information,
and the ideologies embedded in IT. Personally, I see this as an opportunity for a new synthesis of ideas and
approaches. Groups B and C could explore this to link theoretical and applied aspects. The tension is a healthy
one and is inevitable with such a broad topic of discourse.

Neglected Areas:

Susan’s presentation on "trust" and personal contact through social networks needed more discussion -- this is
both an accessibility issue and IT implementation issue.

While Groups A and B were able to establish some common linkages, Group C’s focus was more internal to the
issues of introducing information technologies into communities (the empowerment issue). Maybe this can be
tied more clearly to questions of accessibility and access. Linkage to Susan’s and Ron’s presentations and to
Reg’s and Steve’s papers need emphasis.

Questions raised by Aharon Kellerman on spatiality and temporality did not receive much attention, though they
did share common ground with some of the ideas of Ken, Matt, Stuart, and Steve.

While the matter was discussed, the idea of instituting a broad general space-time survey (diaries) in
metropolitan areas was apparently deemed impractical -- too bad.

(On measuring space-time diversity:)

The question of measuring the space-time diversity of urban environments needs clarification. It relates to the
dynamic nature of accessibility and to the fact that every situational change in person/group, time, place, or
activity alters the set of possible options. Diversity measures (e.g., the Shannon-Weaver Information Statistic)
might provided a partial answer. It is hypothesized that role group diversity is increasing and that

space-time activity options across role groups display a range from low diversity (specialization or little
variation in activities in time and space) to high diversity. Role groups could be defined a-priori based on the
existing literature or be derived from empirical analysis to incorporate indicators responsibility (family, job),
constraint (income, education, mobility), social network, etc. Activity options could be derived

from the time-budget literature and be based on space-time diaries.

(On transportation:)

A general observation: Transportation, per se, is not given specific recognition in this report, reflecting the focus
of discussion in Baltimore on information technologies and GIS. The discussion in Baltimore did touch on
behavioral aspects of transportation and A5 (3) does mention data requirements. Yet, as a major facilitator of
interaction and as a principal force in structuring space-time patterns, it is not given sufficient attention. Some
of the papers did have a transportation focus (Burns, Helling, Janelle). But, excited as we were to embrace
consideration of the newer forms of accessibility, we neglected the persistent importance of transportation.
(On the tension between materiality and immateriality:)

The continuing material basis of human life (regardless of trends towards dematerialization) assures that human interactance will always be constrained by transportation resources. The mediation of communication and information technologies in reducing this constraint needs research, but so does the constraint of transport on the possible applications of IT and on its role in contributing to differential patterns of accessibility.

Seymour Mandelbaum, on the structure of the research agenda:

There is a breathless quality to the report that might be alleviated if you divided the two major themes that engaged us and were more expansive in introducing them.

Theme One: Representing Cities

The ways in which we variously represent cities are shaped by our sense of salient issues and the technologies at hand. The premise in this first theme is that we are still largely bound into a representational mode that describes the clustering of populations within spatial zones and the travel time or distance between zones. The central metaphor of that mode is that of "mass" and "gravity."

Even when it is applied to nineteenth century cities, that representational mode loses information and serves some purposes better than others. (Cities characteristically appear, for example, as settings and instruments rather than as moral objects or agents.) The urgency expressed in the proposal is grounded in a sense that the development of communications has increased the information loss (e.g. we know less than we use to about interaction patterns when we simply observe trips and travel times) and reduced the usefulness of our representational tools and metaphors.

The first theme at the conference was the importance of using the new information technologies to create and cultivate an amended set of representational modes and tropes.

Theme Two: Access

The second theme isn’t addressed with the same clarity and authority as the first. There are two competing versions of this theme. One is devoted to the attempt to understand the impact of communication and information systems -- a-spatial technologies -- upon urban form; the second to shaping access to those systems.

The first version has a long and (as Ron Abler suggested at the Tuesday afternoon plenary session) rather dismal history: for almost every contention about the impact of telecommunications on concentration or centralization there is an equally compelling case for its obverse. We cannot entirely avoid all of the conceptual difficulties of this theme but we need not bang our head deliberately against a stone wall. (The title of the conference butts against that wall by trying to distinguish a set of "spatial technologies" that are independent of the concept of "city.")

Listening to the Tuesday talk and reading the research notes, I think we would come closer to the essential interests of the group if we focused on the second version of this theme. Here are all these new communication and information systems. We are interested in understanding who has access to these systems, who uses them, and how and in what ways they are useful to individuals and collectivities. ("Access" and "accessibility" seem to me both to point to a possibility: the relevant contrasts are between access, use and utility. So, for example, I know how to use the machine on
which I am writing this memorandum to send messages across the Internet -- that is, I have access to the Internet -- but that fact doesn’t tell you how I use that access or its utility.)

There are two sorts of issues presented by this theme. The first engages the measurement of access, use and utility over time. (Consider the sense of urgency that pervades accounts of the superhighway and the implicit insistence that we cannot afford to replicate the diffusion rate of the telephone.) The second deals with the relations between the three dimensions, the appearance of bottlenecks, and the design of diffusion campaigns. (You will recognize that second set of issues in "The Intelligence of Citizens.")

**Laxmi Ramasubramanian**, on the discussions in Group C:

As a member of Group C, my personal interpretation was that there was a certain creative tension between the folks who were advocating the spatial data infrastructure and interoperability solutions (the data perspective) and those who were more concerned about operationalizing the issues from the users’ perspective. Related to this was the discussion about the expected abilities of the “user” and the need to clarify the kind of user we were thinking of.

While I am happy that there is mention of community-based organizations (CBO’s) as the focus of research, it is not clear why community-based organizations were chosen and if or whether other aggregations or units of analysis were even considered. I remember Seymour making a case for religious groups and some discussion about what we meant by CBO’s in the first place.

I must reiterate that as a junior scholar, it was incredibly useful to me to read the ideas of the senior scholars and to hear them and to have the opportunity to talk with them in an informal setting. Thanks to you and the other organizers for giving me and the other young scholars this opportunity.

**Mel Webber**, on the normative aspects of accessibility measures.

[Re: A1 and A7] A major rationale for an accessibility index is its normative utility. We need such a measure for evaluating alternative metropolitan spatial structures and other spatial arrangements. We’ve always appraised urban forms against preconceptions of density and building types. Far more important are the functional consequences of spatial patterns, not their static morphologies. If we could compare NY and LA in the language of accessibility, rather than that of density, I suspect we’d find them to be very similar. City planners and others have typically judged the merits of one urban form over another on quite different criteria than their comparative levels of accessibility, but it’s accessibility that’s important, not shape.

Further, accessibility levels vary widely among demographic groups. It would be extremely helpful in seeking to improve welfare to know how much variance there is. An accessibility index could become something like a surrogate index of well-being for different population groups. This is to say, we need such indices for more than their scientific interest, for more than their values as descriptors. We need them for normative policy purposes, as bases for evaluation.

[Re: A8] The most egregious externality of the auto highway system is not air pollution, fuel consumption, congestion, and perhaps not even accidents. It’s the loss of transit service among carless persons -- folks too young, too old, too handicapped, or to poor to drive. They’ve lost access to all sorts of opportunities, directly because the automobile has been such a successful and effective transport mode. So we need to find a new way of supplying transportation services to transit dependents. It can no longer be trains, or buses. They’re too big and so can’t match the small numbers of persons with the same origins, destinations, and schedules. We need to exploit the new telecommunications and new computing technologies to create a new kind of transit service that uses automobiles as transit vehicles.
APPENDIX A:

CALL FOR PARTICIPATION

National Center for Geographic Information and Analysis

Spatial Technologies, Geographic Information, and the City

A Research Conference

Baltimore, September 9-11, 1996

Spatial technologies, that is, the complex of new transportation, communication, and information technologies, are rapidly changing spatial relations in today’s cities. The appearance of "Edge Cities" on the periphery of metropolitan areas, and the experiments with Intelligent Transportation Systems, have already captured a lot of public attention. But spatial technologies also affect accessibility conditions for different activities and population groups, as well as the urban structure itself, in ways that are not as visible and often very difficult to gauge. The conference will explore the ways in which these technologies are both transforming our cities and, in the case of information technologies in particular, also expanding our ability to plan for these changes. A specific focus will be on the role of geographic information technologies in enabling us to deal with changing conditions of accessibility, distance, and spatial interaction in urban environments. This is a critical but as yet little researched area. We will review the current state of knowledge on these issues, chart potential research directions, and focus on the ways in which planners and policy-makers might respond to these new developments. We see geographic information science and technology playing a significant role in bringing together those working in this complex area, in particular, experts in urban geography and planning, urban transportation and telecommunications, urban sociology and service provision, and GIS. To this end, the conference will address the following broad questions:

- What changes in accessibility are brought about by spatial technologies affecting spatial interactions in cities?

- How do these changes affect different geographically or socially defined urban population groups?

- How can geographic information science and technology be used to help identify, measure, model, and plan for the impacts of changing spatial technology on the city?

Within these broad themes, the following more specific questions may be addressed:

**Relating to changing conditions of urban accessibility and their impacts:**

- What empirical evidence is available to support the widely conjectured changes in urban accessibility brought about by the increasingly widespread use of communication and information technologies?

- How are urban land use and structure, at different geographic scales, responding to the changes in access
brought about by modern spatial technologies?

- How can land use and transportation models be adapted to reflect the substitutive, complementary, or synergistic effects of new spatial technologies?

- What empirical work is available documenting how access (and lack of access) to information and opportunities is practically experienced by traditionally disadvantaged urban populations (inner city residents, the aged, working mothers, etc.)?

- How will advanced spatial technologies, especially electronic information networks, change conditions of access to employment opportunities for geographically localized, disadvantaged urban populations?

- In the context of urban service delivery, to what extent will the new spatial technologies be substitutive, complementary, or synergistic relative to one another and to the more traditional ways of bringing information and services to urban populations?

- What are the trends in the electronic delivery and use of retail, library, and other services, and what are the positive (e.g., improved access) and negative (e.g., further competitive disadvantages, job losses) impacts on urban populations?

**Relating to the role of geographic information science and technology:**

- What new conceptual or formal models need to be developed to capture changing notions of distance and access, and how can these be most usefully implemented in GIS?

- What kinds of data will be needed to implement the necessary concepts and models, how will these be collected, and how will they be accessed and synthesized?

- How can GIS-based systems handling aspects of the urban access issue be fruitfully interfaced with other relevant technologies (especially the National Information Infrastructure), as well as with the informal, socially-based information networks?

- What current uses of GIS in urban planning and transportation, policy making, and management are relevant to the access issue? Which are the institutional structures, agencies and stages within the urban policy process where GIS can make the most positive contribution to the problem of access?

- Who will be the main users and managers of GIS-based systems intended to contribute to the improvement of urban access conditions for disadvantaged populations? What are the user needs, professional and managerial as well as among the public at large, with respect to such technologies?

The Conference will be sponsored by the National Center for Geographic Information and Analysis (NCGIA). We are planning for a meeting of 25-30 scholars who will contribute research notes to be circulated to all participants prior to the meeting. The conference itself will include both plenary and small-group discussion sessions, and hands-on workshops. Its goal is two-fold: (a) to prepare for the formulation of a research agenda identifying major themes and funding opportunities for concerted research efforts, and (b), to plan for an edited book summarizing the state of knowledge and outlining the major issues in the general subject area of the conference.

Research notes of about 2,000 words, presenting empirical or theoretical work or reviewing the state of knowledge in the areas of interest to the conference, should be sent to the following address by March 31, 1996, in both hard-copy and electronic (e-mail) formats. Notification of acceptance will be issued on May 15.
important selection criterion will be the degree to which submissions integrate the three thematic dimensions of urban accessibility, impact on populations, and geographic information. Research notes should be accompanied by a brief resume and statement of the applicant’s research interests beyond those directly reflected in the note.

A number of fellowships of up to $500 ($750 for West Coast and overseas applicants) will be available from the National Center for Geographic Information and Analysis towards accommodation and reasonable travel costs. Applications for funding must be included with the research note submissions, along with a mention of any other sources from which additional funding may be obtained. Please quote lowest available economy fare. Overseas fellowship recipients must use US air carriers.

For further information please contact

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Conference steering committee:

Ron Abler (AAG), Mike Batty (University College, London), Helen Couclelis (NCGIA/University of California, Santa Barbara), Ken Dueker (Portland State University), Susan Hanson (Clark University), Kingsley Haynes (George Mason University).
APPENDIX: B

THE RESEARCH NOTES
There will be no more there, Everything will only be here.

Humankind has employed numerous technologies to redefine places (and regions) throughout human existence. Television, computers, the Internet, and the World Wide Web are recent, but increasingly dominant variations on a persistent historical theme. Existing and prospective media networks appear to permit fundamental transformations of traditional economic, legal, political, social, and cultural relationships. The power and promise of evolving information technologies have led some analysts to question the fundamental assumptions and principles underlying geography and related specialties, including the viability and validity of place as a basic locus of human experience, and an intellectual construct. Current speculation on the nature of place in relation to information technology can be divided into four realms of increasing abstraction: 1) the places and spaces of economic geography; 2) legal and political conceptions and definitions of place; 3) social and cultural dimensions of place; and 4) perceptions of places and spaces. A distinction between geography and space cuts across all four aspects of the question.

Despite widespread belief to the contrary, information technologies cannot and will not repeal the fundamental laws of economic geography. In communications technologies as in other kinds of economic relationships among the places of the earth, frictions of distance remain and will persist. Geography is ineluctable.

Precise legal definitions of places, especially political units, have been muddled by increasing attempts by law enforcement agencies in some places to assert jurisdiction over acts committed well beyond the traditional reach of local law enforcement. As increasingly valuable resources, information and information flows will become sources of domestic and international conflict.

Social and cultural relationships have always been intimately linked to communications media and to places. The supple nature of emerging media and their often high costs of participation open new possibilities for defining both place and society in ways that will highlight the tensions between integration and segregation of diverse social and cultural groups.

Because they are products of fertile human imagination, the perceptions of place and places enabled by evolving information technologies offer especially exciting (and occasionally alarming) possibilities. Information technologies may provide substitutes for direct experience of the places of the earth, they may enhance that experience, or they may do both.

Consideration of these four tensions leads to a distinction between cybergeography and cyberspace. The difference between the two highlights the role of human choice in directing the variety of ways information technologies will be employed to define places--actually and virtually--in the future.
Man’s Place in the Home: Telecommuting, Identity and Urban Space

Stuart C. Aitken and Matt Carroll

A recent Hewlett Packard commercial portrays a man who, enabled in part by laser printer technology, brings work home from the office. The commercial is narrated by the thoughts of his crib-bound baby son who praises the paternal bonding and increased productivity made possible by his father’s working at home. The commercial is a play on two enduring assumptions about work: that paid employment occurs outside the home and that childcare is the responsibility of women. It suggests a 1990’s male who is patently domesticated while still in control of his productivity. The commercial is also a depiction of the "electronic cottage" concept envisioned by Alvin Toffler nearly two decades ago. Toffler (1980) claimed that computers and telecommunications technologies, by allowing certain forms of paid work to occur at home, would facilitate a transformation in family structure, gender roles and city space. By the end of 1996 the population who work out of the home with telecommuting technologies will surpass more than 10 million in the United States and increase over ten percent annually for the remainder of the decade (LINK Resources Corporation 1994). The purpose of this paper is to explore the ways that our gendered notions of city space, and our traditional thinking of the relations between home and work, change with spatial technologies such as telecommuting. First, we review the feminist and poststructural literature on urban structure and the politics of identity. In so doing, we highlight some of the problems of using home/work separation as a basis for urban modeling. Second, we raise issues related to the politics of identity formation that may arise as men increasingly find themselves working at home. Third, we explore the extent to which men’s gender roles are changing with participation in childcare and domestic activities. These last two issues are investigated with empirical data from an ongoing project on changes in the spatial nature of family, work and community. Finally, an evolving critical theory of urban scale suggests ways of coming to terms with the new spatial and gender relations between home and work.

Home, Work and the Nuclear Family Myth

The empirical basis of the paper is derived from an ongoing project in San Diego on the geography of families with young children. The study joins a decade of social science research into the gender divisions of labor and the patriarchal basis of urban modeling. We are particularly interested in the enduring power of nuclear family myth, and the political identities and urban spaces that this myth creates. We use the term myth in the sense that Roland Barthes meant when he suggested a process whereby a concept becomes naturalized and, in effect, depoliticized. Barthes (1972, 109) attributes myths to specific geographies and histories because there is usually a particular point in time, and place of origin, from which they "ripen and spread." The nuclear family myth first began to look irrepressible when it gained academic and institutional legitimacy with George Peter Murdock’s (1949, p. 1) use of the term as "... a social group characterized by common residence, economic cooperation, and reproduction. It includes adults of both sexes, at least two of whom maintain a socially approved sexual relationship, and one or more children, own or adopted, of the sexually cohabiting adults." Modern notions of the nuclear family restrict one part of its adult complement to wage-employment outside the home and the other to domestic and child-rearing activities. Most often, these two occupations are filled by the adult male and female members of the family respectively and they are thought of, at least in our enduring conception of nuclear families, as mutually exclusive. The purpose of the larger study is to tease out aspects of the mythic geographies and histories of families and communities as they relate to spatial and gendered power relations (Aitken 1997). The birth of a first child often highlights important questions for parents that relate to responsibility, self-identity and notions of family, work, community and society. We document changes in family members’ commitments and attitudes towards domestic work and paid employment from pregnancy to the child’s first birthday and then every year until the child was between 3 and 4 years old. Our inquiry also documents the effects of newborn children on space-time geographies.

The impetus for the larger study derives from an earlier time-geography study of the constraints that encompass home-work separation (Aitken and Fik 1988). The current project broadens this work with a consideration of
changes in gender roles and relations, including the effects of homework, on our understanding of urban space. In depth interviews with men and women focus upon the spatial and gendered changes that occur with young children. We question issues relating to the spatiality of families, work and community. In this paper, we look specifically at how new technologies and work ethics are dissolving and blurring the traditional boundaries between home/work, feminine/masculine, private/public, and interior/exterior that feminist scholarship attempts to deconstruct. We map our empirical findings onto an emerging post structural and feminist theory on urban space and scale. At this time, we are unable to comment on a series in depth interviews that are currently underway with men who use telecommuting technologies and/or work from home. The results from this part of empirical study will not be available before August 1996. The balance of this research note discusses some of the theoretical implications of our work.

Telecommuting Technologies and the Politics of Identity

Telecommuting emerges in a world where home and work are constructed as spatially separate, dichotomous, and gendered realms of social life. Stereotypically, the workplace is the public, productive realm of men, while the home is private and domestic, more often associated with women’s reproductive roles. Feminist analysis has challenged this dichotomy of home and work, claiming that it conflicts with empirical realities of gender preferences (Saegert 1980), does not respond to changing economic contexts (Watson 1991), ignores the complexity and androgyny of the home (Bondi 1992), and underestimates the overlap that has always existed between home and work (Lozano 1989, Watson 1991). Most importantly, the conceptual and spatial separation of home and work are fundamental to persisting gender inequities. Dolores Hayden (1980, p. S171) stresses the importance of developing a "new paradigm" for the home and urban space that recognizes the evolving needs of men, women, and children.

As portrayed by Toffler (1980) and Hewlett Packard, telecommuting appears as a means of blurring the distinction between home and work and increasing available time for household responsibilities. It does so for both women and men; however, modern conceptions of womanhood have been constructed around the home, and recent research suggests that telecommuting by women reinforces gender inequities by reducing husbands’ involvement in household responsibilities (Falconer 1993, Gottlieb 1988). Men’s presence at home presents a clearer challenge to the gender identification of the home and roles associated with gender and space.

Most telecommuters are men (Olson 1989), underscoring the importance of a study focusing on their experiences of home. Feminists have shown that one of the patriarchal bases of urban structure is that men perceive the home as a retreat from a harsh world (Monk 1992, p. 128). Under American capitalism the home has signified a place where a man can return from his day in the factory or office to a private domestic environment, secluded from the tense world of work in an industrial city characterized by environmental pollution, social degradation, and personal isolation.... [and] enter a serene dwelling whose physical and emotional maintenance [is] the duty of his wife (Hayden 1980, p. S172).

From this perspective, the home is also connected to a sense of male control -- even tyranny -- over women and family (Watson 1991, p. 138). A related perspective holds that the values symbolized by the home -- femininity and intimacy -- are threatening, emasculating, and best avoided. Men’s gender roles pressure them to disassociate themselves from the home, lest they be "judged feminine--which is intermingled with the fear of being homosexual" (Kron 1982, p. 113). Fittingly, Joan Kron (1982) calls men’s fear of domestic emasculation "home-phobia." This fear does not banish men from the home, but limits their acceptable activities there to eating, sleeping, and procreating. According to Kron (1982, p. 116 and 286), many societies attach the label "suspect," "ridiculous," or "woman" to the man that spends too much time at home rather than conquering and subduing the outside world. Whether perceived as a threat to masculinity, a safe haven, or a seat of control, men’s associations with the home are unrelated to work -- paid or unpaid. It is not surprising, then, that despite the movement of women into paid work outside the home, men have shown little increase in their contributions to household work (e.g., Hochschild and Machung 1989; Aitken 1997).
The experiences of telecommuters -- or more broadly, home-based workers -- are documented by several empirical studies. This research finds gender to be important in differentiating the motivations, experiences, and satisfactions of telecommuters. Men, unlike women, rarely choose telecommuting as a way to perform childcare responsibilities, but do so in order to increase productivity and escape the environment of the corporate workplace. Men see telecommuting as an opportunity to balance leisure with work, not childcare with work (Wajcman and Probert 1988, Lozano 1989, Olson 1989, Gurstein 1991, Holcomb 1991). Gurstein (1991) finds that these priorities are apparent in the resulting time/space patterns of women and men. Men spend more time than women on recreation, sleep, and work and less time on housework and childcare. The lack of temporal and spatial boundaries between home and work means that telecommuting often entails working long hours (Lozano 1989, Gurstein 1991). This is especially so for men, who are more likely to work in professions prone to "workaholism" (Wajcman and Probert 1988, Massey 1995). One of Penny Gurstein’s respondents, concerned for his family, notes that his "goal is to cut back to six days a week" (1991, p. 173).

Some telecommuters express little emotional attachment to the home, despite the amount of time they spend there (Gottlieb 1988). For others, telecommuting allows the home to act as a refuge from the face-to-face authority often found at the corporate workplace. Some also feel that working at home offers them more control over their lives. Many, however, find that their expectations of home and work are not compatible. One man interviewed by Gurstein suggests that telecommuting diminishes the ability of the home to function as a refuge from the world of work: The merging of work and personal life is a crazy set-up. I feel very resentful about it...my whole life is one big lump -- doing everything at the same time ... My whole home has become my office. Every room has paper in it. I can never retreat (1991, p. 175).

Many telecommuters find that a separate home office or workspace is necessary to increase control over their work and preserve the identity of their homes. Nina Gottlieb (1988, p. 152), on the other hand, finds that working from the comfort of home improves some men’s attitudes about work, rather than work destroying their notions of home.

Besides the identity of their homes, the identity projected by the men themselves is an issue. Telecommuters are often perceived as not working or not performing "real" work because they do not leave the house with a tie on every morning. According to Gottlieb (1988), men struggle with the unconventionality of their image. Interestingly, Gurstein finds that men with children prefer a greater spatial separation between home office and the rest of the house than other men: "this can be attributed to wanting to maintain a professional identity apart from their domestic life" (1991, p. 175).

As already mentioned, men rarely choose telecommuting as a means to care for their children and those with children appear to attempt to isolate themselves spatially from childcare roles while working at home (Gurstein 1991). Olson finds that telecommuting’s effect on family involvement is purely symbolic for men, allowing them to "share regular meals with their families and be physically present in the evening hours, even though they might be off in a separate room toiling over their terminals while the rest of the family watches television" (1989, p. 223). Wajcman and Probert (1988) indicate that men, unlike women, become more work-oriented and less family-oriented after telecommuting than before they began. This increased orientation toward work is manifest by workaholism. Wajcman and Probert (1988) attribute the failure of telecommuting to change gender roles to long hours. A supposition that men working at home increases availability for family by reducing time wasted in commuting and workplace distractions seems incorrect; the extra time is used for more work, not childcare or household chores. Clearly, we need a better understanding of how these changes relate to men’s political identities.

**Scaling Men’s Work**

Feminists raise issues that relate women’s political identity to the space of work, home and community (Dyck 1990; Young 1990; Wilson 1991) but, as yet, little is known of the relationship between men’s political identity and urban space. As part of this agenda, we feel that there is need to highlight the problems that arise from the
metaphoric appropriation of the terms "home" and "work" as things that are natural and separate. This separation clearly has an important consequence for masculine political identity. We argue that it is precisely the "givenness" of space which suggests that the separation of home and work is unproblematic. If we assume that gendered power structures are reflected in and formed by space, then we must also take account of how they are hierarchically ordered. Like space, scale is neither natural nor unproblematic. Neil Smith (1992, 73) points out that "There is nothing ontologically given about the traditional division between home and locality, urban and regional, national and global scales. The differentiation of geographical scales establishes and is established through the geographical structure of social interactions." Telecommuting technologies require us to reconsider the assumed naturalness of the separation of home and work and, consequently, the "givenness" of the urban spatial hierarchy. We suggest that it is precisely the assumed naturalness of hierarchical oppositions such as man/ woman, public/ private and home/ work that results in "givenness" of urban spatial hierarchies. As such, we consider it important to look critically at how home-work separation has come to relate to the naturalness of scale in urban modeling. Smith (1992) notes that the language of difference and diversity (including the difference between men and women, work and home) may very well be articulated through spatial scale because it is the social construction of this hierarchical ordering that creates borders and boundaries between people and places.

In this paper, we attempt to determine the issues raised by men working at home and their effect on patriarchal structures that currently place multiple responsibilities on women. These multiple responsibilities couple with what some feminists call an oppressive urban structure that denies women (and men) the potential to realize an unconstrained political identity (Young 1990; Wilson 1991; Bondi 1992). Perhaps telecommuting is one example of a "new paradigm" for the home that will "free each of us to find his or her niche, to select or create a family trajectory attuned to individualized needs" (Toffler 1980, p. 223). On the other hand, it may be that the lack of spatial and temporal boundaries between home and work leads to compulsive work behavior for men, as indicated by Wajcman and Probert (1988). This study is well-situated to address the effect of communications technologies on the distanciation and gendering of home and work.

**Literature Cited**


Biographical Sketches

Stuart Aitken is a Professor of Geography at San Diego State University. He is author two books dealing with the space of children and families (Putting Children in Their Place, 1994; Family Fantasies and Community Space) and is co-author of an edited volume on cinematic representations entitled Space, Place, Situation and Spectacle (1994). In addition he has published over 40 papers in books and academic journals including Environment and Planning A and D, The Annals of the AAG, Transactions of the IBG, Progress in Human Geography, Journal of Cartography and GIS, The Journal Architectural and Planning Research, and Geographical Analysis. His interests cover feminist and critical theory, community and urban design, and GIS applications.

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Access and Information: How the New Electronic Media Changes Everything
Geographical but perhaps Changes Nothing!

Michael Batty

(In 1993) "...if you’d have asked me then if most TV ads will have URLs (Web addresses) in them, I would have laughed"--
Bill Gates, CEO Microsoft quoted in Business Week, July 15th 1996

Introduction

This is a difficult period for geographers and others whose concern is to figure out the effect of space and location on the city both for purposes of science and policy. Rapid although not unprecedented rates of change in communications technologies due to the long wave associated with the emergence of digital technologies in the mid-century, are forcing a dramatic restructuring of spatial relationships within urban areas as work and leisure respond to increasing productivity and opportunities for interaction across an expanding array of media. The emergence of world cities and edge cities is causing a fundamental reevaluation of traditional urban theory fashioned as it was on our observation and understanding, albeit rudimentary, of the industrial city. The fact that much of the new electronic media is comparatively invisible in its use and impact hinders traditional methods of observation and data collection while the speed of change is greater than our ability to record and make sense of this changing milieu.

In the last year, 20 percent of US adults have accessed the Internet through the world wide web and increasingly software associated with making this network more user friendly and accessible is becoming the cutting edge for desktop applications. For example, network browsers are being used for local networks but also for presentation devices while the growth of multimedia - animation and VR - through such software is proceeding apace. Talk of commerce moving to the web, of a multitude of traditional face to face transactions becoming remote, as well as the delivery of traditional public services from health to education, suggests as very different kind of urban form from the one that was associated with the rise of urban society and cities over the last 200 years. The implications seem daunting and the speculation and hyperbole (including my own !) is rife.

How Information Networks Can Affect Accessibility

It is easy to get caught up in the rhetoric but the impact of new information technologies on accessibility are ambiguous and uncharted, notwithstanding their pervasiveness. In essence, the argument is as follows: interacting across computer networks has the possibility of substituting physical communications for electronic with consequent impacts on movement in cities. Teleworking is the classic example but all forms of service delivery are potentially within the frame. The question is thus: to what extent are such substitutions likely to take place and what will be their impact on urban form. The limits to such a debate are clearly marked out in the story by E. M. Forster called RThe Machine StopsS which was published almost 100 years ago, in which he portrays the social isolation of such a world. In fact, from anecdotal evidence, it appears that electronic networks are in fact complementing and perhaps even increasing interaction, adding a new layer of complexity to urban society, rather than replacing or substituting for physical interactions.

What can probably now be said is that the impacts of networking are likely to be second rather than first order: not those of direct but of indirect substitution. For example, the largest changes in movement patterns in cities over the last twenty years are due to the purchase of second and third cars which have led to massive increases in tripmaking for education, leisure and shopping activities; changing perceptions and constraints on the use of time which have spread movement out during the day; increases in traffic congestion and related gridlock which in a European context at least is forcing people back into the city; dramatic declines in public transportation due...
to increasing car ownership but also changes in the way public activity is perceived and valued which in turn relates to the rise of individualism and the demise of socialism.

**Historical Determinism**

In my view, this meeting is about charting the limits to the debate, one which has only just begun and one which so far does not have any sense of an organized research programme within its grasp. Studies of previous revolutions in communication are thus warranted and it is here that the role of historical inertia - determinism if you will - becomes important. In urban societies highly constrained by limits on space and land, where people live at very high densities, the automobile has had a quite different impact from cities in the new world. It has been harder to provide the physical infrastructure and the classic examples of Redge citiesS are harder to find. Everywhere there have been significant changes in physical accessibility but these have been much more subtle than the traditional models of the spreading city might imply. The same is certainly true of electronic communications: the telephone is not perhaps a good example as this is clearly a highly passive device in terms of delivering services but electronic networks are also developing to add as well as replace routine functions of consumption and production. Like highways, network infrastructure develops in response to the dissemination of the vehicles - computers - which make electronic travel possible, and there are many predictions that global networks such as the Internet will have to be radically overhauled if they are to act to deliver services such as commerce in anything other than an idiosyncratic fashion. In fact, it is much more likely that networks will be assembled at very scales for specific purposes, hence the current drift towards intranets rather than the Internet.

A recent poll in Business Week (August 26 1996) suggests that only around 7 percent of the population are likely to develop serious use of the Internet with the consequent implications that this media will have much less impact on physical service delivery in cities than might be supposed. And that this percentage will rise at a much slower rate than general usage of the net.

**Geographic Information and Scale**

The role of GIS and related technologies in this ferment is also anomalous. GIS enables geographic scientists to compose and synthesize information about the city more effectively. It enables the great streams of digital data which are emerging to be organized. And it enables designers, planners, and policy makers to use such data for more effective decision-making. But like many new information technologies, GIS is being quickly disseminated into highly routine decision-making. Just as Herbert Simon once argued that it was impossible to answer the question how management science changed management because it had and this had in turn changed management science, so it is increasingly difficult to see GIS technologies as standing apart from the very systems that GIS is designed to inform. In short, GIS is being used to study systems which increasingly function using GIS which is part of the general problem that we use computers and data to study systems which are composed of those same computers and data. GIS is thus becoming part of the information infrastructure.

In this context, it seems to me GIS will enable us to say something very significant about the role of scale in urban systems, primarily because it admits the possibility of being scale independent and thus offering an ability to understand the effect of scale at different levels. Of course the role of scale is being affected by the very technologies that we are working with but as I have argued above, this impact is uncertain and hard to disentangle from a myriad of other often correlated factors. In the development of postindustrial society, it is now very clear that local and global events coincide and interrelate in very subtle ways and that this in itself is a consequence of the changing role of scale. For example edge cities are easy enough to understand at the scale of the metropolis but world cities can only be understood globally and can only function using global networks. GIS has the ability to transcend scale.

Perhaps the most illuminating aspects of GIS and scale relate to the most local. With the development of property parcel information systems and address point data, very detailed effects of scale in urban areas can be explored systematically for the first time. Accessibility at the level of streets and city blocks for example, even
within buildings and rooms have rarely been studied to date but it is clear that questions of crime and safety in cities, questions of transition and land values, of segregation and polarization must be explored at these levels. Anything coarser will simply miss the critical issues. In short, GIS is likely to give us an ability to develop theories and policies at much more local scales than we have been able to do effectively hitherto and to relate these to broader scales, thus enabling us to link micro to macro not just as another exercise in spatial aggregation but as a way of showing how physical form merges into social and economic activity for long the domain of human geographers. In my presentation, I will show some example as to what can be done with GIS at these more local scales.

Summary

I use this note simply to point up a series of ideas which doubtless will be widely discussed at the meeting but to also point to the disjunction between using GIS in traditional terms and studying the way GIS is becoming part of the very infrastructure that we choose to study. This seems to me to be the domain we have to chart and one whose limits we have to be clear about from this meeting.

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Automobile Dependence, Gender and Inner-City Residence, and Travel Demand Management

Elizabeth K. Burns

Current empirical work on automobile dependence, gender and inner-city residence, and travel demand management offers insights into this conference’s agenda of spatial technologies, geographic information, and the city. Geographic information systems (GIS), as one spatial technology, are now in common use in numerous urban public agencies to monitor, evaluate, and develop diverse policies and programs. While these GIS efforts have been put in place as an enabling technology, the activities supported by these efforts have tangible connections with travel and communications technologies. These GIS efforts allow monitoring, evaluation, and development of changed urban accessibility. It is now possible to identify intended and unintended consequences for different geographically- and socially-defined urban population groups.

Current urban transportation research addresses these issues in the empirical setting of low-density, automobile dependent cities of the American Southwest. In metropolitan Phoenix and Tucson, Arizona, growth in the labor force and number of daily trips exceeds the rapid population growth. Involuntary mobility describes the actual situation where travel is required between separate land uses. Access to a vehicle, as driver or passenger, is a prerequisite for participation in the labor force. These cities have pressing air quality problems, in large part as a result of vehicle travel, that are being addressed by various transportation system management and travel demand management efforts. Implications of spatial technologies for specific geographically- and socially-defined groups are just now being identified in these cities. Study of employment location of and travel by inner-city, low-income residents complements recent study of commute trip behavior in terms of mode of travel, distance, and time of employed women and men with similar marital and child-raising status.

This set of urban economic, social, and environmental issues is being addressed through spatial monitoring and analysis. These empirical research activities are described below with discussion of their possible extension. These initiatives can lead to wider applications of the geographic information sciences through expanded spatial analysis and modeling for more informed future decision making.

1. Urban accessibility

a. Empirical evidence. Changed urban accessibility merits direct study with originally designed data collection and analysis approaches. At present, however, there are often agency funding constraints. This study is also not always a high priority with key research agencies. There are, however, at least indirect ways to identify some of the widely conjectured changes in urban accessibility brought about by the increasingly widespread use of communication and information technologies. Urban public agencies already collect useful data for their own purposes that can partially identify these impacts.

It is possible to obtain employer and employee survey data collected by urban travel demand management agencies as public records, while recognizing some limitations on the data. Only selected populations may be studied, surveys may not be under the researcher’s control, and there may be required limitations on reporting of individual results. For example, the substitution of actual commute trips by working at home or telecommuting from home or another site is monitored by annual employee surveys conducted at individual private companies as part of metropolitan travel reduction programs whose public purpose is reduction of urban travel for air quality and congestion mitigation benefits. The Maricopa County Regional Trip Reduction Program makes data on metropolitan Phoenix available under these conditions. Knowing whether telecommuting leads to additional non-work trips on telecommute days is not known directly from an annual employee survey, however, and requires other data collection approaches such as daily activity diaries.
b. Urban land use and structure. Ideally, the impact of new spatial technologies should be monitored over time at different scales as precise as individual building and travel facility locations and extending to urban neighborhoods, districts and communities.

An incremental approach involves teasing out these impacts from existing data sources while demonstrating the value of more focused research. Companies that participate in travel demand management programs are identified by Standard Industrial Classification code and have an employee profile identifying occupation, travel behavior and demographic characteristics. These companies annually monitor individual work sites to identify compliance with trip reduction goals such as increased passengers per vehicle or reductions in miles traveled.

Travel behavior and employer policies at individual work sites can be aggregated to provide ongoing evidence of the spatial distribution of adoption of travel substitution in the form of telecommuting, adoption or lack-of-adoption by employees in particular occupations, and employee participation from distinct geographic-and socially-defined groups. Major employers with large single work sites, such as universities, airports, industrial and office parks, increasingly monitor and analyze travel using geographic information systems as part of regulated efforts and for their own marketing and management purposes (Burns, 1994; Burns, 1992).

c. Adaptation of land use and transportation models. Current large-scale land use and transportation models have been in place for the past thirty years and are increasingly questioned for lacking essential characteristics that reflect the substitutive, complementary, or synergistic effects of new spatial technologies. The traditional four-stage transportation model consists of trip generation, trip distribution, mode choice, and network assignment. High priorities for revision include: data on the length and timing of individual trips rather than aggregate link vehicle miles of travel, more accurate estimates of the spatial and temporal distributions of travel, increased data on the characteristics of the vehicle being used for particular trips, and information on freight as well as person travel (NCHRP, 1996). The author serves as a member of the national panel developing immediate, mid-range, and long-range procedures to be recommended for adoption by metropolitan planning agencies as improvements in land use and transportation models.

These improvements can provide more realism in understanding personal travel behavior choices. Travelers typically make decisions by considering time, place, cost, mode, route, in a context of required and discretionary daily activities. The standard four-step process treats these choices sequentially rather than simultaneously and usually without much sensitivity to the household or wider policy context. Indeed, a more regional and multi-scale approach is being considered. Instead of considering air quality and emissions from land use activities as dependent on transportation access, the future approach reverses this sequence. Urban air quality should be addressed first at a regional scale. The spatial and temporal distribution of emissions then results from specific activities and events. Finally, transportation and land use models describe and model current and future spatial growth patterns and accessibility with feedback to urban emissions and regional air quality.

2. Impact on populations

a. Empirical evidence. Large data sets of annual employee travel surveys provide a current resource to understand some impacts of access to new spatial technologies on specific geographically- and socially-defined groups. The following examples illustrate this approach for two groups of continuing interest to geographers and planners: inner-city residents and employed women. Inner-city residents are thought to be disadvantaged by the broad shift of employment from central cities to suburban locations over the past thirty years. This spatial mismatch is especially acute for low-income inner-city residents who are black or Hispanic, with low levels of education. Industrial jobs have left and residents are not qualified for new service and other central city jobs. Using 1995 employee and employer data for inner-city Phoenix, Burns and Gober (1996) identified the percentage of inner-city residents that 181 major inner-city employers hire. Of the 49,000 employees, 14% live in inner-city zip codes. This match was identified using a geographic information systems package, MapInfo, to identify employer locations and to address match employee work and residence locations by zip code.
Above-average levels of inner-city employment were manufacturing/production workers (36%) and skilled crafts and trade workers (18%), while only 7% of the professional/managerial workers live in inner-city zip codes. Inner-city employers with the largest proportion of inner-city workers are those in personal services (53%), agriculture (42%), hotels and other lodging (33%), retail trade (32%). While public administration provides 40% of jobs in this survey, City of Phoenix inner-city employment was just above average (16%), and state employment was only 9%. Industrial categories that employ a relatively small number of inner-city residents are communications and public utilities (5%), finance, insurance, and real estate (7%), transportation and material moving activities (8%), and other professional services, including legal and social services (11%).

This research illustrates some issues on changed conditions of access to employment, use of innovative transportation technologies, and public service delivery. This research is being conducted as part of a joint City of Phoenix, Arizona State University, U.S. Housing and Urban Development Community Outreach Center Partnership. At this time, City of Phoenix and Maricopa County staff are considering sharing the academic analysis of employer and employee data with individual employers whose labor force matches the skills of nearby inner-city residents. The advanced spatial technology in use here is descriptive geographic laborsheds for inner-city employers, while the potential is for detailed policy efforts with individual employers with specific labor needs. This approach is politically sensitive, however. Both City and County staff are cautious about approaching private employers who now hire below-average percentages of inner-city residents. This approach, however, is considered the most effective for both City job training efforts and County trip reduction activities.

Employed women provide a second case study. The lower average earnings of women in all occupational groups has led to a traditional interpretation of women's travel as constrained by income. Women, on the whole, remain responsible for household errands and child- and elder-care. Therefore, women are expected to live closer to home than men, to use travel modes of low cost (bus), and to be more willing to work at home (telecommute). Recent findings by Rosenbloom and Burns (1995) emphasize that employed women in metropolitan Phoenix and Tucson are more dependent on driving to work than men of similar occupational, marital and family status. County surveys included a demographic questionnaire for 1990 and 1991 at Arizona State University and the University of Arizona with a minimum of 2,500 respondents on each campus. Women are more likely than men to drive alone or carpool, equally likely to use the bus, and less likely to walk, bike or use another mode, including telecommuting. Although unmarried people generally are more likely to drive alone than those who are married, women are always more likely to drive alone to work regardless of marital status. Having children tends to increase the likelihood that both men and women will drive alone. Employed women with young children (0 to 12 years) are the most likely to drive alone. This mode choice holds true even when employed women and men of similar household income are compared (Rosenbloom and Burns, 1993).

This research illustrates other insights into changed access to employment, use of advanced spatial technologies to substitute communication for travel, and issues of who actually conducts daily activities. This research shows that working women retain responsibilities for obtaining household services, child care, and emergencies. This demographic and domestic context for travel decisions means that the availability of new spatial technologies, such as telecommuting, is not enough to ensure their adoption by all potential participants. Women drive to work so that they can conduct before- and after-work and mid-day errands and have a car available for child-care emergencies. Working women in metropolitan Phoenix and Tucson were less responsive than men to travel demand measures initiated from 1990 to 1991.

3. Geographic information.

This research suggests some ways to capture changing notions of distance and access. Subjective concepts of distance and access play a role in creating barriers based on perceptions, such as an inner-city employer's unwillingness to hire inner-city residents. Inner-city residents could benefit from a GIS application matching employment locations by schedule and occupation, residential origins of current and potential employees, and current and needed transit routes.
Needed data sets will be collected by local, regional, state, and federal public agencies for their own purposes and supplemented by additional, focused surveys for specific purposes (demographic variables, specific occupational types of employers). The disadvantage of not having control over data collection and preparation is offset for academic researchers by the benefit of agency's expenditures for data collection and preparation.

While there is great potential to integrate disparate travel reduction data sets and other sources of spatial data, not all agencies are ready to share data or to adopt common standards. Within the field of urban transportation in one metropolitan area, my experience suggests that it is difficult to get City and County agencies to recognize the mutual benefit of sharing data which will serve multiple public purposes. It is important to note, however, that academic researchers can be the catalyst for identifying these potential benefits. These benefits are of significant interest to national funding agencies.

Current uses of GIS in urban planning and transportation, policy making and management are just starting to address the full implications of urban access. Full use is not being made of the data now being collected. Travel reduction agencies have a wealth of information on employee residential location, gender, occupation, schedule, and travel behavior. Traditional modeling still relies on aggregate flow analysis, however. Non-profit groups, such as community and environmental activists in inner-city neighborhoods, and private employers are likely allies in developing and sustaining geographic information efforts when these efforts are linked to their own goals.

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Biographical Sketch

Elizabeth K. Burns is Professor of Geography and Director of the Center for Advanced Transportation Systems Research at Arizona State University. She received her Ph.D. in Geography from the University of California, Berkeley, in 1974 and is a member of the American Institute of Certified Planners. Her research interests include urban travel demand, growth management, and urban applications of geographic information systems. She directs the 1995-1997 Arizona State University Provostís Multidisciplinary Initiative on iGeographic Information Systems: The Application of Computer Technology in the Southwestern Environment.
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Harrisburg Internet Project Proposal

Barry Cross
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Introduction

Recent work with the City of Harrisburg has resulted in a proposal for the development of the Harrisburg Internet Project which will provide access to technology, including the Internet and geographic information systems (GIS), to the citizens of the city who are currently isolated from such technologies. The Harrisburg Internet Project will include direct interaction with the target population; and with the planned surveys, there is the potential to measure the impact of the Project on the inner city community. This initiative with its use of Internet and GIS technology, and the focus of the project on a City environment seem well suited to the upcoming conference. If implemented, the project will serve as a real world example which could reinforce or shed new light on related research.

Project Background

It is clear from the demographic profiles and statistics that a high percentage of the City of Harrisburg citizens are isolated from access to computing technologies and; therefore; the increasing amount of information that is available through the National Information Infrastructure. It is imperative that the City move to reduce these disparities in our community in order to meet our objective of an integrated urban environment. By implementing the proposed system, the under served citizens of Harrisburg will be given access to the World Wide Web and basic computing resources including electronic mail, word processing and spreadsheet applications. This infrastructure will be augmented with a marketing and training program to ensure the success of the program. Measurable results will take the form of a more computer literate population, reduced requests for typical information at City Government Offices which will allow more time to be spent in more valuable activities, and ultimately a more informed public which will positively reinforce government services.

The Harrisburg Internet Project (HIP) is designed to provide access to basic computer resources including connectivity to the National Information Infrastructure to the citizens of Harrisburg who are presently isolated from such technology due to classic economic and social factors. In addition to providing access to the infrastructure itself, the project will also include the creation of a WWW home page for the City of Harrisburg whose content will primarily focus on information that will benefit the targeted group of citizens but will also be increasingly useful to the public at large. The ‘focus’ content will include information from City Departments and Agencies and Non-Profit organizations whose goal is to address the problems of the target group. Eventually the site will provide access to the City’s Geographic Information System as well.

The technological solution will include 10 ’Public Access Sites’ distributed throughout the City of Harrisburg equipped with a personal computer, word processing, spreadsheet, electronic mail applications and Internet access through the HIP server. The most difficult aspect of the proposed project is to truly overcome the barriers that currently isolate the target group from technology in an often times discouraging environment.

Support for End Users

From discussing the end user characteristics with non-profit representatives and several citizens fitting the profile of our target population it has been determined that a multifaceted training approach will be needed. This approach will include the publication of a the ’HIP Users’ Guide’ which will list the basic knowledge needed to work an Internet Browser, general information about HIP and how it can be used for retrieving commonly requested information, and will also include generic information on using the WWW to access not so
commonly requested information from any site in the world. Additionally, it has been determined that the most effective way of training end users is to have a knowledgeable person at each of the 'Public Access Sites' that will be able to assist first time users of the system at specific times each week. The non-profit personnel will contribute to the project success not only in terms of a resource for Public Access Site assistance but the non-profit organizations like the various City Government Departments will be key to the development of pertinent information content accessible from the HIP site.

In order to insure accessibility to the 'Public Access Sites' the program will make use of space that exist in non-profit offices and other public sites throughout the City where the target population have easy access, and currently frequent. These sites will be public places which will insure security of the equipment. Appropriate steps will also be taken to receive local and regional television and newspaper coverage of the project which will reinforce and increase the use of the system.

**Project Evaluation and Conclusion**

In order to evaluate the effectiveness of the project, a survey will be taken prior to system implementation to assess the awareness of Internet technology and how it can be used to access information. A second survey will be conducted approximately six months after the system is operational to determine how that awareness has changed. Perhaps it is these surveys and their evaluation which would benefit other research efforts which address technology and the inner city.

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**Brief Biography for Barry Cross**

Barry Cross is a GIS Analyst for Intergraph Corporation in King of Prussia, PA. Prior to joining Intergraph in 1991, Mr. Cross worked for AT&T Corporation as a GIS Consultant to local and county governments. Mr. Cross received a Master’s Degree in Geography and GIS from the University of Connecticut in 1989.

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This proposal was written in cooperation with Robert Marsters of the City of Harrsiburg, PA. Robert Marsters is a GIS Analyst for the City of Harrisburg, PA and holds a Masters Degree in Geography and GIS from the University of Buffalo.

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Innovations in Land Use-Transportation Models: Opportunities for Spatial Analysis

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Abstract

Land use-transportation models are again attracting the attention of regional planners after many years of being relegated to specialized practice. In the US, this renewed attention to modeling has been generated by the inability of conventional models to adequately address urban design initiatives, questions about the environmental and spatial consequences of infrastructure investments, pricing policies, and a host of demand management proposals. Legal mandates that require quantification of expected impacts and provide forums for public review and debate of transportation decisions have also provided a push for better models and data. Modeling improvements, building upon research advances made over the past two decades but only partially implemented in practice, include the reformulation of the old four-step models into six or seven step, nested models of household and individual mobility and access decisions. Further transformation to microsimulation of demand using sample enumeration techniques and to activity analysis rather than travel analysis is occurring at the state of the art.

The model development initiatives are supported by innovations in household survey research. Approaches combining stated preference (SP) and revealed preference (RP) questions with multi-day household activity diaries are being implemented in several metropolitan regions of the US. Several of these surveys are panels and the intent is to re-survey members on six month to one year intervals. In some applications, focus group research is used both to design the survey instruments and to explore certain questions in additional depth before and after the surveys. In addition- the RP waves are to be used to refine and scale SP responses to further improve data quality.

Linkages with GIS databases and technologies are in use in most of the metropolitan areas, although GIS is not fully integrated with the advanced models both because of ongoing data problems and because available GIS programs are excessively slow for the advanced modeling applications proposed (e.g., activity sampling and on-the-fly calculation of travel times and costs for samples of 10,000 or more individuals.) GIS is available, however, to support input data preparations and output functions including mapping, with resolution to the parcel level in some cases.

The advanced modeling methods and the data collection efforts to support them offer opportunities to conduct research on a variety of issues of interest to information technology researchers. In particular, it is now possible to do much more detailed and extensive analyses of equity and distribution of impacts for both current conditions and future policies. Questions such as the prevalence of telecommuting as a part-time as well as a usual behavior, the effects of telecommuting on other in-home and out-of-home activities (participation and scheduling), and a variety of questions on spatial and temporal distribution of activities can be addressed with the surveys as they are currently formulated. Further, because the surveys are intended to be panels, it should be possible to add new questions from time to time, permitting e.g. the examination of personal holdings and use of electronic equipment (computers, cell phones, email, etc.) as well as exploration of attitudes about information technologies and their effects. Modeling capabilities should support both scenario testing and forecasting.

The paper presents examples of the kinds of analysis made possible by new models.
Neotraditional Design: Resisting the Decentralizing Forces of New Spatial Technologies

Kenneth J. Dueker

Introduction

There is a disparity between the urban planner’s vision of compact urban development and the reality of long-term urban decentralization trends. The conventional wisdom is developing in the planning profession, based on the New Urbanism movement that is a near obsession with the specter of "urban sprawl," and leads to land use and transportation plans that attempt to reverse current trends and consumer preferences. This often leads to a self selection of evidence to claim success. For instance, as will be illustrated Portland’s success story with Light Rail Transit and its Urban Growth Boundary is not consistent with actual data on mode share change, multiple-family housing patterns in relation to LRT, and distribution of new housing. Yet, planner’s tend to dismiss the data as what is wrong and what needs to be changed with more effort.

Growing auto ownership and declining transit ridership resulting from increases in trip making for non-work purposes tends to swamp increases in traffic carrying capacity. This leads planners to propose policies to tolerate congestion and to calm traffic in an effort to increase densities and a revitalization of inner cities. Meanwhile, the data show decentralizing forces seem to continue unabated. Given the market segmentation of consumer preferences for lifestyle both outcomes are occurring, but planners seem to be wishing the back to the city movement is the majority while the evidence indicates it is a small market segment.

The danger is that this movement is based on the neotraditional design concept, which is predicated on the long discredited concept of "environmental determinism", wherein design shapes behavior.

Neotraditional Design Concept and Issues

The neotraditional design or New Urbanism paradigm (Duany and Plater-Zyberk,1991; Calthorpe, 1993) is a new manifestation of environmental determinism, wherein the urban designer’s role is to social engineer, to effect (social) change through urban design. (Ellin, p 134). Ellin (1995, p. 137 critiques this "...search for urbanity (as) misguided when it ignores the contemporary context altogether or falls into the trap of environmental determinism presuming that traditional urban forms will engender traditional urban lifestyles.

Audirac and Shermyen (1994) characterize the new urbanism as a postmodern reconstruction of American suburbia that goes by various names: pedestrian pockets on the West Coast, urban villages in the Northeast, and neotraditional neighborhoods in Florida. They are similar with pedestrian friendly streets and town cores of mixed uses. The transit-oriented development variation focuses around transit stations and mixed use developments.

One aspect of the transit-oriented development concept has been addressed by transportation planners is to determine whether neotraditional neighborhoods generate less traffic, have lower SOV mode shares and lead to better job housing balance. By examination of existing neotraditional development patterns in older central cities the answer is yes, but translating that conclusion to new transit-oriented developments in suburban locations is problematic.

The transit-oriented design issue has two important dimensions. One is whether we have the ability to reshape the existing development patterns and density. Will people be willing consumers of a new product? The second aspect is whether the new form will produce fewer auto trips and thus more transit and non-vehicular trips. What will happen to those who are priced out of single family housing? Will they pay a higher price for higher density, or will they move out to exurbia or nearby small towns and commute farther? Will those that stay shift from driving alone to ridesharing or transit? Although there is evidence that existing transit-oriented development patterns, usually developments in older areas well served by transit, have higher transit ridership rates than newer auto-oriented areas, it should not be argued that new transit-oriented developments will have as large an impact as these comparisons would suggest. Will people moving to new transit-oriented developments be former auto-oriented residents who will change their behavior or will it attract transit-oriented residents from
older, but similar developments who will bring their transit behavior with them?

Recent research by Genevieve Giuliano finds a weakening transportation-land use connection. Her analysis of the Portland’s LUTRAQ study is that "land use policies appear to have little impact on travel outcomes; most of the observed change is due to the TDM (Transportation Demand Management) policies, rather than to the land use and transit policies. Without TDM, travel impacts of the LUTRAQ alternative are minor." (Access, Spring 1995, p. 8)

Giuliano concludes that "scholars view transportation as an ineffective means for shaping urban form for three reasons:

- the transportation system in most U.S. metropolitan areas is highly developed, and therefore the relative impact of even major investments will be minor.
- the built environment has a very long life; most structures survive 50 years or more. Even in rapidly growing metropolitan areas, the vast proportion of buildings that will exist 10 or 20 years from now are already built.
- transportation is of declining importance in the locational decisions of households and firms. Transport costs make up a relatively small proportion of household expenditures, and increasingly flexible work arrangements (including telecommuting) are likely to make access to workplaces even less important in the future." (pp. 8-9)

Giuliano concludes that "if the aim is to reduce environmental damage generated by automobiles, the effective remedy is to directly price and regulate autos and their use, not land use. If the aim is to reduce metropolitan spatial segmentation, the effective remedy is to expand the range of housing and employment choices, not travel choices." (p. 11)

Giuliano’s recommendations will be difficult for Oregon planners to accept, as many subscribe fully to the doctrinaire belief manifested by a resurgence of environmental determinism characterized by neo-traditional design, called "new urbanism". William Fulton challenges the extreme New Urbanism planners to stay in touch with today’s world, and not "believe that ideal communities miraculously spring forth, fully formed, from weekend design charettes..... and [they] don’t want any competing ideas to see the light of day." ("Viewpoint", Planning, July 1995 p. 50)

Gordon and Richardson have argued extensively the proponents of compact development cannot support their sweeping claims of the costs of sprawl, and that continued improvements in transportation and communications will obviate the need for concentrated settlement patterns.

Planner’s resurrection of environmental determinism is inconsistent with continued decentralization trends. For example, Tietz (1996) sees Barton and Silverman (1989) critique of gated communities as an extension of suburban fragmentation as a contradiction to ever-greater global communications and electronic interconnection. Telecommunicatons and transportation technologies are leading to greater dispersion potential for population. Long distance commuting, telecommuting, and exurban living are major decentralizing forces that fly in the face of urban containment and densification policies that planners are using to combat urban sprawl. Urban sprawl is a specter that does not warrant the attention given our inability to identify and measure the costs of sprawl.

ITS (Intelligent Transportation Systems) is a spatial technology that promises both smart cars and smart highways, that will maintain supremacy of the auto, and in conjunction with telecommunications will enable long, but less frequent commutes and more affluent communities, insulated by low density and far removed from inner city decay, thereby increasing disparities in our society. Boyer, in CyberCities ( ) argues that the proliferation of computers and telecommunications are destroying cities, people become less interested in the physical city and more interested in what’s on their screen. She links cyberspace and sprawl.

Graham and Marvin ( ) paint a different and more modest picture of the impact of telecommunications on the city. They argue that urban planning is blind to telecommuncations issues. They conclude that ":what is emerging is a "more totally urbanized" world, where rural spaces and lifestyles are being drawn into an urban realm", and draw our attention to the impact of earlier technologies on the city.

Portland is an example of an area that has embrace the neotraditional planning concept, but the data do not support the belief. Whereas in most large metropolitan areas there is unending debate concerning land use
and transportation, Portland seemingly has its act together with apparent consensus on using investment in light rail transit and a tightly drawn urban growth boundary to combat urban sprawl. Perhaps, it is the timely to examine this remarkable and unique experiment to reverse a long-standing trend of urban decentralization. Portland politicians and planners have embraced the notion that Portland ought not be like other cities, LA and Seattle in particular. Is this is a decision that planners and politician are capable of delivering? Is it a decision that the public will embrace by changing their mode of travel and type and density of housing?

As an urban transportation researcher, I find this to be a fascinating real-world experiment to monitor and analyze. However, I am concerned that Portland area residents have not knowingly consented to be willing research subjects in a radical experiment. This experiment in reversing urban decentralizing trends is being done without substantial discussion and debate of downside risks. The planning process and the media coverage of it have not provided sufficient careful examination. Belated attempts in legislative hearings concerning state funding for light rail to examine the premises upon which the light rail investment is based by expert witnesses was largely dismissed by proponents as opinions of outsiders who don't understand Oregon.

What if the opponents are right that light rail is not cost effective, and what if Oregon is not different? Comparing 1980 and 1990 census data for Portland, Los Angeles, and Seattle indicate that we are not really different. All three urban areas declined in the share of commuters who use transit. In fact, Portland lost by a greater amount than the other two cities.

A report by the U.S. Department of Transportation, New Perspectives in Commuting, is based on early data from the 1990 decennial census. Commuting behavior has not responded to our current transportation and land use plans. "The Portland area trends from 1980 to 1990...are a model of the national trend. In Multnomah County, carpooling dropped from 17.7 percent to 12.9 percent, and transit use declined from 13.1 percent to 9.6 percent. Outlying counties showed similar patterns. Transit declines in the City of Portland itself were particularly marked with shares dropping from 15.9 percent to 10.9 percent. Only working at home and driving alone showed significant gains in shares. ... Portland was one of the cities in which driving alone increased more than the increase in workers."

The same report also shows that Seattle and Los Angeles gained transit ridership among commuters while Portland lost. This is partly attributable to faster growth rates in Seattle and Los Angeles during that period, but the loss in share carried by transit from 1980 to 1990 was higher in Portland than in LA and Seattle. Portland’s share of work trips by transit fell from 8.4% in 1980 to 5.3% in 1990, while LA’s share fell from 6.4% to 5.7%, and Seattle’s share fell from 10.7% to 7.8%. These data should serve to alert Portland area residents to be less smug that we are on the right path, and Seattle and LA are going to wallow in congestion and sprawl.

Conclusions

The neotraditional design concept turns a deaf ear to two important literatures, one that discredits physical determinism and another that developed environmental design from the excesses of gridiron street pattern designs. The lessons of Ian McHarg’s Design with Nature, Kevin Lynch’s Site Planning, and William Whyte’s cluster design concept, ought not to be ignored by a nostalgic return to the gridiron street pattern. Sensitive environmental design would be compromised by a rigid return to the gridiron pattern.

The neotraditional design concept is a nostalgic view of family, neighboring, travel and communications in a world that no longer exists. The family interacting with neighbors via the front porch and walking to the corner store, school, or work is no longer the norm. Personal transportation in the form of the auto has broadened a person’s action space and options, so that opportunities within walking distance are not competitive or satisfying. At the housing unit level, the technologies of air conditioning and television have made the front porch obsolete. On the other hand, this cocooning of housing makes higher density housing more acceptable, exterior noise is masked.

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Urban Dynamic Issues

Urban issues, related to the dynamics of social, environmental, and economic conditions within the greater Baltimore area, continue to challenge the public and private political and administrative agents attempting to service the disadvantaged and ameliorate symptoms of poverty. One challenge facing researchers and community-oriented services agencies regarding urban conditions lies in defining which variables to study or monitor as a basis for measuring and mapping urban humanity’s elements of complexity. Resources, derived from federal, state, municipal, and private organizations to assist with urban population stability issues, must be efficiently applied under current trends of diminishing societal resources at regional and national scales. Populations in acute need of assistance, are significantly affected by the access to services and service agents’ ability to actively plan and operate among spatial realities of locations, transportation networks, and support sites. The critical nature of the impact of these urban geographic factors on the ability to meet the immediate demands for providing housing, health care, food, safety, and other social programs cannot be overstated. Longer-range issues of environmental health, education, and economic promise for the disadvantaged can also be linked to the imperatives of urban geography. Data and systems which facilitate the manipulation of baseline geographic information can be viewed as requisite components for any strategy to meet the demands affecting service and accessibility for major population segments within any urban setting. Baltimore’s regional urban environment contains all elements of the spatial interactions and accessibility topic, thereby providing an opportune backdrop for communicating the status and promise of spatial technologies for the urban human condition.

Servicing Challenges for Urban Disadvantaged

Many challenges exist regarding the provision of services and access to urban disadvantaged portions of the populace. In Baltimore, the use of spatial technologies to meet some of these challenges has met with various degrees of success by a wide cross section of agencies. Common applications for many of these agencies include categories under geographic handling of street address locations, delivery and routing, transportation access, and service location siting. In addition, the capacity to maintain customer/client files linked to geography remains a common theme. Analytical requirements for assessing demographic trends, ratios, and related social indices represents an additional recurrent capability desired under most community service oriented programs. These common features of spatial technology support requirements exist among various agency charters, however, the commonality provides the ability to investigate data needs, analytical procedures, and technical capacity within a comparative framework. This urban analysis framework can be instrumental for further analysis on potential improvement capacity of spatial technologies to meet fundamental demands of community services related to disadvantaged and poverty program administration. Research by UMBC is directed at examining the potential of regional spatial databases, along with geographic information systems, to support a variety of community service programs. These programs include the Shriver Foundation, Meals on Wheels, Baltimore Neighborhoods, Inc., Revitalizing Baltimore, Inc., Urban Resources Initiative, Save Our Streams, Medicaid, and the Urban History Project. These programs cover the gamut from food to health, from environment to volunteer mentoring, and from urban restoration to urban forestry regeneration. Their common theme resides in the goal of improving the quality of life for the lower strata of society and the need for spatial analytical tools to assist with their goals.

Evolving Potential Solutions

An evolving trend, well demonstrated in the Baltimore region, is in the creation and sharing of spatial data
infrastructures. Federal support of this trend can be identified through the National Spatial Data Infrastructure (NSDI) initiative, directed under Executive Order 12906 and being guided in part by the Federal Geographic Data Committee’s activities. NSDI objectives are fostering the development of digital spatial data resources throughout federal and state agencies making available to the public vast quantities of quality digital data. The ability to bridge the spatial data resources gap is a topic being addressed by a new research initiative known as the baltimore washington regional collaboratory. The baltimore-washington regional collaboratory consists of a series of partnership research initiatives supporting investigations into land use spatial dynamics and human impacts for social, economic, and environmental studies. These projects examine the use of spatial data from the NSDI for meaningful scientific inquiry, land use management, and policy or ecosystem analysis. A challenge to the collaboratory is the coordination of the data collection, methodologies, and research results. This challenge was addressed by sharing data in a distributed fashion through the internet and regular communication through workshops and conference calls. The baltimore-washington collaboratory effort is critical to the NSDI concept and implementation as this project encourages and facilitates inter-agency collaboration and the sharing of myriad types of data. The collaboratory includes in its scope the widest data user community possible, including universities, federal, state, and local government, as well as the non-traditional GIS/geospatial data community (e.g. Historians, neighborhood coalitions). The collaboratory will provide a data documentation schema that is "user friendly", which is the first and most basic step towards data sharing and the implementation of NSDI concepts and for the integration of disparate data sets among interdisciplinary scientists, resource managers, planners, and educators. A compelling argument can be made with regards to the need to improve the connections of a wide base of researchers and data creators to the NSDI. This data can provide a framework or foundation for many environmental, social, and economic enterprises in the urban setting. Initially these data provide a framework of roads, political boundaries, land use, hydrology, and census information at effective scales not larger than 1:24,000. This scale has proven valuable for most applications above the neighborhood or block level. However, increased levels of spatial data, and data categories, will be needed to provide neighborhood organizations the spatial context for managing their range of pressing concerns, probably down to the individual housing unit level.

The Baltimore-Washington Regional Collaboratory is addressing some of the major elements needed to provide spatial technologies to the urban setting. The Collaboratory began as a cooperative research program with UMBC and the U.S. Geological Survey to study the human impacts on land transformation processes, specifically that of urbanization, over the past couple hundred years. This study incorporates the gathering, processing, and management of multiple spatial data sets for the greater Baltimore-Washington metropolitan areas. Federal collaboration on this project has grown to include the National Aeronautics and Space Administration, the Bureau of Census, and the Smithsonian Institute, with other agencies in communication for future involvement such as the U.S. Environmental Protection Agency, the Housing and Urban Development Agency, and the National Biological Service. Many state agencies are involved with the Collaboratory through Memorandums of Agreement, including Maryland Department of the Environment, Maryland Department of Natural Resources, and Maryland Historic Trust. At the local level, counties and municipalities are participating in the Collaboratory with the express interest of advancing the state-of-the-practice regarding the application of spatial data and technology to improved land management, environmental protection, planning, and social services. Various police and emergency service organizations are providing important infrastructure components to apply spatial technology on a real-time basis for safety and emergency response. The Collaboratory provides an atmosphere fostering data sharing and improved understanding of the role that spatial technology can play among urban service organizations.

Another important function of the Baltimore-Washington Regional Collaboratory is in providing the spatial data framework and expert resources for validation, calibration, and testing geospatial application models related to the human ecological urban studies. Interest exists among a loose coalition of university, private, and government organizations regarding the identification and parameterization of factors along an urban-rural gradient for interdisciplinary modeling. Another coalition working with the Collaboratory is interested in defining methods to empower disadvantaged groups with the technology required to secure and manage community block grants for improved handicapped access to community services. These examples demonstrate
a sampling of the Collaboratory’s potential utility to serve as an incubator, or testing facility, for groups seeking spatial technology solutions that might not otherwise have access to sufficient resources to determine the efficacy of these spatial tools. The involvement of local groups has a significant impact on the extension of the Collaboratory resources. These local groups bring to the table valuable data resources that would prove extremely costly to garner through traditional data collection methods. In the aggregate, these locally contributed data resources may prove instrumental in fulfilling many of the long range objectives for urban revitalization and sustainable development.

Implications for Future Trends in Urban Studies

A pragmatic result of the Baltimore-Washington Regional Collaboratory is the collection of functional data and processing requirements for a litany of urban related applications. This style of interactive relationships among multiple disciplined groups tends to foster the identification of major research areas under the heading of spatial technology. Research categories range from methods to interlink process, flow, network, and dynamic feedback models to object-oriented spatial query and analysis structures. Distributed storage and access of spatial data via electronic networks and access to suites of spatial statistical algorithms represent additional research and development arenas, in addition to the list of fundamental research questions attendant to theories of the edge city, corridor growth, and urban decay. The rich urban research environment, afforded through the Collaboratory’s interacting partners using shared digital spatial data resources, can be viewed as a prototype for future urban research programs where theory, policy, research, and practical solutions are juxtaposed within a geographic context. This is a critical feature if academic and government research results are to reach any potential for operational practice. The combination of grassroots initiatives within the organized constructs of expertise in theoretical understanding of urban structures may yield valuable products, tools, and new theories for improving the urban condition in this country. The advent of spatial technologies’s capacity for measuring, mapping, and modeling provides the catalyst for these potential future trends.

Biographical Sketch - Timothy W. Foresman

Dr. Tim Foresman has over 19 years of professional experience in the fields of remote sensing and geographic information system applied to environmental protection and urban/rural land use management. He received his doctorate in geography at the University of California at Santa Barbara. Tim has been a project scientist for the Department of Defense and the U.S. EPA where he brought the technologies of remote sensing and GIS to a variety of environmental protection programs including Superfund. His experience includes private consulting and county government use of spatial analysis tools. He currently serves as Assistant Professor of Geography and is the director of the Spatial Analysis Laboratory at the University of Maryland Baltimore County. Dr. Foresman is Principle Investigator of the NCGIA and NASA funded Remote Sensing Core Curriculum program and the Baltimore-Washington Regional Collaboratory project.

Short Vitae - Timothy W. Foresman

Present Position:
Assistant Professor of Geography; Director of Spatial Analysis Laboratory, University of Maryland Baltimore County

Research Area:
Integration of remote sensing and geographic information systems.

Experience:
Tools for land use management. Design of large scale spatial database systems. Environmental model linkage to spatial data systems.

Education:
1987 Doctor of Philosophy in Geography, University of California at Santa Barbara, Santa Barbara, California
1981 Master’s of Science in Environmental Engineering, University of Southern California, Los Angeles, CA
1978 Master’s of Science in Ecology, San Diego State University, San Diego, California
1974 Bachelor’s of Science in Biology, San Diego State University, San Diego, California

Positions Held:
1988-1991 GIS Manager, Clark County, Las Vegas, Nevada
1987-1988 Environmental Consultant, Lagunitas, California
1986-1987 Manager, Remote Sensing/GIS, SAI, Inc. San Rafael, California
1984-1986 Environmental Scientist, US EPA, Las Vegas, Nevada

Professional of Science, Societies:
American Association for the Advancement of Science, American Society of Photogrammetry and Remote Sensing, AM/FM International, Association of American Geographers, Ecological Society of America, Sigma Xi, Urban Regional Information Systems Association

Special Honors and NASA-ASEE Summer Awards:
US. Naval Engineering Fellowship (1982); Faculty Fellowship (1993, 1994); Who’s Who in American Engineers and Scientists (1992); Registered Ecologist (1980)

Special Experience:
Dr. Foresman has been a leading researcher on the application of remote sensing and GIS technologies towards environmental and land use management topics. He was the principal investigator for both the US Navy and the US EPA research programs focused on the design and implementation of spatial information systems for land use management and hazardous waste management (Superfund). He currently heads the UMBC Spatial Analysis Laboratory, and is principal investigator for NASA sponsored grant on Remote Sensing Core Curriculum and a long-term NASA research grant for global ecosystems and EOS. He serves on the executive committee for the NSF funded NCGIA #15 Multiple Roles for GIS in U.S. Global Change Research.

Key Publications:


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To date, most attention and compliance to the ADA mandates for equal access to transportation has been focused on the non-ambulatory/wheelchair bound traveler. These modification costs have been tremendous. Buses and trains have had to be retrofitted or new equipment purchased to provide wheelchair lifts and designated seating areas. Much transit infrastructure has been totally rebuilt to allow for elevators to bypass stairs, level access boarding and other costly structural modifications. Not so subtle grumbling is heard when few wheelchair users are seen in these facilities or on the expensive retrofitted buses. The blind and visually impaired in this country represent a significantly large group of disabled persons (almost three times the number of wheelchair users) who also need help with transportation modifications. The good news, uncovered in the empirical analysis resulting from our survey, is that their needs do not seem to require anywhere near the massive financial outlays required by the adaptations for wheelchair users. Traveling for visually impaired people means moving through a world lacking many or all of the visual cues that sighted travelers, and many transit providers, take for granted. The absence of visual cues such as bus stop signs, bus numbers, bus schedules, and street signs are the main barriers to equal access to transportation reported in this study. This group’s main need is simply more and better INFORMATION. Thus:

1. The single most important characteristic of public transit use for blind and vision impaired people is not related to hardware improvement but rather to improving access to information.

2. The type of information most needed consists of:
   (a) Brailled or large print timetables and schedules.
   (b) Larger signs on transit vehicles to identify their routes.
   (c) Information at transit stops regarding whether or not a vehicle has just passed and wait time for next vehicle.
   (d) Clearer PA systems in terminals and on board vehicles.
   (e) Announcements of stops - either mechanical or verbal.
   (f) Auditory messages and signals at lights when change of vehicle or route necessitates crossing the street.
   (g) Talking signs on transit vehicles and in terminals.
   (h) Joint auditory/tactile information in terminals (e.g., talking tactual maps).
   (i) Transit HOT LINES with human operators, not touch-tone access to pre-recorded messages.

3. Survey results indicate that improving information access should relieve many of the frustrations blind and vision impaired people experience when having to use public transit.

4. Auditory messages are needed to complement the abundance of visual messages currently available to sighted travelers.

5. For relatively little outlay, it may be possible to improve the attractiveness of public transit for this group.

Our respondents indicated that they needed more information about services for disabled travelers, that transit information was not always easy to obtain and that it was not always easy to understand and use. Some of these needs can be addressed simply with better enforcement of existing procedures. Our respondents heaped praise on the local bus drivers for their assistance with their required stops, but a common theme was that bus stops and streets were not always announced, leading to missed stops and confusion. Also mentioned was the poor quality of announcements at the hub terminal. Both of these concerns could be addressed with stricter enforcement, or if needed, a taped announcement, either manual or automatic. Another problem that is easily addressed is that seats reserved for disabled, located near the door and the driver, were not always kept available.
for their intended patrons. Again stricter enforcement of existing rules would alleviate this problem. Our blind and visually impaired travelers also rated the telephone hotline, with human operators, as very valuable. Some travelers, however, were not aware of this service. When asked to rate difficulties when using transit the problems were not with entering or exiting, paying the fare or other design issues. The most difficulty was lack of information issues like knowing which bus to enter, knowing their location on a moving bus and dealing with transfers and crossing the street. More easily provided information was shown by their desire for timetables in suitable format, large print or Braille, available onboard.

The few technological helps they desired are certainly not as costly as infrastructure or equipment retrofitting. They showed a preference for auditory prompts at terminals and bus stops giving bus numbers and times of arrival of the next bus. Given the inability of many in the general public to read or understand transit schedules, these investments in auditory information systems would likely increase ridership in the total population. High preference was also shown for "talking signs," identifying output from a bus or sign that is transmitted to a handheld auditory device. They also indicated concern when crossing streets and therefore requested auditory traffic signals. These requests are the only technological aid requested that would be used only by the visually impaired.

In this paper we discuss how GIS can help solve some of these problems. In particular, we examine how GIS might be used to simplify schedules, to find where vehicles are currently located, to help plan new routes, to help disabled people find home locations near transport routes, and so on. We also explore the possible use of different visualization methods and user interfaces.

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**Brief Biographical Sketch:**

Reginald G. Golledge is a Professor of Geography at the University of California, Santa Barbara. His interests include spatial cognition, the acquisition and use of spatial knowledge across the life-span, cognitive mapping, individual decision-making, household activity patterns, and gender issues in spatial cognition. Legally blind, some of his current research includes: comparison of spatial abilities of blind and sighted persons; development of a Personal Guidance System (PGS) for blind travelers; disposable and tactual strip maps for blind travelers; evaluation of auditory / tactual information systems as travel planning aids; and travel needs of the non-driving disabled.

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Modeling Third Wave (Virtual) Accessibility

Michael Gould

This paper discusses ideas on past, present and possible future ways to model accessibility using geographic information technologies. Although accessibility modeling is traditionally associated with shortest path (transit) calculations, we have used it for urban and regional planning purposes to address not so much the routes as the population or area served (or marginalized) by possible routes. Third Wave phenomena such as telecommuting and teleshopping are changing the way we view and model urban accessibility. Primary interest rests on developing and mapping new indices to represent the concept of virtual accessibility to economic activity centers.

Accessibility

The study of accessibility began in the 1850s (Carey 1858-9) and was popularized during the quantitative revolution a century later, beginning with economists like Stewart, Zipf and Huff. Most early attempts to represent spatial opportunity (of cities, individual shoppers, etc.) were based on aggregate accessibility and were purely topological: nodal connectivity (after Shimbel 1953), alpha and beta indices (Kansky 1963) and general use of connectivity (O-D) matrices without any sort of spatial technologies including cartography. More complex, geographic accessibility models then went beyond topology to consider along-network distances, weighted links and nodes to simulate attraction, intervening opportunity, etc., resulting in a variety of useful disaggregate accessibility indicators or measures of how easily people get the services they need.

One example of such a geographic accessibility indicator (GAI) was developed for a study of transport accessibility in Spain, sponsored by the Ministry of Public Works and Transport (Gutiérrez, García, Gould and Monzón 1993). The GAI captures the notion of infrastructure quality but moreso the geographic centrality of each origin node (i), so that large cities located near the centre of a region receive large accessibility values while peripheral ones (of the same size) receive lower values. Given a point pattern (450 populated places in our national study; at an urban scale they might be shoppers, school children, medical patients, etc.), we calculate the overall opportunity of each point, as follows:

\[
GAI_i = \frac{\sum_{j=1}^{n} (RI_{ij} \times ICEA_j)}{\sum_{j=1}^{n} ICEA_j}
\]

where

RI is the real impedance via the network, between nodes i and j, and ICEA is the Income (or attraction) of the destination Center of Economic Activity (j).

The GAI is scale independent, and was also applied to the Metropolitan Madrid street network (see map 4, by Gómez) to visualize accessibility taking into consideration each of the M-30, M-40 and future M-50 orbitals. Another Indicator of Accessibility by Infrastructure (IAI), focuses primarily on the quality of the transport network connecting i and j:
\[ I_{AI_i} = \sum_{j=1}^{n} \left( \frac{RI_{ij}}{II_{ij}} \times ICEA_j \right) \]

where

RI is the real, calculated impedance via the network, between nodes i and j, ICEA is the Income (or attraction) of the destination Center of Economic Activity (j), and II is the Ideal Impedance between i and j (assumes Euclidean distance and optimal infrastructure).

The IAI helps us to understand the situation whereby people may live geographically near to an airport or the CBD, for instance, yet have poor accessibility due to road conditions, traffic, and other attributes of the real-world, physical infrastructure.

In the case of both indicators the Real Impedance, for the case of highways, is simply the summation of arc (link) and node impedances, as follows.

\[ I_t = \sum I_a + \sum I_n \]

The most important impedance, or travel cost, in our study was the sum of travel frictions along arcs, most importantly network distance but also capacity (highway class), average speeds, percentage heavy vehicles, etc. of each arc, as follows:

\[ I_{ij} = T_{ij} (1 + C_i + C_t + C_n) \]

where

T is the expected travel time, based on published distances between i and j and the speed limits of the link(s),

Ci is a coefficient of infrastructure, where highways are given a small negative friction, average provincial roads zero friction and lesser quality roads a small positive friction (penalty),

Ct is a coefficient of traffic, considering factors such as average traffic intensity and percent heavy vehicles, and

Cn is a coefficient of nationality, whereby links crossing between Spain and neighboring regions in Portugal and France receive a slight friction or penalty.

Node impedances were not considered in detail in the national study, but are routinely used in urban network modeling because they may represent factors involving traffic intersections, turn restrictions or penalties, as well as simple crossing penalties (important to the discussion below).
The values of both GAI and IAI are calculated using the network modeling capabilities, such as determination of shortest paths from i to j, of a feature-based GIS. These values become ordinary point attributes in the GIS database. Once each point of interest (city, household, etc.) receives its accessibility value we then interpolate isoaccessibility lines, determine area or population falling within each accessibility region, and model temporal sequences of accessibility growth or decline. An example for Spain is found in maps 1-3, which show differences between IAI values in 1992 and those expected in 2007 if the Ministry’s Infrastructure Plan is fully implemented. Variations on GIS-based accessibility modeling in an urban context are found in Lakerveld (1992), Arentze, Borgers and Timmermans (1992), Geertman and Reitsema van Eck (1995) and Gutiérrez, Gómez and Gould (1996). The use of geographic information technologies has allowed accessibility modeling to move from the sterile, isotropic world of O-D matrices to more realistic geographic networks and to provide more descriptive output using automated cartography. Furthermore, using geographic information technologies accessibility can more easily be linked to, or compared with, other geographic themes such as land use and property value (cadastre) for predictive modeling. Thus, automated accessibility analyses can provide the urban or regional planner with more scenarios more quickly, each the synthesis of relevant spatial information (normally layers).

Map 1  Map 2  Map 3  Map 4

Third Wave Accessibility

The Toffler’s (1980; 1995) First-Wave civilization saw accessibility in terms of food gathering and production: people generally settled near fertile areas. The Second Wave treats accessibility in terms of transportation of raw materials to processing facilities, and then to the customer. Recently, the sweeping diffusion of telecommunication infrastructure and services has spurred a new view of accessibility, so that it can no longer be described strictly in terms of spatial opportunity. Third Wave accessibility goes beyond physical access to tertiary economic centers such as shopping malls or medical centers, to describe virtual access to quaternary/quinary centers: information services. This phenomenon was distinguishable some 20 years ago in the USA when the telephone company convinced millions of Americans to "let their fingers do the walking".

Access to information on regional and personal preferences and lifestyles led to market segmentation, which fueled the micromarketing revolution, including shopping from home via printed catalogs and television offers, using the ubiquitous credit card. Southern Europeans have not succumb (yet) to this information immersion and subsequent marketing blitz, preferring the intense personal contact of daily street life; dealing at times with large amounts of cash and waiting in lines is a price many are still willing to pay. This is a clear trait of Second Wave society, on the verge of entering the Third. The concept of accessibility in the American city began evolving more than a decade ago when commerce moved from the street to telephone and express courier networks. The latter peaked during the late 1980s, but is already admitting heavy casualties at the hands of fax and E-mail (and the US Postal Service expects to lose 50% of its traditional business by 2000): "next day" is too long to wait.

Under the Third Wave model of accessibility traditional geoeconomic models break down, because the spatial dimension (distance, centrality) is essentially lost. The toll-free phone number now permits that someone in Maine wishing to purchase a computer can just as easily buy it from San Diego than from Bangor. The only impedance in the virtual shopping network is temporal: a courier may require two days instead of a half day to make delivery. Of course this assumes we are buying atoms not bits. Pushing the virtual shopping network a bit further, we find financial institutions transferring bits representing billions of dollars from New York to Hong Kong with the click of a mouse. Transmission along high-speed networks is theoretically the speed of light, but
is practically constrained by network traffic at the many intersections: essentially the node-crossing penalty mentioned above. Thus, given equal network infrastructure and protocols, the difference between an interurban and a transcontinental electronic transfer has little to do with distance per se, but rather with the number of nodes (switches) crossed along the way. So we are back to Shimbel’s index of nodal connectivity! Curiously, like many spatial relations in our everyday (naive) geography including those used for interurban navigation, topology without geometry proves sufficient.

Where, then, to locate a Third Wave business? Again, Christaller and Lösch are brushed aside as space gives way to cyberspace. Traditional models of urban accessibility are simply not relevant today. At urban scales, a financial institution need not be located on Wall Street (a prestige P.O. box perhaps), because location on a high-bandwidth network—anywhere in the city or the world, really—is all that is necessary. Today’s information-based companies are taking advantage of Third Wave accessibility by relocating quality control facilities to locations around the globe which are convenient with respect to information production. American software companies are opening QC outposts in small, tranquil villages in Hawaii and Scotland, offering employees a stress-free lifestyle and the company a 6 hour differential. Information (databases, source code) is uploaded at quitting time on the east coast, when in Hawaii it is time to start work. The next morning EST, the corrected information has been downloaded from Hawaii and is waiting to go. In the case of Internet-based services, some of the more interesting and heavily utilized WWW services are located in remote areas having no substantial geographic market. Mirroring of important databases across spatially-distributed servers assures users in whichever region minimum response time.

**The Digital City**

New infrastructure, whether technologically new (high bandwidth telecom networks) or just additional (more highways), is changing the composition of the Third Wave city. At the onset of the Third Wave in the USA (1960s), edge cities were the result of the desire to escape the congested, expensive central city. Rent was cheaper on the fringe and there was no need for information and high-tech service industries to be located near raw materials or cheap labor in the CBD: many high-tech employees lived in the suburbs already. Landuse and land values changed, as the suburban region or belt became home to enormous, tax-paying R&D and commercial parks. Now that the Third Wave is well established (some would say already burning out) companies now realize that physical location adjacent to the large city is less important than ever. Thus, the edge city is losing traditional tenants and property values are declining in an effort to attract newcomers. This inevitably affects land use in major cities, a trend less noticeable in places where cities are smaller such as in southern Europe, though it is soon expected to reach such areas according to predictions of 200 experts of the Europe 2000 project (Hall, 1976). Specifically, this study predicted that in the year 2000 many workers in the Madrid area will live in tranquil farmhouses between 70 and 150 km from the capital, in the Sierra de Guadarrama for example. It is interesting to note that this Sierra is now growing very quickly in popularity, not only for second residences but also for primary ones. Unfortunately, most are long-range (traditional) commuters who drive more than an hour to work each day: the mountain roads which empty onto the Madrid plain are the cause of some of the worst traffic jams in the city. This may change soon, however, thanks to fierce competition among Internet Service Providers (ISP) and a special Internet rate offered by the phone monopoly, making it possible to be on-line all day (8 hours) for as little as 1200 pesetas ($9.00)...about the cost of gasoline necessary to commute 100 km round trip.

**Implementation Possibilities**

How can geographic information technologies help urban planners and analysts? In the area of accessibility, GIS can be used to implement and visualize the results of new models (indices) which synthesize physical and virtual attributes of accessibility. It allows us to ask what are the geographical effects of activities essentially devoid of geographical dimension, as are telecommuting and teleshopping. In the same way we presently calculate accessibility via road or rail, we hope to add virtual accessibility to the formula, and then search for inequalities: determine which connected populations become better connected and which marginalized
populations become further removed from society’s opportunities.

The product of the accessibility indices mentioned above is a single value assigned to each node of interest (populated places, customers, etc.). Therefore, just as several economic and network-based attributes figure in the final accessibility value, we may add virtual accessibility (VA) attributes as well. Candidates for VA attributes are the following:

- Telephone service? (binary)
  - If yes to above, analog or digital?
    - ISDN or other medium/high bandwidth service available?
    - Internet service provider (ISP) within local calling area?
    - Price of monthly/annual Internet service
    - Basic computing appliance available?
    - Percent of relevant Internet information in local language (Spain ~10%)
    - On-line services available (global, national, local)
    - Other information services: fax-on-demand, voicemail trees, etc.

One can easily imagine the approximate virtual accessibility levels of the people in the following scenarios.

Scenario 1. Person A lives in the center of a primate city; in an intelligent building wired with a T-1 connection; has direct access to Internet; is fluent in English; runs a home business (stock trading) via the Net; walking distance to major economic activity.

Scenario 2. Person B lives 80 km from a secondary city; in a farmhouse in the hills; not near to any major highways; connects to Internet via POTS (14.4 Kbps); understands some English but relies mostly on spanish servers.

Scenario 3. Person C lives in a isolated rural village of 200 inhabitants; one public phone in town; 120 km from major city; travels to city once or twice annually.

The key to determining the GAI and IAI described earlier, is the Real Impedance (RI), whose increases causes accessibility to decrease. Just as our coefficient of infrastructure, Ci, uses negative impedances for high-speed motorways (or TGV-class trains), so too may negative attributes be associated with virtual connectedness. The summation of arc and node impedances, therefore, is the logical place to add VA attributes. An optimal scheme has yet to be worked out (suggestions solicited at the Conference), but it seems evident that basic telephone connection is a binary attribute which should enter into the equation. Actual telecommunication services available and exploited, however, is a difficult issue to handle. In the case of Spain, anyone with a telephone connection can, theoretically, connect to Internet via the telephone company’s recently unveiled nationwide InfoVía service. Perhaps a better indicator of potential connectedness, then, is overall purchasing power, necessary to assume the cost of a PC and modem, along with the minimal (but real) connection (telephone) charges. This cost, on the order of $2000 fixed and $30/month variable, cannot be assumed by everyone, no matter how appealing the Internet offering may be. (It would be fascinating to be able to look 20 years into the future, to see what might happen if Newt Gingrich's idea of donating laptop computers and modems to America's poor were put into practice!)

Considering these possible attributes in terms of reducing the impedance to accessibility, therefore, would change the accessibility maps shown earlier. In the case of cities (neighborhoods, blocks, buildings) having a high number of people as in scenario 1, the overall accessibility level would increase, effectively "nearing" these people to the economic services (information) they need. In the case of scenario 3, the already low accessibility level-based on lack of road connections-would be reduced still.

We are hoping to receive funding from the telephone monopoly (Telefónica) and the newly created Ministry of
Development, to update our urban, regional, and national accessibility maps, to include notions of virtual accessibility.

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Surveillant Simulation and the City: GIS and Urban Panopticism

Stephen Graham

Extended Abstract

This paper critically explores some of the emerging relationships between geographic information technologies and socioeconomic restructuring within cities. It argues that the widespread application of sophisticated GIS-related technologies, amongst a whole plethora public and private service organisations (from retailers, banks, utilities, crime control agencies and media corporations), is helping to underpin intensified processes of socio-spatial polarisation and fragmentation within urban areas. The paper has three parts.

1. GIS, Cities and Surveillant-Simulation

In part one, I set the scene by drawing, first, on John Pickles’ (1995) recent work, on the links between GIS and surveillance, and, second, William Bogard’s (1996) new book on the links between intensifying surveillance and electronic simulation within what he calls "telematic societies". These, he defines as "societies that aim to solve the problem of perceptual control at a distance through technologies for cutting the time transmission of information to zero" (Bogard, 1996; 9). Here I suggest that GIS technologies are increasingly being integrated into a broad raft of other telematics technologies (home and transport telematics, virtual reality, image databases, analogue and digital Closed Circuit TV etc) to underpin systems of "surveillant simulation". Increasingly, I argue, GIS applications are being constructed which are both surveillant and simulating at the same time. They are critically important technologies within the broader shift towards societies where, as Bogard puts it, "forms of control are refined and intensified in a system geared to the frenzied, instantaneous production of images" (Bogard, 1996;9). Within GISs, vast, superimposed systems of spatially-referenced data are integrating together, visualised and, increasingly, linked electronically both backwards into data capture and forwards into business and organisational decision making. The result is the construction of a whole complex of surveillant-simulation systems, as crucial socio-technical ensembles within cities. These underpin increasingly cybernetic and panoptic processes of urban development. There is growing evidence that such systems provide the technological basis for fine-tuned service restructuring, organisational change, and social control, based on cybernetic feedback loops for data and image flows, and sophisticated spatial visualisation/simulation.

The implication of this for understanding the city is that traditional concern with surveillance amongst followers of, say, Foucault, increasingly needs to be collapsed together with Baudrillarian debates about the role of simulation and simulacra within urban change. Ever-more pervasive data surveillance is spatially visualised and operationalised through sophisticated GIS and, increasingly, Virtual Reality and computer monitoring technologies. Increasingly, these are being used to provide comprehensive simulations of the "real" world which are then taken to be the "real" world - the basis for a myriad of decisions about who belongs where, how to maintain profitability, and the appropriate roll out of urban services. Gelerntner (1991; 3) captures this with his notion of "mirror worlds" -- software constructions which become such life-like metaphors for the "real" city that they are taken for "software models of some chunk of reality, some piece of the real world going on outside your window".

Such electronic surveillant-simulations, I argue, are increasingly being constructed to support decision making, business restructuring decisions and the development of further iterations of surveillance by service organisations within cities. In fact, within the context of an increasingly profit-driven, liberalised/privatised and globalising corporate environment, surveillant-simulation systems are emerging as crucial techniques for bolstering profitability, flexibility and responsiveness. For retailers, banks and utilities, for example, GIS surveillance systems are increasingly being woven into processes of business process re-engineering and service restructuring. This makes it possible to drive service plans and the "roll out" of investment across cities according to tight geo-demographic targeting criteria. And as cybernetic loops monitoring consumer behaviour
become more sophisticated (through retailers, mail order, consumer credit, profiling agencies, home telematics systems, road transport informatics, wide-area Closed Circuit TV etc), it is increasingly becoming possible to replace aggregate geo-demographic spatial data sets (say, at post code or census tract level) with individual sets based on actual citizen behaviour or consumption. Thus simulations of the city merge ever-closer to totally panoptic, real time simulations of the city (the best example here being CCTV). Such panoptic and cybernetic networks increasingly start to resemble the command-control- and communications webs already developed in the military. In the consumption field, the process of targeting reaches its limit, as service enterprises attempt to compete for market share within increasingly liberalised markets (whilst, of course, gradually easing out of less-profitable commitments or obligations covering poorer groups and areas).

2. Surveillant-Simulation in the City: Three Examples

In part two, I explore three examples where GIS is being used as the basis for surveillant-simulation across a range of urban service providing organisations. The first case is the UK utility industry, where GIS is being rapidly applied to allow utility corporations to take-advantage of the newly liberalised regulatory situation. Here, national and regional public monopolies have recently been transformed into profit hungry, shareholder-driven enterprises. Utility firms are re-engineering their structures and engaging in ever-more global mergers, acquisitions and strategic alliances within the globalising energy, telecoms and water industries. Increasingly, they are engaging in surveillant simulation to support the competitive "cherry picking" of lucrative market segments within cities whilst withdrawing from unprofitable social and spatial commitments. Geo-demographic profiling is being used to support improved infrastructure planning and direct marketing. Customer loyalty schemes are being developed to foster intimate knowledge over lucrative consumers. Utility meters are increasingly being transformed by telematics into interactive systems for surveying and simulating real-time household behaviour. Finally, real time telematics technologies are providing the technological foundation for markets in utility services to operate over single technical networks previously considered to be natural monopolies.

The second case explores the emerging linkages in the consumption sphere between GIS and telematics applications in retailing and home teleservices (interactive cable TV, phone, video on demand etc) into surveillant simulation systems. There are three levels to consider here. First, retailers and banks are increasingly integrating GIS and geo-demographic targeting into store investment and disinvestment decisions. In the UK, for example, the main retail banks have used GIS techniques to withdrawn 25% of urban bank branches on the basis of careful assessments of profitability. But the parallel trends towards telemediated services (banking, shopping, services) requires the locational restructuring of service networks n urban places to be considered alongside social and spatial access to services in electronic space. Examples are presented here of the UK’s leading phone bank, First Direct, the relationships between physical and electronic access to retailing services. Finally, the possible broader role of surveillant simulation systems in mediating the increasingly cybernetic links between social access to services in urban places and electronic spaces.

The third and final example speculates on the potential links between surveillant simulation technologies such as GIS, Closed Circuit TV (CCTV) and cellular phone networks and crime control initiatives. Some examples are presented of the remarkable extension of sophisticated city-wide CCTV system within the UK, and the current shift towards digital systems based on algorithmic monitoring and linked to sophisticated data bases of recorded crime and recorded criminals. The US shift toward electronic tagging of offenders, and the use of cellular radio systems for surveillance is also explored. I then speculate on some on the potential implications convergence between a raft of digital technologies (facial recognition databases, cellular tagging, GIS, and CCTV, and systems of Road Transport Informatics (RTI)), to provide wide-area systems for surveillant simulation. The danger, I argue, is that the commercialised environment within which these technologies are being shaped and applied, along with the growing fears of cross-class social interaction, will lead to growing social control and the fine-tuned segregation of people based on where they are deemed to "belong" within cellular and fortified urban structures.
3. Conclusions: Towards a Critique of Surveillant-Simulation in the City

The growing links between a raft of digital geographic technologies are currently being shaped by powerful industrial interests to infuse urban areas with increasingly pervasive systems of surveillant simulation. Such systems signify a notable intensification in shifts towards panopticism in the city. Data capture becomes increasingly automated, driven by actual social behaviour, and approaches nearer to "real time" feedback speeds. Visualisation becomes more sophisticated as GIS and other virtual reality technologies provide the technological underpinnings for complex and increasingly "real time" simulations of the urban realm. And these visualisation and simulations combine in turn to provide the potential for fine-tuned organisational restructuring, service targeting, and new, intensified systems of social control and segregation. Such technologies are being developed and applied within the context of a strong supply push from an increasingly globalised media-telematics industries. What Bob Lilley and Paul Knepper (1993) call the "corrections commercial" complex - ie the fast-growing complex of security, military and prison corporations- who are, post Cold War, attempting to colonise civil markets, are also key players in this supply-side push. They are being further supported by the broader debates about the supposedly world-improving momentum of the "information superhighway", the imperative to apply telematics uncritically to every aspect of civil life, and the pervasive crisis of public confidence in home, street and transport security.

The result in advanced industrial cities seems to be the emergence of urban landscapes made up of many superimposed layers of surveillant simulation. Each layer has its own finer and finer mosaic of socio-spatial grids; its own embedded assumptions and criteria for allocating and withdrawing service access; its own definitions for specifying the "acceptable" presence of individuals in different "cellular" spaces; and its own cybernetic loops of system feedback, within which systems of surveillance become ever more integrated into systems of simulation. The broad result is the development of social control systems of unprecedented intensity and power which are virtually invisible and unregulated. What is most worrying is that the more disturbing aspects of these trends tend to be virtually ignored within public debates about cities and technology. In fact, many are actually being welcomed under the banners of "improved customer service" or the use of technologies to provide technical quick fixes to the complex urban social problems of crime and alienation.

In the academic GIS literature, too, critical reflection on these trends is scarce; many GIS academics are themselves too financially reliant on the lucrative spoils of these processes to offer any critique. Most often, as Pickles (1995) argues, positivistic and technologically utopian scenarios prevail. Simple catch-all disclaimers about GIS being applied to "the benefit of all", within a culture of technical rationality, are used to deflect attention from awkward issues about changing power relations, urban social polarisation and intensified social control. Longley and Clarke (1995:4) for example, started a recent review of the role of GIS in business and service planning with the convenient assumption that "businesses and services function in society through their rational use of resources to fulfil economic and social objectives". Without recognising how GIS and its applications are being enrolled into the changing nature of social relations, the danger here is that GIS research will be unable to offer genuinely useful perspectives on the remarkable processes of socio-technical change within contemporary cities.

References


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**Biography**

Stephen Graham is a lecturer in the Centre for Urban Technology (CUT) in Newcastle University’s Department of Town and Country Planning. A qualified town planner, he has worked in Sheffield City Council on both physical development planning and the development of urban telematics policies. His research at CUT centres on the role of telematics in the social and economic restructuring of cities, technology and the future of cities, and the possibilities telematics offer for innovations in urban policy and planning. He has published widely on these areas. His recent books include Telecommunications and the City: Electronic Spaces, Urban Places, published by Routledge in February 1996 (co-authored with Simon Marvin), and Managing Cities: The New Urban Context, published by Wiley in 1995 (co-edited with Patsy Healey, Stuart Cameron, Simin Davoudi and Ali Madani-Pour). More details of his work can be found on the Web at [http://www.ncl.ac.uk:80/~ncut/](http://www.ncl.ac.uk:80/~ncut/)

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INTRODUCTION

The purpose of this paper is to describe how science and technology development impacts local metropolitan development. From this description it should be clear that national policy toward science and technology has a very real impact not simply on the intended innovation, development and commercialization of technology in particular industrial sectors and overall economic competitiveness but that such policies impact intentionally or not the local environments of where these industrial sectors operate. These secondary and often unanticipated impacts of science and technology policy are often centrally important to local development.

Our argument is that technology -- its development and use -- is impacting the organization and spatial patterns of US metropolitan regions. We use the high technology in general and information technology in particular to demonstrate the impact of the spatial reorganization of the Washington US National Capital Region as a case in point. Further it is our view that such a system of impacts on metropolitan organization may be broader than simply the present US case.

We focus on the US National Capital Region and patterns of infrastructure investment in a dynamic information technology sub region -- Northern Virginia -- to describe and analyze this situation.

The low density, decentralized, multinodal metropolitan region is moving quickly from an American to a global pattern of urban organization. In spite of resistance from city and regional planners and extremely powerful state and provincial regulation the pattern continues to proliferate particularly in developed economies. Further predictions of disastrously long commuting times and mass return to the inner city appear to be over drawn. This is a pattern of urban spatial organization that is not likely to go away in high income automobile oriented democratic societies. Policies may modify this pattern at the margins but are not likely to create wholesale restructuring. Such systems of edge cities have patterns of organizational, public service delivery and infrastructure investment that are intriguing in their own right -- whether you like them or not.

Regional Organization

The emergence of the new urban region raises a number of important policy questions. Many of these focus on the changing role of actors such as the nation state, the state/province, local government and business and community organizations in the economic development process. Others focus on the fact that these are high cost regional economies and need access to low cost inputs such as back office production operations. As these new regional economies emerged their role expanded and in many cases now supersedes that of local and state/provincial governments in providing leadership and steering for economic development. The steering of development activities and policies has been largely organized in the form of a partnership between the public and private sectors. Universities and other research organizations (e.g., national research laboratories) also figure prominently in these partnerships. Today one finds formal but not governmental organizations representing the interests of regions and taking responsibility for steering their development like, for example, Baltimore, Cascadia and the Ruhrgebiet (a region that overlaps with parts of France, Germany and the Netherlands).

This leadership/steering process has not been widely institutionalized in formal government bodies although much experimentation is underway in Europe (e.g., formation of autonomic regions in Spain, Portugal and Italy; and, regional decentralization in France).
Experience in the US is that the development and steering of economic development strategy comes initially from the non-government sector where longer range objectives can be considered in a non-partisan and non-political context but where short term objectives tend to dominate. The partnership later broadens to include government representatives (political partners are important but not dominant) and other groups.

The highly fragmented jurisdictional complex as in the national capital region has retarded the development of organizations that can lead or steer economic development at the metropolitan level. Yet other new urban technology regions have highly sophisticated and well developed organizations that maintain economic development strategies. These strategies have targeted product and service niches along with associated markets; have advanced regional production and marketing network cultures that includes regionally coordinated and integrated technology development; and have relatively smooth interaction among public and private sector components, and among research and educational components.

The National Capital is a complex of at best loosely confederated counties that belong to the Washington Metropolitan Region which is composed of a federal district and several other suburban counties located in the states of Maryland, Virginia and West Virginia. Most other metropolitan regions are located in one or two states and as a consequence have developed richer region-wide institutional infrastructures including region-wide community foundations; transportation, housing, social services, etc.; planning and management bodies, development policies and institutions to implement them; and in some cases region-wide governments. Because of the high level of jurisdictional fragmentation in the larger functional region and the DC plus the rest of region (inside/outside beltway) mentality, these institutions have developed in only the most rudimentary fashion for the National Capital. However important building regional cohesion at the National Capital Region level may be an activity that will most likely evolve slowly and more importantly will evolve even more slowly as long as the level of cohesion in its sub-regional components remains low. Northern Virginia’s relatively high placement in the regional value added chain places it in a position to provide leadership for cohesive planning and development of the National Capital Region, However, it must become more cohesive itself before it can exercise this leadership potential.

The Northern Virginia sub-region, for example, was for the most part dominated by a rural orientation as recently as twenty years ago, Life among its residents was relatively uncomplicated and predictable and for the most part county level institutions and government were sufficient to address all but a few issues (for example, waste water treatment became a regional issue in the early 1970s). Consequently, few regional institutions were needed and only a few such institutions existed (for example, the Northern Virginia Planning District Council was formed in the late 1960s but even today its role is primarily information provision and advisory in nature). With the increased growth of the 1970s and 1980s issues and problems spilled across local jurisdictional boundaries. Yet the development of institutions to deal with these new region-wide issues (e.g., transportation, development, housing, human services, health—AIDS) have been slow to develop and to the extent that they have they may for the most part be viewed as being in a nascent stage of development. Even the business community which operates across jurisdictional boundaries has been slow to develop representative bodies that cross jurisdictional boundaries, e.g., each jurisdiction has its own chamber of commerce, economic development agency or authority, and the Northern Virginia Technology Council which is a region-wide organization is still almost totally dominated by participation from one jurisdiction, Fairfax County.

There is a need for much more robust and more rapid development of institutions that can address the regional manifestations of problems and opportunities. Some of the key issues that need to be effectively managed by such regional institutions include the cost of congestion and high cost of business operations in such an environment as Northern Virginia as well as barriers to entry for individuals (affordable housing) and to firms. A first step that would be helpful in this would be the formation of a regional organization for strategic regional economic development.

This does not speak to the patterns of growth of shadow governments (e.g., TYTRANS-Tyson’s Corner’s Business Transportation Organization or local housing owners associations (that manages private streets and
garbage disposal) or privately delivered "public" services (e.g., multi-purpose mall and commercial center private security services). There are patterns of developing new organizations to meet rapidly expanding local needs in locations where previous systems for meeting those needs were not in place.

Infrastructure

Infrastructure policy is driven by many considerations--public interest, institutional dynamics, political assessment, ideology, and knowledge or perception about how a process works. Historically, infrastructure investment has been seen as an acceptable point for public policy intervention in the national and regional economy. In fact, traditionally infrastructure investment has been the pivotal point of partnership between the private and public sector in pursuit of economic transformation. The use of infrastructure by the private sector to assemble inputs and distribute outputs has been widely appreciated. Further, the ability of private sector organizations to benefit from shared use of infrastructure investments is also well recognized. Similarly the role of the public sector in directing large, risky investments and allocating their use among competitors may be a contentious issue but certainly is not new. What is less appreciated is the changing meaning of infrastructure and its many roles in regional system dynamics.

A new conceptualization of infrastructure is central to the development of strategies for infrastructure investment in the restructured economies of the twenty-first century. It is also central to our appreciation of the comparative advantages of regions. Most recently we have seen new attempts to link change in national and regional productivity to patterns and levels of infrastructure investments (Reich, 1991; Munnel, 1990). In the US, Senator Moynihan’s proposal for a national infrastructure policy and a federally backed infrastructure investment fund is another manifestation of the recognition of linkage between infrastructure, economic development and the role of public policy in stimulating or providing an underpinning for private sector expansion. However, before policies are enunciated it is important that we recognize some central concerns in infrastructure definition and in its changing role in regional economies.

The division of infrastructure into social and economic components is a place to begin. The concept of social overhead capital or simply soft infrastructure has been linked to education, health, social and recreational support, and partially to environmental concerns. This human capital/quality of life perspective is augmented by a direct orientation to the welfare of human resources and its consequences which is assumed to be increased labor productivity. Economic or "hard" infrastructure in the form of roads, harbors, airports, and utilities is also seen as a complement to productivity. In this case it is recognized as complement to producer capital in the form of making factories, machinery, equipment, and production technology more efficient. Finally, consumer capital is also made more efficient through the volume and quality of housing and the distribution structure produced (Chatterjee and Hasnath, 1990). In such cases the purpose of public infrastructure investment is to lower relative prices, increase access to labor, raw materials and technology and to reduce the costs of production and hence the cost of final products. Theoretically at least this moves us from one equilibrium level to another with lower prices and higher consumption resulting in better incomes and higher levels of employment (Lakshmanan, 1989).

The long time horizon of the productive life of infrastructure facilities, their large scale, and the all or nothing nature of the investments, make them very sensitive to the costs of capital and inherently risky. This, it has been suggested, requires a public sector role for such investments. Further, the fact that infrastructure is shared both by public and private sector users and across alternative private sector users with no industry or firm specific characteristics, and often has natural monopoly elements to it, suggests that the public sector has an appropriate production, allocation and distributional responsibility. Hence, although it is assumed that private sector benefits flow from infrastructure investment the public sector has traditionally played a central role.

There has been much discussion of the crucial role of infrastructure and the temporal order in which infrastructure and other forms of capital should be provided so as to stimulate economic development. However, what infrastructure consists of is rarely reviewed, and its characteristics and composition are often
defined ad-hoc. In spite of speculation about the causes and the patterns of economic change, there is no
coherent theory of economic development into which infrastructure has been incorporated. This makes the
attempts to describe the role of infrastructure difficult, since countries or regions in different stages of
technological evolution are usually interested in incorporating infrastructure investment into policies for
expanding economic development.

In developed economies, on the other hand, especially those undergoing structural transformation from an
emphasis on manufacturing and goods production to services and information management, infrastructure
investment is still a central concern. The change from a goods producing economy towards a service economy
relates to both what is produced, how it is produced and where (Gershuny, 1978; Stanbeck et. al., 1981). Not
only is there a trend toward a greater variety of services but increasingly services are produced jointly with
goods. Further, goods are produced that incorporate a demand for services for effective utilization. There is a
significant growth in producer services and producer service like functions and an expanding emphasis on
investments in human capital. Change in the organization of production reflects the shifts in technology, in
labor and consumer markets, and in the organizational system as a whole including the process of service
delivery itself which has become increasingly routinized, standardized and "industrialized" (Levitt, 1976;
Gershuny, 1978). As a consequence of the above changes, different types of services appear to be locating at
different levels in the urban hierarchy thus transforming the urban system (Daniels, 1985).

Information utilization is the differentiating characteristic of the expanding service sector industries.
Telecommunications systems are central not only to solicit business, to deliver products but to design products
that fit specific consumer wishes. To quote Lakshmanan (1989):

Communication systems are to service industries what road, railways and canals are to (goods-producing)
manufacturing. A major effect of the emerging innovations in telecommunications, electronics and computing is
to increase the sizes of the service markets by breaking down the market barriers, integrating dispersed markets
and facilitating the creation of new markets. These innovations increase the speed, density, and quality of
information flows, which in turn augment the potential pace of technological change and the diffusion of
innovations. Further, since these developments in the telecommunications sector are taking place in a period of
increasing international of the service sector, the facilities and networks extend beyond national boundaries
(undersea Cable, Geostationary Satellites, etc.). Currently the impacts of these telecommunications
developments are keenly felt in many information-rich producer services, whose range and quality are being
transformed. When the potential of these developments is realized by consumer services as well, major impacts
on the range and quality of services, on labor utilization, and work organization are likely. The key analytical
questions here are: What role does this increase in capacity and lowered unit cost in telecommunications and
information technology have on future economic growth and in facilitating the transition to a dominant service
economy? Given the rapid technological innovation and the growing deregulation of the telecommunications
industry, public policy choices on types, sizes and locations of communications infrastructure investments
become important to future economic growth in an increasingly international production system.

Infrastructure Content

In order to clarify the use of the infrastructure concept, Youngson (1967) concluded that infrastructure is not a
set of things but a set of characteristics. Two such characteristics are recognized. Capital is infrastructure if a) it
is a source of external economies; and b) it has to be provided in large units "ahead of demand." If capital
expenditures satisfy either of these characteristics, Youngson suggests they should be viewed as infrastructure.
Both imply the desirability of a certain amount of public investment since, due to positive, external economies,
the pattern of investment in a private enterprise economy would to be below that which is socially optimal. The
second characteristic of provision ahead of demand indicates an expectation about the future and this is an
important consideration. Error uncertainty and imperfect knowledge about that future will play a central role in
an infrastructure investment whose purpose is to serve the cause of regional economic change.
The argument for such infrastructure is particularly strong in the case of those investments which may be thought of as somewhat nonspecific in character—that is, those which can be utilized in the production of a wide variety of final outputs such as social overhead capital investment in education. The ultimate return to society for education may be out of all proportion to the costs. The indirect benefits which are derived from public and private spending in education extend far beyond the direct benefits (e.g., the economic returns from a major new idea or the effective incorporation of such an idea into existing technology). It is indeed a matter of facilitating the evolution of new ideas, of new combinations of the factors of production, and generally promoting the Schumpeterian notion of innovation. In that context innovation is the key to economic advancement. Infrastructure facilitates investment that promotes innovation (Suarez-Villa and Hasnath, 1993). As appreciation of the role of infrastructure in facilitating the emergence of new combinations of factors of production is recognized the analysis of infrastructure inevitably includes the study of economic transformation and system dynamics.

Infrastructure and Regional Dynamics

Many regions that directly provide capital goods—designed both to supplement and to induce a favorable response from productive enterprises—take advantage of the beneficial effects of infrastructure. It would appear that the stock of infrastructure has several effects on the level and mix of directly productive activities. First, investments in physical and social overhead capital will increase the efficiency and reduce the prices of production inputs. Not only do costs such as those of material assembly and skilled labor become lower, but increases in the capacity of infrastructure very often lead to an improved quality of service. A multi-lane limited-access highway has a greater capacity than a single-lane road; however, it is also faster and safer, further, it also generates new demands in terms of labor and capital.

Although the improvement of transportation infrastructure will result in production expansion in some regions and production reduction in other regions as interregional trade is facilitated and competition intensified, relocation of capital and labor will also take place (Rietveld, 1990). For example, even though infrastructure construction is locally produced, the locality may not reap the final benefit of development, as a new transportation line may create a "corridor" effect by channeling economic activities through or around the locality to both ends of a distribution with direct origin and destination linkage bypassing intermediate nodes.

These cost reduction and output expansion effects of infrastructure investments are empirically captured through the formulation and estimations of cost functions and production functions. Since social overhead capital is available to all firms in a region, it is viewed as entering the production functions of regional firms. However, while available to all, total use must be equal to or less than the physical capacity (e.g., traffic lane capacity, sewage pipe diameter, etc.) in order to maximize benefits (i.e., at an efficient level of congestion). In this way infrastructure is viewed as a stock variable at least in the intermediate term.

Further, inadequate supply of certain infrastructure elements will produce bottlenecks hinderous to the full utilization of other production factors. According to Rietveld (1990), two approaches are found in relation to bottleneck phenomena: 1) A bottleneck exists when actual production costs are far above potential production costs as predicted by the production function (Biehl, 1986). 2) A bottleneck exists when the mutual relationships between inputs as represented by marginal rates of substitution are out of balance (Blum, 1982).

Infrastructure investments are viewed as facilitating economic change and rationalizing regional production distribution, in other words as a mechanism of system dynamics. Public infrastructure investment affects private investment in two ways. On the one hand, public capital appears to enhance the productivity of private capital, thereby raising the rate of return and encouraging more private sector investment. On the other hand, public capital may serve as a substitute for private capital; to the extent this occurs, more public capital will result in less private investment (Munnel, 1990). This is a critical balance and must be disaggregated by infrastructure type to be fully appreciated. In particular it appears that transportation and telecommunication infrastructure generate the highest regional output elasticities, followed by water investments with the lowest contributions.
from public building investments in public operations (Munnel, 1990).

**Future Infrastructure**

Much of our focus up to this point has been a review of the general thinking and analytic procedure we use in evaluating infrastructure investments for regional systems. However, much of this has been limited to historically important fixed infrastructure mostly for the support of traditional manufacturing capital. Lakshmanan (1989) has suggested movement of information is to the service sector what goods movement is to the manufacturing sector. With the rapid expansion of the service sector in general and its information management subcomponent, communications will be the 21st century’s substitution for highways. In Batten and Thord’s (1989) book on *Transportation for the Future* the issue of substitutability between communications and mobility is a constant theme. Anderson, Anderstiz, and Härsmann (1989) develop the argument that knowledge and communications infrastructure will be the backbone for a global system of interactions. This integration plays a central role in bringing together the demand and supply side of a complex global economy. It is the attempt to reduce the costs of interaction (transaction costs) that is the driving force in the new infrastructure patterns and technology choices.

Smilor and Wakelin (1990) divide future infrastructure into the same hard and soft categories we have already seen but the content of their lists change. Hard infrastructure includes transportation, telecommunication, research parks and support facilities, quality of life facilities and utilities; soft infrastructure includes human resources, financing, business services, technology transfer, leisure activities, legal and institutional services. They argued that it is this soft category of infrastructure which will grow at a much accelerated rate and will be essential to future economic growth and technology development and applications.

<table>
<thead>
<tr>
<th>Study</th>
<th>Geographical Scale</th>
<th>Output Elasticity</th>
<th>Output and Infrastructure Variables</th>
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<tr>
<td>2. Munnel (1990a)</td>
<td>US</td>
<td>0.33</td>
<td>National Output &amp; Public Capital</td>
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<tr>
<td>3. Hulten and Schwab</td>
<td>US</td>
<td>0.03</td>
<td>National Output &amp; Public Capital</td>
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<td>5. Munnel (1990b)</td>
<td>State (US)</td>
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<td>Gross State Product &amp; Public Capital</td>
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<td>6. Deno (1988)</td>
<td>Metro area (US)</td>
<td>0.31</td>
<td>Manufacturing Output &amp; Highway Capital</td>
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<tr>
<td>7. Eberts (1986)</td>
<td>Metro area (US)</td>
<td>0.03</td>
<td>Manufacturing Value Added and Core Public</td>
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As noted above, communication infrastructure includes a variety of information capital (e.g., telephones, satellite communications, integrated digital networks, etc.) and information labor. Such capital reduces the temporal and spatial costs of coordination and over time increases the division of labor productivity. All of this in turn increases the output of goods and services, income, assets, reinvestment in infrastructure, an institutional complexity. Thus the information communication infrastructure is viewed as a key sector, receiving resource inputs and imposing transaction costs and making claims on production output as well as providing production inputs. This sector influences the nature and level of social of political participation and the structure of incentives and organizations in society.

In the competitive game of international economic growth, societies that have vigor and adaptability in their social and political institutional structure incur adjustment costs more effectively and hence speed up their technical change and development. The private and public organizations in such societies adopt a dynamic strategic perspective (in addition to their ongoing system maintenance) and engage in future scanning, goal setting, strategic decision making and programming, that lead in turn to modification of the incentive and organization structures. In such adjustment activities the communication infrastructure plays a key role.

Northern Virginia Infrastructure

What we have outlined here is a highly abbreviated version of a future model of infrastructure and many more linkages need to be identified. However, it gives an idea of future infrastructure development trends and of the need to integrate our current investment patterns so as to be responsive to these future needs.

Transportation Capital Costs

Highways

Through 1995, funds committed to highway projects total $912.6 million. This figure includes $209.9 million for freeways; $546.9 million for arterial roads; and $155.8 million for other roads, including local collector roads and miscellaneous projects.

Planning documents adopted by individual local governments for the year 2010 include $1,104.8 million for freeway improvements; $1,162.4 million for arterial highways; and $165.4 million for other roads. Total locally planned expenditures are $2,432.6 million.

The 2010 Virginia Department of Transportation (VDOT) recommended plan for the Northern Virginia region projects $1,684.3 million needed for freeways; $1,407.4 million needed for arterial highways; and the same $165.4 million for other projects. Total highway expenditures recommended by VDOT are $3,257.1 million through 2010.

HOV

HOV lanes are designated as "separate" express lanes and "diamond" lanes. Through 1995, $168.8 million has been committed for constructing separate HOV lanes, and $15 million for designating and constructing diamond lanes. Total committed funds are $183.8 million.

Local plans through 2010 call for spending $672.8 million on separate lanes, and an additional $15 million for diamond lanes. Locally adopted plans call for total HOV spending of $687.8 million.

VDOT’s recommended plan encourages major expansion of the regions HOV lane designations. It calls for $753.3 million for separate lanes, and $563.8 million for diamond lanes. The total recommended by the state for
HOV is $1,317.1 through 2010.

Transit

Public transit plans designate four categories: commuter rail, other rail (including rehabilitation of Metrorail rolling stock and facilities), bus on HOV, and Metrobus and local bus (including rehabilitation of Metrobus stock and facilities). The total committed for spending through 1995 includes $59 million for commuter rail; $171 million for other rail; zero for bus on HOV; and $93.7 million for Metrobus and local bus.

Plans adopted independently by local governments through 2010 include $59 million for commuter rail; $734 million for other rail; zero for bus on HOV; and $283.4 million for Metrobus and local bus. Total local public transit spending is planned at $1,076.4 million.

The VDOT 2010 plan is more strongly supportive of public transit than the local governments, calling for a total of $2,687.9 million. It recommends spending $118 million for commuter rail; $2,090 million for other rail; $189.7 million for buses on HOV; and $290.2 for Metrobus and local buses.

All Surface Modes Combined

Committed spending for capital costs through 1995 for all modes is $1,420.1 million. Locally adopted plans call for spending $4,196.8 million through 2010, compared to VDOT recommendations of $7,262.1 million for the long-run period.

Airports

Both Washington National and Dulles airports are in the midst of major capital improvements. The Metropolitan Washington Airports Authority Capital Development Program is divided in two components, one for each airport. Total capital improvements for Washington National will cost $933 million. Of that, $165 million is already completed; $186 million is in the construction phase now; $478 million are in various stages of design and procurement; and future improvements total $104 million. The FY 1994 budget is $205 million.

Capital improvements for Dulles International Airport will cost $985 million; of that total $119 million is already completed; $320 million is currently in construction; $61 million is in design and procurement; $485 million is required for future improvements. The capital budget for Dulles for FY 1994 is $199 million.

Information Technology Infrastructure

Significant deregulation in the telecommunications industry began in the late 1970s, followed by a trend toward privatizing the provision many public services, including information and communications. One important result of these policies has been a blurring of the distinction between the public and private sectors, a fact made clear by ubiquitous calls for public-private partnerships. The outcome of these twin trends of deregulation and privatization has been the emergence of what Fortune magazine has called The Netplex, more than 1,200 telecommunications and information technology firms in the National Capital region--most in Northern Virginia--that have formed the foundation of the nation’s information infrastructure.

At the core of the new information infrastructure is the Internet, the network of more than 25,000 computer networks and systems around the globe originally pioneered by the Pentagon about 20 years ago to allow communications to continue in any event, without relying on centralized computer systems. The investment in this new infrastructure must be measured largely in financial capital spent for services and data. Depending on what yardstick one uses,. current annual expenditures range from $1 billion to $2.8 billion. However, MCI, one
of the most aggressive providers of telecommunications and information services, estimates that figure will rise to as much as $40 billion a year by 1998.

Sewer and Water

**Fairfax County**

Fairfax County provides sewer service to its citizens through a system that includes its own sewer lines and pumping stations, one county-owned treatment plant, and contractual agreements with the District of Columbia, the Alexandria Sanitation Authority, and the Upper Occoquan Sewage Authority. Fairfax County has a capital improvement program that includes support for 19 facilities expansions or upgrades. Expenditures through FY 1994 for these projects were $293.5 million. Proposed expenditures for FY 1995-1999 are: FY95, $30.1 million; FY96, $96.43 million; FY97, $105.2 million; FY98, $105.2 million; FY99, $483.8 million. Total costs planned for current capital improvement projects from FY 1994-1999 are $820.8 million.

Fairfax County water services are provided in a manner similar to sewer services, including a county water authority and agreements with neighboring jurisdictions. Projects are financed with revenue bonds and net operating revenues. Revenue bond financed projects include $116 million through FY 1994; FY95, $26.2 million; FY96, $10.15 million; FY97, $4 million; FY98, $2 million; FY99, $1.2 million. Total revenue bond project costs FY 1994-1999 are $161.453 million. Additional projects paid for with net revenues bring the total capital improvement program for water to $249.175 through FY 1999.

**Loudoun County**

The Loudoun County Sanitation Authority Capital Improvements Program (CIP) for water and wastewater systems for the 1994-1998 period is projected at a cost of approximately $60.6 million. The 1994 CIP is budgeted at $13.9 million; for 1995, $13.7 million; for 1996, $12.2 million; for 1997, $10.8 million; and for 1998, $9.9 million.

Educational infrastructure is another key element in fostering and maintaining economic growth. Continuing knowledge explosion makes knowledge obsolete at an accelerated rate. Universities and other educational channels (ranging from local level training centers to interregional satellite teaching systems) will be an important part of the future infrastructure package, which will be made not only human resources producers but also incubators for new business and technology.

**Implications**

Clearly the Northern Virginia infrastructure is continuing to expand at a rapid pace fueled by a modestly strong regional economy that even during the recent recession had resilience and job generating capability. The result is a strong tax and user fee base for support of infrastructure growth. Incomes remain high with the result that the demands for high quality infrastructure also remains strong. Further the rapid expansion of infrastructure in the 1980s means that age and technological obsolescence has not caught up with the infrastructure that has been put in place. Hence maintenance costs have not been impacted by large scale replacement requirements.

With respect to a regional perspective the three major transportation corridors--I-95, I-66 and the Dulles corridor--still dominate as radial arteries from the Washington-Arlington-Alexandria core. The beltway’s partial circumference is now complemented by the cross Fairfax Parkway and what soon will be the western bypass. Except for the two major environment zones residential in-full is marked by a few dominant employment centers-Garreau’s Edge Cities--Crystal and Pentagon City, Fair Oaks, Tyson’s Corner, and the Dulles Complex. The air interface to other regions and the rest of the world is dominated by the expanding airports of National and Dulles.
The northern Dulles Corridor has the largest concentration of vacant commercial space in the region which can be viewed as a problem or an opportunity depending on your perspective. However, significant vacant commercial space still exists throughout the region particularly on the periphery although residential space has been rapidly absorbed. The cost of support of the underlying infrastructure in these peripheral areas will remain significant for some time to come.

All in all the infrastructure growth pattern is still built on an optimistic growth perspective and except for ground transportation still leads development.

Institutional Infrastructure

The development of institutional infrastructure has in part been dealt with above. However, there are other institutional issues including education. Here the problem is not so much with the provision of quality education services in the region but rather with the provision of educational services in the future that are integrated directly into and targeted to the needs of the regional economy, i.e., worker retraining and life long learning. Only when a long term strategic plan for the development of the region is adopted and executed will it be possible to accurately identify many of the areas of retraining that will be needed. Thus, the efficient design and delivery of practical education services will depend on the formation of the regional steering organization described above. Further, it will depend on the development of a much more advanced intra-regional communications infrastructure to support new forms for delivering educational services and learning, e.g., distance learning. Being able to target educational services in this more precise way is important given the significance of a highly skilled and adaptable work force to the continued competitiveness of the high technology region. Some estimates of the contribution of education (training and knowledge production) to regional product are as high as 60 percent of the total and more than twice as much as the contribution of traditional capital.

Currently regional analysis for the Northern Virginia Region is fragmented. There is a need to make data on the region available through a centralized or decentralized clearinghouse mechanism and to add value to this data through analysis that is readily available. Such a process could be enhanced by a regional communication and data network with open access to public and private users, Today research of this nature is provided in part by the Northern Virginia Planning District Commission, local governments, the Washington Council of Governments, the Greater Washington Research Center as well as some private research firms in the area. The region-wide organizations tend not to take a specifically Northern Virginia orientation while the Northern Virginia groups tend to focus on providing information more than to adding value to the information through analysis (there are some exceptions, some of the work by the NVPDC is quite good). The Center for Regional Analysis at GMU is building the capacity to fill this gap.

PATTERNS OF TECHNOLOGY INVESTMENTS

Below we provide a summary of an analysis of the technology sector of the Greater Washington regional economy. It is based upon original data collected from a data base of technology firms in the region developed for this project. The study was motivated by the recognition that much of the rapid economic growth experienced during the last twenty years was driven by the development of a large cluster of technology-intensive companies. The report describes and analyzes the size, distribution of companies by type of technology, geographic distribution within the region, economic effects, occupational structure, and educational needs, as well as some of the barriers and opportunities facing the technology sector.

The Greater Washington region, in addition to being one of the nation’s fastest growing regions, also has the highest average family income and the highest educational attainment of any metropolitan area in the United States. This occurs partly because the region is the seat of the federal government and, therefore, attracts highly educated people. It has also been accentuated by growth of the technology business sector which now forms the core of the region’s economic base, despite a continued high level of dependence on the federal sector. The
study aims to learn more about the technology sector in order to help sustain economic development in the region.

Much of Section 1 is devoted to developing a definition of technology and technology firms, used to determine what firms to include in the technology data base. Technology firms produce technology, produce products that are technologically intensive, or use technology to address complex problems. This definition is consistent with prevailing views of technology as described in the scholarly literature on the subject.

Characteristics of the Firms in the Data Base

- There are 2,331 technology firms in the Greater Washington region: 3 percent in the District of Columbia; 41.6 percent in Maryland; and 55.4 percent in Virginia.

- Technology sector employment is 262,337: 1.5 percent in the District of Columbia; 39.1 percent in Maryland; and 59.3 percent in Virginia.

- The region’s technology firms are most heavily concentrated in computer software and hardware; technical and management consulting and professional services; systems integration; information services and communications; engineering services; defense/aerospace; and bio-technology/bio-medicine. There are small but significant clusters of firms in the critical technological areas of energy, environment and transportation.

- The large majority of companies have fewer than 100 employees, illustrating that the technology sector is composed of many small and medium sized businesses. Yet the 29 firms that employ 1000 or more account for 42 percent of all technology employment. There are significant differences in the presence of large and dominant companies among the different technology subsectors, with technical and professional services, telecommunications, defense and aerospace, and energy technology groups having more large companies. Computer software and hardware, information services and other communications, engineering services, manufacturing, bio-technology and bio-medicine, environment, and transportation are dominated by small and medium sized businesses.

- Technology firms are located in clusters along major transportation corridors. These are the Capital Beltway; Interstate 66, Route 28 and the Dulles Toll Road in Virginia; and I-270 and I-95 in Maryland. This pattern is characteristic of all technology subgroupings except defense/aerospace and bio-technology/bio-medicine which are located primarily in Virginia and Maryland, respectively. It is important to reemphasize that only 3 percent of the firms and 1.5 percent of the employment in the technology sector are located in the District of Columbia. Thus, most technology activity is clustered in the outer geographic part of the region.

The Economic Effects of the Technology Sector

The technology sector of the Greater Washington region plays an important role in the formation and dynamics of the region’s economic base. Directly employing 262,337, the technology sector ranks second in size behind retail trade among all sources of private employment. The sector is characterized by above average earnings and directly generates approximately $21 billion in total industry output -- 10 percent of the region’s total. It also contributes significantly to state and local government finances. It is the fastest growing large technology region in the United States, outpacing, e.g., the employment growth in the Silicon Valley and the Boston 128 regions by 30 percent or more between 1988 and 1992. Major findings of the study include (Appendix):

- Northern Virginia, with 155,675 technology employees, accounts for almost 60 percent of the region’s technology work force, while suburban Maryland’s technology sector employs an additional 102,654.
Although the sector is relatively small in Washington, D.C., (4,008 employees) it ranks 23rd among the 54 that were considered.

- Total earnings in the technology sector amount to $9.3 billion and are distributed across the region in a manner similar to employment. Although the sector accounts for only 1.7 percent of all private sector firms, it directly generates 16 percent of all private sector earnings.
- Economic impact analysis shows that the 262,337 jobs in the technology sector indirectly support an additional 234,733 jobs in other sectors of the regional economy.
- Earnings associated with employment indirectly linked to the technology sector are approximately $5.5 billion. Direct, indirect, and induced earnings of the technology sector account for 24 percent of all private sector earnings.
- The fiscal impact is significant, with technology directly generating $2.3 billion of own-source revenue to state and local governments, and indirectly generating an additional $1.5 billion annually.
- Local governments in Northern Virginia receive $546 million annually from direct technology-related activity, while local governments in suburban Maryland receive $440 million. In the District of Columbia, $14 million in own-source revenue are generated.
- The total own-source revenue impact to local governments is $1.67 billion annually -- $912 million in Northern Virginia, $741 million in suburban Maryland, and $19 million in Washington, D.C.
- In total, this sector accounts for nearly 16 percent of local government own-source revenue region-wide. In Northern Virginia, over 33 percent of this revenue source is linked to the technology sector.
- Own-source revenue accruing to the state governments of Virginia and Maryland total $1.2 billion and $988 million, respectively.

Labor Force and Training Requirements

Analysis of the labor market implications of the technology sector focused on occupational utilization of the sector and the educational requirements associated with this set of occupations. While some occupational segments of the technology sector resemble those of other sectors, there are also some distinct differences.

- Like other sectors of the economy, the technology sector utilizes a large proportion of executive, administrative, and managerial personnel. Together, these occupation classes account for 55,178, or 21 percent of the technology labor force.
- Administrative support occupations make up an additional 68,128 positions while marketing, production, maintenance, and other support occupations contribute 51,061 positions.
- The technology sector also utilizes a large proportion of skilled and technically trained personnel belonging to the broad classification of professional specialties and technologists.
- Among the utilized occupations belonging to this class are (16,807) engineers, (8,132) surveyors and architects, (7,302) computer, math, and operations researchers, and (27,117) a variety of technicians and technologists. These workers, combined with executive and managerial positions, account for 50 percent of the technology labor force.
- The educational profile of the industry reflects its occupational composition. On average, technology
firms utilize proportionately more labor with a least some college training than the rest of the economy. In addition, the education and training utilization rates increase with higher levels of education.

- Proportionately, the technology sector uses approximately half as many workers with less than a high school education, 10 percent more labor with some college training, 19 percent more labor with four years of college, and 23 percent more with at least some graduate level training than the total economy.

- It is suggested that the ability of the region to attract, train, and produce a quality work force could prove to be one of the most critical factors to the continued vitality of the technology sector.

Barriers and Opportunities

The technology services that characterize much of the technology businesses in the region in many cases, (1) are in the early part of development cycles, (2) have limited traditional assets given that they are human capital intensive, and (3) tend to be small and medium sized. These attributes, when combined with rapid innovation and change, pose a number of barriers and opportunities. Several of the more important ones are considered in the report and the related findings are summarized below.

- The region’s traditional asset poor, small and medium sized technology firms have difficulty obtaining financing, especially for growth. This problem is accentuated by the limited availability of capital in the region. More and expanded capital formation programs like those in suburban Maryland and planned for Virginia are needed. Further, public and private programs are needed to market the technology sector because its scale and nature are not well known and not well understood by investors outside of the region. More information is needed to better understand the amount and the nature of the need among the different technology firm groups.

- Neither the size nor the nature of the education demand of the technology sector is well understood. Clearly there is more demand for advanced and graduate level training than for most other sectors. However, because of the rapid pace of innovation and change in many parts of the technology sector, traditional "talking head" type training programs will not be as effective. New approaches to education and training, emphasizing continuous and process specific interaction among the firm, the student/trainee, and the education provider are needed. An analysis and forecast of the education needs of the technology sector is needed.

- The region’s technology sector is heavily, but not totally, dependent on the federal government. Increased volatility and unpredictability of the federal budget, e.g., defense build down and/or deficit reduction proposals, are forcing considerable business restructuring and reengineering in the technology sector. Given its high level of dependence, the region should develop a strategy to manage its relations with the federal government to ensure sustained economic development.

- Local and state taxes are a minor but symbolically important factor in the location of technology businesses in the region. Issues of tax cost have been considered, for example, in Northern Virginia and Fairfax County. However, there is a large tax burden differential between the District of Columbia and the lower burdened outer parts of the region. The combined effect of coupling higher taxes with lower quality public schools and higher crime rates has constrained technology business development in the District and has reinforced the heavy concentration of technology firms in the outer parts of the region.

- Technology firms are subject to a wide variety of federal rules and regulations that are barriers to their development. These range from anti-trust (e.g., telecommunications) to the Food & Drug Administration (bio-technology and bio-medicine) to product liability issues (e.g., aircraft and aerospace industry) to intellectual property (e.g., software engineering and bio-technology/bio-medicine) to rules set by the
Federal Accounting Standards Board and defense procurement reform (e.g., defense and aerospace). Barriers related to these issues are not specific to the Greater Washington region’s technology sector. Regional organizations and leaders are, however, in a position to provide national leadership because of their location where federal policy is made. Providing such leadership would both help elevate the external perception of the region’s technology sector and would, by helping to improve competitive conditions in general, contribute to increased competitiveness of technology businesses here.

From this analysis it can be seen that the growth in new technology and its associated jobs reinforces the dispersed peripheral structure of the regional metropolitan economy and that this dispersion is not a function of residential distributions alone. Further from this pattern infrastructure associations are explicit and clearly linked to new economic growth patterns and vice versa.

SOCIETAL CONSIDERATIONS

One part of the region’s economy is partly dependent on other parts of the National Capital Region for labor, markets and services. The quality of physical environment is in part dependent upon the levels of residuals (airborne and water) generated in other parts of the National Capital Region and even beyond to include the watersheds of the Potomac and Chesapeake basins as is the environmental quality of these larger areas dependent in part on activities in sub parts of the region. Similar arguments could be made in terms of quality of life were factors such as crime, education, entertainment options, and so on are important. In short, it is important to recognize that parts of the region is part of a larger frame of reference, that the frames vary depending upon the purpose or problem being considered and that the future of the region will depend in part on how its relations with these other frames of regional reference are managed.

Patterns of Development in the Region

There has been a significant divergence in the development paths of the District of Columbia and the Northern Virginia and Suburban Maryland parts of the region, Table 1 shows the population of the District decreasing from a high of 763,956 in 1960 to 606,900 in 1990. During this period the Maryland and Northern Virginia suburban areas grew from 1,203,979 to 2,586,997 (115 percent). While employment levels were similar in 1970 (645 thousand in the District; 715 thousand in the suburban areas) by 1990 suburban employment was 1,508 thousand (an ill percent increase) with the District increasing slightly (14.7 percent) to 740 thousand (Table 2). Similar changes occurred in personal income, commercial construction, and retail sales.

Beyond these more obvious quantitative indicators other structural changes occurred. Until the late 1980s unemployment in the District tended to be at about the national average (Figure 1). Since then unemployment rates have increasingly exceeded the national average. Over the same period suburban unemployment rates have decreased relative to the District. Crime rates per 100,000 population in the District are nearly twice as high as in Northern Virginia or Suburban Maryland (US Federal Bureau of Investigation, Uniform Crime Reports, 1985 and 1992). High school drop out rates are nearly twice as high as in the District (US Bureau of the Census, Summary of Social and Economic Indicators, 1980 and 1990). The fiscal base of the District is seriously jeopardized with almost daily reports that it will need a "bail out," make ever more severe cuts in expenditures to balance the budget or become insolvent. Finally, business formation rates, an indicator of innovation levels, have historically been low (about 22 percent of the regional total) in the District compared to much higher levels in the suburban jurisdictions (see Table 3). These rates have decreased in the District relative to the outer parts of the region over the past several years (at the same time the rates in Suburban Maryland have decreased relative to Northern Virginia). Given these significant distinctions between the District and other parts of the Metropolitan Region one would expect some economic structural differences to exist.

Figure 2 illustrates the economic structure of the economies of the District, Northern Virginia, Suburban Maryland and the U.S. in 1991 using personal income as an indicator of the size of different sectors. The data show that the whole National Capital Region may be described as a government, and business and technical
services center and that manufacturing is relatively unimportant. When the services are examined in more detail (Figure 3) notable differences appear. Business and engineering/management services are much more important in Northern Virginia and Suburban Maryland; membership organizations and legal services are much more important in the District. Further, the federal sector, while important throughout the region, is considerably more important in the District although nearly half of all direct federal employment in Northern Virginia is in Arlington.

Table 1

National Capital Region Population by Jurisdiction and by Major Sub Region

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<td>Northern Virginia</td>
<td>580,369</td>
<td>887,738</td>
<td>1,075,662</td>
<td>1,437,208</td>
</tr>
<tr>
<td>Suburban Maryland</td>
<td>698,323</td>
<td>1,184,528</td>
<td>1,244,124</td>
<td>1,486,295</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>763,956</td>
<td>756,668</td>
<td>638,432</td>
<td>606,900</td>
</tr>
</tbody>
</table>


Table 2

National Capital Region Employment by Place of Work

1970-1990 (Full and Part Time Wage and Salary)

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>1960</th>
<th>1970</th>
<th>1980</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Virginia</td>
<td>372,735</td>
<td>544,879</td>
<td>881,268</td>
</tr>
<tr>
<td>Suburban Maryland</td>
<td>385,092</td>
<td>549,990</td>
<td>755,656</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>644,933</td>
<td>670,385</td>
<td>740,090</td>
</tr>
</tbody>
</table>

Table 3

New Business Formation in the National Capital Region

Percentage by Major Sub Region

<table>
<thead>
<tr>
<th>Year</th>
<th>Virginia</th>
<th>Maryland</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>During 1980s</td>
<td>43.0</td>
<td>35.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Since 1991</td>
<td>56.4</td>
<td>28.3</td>
<td>15.3</td>
</tr>
</tbody>
</table>


This analysis shows that the District is the home of the federal government and as such the superordinant locus of public policy making in the US. More than 40 percent of income generated in the District is paid directly by the federal government. Further, while the service sector generated nearly 40 percent of the income 25 percent of this is in legal services--a large amount of which is in such government related activities as lobbying and regulation. Beyond this engineering and management accounts for nearly 20 percent of the services (most of this is in management). The other major components of the service sector in the District are education (a number of universities are based there) and amusement and recreation services although in the latter case the proportion is less than for the US, as a whole. In conclusion, the District economy is dominated by the federal government -- the business of making and executing public policy and regulation -- with some additional semi-independent components such as visitor and educational services.

In contrast, Northern Virginia has only about half as much of its income generated directly by the federal government as the District which, by the way, is still a somewhat greater proportion than for the US. The core of the Northern Virginia economy is business and engineering/management services of which a significant part is in, advanced technology enterprises. Approximately 124 thousand work in the technology sector which focuses on technology services such as systems integration, systems architecture, systems design, and information technology including the development of network goods (hardware and software) and services (design, installation and maintenance of networks).

The Donut Metaphor

The above analysis shows that the relative decline of the economy and quality of life in the District. We may illustrate this with a donut metaphor which treats the District as the "hole," and Northern Virginia and Suburban Maryland part as the "donut" (Figure 4). In adopting the donut model it is an easy next step for some to conclude that the hole is no longer needed, i.e., that it is possible for Northern Virginia and Suburban Maryland to chart development paths essentially independent of the District. In short, with this view not only is the District considered to be irrelevant but by continuing to treat it as part of the region some believe that it will drain resources from the future development of the donut, The donut model is part of the mind set of more than a few leaders,

The donut model raises two kinds of questions. First, "what explains the fact that we can even suggest a donut metaphor to describe conditions in the region?" This question is considered in the next part of the paper.
Second, we must ask "is the donut a viable metaphor for policy formation for the future of Northern Virginia or is not a more collaborative approach more appropriate?" This question is addressed in a subsequent part of the paper.

Why the Donut Model

There are several factors that have led to the differences between conditions in the District and other parts of the National Capital Region. One is a long term national trend to locate new development on the edge of metropolitan regions. The renewed vigor of this trend over the past 20 years is described in a recent book by Joel Garreau (1990) *Edge Cities*. The trend has its roots in transportation developments in the early part of the Twentieth Century, namely with the advent of reliable trucks and automobiles, and highways; and with policies that have kept the cost of operating vehicles relatively low. There are also cultural and social values and policies that have contributed to concentrations of the less well off in the interior parts of metropolitan regions. Thus, part of the reason for the difference in conditions between the District and other parts of the region is historical due to intra-urban migration and business location trends toward the periphery.

A second reason for the divergence between conditions in the District and the outer parts of the region has been the inability of the historical core to link development on the periphery to its institutions. There is a tendency on the part of core cities even in the best of circumstances (e.g., the unigov environment of Indianapolis) not to recognize growth on the periphery, especially when state and/or local boundaries intervene, until that growth has become quite sizeable relative to the core. This has certainly been the case in the National Capital Region. The boundaries between the District and the two states veiled the significance and the regional impact of growth in the outer areas from institutions such as the Greater Washington Board of Trade (which did not add the "Greater" to the organization name until the late 1980s), the Washington Post, the etc. In fact, it is only recently that these institutions have recognized the need to significantly reshape their agendas to more fully align themselves with the altered economic geography of the region. The fact that the growth in outlying areas occurred very rapidly. (growth in the outer parts of the region grew at or above 4% annually for the past 20 years) made it even more difficult for the traditional institutions to fully appreciate the changing geography of economic activity until quite recently.

In the 1960s and even in the early 1970s development activities in the outer parts of the region were not large and were confined to a few locations. Jurisdictions in these outer areas operated relatively independent from one another as they always had in their rural and agricultural dominated past. About the only thing they had in common was that they served as bedroom communities for those who worked in the District. The fact that economic growth in these areas unfolded very rapidly meant that it was very difficult for the government and non-government institutions (e.g., chambers of commerce) to adjust in time to provide more regionally integrated leadership. Consequently, as illustrated in Figure 5, not only is the District separated from the donut, but the parts of the donut are highly fragmented among themselves whether one views this from state or local government levels. In short, there is a high level of fragmentation throughout the National Capital Region and it exists at many levels.

Convergent or Divergent Development Paths?

We must now ask if there are any compatibilities and necessary complimentarities between the District economy and the Northern Virginia economy? If the answer is no then the development paths of the donut and core could diverge with minimal or no affect to either part. On the other hand if the answer is yes then it is important for Northern Virginia leaders to recognize that it is part of an interrelated whole and to develop strategies and tactics for charting a more collaborative future.
David Rusk in a recent book Cities Without Suburbs (1992) examines this pattern throughout the US. He observes that when population loss in the traditional core city area falls by more than 20 percent and when income falls below 70 percent of the median income of the outlying areas conditions throughout the whole metropolitan region, which will have already have deteriorated, become extremely resistant to change. By conditions he means a whole gamut of problems ranging from crime and education to tax base and growth to environmental conditions. In short, if the "hole" is allowed to deteriorate below some threshold the whole region will experience negative spillovers that are very difficult to manage. The National capital Region is below the threshold with respect to population loss (about 26 percent) and moving toward the income threshold although it is still well above it at 88 percent. However, Rusk notes that even at the 88 percent income differential negative spillovers tend to occur and become increasingly difficult to manage. Rusk’s analysis based on data from 100 US cities suggests that outer parts of metropolitan areas need to pay attention to what is happening in the interior and help address deteriorating conditions. Failure to do this may result in the export or diffusion of conditions in the interior to outlying areas and thus deterioration of conditions there.

This is probably the strongest reason for taking a more interjurisdictional approach. Some have estimated that about 60 percent of the Northern Virginia economy is dependent either directly (employment and/or contract) or indirectly (via multiplier effects of the directly generated demand and spending and re-spending) of the federal sector. The high level of dependency on federal policy making and budgeting have been important to Northern Virginia in the recent past (last 20-30 years) and will be important for Northern Virginia’s present and future. The locus of policy making and budgeting is in the District. For this reason it is also important to improve and enhance the District as a place where federal policy is executed and developed. After all, the largest market for Northern Virginia goods and services (after internal Northern Virginia consumption) is the federal government. Further, by improving the quality of the environment (physical and social), the District’s attractiveness for other activities like, for example, touristic and related visitor services will be enhanced. Yet the regional leadership and institutional capacity to move in this direction is not well developed.

Should the Donut Model Guide Regional Development Policy?

The donut model suggests that the outlying parts of the region and in particular Northern Virginia should adopt an independent development path. However, the arguments presented above suggest that blindly following this path of independence would gradually lead to a wide variety of negative spillovers and to deterioration of the highly successful economy and high quality environment the region has enjoyed over the past 20 years. Thus, some degree of interdependence must continue to evolve.

Despite the rapid development path that has hindered the emergence of a more integrated and cohesive region some activities aimed at helping the National Capital Region build cohesive leadership have been undertaken. The Washington Council of Governments recently executed a consciousness raising project that included several hundred people participating in a variety of meetings throughout the region. The effort surfaced a wide variety of issues and identified a number of barriers to developing a more cohesive approach to regional problem solving and governance (not necessarily government). The Washington Board of Trade has formed a senior leadership development process now called the "Potomac Conference." The purpose of this group is to develop a more cohesive leadership for addressing regionwide economic, social and environmental problems. To the group’s credit it has formed a regionwide program to market the National Capital Region globally. However, its ability to focus resources on other regionwide issues has been limited. Beyond these two efforts activity to build a more cohesive ability to deal with problems throughout the National Capital Region has been insignificant.

While more efforts of the type undertake by the Washington Council of Governments and the Greater
Washington Board of Trade are needed progress will be slow because each of the three major subregions have very different institutional and statutory foundations and are highly fragmented themselves, particularly in the cases of Northern Virginia and Suburban Maryland. A more likely intermediate term possibility to build the capacity to more reasonably and effectively address regionwide issues would be the development of more cohesion within each of the three major subareas. Certainly it will be easier to pull the leadership of Northern Virginia together to address common issues including relations with the District (and for that matter, Suburban Maryland or even Baltimore) and the State of Virginia than it would be to achieve cohesion at the National Capital Region level. If this were to occur in each of the major parts of the National Capital Region we would then have three groups somewhat capable of expressing their region’s priorities, goals and visions and acting on them. One might envision regionwide development strategy and problem solving being steered by the interaction of the three groups -- much like the interaction that occurs among giant tectonic plates. As one moves the others gradually adjust (sometimes violently but usually through a series of smaller tremors) and then the whole system settles down until another plate makes an independent change in course. The tectonic plate metaphor appears to be a much more viable model for steering the future development of the National Capital Region than the donut model which captures a good bit of the current reality. The tectonic plate metaphor allows each major entity to enjoy a good bit of autonomy in its development path but at the same time ensures that the development path of the whole will be conditioned by checks and balances generated by the other two "plates."

Alternative Models

Besides the "Donut" and "Tectonic Plates" perspectives, some have advanced the concept of a metropolitan area made up of a non-hierarchical network of specialized nodes. Finally and not in jest a new perspective of the leapfrogged and abandoned edge cities with external satellite cities has been proposed by Stough in Edge City News (Jan./Feb. 1996). This model maximized the expanded transportation structure and is dependent on effective use of new telecommunication technology and efficient application of Intelligent Transportation Infrastructure.

The social implication of these systems in terms of spatial class and income reorganization for the US society in general and urban social systems in particular is well beyond the discussion that most groups have been willing to confront.

REFERENCES


Hanson, R., ed. (1984), "Perspectives on Urban Infrastructure," *National Academy Press* Washington, DC.


**APPENDIX**: Selected Maps and Exhibits
Figure 1

Monthly Unemployment Numbers
Washington Metropolitan Area

% of Labor Force

Month/Year

-■- Wash. D.C.  — Maryland  — State of VA  — Northern VA
Why We Should Care About intra-metropolitan Accessibility and How We Measure It

Amy Helling

Abstract
Notions of intra-metropolitan accessibility are at the heart of many transportation and land use policy prescriptions, ranging from promoting jobs-housing balance to providing commuter rail and reemphasizing the pedestrian and transit orientation of traditional neighborhoods. In spite of how central the concept of accessibility is to these types of initiatives, it is often misunderstood and poorly measured. In this paper, I briefly summarize issues concerning measurement of intra-metropolitan accessibility and empirical research into various accessibility measures' effects on travel, land use and density. I argue that relatively simple operational definitions have substantial explanatory power within metropolitan areas, and make accessibility an appropriate performance objective for metropolitan transportation policy and local land use policy. I discuss the implications of increased access via telecommunications and the potential of GIS to create and analyze such measures. The paper concludes with a proposal for collaborative research which would develop the same measures of accessibility across several U.S. metropolitan areas, in order to ascertain how robust their predictive power is, and hence how they might best be used for planning purposes.

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Spatial Technologies, Geographic Information, and the City - Some Theoretical And Practical Observations

Ken Hillis

With reference to the societal impacts of geographical information and analysis, in 1992 an NCGIA Consortium noted that:

... the lay person’s access to electronic information will improve awareness of political and environmental affairs, and may preserve a healthy level of interest in global and local governing policies. One may envision a network of consumers of spatial information, who require appropriate education including the skills to access. Research on the use and value of such access, and the ethics associated with access and privacy are clearly needed. (ibid.:1992:26-27)

This conference is concerned with changing conditions of accessibility, distance, and spatial interaction in cities. All interaction has a spatial dimension. British communications geographer Roger Robinson (1977) defines accessibility in a way that assists theorizing the impact of spatial technologies. He argues that the density of a network linking a variety of regional nodes will have an impact on accessibility - a concept he refines to explain the evolving relationships among decision making, movement patterns, and networks, as well as to describe a measure of the ease by which places can be reached from one another (Johnston et al, 1994:2).

Accessibility focusses on 'structures' within which movement takes place (Robinson, 1977:88). It brings together disparate spatial characteristics into a single form: the accessibility of a location on a network is influenced by the location’s relative position within the network, changes in transportation technology, what is being moved, and introductions of new media (ibid.:65-68). Accessibility implies the impact of communications on a network. A geographer might say: such a location has x% of accessibility, thereby expressing where the location stands relative to others in the network. The concept's incorporation of decision making suggests the increasing interplay between the 'human dimension,' technical processes, and information flow. Robinson (1977:88) argues than an ideal accessibility would be "low cost immediate transference of anything in any direction, with the resistance of distance reduced to almost nil." Robinson forecasts and idealizes then-anticipated but now-current on-line networks within which "relative location will cease to be significant in economic terms" (ibid."88).

Robinson’s 'relative location' can be theorized with respect to access to information, and how this might apply to GIS and urban planning. David Brusegard (1989:11) details the relationship between the utility of geographic information and those agents charged with decision making and carrying out goal-oriented tasks. This observation applies well to marketing professionals or planners, for example, but does not hold with equal force for, say, homeless populations or inner-city working poor, for whom abstract spatial generalizations facilitated by GIS have little experiential point of purchase. Now, Paul Strassman (1984:117) notes that the more people share information, the more its importance increases. However, this argument ignores the reality that not only must information be available in accessible forms to potential users, but that its withholding also can form part of its power: that information readily readable by a planner but not by an affected neighborhood population may be precisely the point in hierarchical political organizations. Planners may claim that the information is available and ignore coming to terms with the fact that its inaccessibility to affected individuals and groups serves to reify the power of both planners and the state apparatus they serve.

With respect to a GIS, the sophisticated and 'brand name' nature of the software and hardware (see Curry: 1995) further 'ups the ante.' A different, technologically produced reality that differs from the concrete world which it models comes to define what is real, and - given technological limitations - in a hierarchical fashion, however unintentional this might be. Lack of access to new virtual technologies and ITs (Information Technology) reflects the emergence of a new distinction between halves and halve-nots. The old class lines and economic differences still obtain but privilege now also comes to mean who has access to this technology and therefore
the virtual worlds to which it is a 'porthole.' Access to ITs and spatial technologies should not be conflated with metaphors of literacy. Both the literate and the oral worlds - text and voice - have language in common. A parallel commonality need not undergird a planner using a GIS to model urban processes and change, and those affected by her or his actions. Not only are citizens often unaware of the nature and implications of the technology to which they are being subjected, frequently they do not know this subjection is underway.

Already in Robinson’s earlier noted definition of accessibility, movement is privileged over distance. Though geographers, for example, seldom explicitly conflate space with distance, experientially we understand the former’s effects in the latter. However, distance becomes phenomenologically real when we move through it, and how we move through it depends, in part, on our relative degree of social (dis)advantage. Telematics and ITs already suggest a new working arrangement for power. If these networks are where power now moves or circulates, this is to say something different than an observation about any distance between where power resides and an individual’s location in space. Aspects of power accessible in relative fashion to human control may have been transferred into cybernetics and networks (of which GIS forms a part) without a full recognition of the consequences of same. We cannot continually discuss the importance of the 'continuous plane' of circulation within geographic discourse without coming to grips with the fact that the 'space' of power, metaphoric or concrete, has shifted. Space used to equal distance. This equation has been ‘solved,’ in part by ITs, by replacing it with a new one - space = movement - where movement means continual transit across the old space of distance, often by the use of ITs. In this sense, power is now in continual application, and is asserted and accessed by movement - here suggested to now take on both concrete and virtual forms. Power is no longer most vulnerable when visible, but when it stops moving.

The continuous circulation within on-line environments is a new 'center' of power in direct competition with the older materially discrete notes (variously regions, cities, human beings, or other 'geographic individuals' operating at different scales) it was originally intended to link. The 'space of continuous circulation' established by spatial technologies is really a conduit for messages that has emerged as an ironic center in and of itself, thereby challenging contentional understandings of how power works and how social relations are organized. Access to geographic information that might be of use, for example, to local community groups, might be available by world wide web and originally stored on a spatially- distant mainframe computer. Equally, however, corporate and other decisions impacting upon urban localities need not be made at the geographic center of any urban area, and indeed a GIS may contribute to centralizing decision making that may uniformly be applied to a variety of spatially discrete and socially distinct communities without regard to content. Current spatial technologies have the ability to increase social distance between economic halves and halve-nots, and to extend the definition of halve-not to individuals having little or no access to the virtual sphere that increasingly defines how the real will be conceptualized and defined. It is often in the self-interest of professional elites to subvert examination of these possibilities beneath an assumption that the increased power these technologies confer on technically proficient elites (themselves) will be of benefit to all - whether this benefit is suggested to take the form of an (always in the future) equal access to the technology, or a less directly-accessible benefit made available by more traditional means analogous to how the poor are theorized to gain from trickle-down economics.

The above discussion of the context within which spatial technologies impact access and distance/space does not refute the day-to-day positive and pragmatic value of this technology. For example, OC Transpo - the regional transit authority for the Ottawa, Ontario, National Capital Area - makes extensive use of spatial technology. Each bus is equipped with a sensing device and two-way radio. All major intersections throughout the urban area are equipped with sensing devices which transmit the location of each bus to a central display that is monitored for bus headway and timetable adherence. Radio communication permits flexibility at off-peak hours, as the location of buses on intersecting but separate surface lines can be monitored and coordinated at transfer points, thus minimizing long waits during freezing-cold winter months. This technology largely eliminates the need for human surveillance of the fleet. It uses available resources more efficiently, and the Region’s financial support is evidence of a commitment to maintaining mobility for the Ottawa area’s population that relies on the bus for getting around. It is notable that Ottawa enjoys a 75% modal split in favor of public
transit with respect to all individual trips to and from the CBD during morning and evening rush hours. Public transit in the capital is not a marginalized service, though it seems almost too obvious to note that such investments in spatial technologies, which extend and render more efficient transit’s spatio-temporal range of service, have the potential to minimize auto use, and thereby street maintenance, and ancillary land uses devoted to parking of cars and so forth. Tax dollars spent on spatial technologies in this regard may well allow other monies to be redirected to a wide range of public services that most would consider socially desirable, though of course, this need not be the case.

With respect to access to information by disadvantaged groups, a key issue is data ownership, which comes to have heightened ethical and political importance: these data are representations of people who may not even be aware of the data’s existence. Geography, with its emphasis on pattern, has tended to abstract people through its mechanisms of spatial analysis and the freezing of ongoing temporal processes into discrete and framed ‘event patterns.’ Given the power of GIS’s commercial and military clienteles, theorizing the application of spatial technologies within peopled urban contexts needs to include consideration of how this tradition of pattern and privilege may contribute to undesirable occlusions of different human populations who are part of the collectivity called society, and to initiate dialogue intended to minimize this.

During a period of retrenched public spending, spatial technologies seem well suited to making the bus system more efficient and cost-effective. However, their use by planners for urban geodemographic profiling may well lead to the production of sensitive information about groups that will demand what I will term a principled and carefully thought out ethics of refusal on the part of planning departments, such as this information is not made equally available to all by the professional elites who control it and access to it. For all are not already equal, and publicly-financed production of spatial information, which might reveal, for example, the ‘fit’ between illegal drug use and a specific land use zoning pattern, could well lead to the mounting of a ‘moral’ argument in favor of a rezoning beneficial to those already ‘more equal’ than others. Perhaps it was always thus, though the enhanced power of these technologies and difficult accessibility suggests a ‘change in degree’ such that it becomes germane to ask at what point the cumulative effects of changes in degree become a ‘change in kind.’

Even if it were to become technically, economically, and socially feasible for all to equally access some future GIS, should all groups be theorized as benefitting equally from this access regardless of their size and political thrust? As Mark Monmonnier (1996:63) aptly notes, such ancient devices as ridicule may be more politically effective than reliance on expensive technologies and the elites required to service the latter. At the service of administration and control of populations, GIS will enjoy State and corporate support at a variety of levels of scale in gathering data for surveillance mechanisms that are analogous to a virtual panopticon controlled by the few. This would still be true for modelling locational conflicts involving disadvantaged urban populations. Modelling such conflicts ought to be informed by deliberation of who decides what is a conflict, and its extent.

The widespread diffusion of GIS and ITs more generally makes urgent the need for a sustained examination and development of the question ‘Who decides the nature of disadvantage?’ They who are defined as ‘disadvantaged’ ought to have a say in determining not only how the technology will be applied to them, or even how they might achieve opportunities to put it into ‘praxis,’ but also what constitutes a definition of disadvantaged. Stated otherwise, there is little political leverage to be obtained from defining oneself as a victim in and of itself. To do so already positions oneself as merely subject to GIS technology and practice via one’s inclusion as data within a representational space that one ‘consents’ - knowingly or otherwise - to allow others to define, operate, and manipulate. Yet GIS, as part of a spectrum of ITs, is now gaining wide cultural acceptance even though its implications often are poorly understood by affected individuals and groups. As I noted above, the nexus between IT, who controls it, and who accesses it, has the ability not only to shrink the distance between halves and halve-nots, but also to enhance it. In the new virtual world of information, disadvantage need not lose its association with economics and class even as the experience of those without the skilled ‘cultural capital’ to access this technology comes to redefine and extend the meaning of disadvantage.

References


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This paper reviews space-time properties of urban structure with regard to developments in transportation and communications. Space-adjusting technologies, in combination with the timing of land uses and activities, are shown to impart discontinuities in the topology of urban regional structure. Such discontinuities influence the formation of parallel, but different, activity patterns in the daily lives of representative urban subpopulations and contribute to continually changing density patterns of human occupancy at different times of the day. Examples of these phenomena are illustrated for North American cities. The importance of being able to visualize rapid changes in these patterns is presented as an important challenge for applications in Geographic Information Science. The ability to identify these patterns has important practical significance regarding planning issues and has implications for the development of sound academic understanding of relationships between urban social and spatial structures.

CONTRIBUTORS TO SPACE-TIME DISCONTINUITIES IN URBAN REGIONS:

Two factors are particularly significant in distorting the space-time structures of cities and their regions. The first is the differential use of the time dimension by specific land use activities, sometimes referred to as the "timing of space." The second involves space adjusting technologies that alter the significance of distance in peoples’ choice of activities.

The Timing of Space:

The timing of space, a concept proposed by Parkes and Thrift (1975), refers to the opening hours of establishments; some banks are open from 8:00 a.m. to 8:00 p.m., others from 10:00 a.m. to 4:00 p.m.; some restaurants and grocery stores may be open for 24 hours a day, while others set more limited schedules for customer access. When the lights go out, they no longer serve as part of the activity system for the urban resident. In a typical North American city of 300,000 people, several thousand such timing decisions occur daily. Some conform to set societal standards for the timing of work, schools, and other activity sites. But, increasingly, the temporal ordering of cities has become more diverse and less predictable.

Policy options to mediate congestion on city streets have encouraged large employers to stagger the work hours of employees; other employers have responded to changing needs of employee groups (e.g., workers from two-income households and single-parent workers) by introducing flexible work-hour arrangements. The "colonization of time," particularly night time, is a concept advanced by Melbin (1978) to refer to the increasingly long opening hours of many establishments; but, in addition, there is evidence of an increasing number of activities that practise temporal specialization -- e.g., "breakfast-only" restaurants, and "lunch" shops, etc. In contrast to the traditional norm of standard 8-hour work days, there is considerably more diversity and independence in the timing of activities within cities of the late 1990s.

For any particular time of the day, one can envision a supply of accessible (i.e., open) activity sites of a given category (e.g., pharmacies, gymnasiums, bars). In the aggregate, these timing decisions have considerable impact on the overall movement patterns of populations for commuting, shopping, recreating, and other activities. Surprisingly, there are no systematic databases that describe this phenomenon for individual North American cities.

The Role of GIS. Could an active on-line GIS representation incorporate information of the timing of the city and its parts? Would this be of value to landuse planners, traffic engineers, bus route planners, emergency
health care, policing, and fire protection units, marketers of consumer products and services, and others? In a fully wired city, could this information be signalled on occurrence of the opening and closing of establishments? Could this information be accessibly via home computers to households as well as public agencies?

Such a GIS database might be used to increase our understanding of urban social issues. For example, how do the time supplies of activities differ in accessibility for different subpopulations in different parts of the urban environment? Would such a database allow us to isolate categories of temporal coordination and compatibility problems that are specific to gender, age, ethnicity, and income, to shift-workers versus part-time employees, two-worker households versus one-worker-two-parent households, or single-parent households? As noted by Burns (1979) temporal considerations are fundamental to the whole issue of accessibility and opportunity in the modern city. Some of the most significant social issues of the modern city are represented in current political debate over the temporal ordering of urban life, particularly as seen in the conditions of employment and the timing of affordable childcare (Janelle, 1993). Representing the city around the clock is critical to understanding its reality and to dealing effectively with its structural and social problems.

Distorting Space-time Relationships and Visualizing the Impacts of Space-adjusting Technologies

The timing of spaces is a determinant in the accessibility to opportunities, but the ability to move from one location to another is a related complementary problem. For this reason, representations on the temporal patterns of activity sites should be coupled with indications of how transportation and communications technologies permit access to such sites from throughout an urban region.

Travel time is commonly regarded as the single-most significant indicator on the impact of transportation-based innovation. Yet, from analytical and visualization perspectives, it poses considerable difficulties. Reasons for this include:

- Except for time-tabled public carriers (e.g., buses and rail), there is considerable variability in actual travel times between locations in urban space. This results from combinations of congestion and behavioral factors, and from the alternative routings that link locations.

- Travel times between locations may vary with direction of travel, resulting in situations where the time distance from locations A to B may or may not equal the time distance from B to A.

Given a complete set of estimated or measured travel times for the links in a network, algorithms are available to calculate minimum time distances between nodes in the network. This methodology is used in trip assignment models in transportation planning, and provides a means for calculating isochrone maps (lines of equal travel time) from any particular location to all other locations.

Isochrone maps are commonly used for visualizing the impacts of change in transportation systems over time. However, such maps, even the more refined time-distance transformations developed by Clark (1977) for Seattle and Muller (1978) for Edmonton, suffer significant limitations:

- They document the situation for only one of an infinite number of locations within urban regions.

- It cannot be assumed that travel time from the central point of an isochrone map will equal movement in the reverse direction, to the central point.

- An exceptionally large number of isochrone maps would be required to depict even the most general changes in the travel environment of a city.

To get around the problems of isochrone maps/visualizations, alternative conceptualizations have attempted more aggregative methodologies. However innovative in their conceptualization and execution, they have not
been employed widely:

- **The Velocity Surface.** Angel and Hyman (1976) used a curve-fitting procedure to covert travel data from traffic surveys into a continuous field of travel velocities for the urban road network of Manchester. They argue that the diffusion of traffic, congestion, and speed from high-order links to neighboring lower-order links of the road system follows the logic of contagion models. They demonstrate the use of their methods in estimating minimum-time travel paths between locations in the Greater Manchester region.

- **Multidimensional Scaling (MDS).** Departures from simple Euclidean configurations are expected in any attempt to plot values from a matrix of time-distances among a large set of places. A smoothing out of these departures is achieved by applications of MDS, used in innovative renderings of time-space maps by Ewing (1974) of Montreal, Ewing and Wolfe (1977) of Toronto, and Gatrell (1983 for a region in England. Starting with a matrix of time distances (dissimilarities), MDS may be used to reconfigure the locations of places so as to minimize the stress in reducing complex geometrical relationships in two dimensional map-like representations.

- **Isotach Maps.** An alternative schema, represents travel time in cities by means of isotachs (showing regions of equal average speed of movement). In theory, from such representations, isochrone maps could be calculated for an infinite number of locations. Bunge’s (1966) classic isotach map of regions of equal travel speeds in Seattle ignores directional biases in the speeds of movements within regions. Yet, anisotropic properties of the urban travel systems are common sources of distortion in time-space structures. For example, travel through a region in east-west directions might be faster than in north-south directions; limited-access highways, which allow high speeds, impede movements in directions orthogonal to the path of the highway, requiring vehicles and pedestrians to take circuitous routes to under/overpasses. Such circumstances are not easily reconciled by isotach depictions.

- **Time-space Convergence.** In assessing the space-adjusting properties of transportation innovation, comparative travel-time data at intervals of one to ten (or more) years provide a ready, but abstracted, gauge of changing accessibility patterns in cities. This is illustrated by time-space convergence measures for changes in limited-access highway networks found in many medium and large North American cities (Janelle, 1968, 1995).

Figure 1 shows a hypothetical urban highway network serving a single city. Travel-time distances for 1960 and 1980, and the resulting time-space convergence rates for each of nine locations within the metropolitan area, are shown in the accompanying table. The 1960 pattern depicts a simple crossroads situation, and the 1980 pattern shows a typical limited-access beltway with average speeds of 80 km/hr. The outer fingers of the network are improved to 90 km/hr by 1980. Because of the diversion of traffic around the city, speeds within the city increase from 35 to 40 km/hr. For each place, the average travel time and the average convergence to all other places (shown in the table) reveal that the greatest accessibility gains are recorded for those places that have the highest average distances to all other places.

This example illustrates that locations at the urban edge converge in time-space more rapidly with other places in the city than either the center or any points intermediate between the center and the edge. This transfer of transport accessibility advantages from the centers to the edges of cities needs documentation in regards to economic and social implications. Traditional analytical focus on notions of absolute space hide such profound topological restructuring of cities. In contrast, functional measures of distance (e.g., cost and time) illustrate clearly how space is transformed in response to investments in transport infrastructure. The detection of such changes require an extension of data requirements, and a perfection of means to appropriately illustrate alternative geographical concepts regarding the changing space-time structures of cities.

The Role of GIS. How can GIS incorporate visualizing capabilities to capture the changing nature of transportation’s impact on city structure? While representations of complex and ever-changing geometries may
defy analytical solutions, the capability for rapid transformation of a basic database into a host of different representations is a powerful option. In order of complexity and data requirements, these representations might include:

- Simple arabic numeral notations of travel times along the legs of all road segments within a highway network
- Incorporation of algorithms to locate shortest time/cost paths between designated locations, using both continuous-space and discrete network frameworks
- Isochrone maps from any point location
- Multidimensional scaling (MDS) solutions in two dimensions
- Isotach maps for any designated scale of regionalization
- Mappings of change over time with measures of time-space convergence

Mathematics is short of any practical means to deal with the complex, multiple, simultaneous, and ever-changing geometric configurations of the modern city. However, a system which allows for the depiction of multiple views according to different methodological means and concepts seems a fitting use of GIS technology.

**Discussion:**

This paper presents two areas of need in the effort to refine our understanding of human activity patterns in cities. The first is to monitor the opening and closing of activity sites within cities and the second is to depict, by functional measures of distance, the effort required to move between activity sites within urban areas. Both of these factors impinge on the freedom of accessibility of urban residents. They both contribute to the time-geography of urban life, defining the opportunities and constraints that distinguish social groupings and different regions of the city.

Just as it is important to know how the time supplies of activities differ in accessibility for different subpopulations in different parts of the urban environment, it is also important to understand how well different client groups are served by the transportation options. To what extent do changing transportation and communication environments solve or create accessibility problems for individuals with variable conditions of constraint because of employment, household responsibility, health, and limitations on mobility? There is need to depict the travel environments for diverse client groupings. Captive riders of bus systems, voluntary users of public transportation, people dependent on para-transit services, automobile users, bicyclists, and pedestrians all have different patterns of accessibility. As with the activity sites in the city, public transportation services are often constricted to certain periods of the day and to disparate schedules and routes. These alternative transportation environments need to be identified. The multiple time-space realities for different populations need representation and comparison. Can Geographic Information Science help?

**Biography**

Donald G. Janelle holds a Ph.D. from Michigan State University and is a Professor in the Department of Geography at the University of Western Ontario in London, Canada. He chaired the Department for five years and is a former editor of The Canadian Geographer. Research interests include the time geography and social geography of cities, concepts of relative space in transportation geography, and spatial aspects of urban conflict behavior.
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Information and the Fusion of Spatialities

Aharon Kellerman

Information has been defined as a "compromise between presence and absence", since it represents a "form of something without the thing itself" (Latour 1987, p. 243). Communication is, thus, "being; persons literally occupy the media they use; their existence cannot be separated from these symbolic systems" (Adams 1995).

The flow of information is extremely abstract, even more than that of capital. Whereas capital flows can be measured quantitatively, by a limited number of convertible currencies, it is impossible to measure information, and its contents may be endlessly varied. Capital always departs from a specific location and reaches another one, whereas information is transmitted from one location, and it may either not be received by anybody, or it may reach several locations simultaneously. Moreover, global capital flows undergo local concretization processes through urban construction projects which imply fusions with local spatialities. Information remains abstract and uniform all along: at its origin, in its flow and in its destination.

Information transmission, notably through the mass media, may play a decisive role in the formation and fusion of spatialities as has been shown for films (Hopkins 1994) and television (Meyrowitz 1985; Adams 1992). The spatialities of information comprise spaces of representation or imagination, which may fuse with local material spatial practices (experience) as well as with their representations (perception). Contemporary information flows are interrelated with experienced space. They reflect an increased curiosity about other places and spaces, which may be translated into tourism, which on its part, may bring about additional information flows (see Lash and Urry 1994, p. 309).

Our concern here is with the role of computers in fusion processes of spatialities, which is different than that of television broadcasting. Computer communications is personal in both the creation and maintenance of social contacts, as well as in the selection of information, compared to monolithic television (Adams 1992). This discussion is, therefore, confined to the function of computers as instantaneous information machines, permitting the storage, processing, retrieval and global transmission of information. These capabilities yielded global information networks, notably Internet, which "have come to be experienced as places where we network: a networld" (Harasim 1993, p. 16).

It is important to distinguish between space and place in film, television and computerized information, on the one hand, as opposed to these media as space/place, on the other. Landscape in films was defined "as a filmic representation of an actual or imagined environment viewed by a spectator" (Hopkins 1994, p. 49). The process of transforming real landscapes into artistic ones was termed by Benjamin (1986) "mechanical reproduction". However, space in computers is more complex in its reproduction and expression than in films and television. As will be detailed later, space can be reproduced in computerized information in rather simulated and schematic forms, such as maps. It further serves as a language for the very use of computer information networks, so that language and space become unified rather than separate as was argued for television (Adams 1992).

Television as place was defined as: "(1) a bounded system in which symbolic interaction among persons occurs (a social context), and (2) a nucleus around which ideas, values, and shared experiences are constructed (a center of meaning). It is obvious that these two conceptions of place are closely related: social life is founded on shared meanings and meanings are created through social life; each constructs the other" (Adams 1992, p. 118).

In computerized information transmission the interaction among persons is both symbolic and interpersonal, and these two interrelated aspects of the medium as place are tied with the representation of space and place. The simulation of space and the use of spatial language are forms of representation which constitute social...
formation in the construction of virtual communities and sense of place. The latter reinforce the use of
geographical language and symbols, or a signification of place and space takes place (see Hopkins 1994, pp.
51-2). Space production has, thus, four dimensions in transmitted information: simulation, metaphor and
language, community, and place production or sense of place. These dimensions appear through varied
expressions, associated meanings of space, and local expressions (Table 1). These spatialities will now be
presented and commented upon from the perspective of fusion.

Simulation

Simulation refers to the computerized two or three dimensional presentation of non-local territories and
landscapes, in the form of pictures, maps, or short films. Such simulations constitute an integral part of other
media as well, notably movies and TV. However, here the "importing" of these simulated landscapes is
controlled by the viewer, regarding choice and type of information. Furthermore, whereas previously a person
had to visit immovable places, computer images allow the viewer to remain geographically static and the
"places" to become dynamic. Despite the growing sophistication of multimedia transmission, simulated
landscapes cannot replace the uncontrolled and unmediated physical presence in other locations, but they do
permit the transmission of geographical images without the friction of distance, time and costs involved in
physical visits. Simulated geographical images may faithfully represent transmitted landscapes. However,
sometimes they may bring about a homogenization of distinct places and landscapes, such as in the standardized
street maps of the Magic hotel reservation system.

Simulated landscapes may possibly be integrated in the near future into "mirror worlds", the technology for
which exists already. "You will look into a computer screen and see reality. Some part of your world...will hang
there in a sharp cool image, abstract but recognizable, moving subtly in a thousand places" (Gelernter 1991, p.
1). These places may not only enhance the functioning of virtual communities, but they may permit production
and business, from home or from any other single site. Under such circumstances real places and virtual ones
may fuse with each other.

Metaphor and Language

Language is an important ingredient in place making (Tuan 1991), and vice versa: space can also become an
important element in language construction. Space serves as metaphor in computer networks and programs in
two ways: verbally, through the use of geographical language, and graphically in the adoption of place icons and
symbolic landscapes. Geographical language is used, for example, when "travelling", "navigating", "cruising",
or "surfing" the Internet system (see Schrag 1994). It is also used to describe one’s position on a network,
through phrases such as: "see you online!", "let’s meet online", or just "I’m here" (Harasim 1993). The common
name for global information transmission "the information superhighway" is also geographical. Graphically, the
use of place icons and symbolic landscapes is rapidly approaching Gibson’s (1985) science-fiction "cyberspace",
envisioning three-dimensional urban landmarks replacing text and icons. Symbolic places and landscapes are
used as opening screens for standard computer programs and network communications (e.g. MS-Office, Apple’s
eWorld, Magic Cap, ImagiNation Network), so that they constitute "geographic interface" (Schrag 1994).
Symbolic places are also used as guiding structures for social networks (e.g. MOO), which are organized along
neighborhoods, buildings, rooms, etc.

Spatial metaphors are attractive since they are well known to computer users from their daily lives, and are
simple to use (Schrag 1994). On the other hand, the spatial language must be extremely homogenized and
simplified in order to be understood by people of different cultures and languages. This rather shallow global
spatial language may be in conflict with local rich spatial languages. It seems, however, that the more
meaningless location becomes in global space the more geographical language and symbols increase in
importance for instantaneous computer communications. Thus, when space loses its basic significances as
territory and distance it has an important role as interface, medium, and basic common denominator in virtual
images.
Virtual Communities

Computerized global networks may develop into placeless social communities, or "virtual communities" (Rheingold 1993a; Mitchell 1995), turning the networks into a new social space (Harasim 1993), or "electronic agora" (Mitchell 1995). They amount to an extensibility of human beings across distance (see Adams 1995). Communities without a spatial anchoring, such as religious ones, are not new (see e.g. Halbwachs 1980, p. 136). However, the social bonds in virtual communities may not necessarily be as strong, since joining and leaving may be flexible.

Computerized networks may partially replace space as a mediator and context for the emergence and maintenance of human relations, yet space and spatial language play an important role in the functioning of such social networks. Some global networks may develop around an initial location, (e.g. the San Francisco-based WELL network) (see Rheingold 1993b); others, such as MOO, may also be organized around a symbolic city, implying centrality and agglomeration in the number and intensity of communications to specific "rooms", "buildings", or "neighborhoods" (see Schrag 1994). Such a network structure may also imply differentiated times and codes of usage between business meetings in "meeting rooms", and chats in "cafes" (Harasim 1993). Spatial structuring of virtual communities constitutes a fusion of local and global spatialities. Concepts and ways of behavior shaped and originated locally are fused with global social networks, which set their norms of behavior accordingly.

Place Production

The emergence of global social networks, and the growing interaction with global information networks bears upon the sense of place of users and on processes of place production. Halbwachs (1980, p.134) proposed the terms "implacement" and "displacement" for social reactions to urban changes. By the same token, the simultaneous sensing of local-physical and global-virtual places may be termed "coplacement".

The major aspect in this regard is the growing tension between the distant and the local, the absent and the present, or between disembedded space and place, expressed in distanciation and time-space compression (see Giddens 1990, p.118). Distanciating transportation and communications brought about the so-called "hyperspace", referring to experienced space which does not coincide with the place where it occurred. Conflict may, thus, arise between imported images of places and a possible later lived experience in them (see Gupta and Ferguson 1992). By the same token, when the experienced space is metropolitan and the experiencing people live in non-metropolitan areas, then growing distance may produce fantastic "imagined worlds" (Appadurai 1990).

The development of a sense of place around real places is a long-term and continuous process; this is not so for instantly replaceable virtual places. The latter do not provide the physical sensing of places, nor a third dimension of depth, natural movements, air breezes and winds, or smells and sunshine. In addition, virtual places have no history and may not have an impact on a collective memory. The exposure to distant places and people may, thus, bring about the need to strengthen local identities through the fostering of local heritage. However, the involvement of the media in such processes may turn such a trend into a rather synthetic "global’ localization” (Thrift 1994; see also Massey 1994; Castells 1994).

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Table 1: Spatialities of Computerized Information

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Biographical Sketch

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Gentleman Adventurers in the Information Age: Accessibility, Activity, and Urban Futures

David Lemberg

Jules Verne’s Around the World in Eighty Days (1873) presents an allegory of spatial connectivity in the height of the Industrial Age. In the story, he shows through the journey of Phileas Fogg, a gentleman adventurer, that with knowledge, resources, and initiative, one could use the various transportation modes available to circle the world in 80 days (or in extension could travel from London to any part of the world within a couple of months). In 1872, the completion of a world-wide set of steamship and railroad links allowed Mr. Fogg to attempt and complete the journey equipped with just a set of maps, a packet of rail and steamship schedules, a British passport, and a carpet bag full of pound notes. The story also introduced to the Victorian Age the dawn of the Information Society. Perhaps was even more fantastic to the world of 1872 than the journey itself was the speed at which reports of the journey could be transmitted back to the newspapers (and wagerers) back in London. The new spatial technologies in 1872 were the undersea telegraph cables and fast mail-packet ships, which introduced the world to the fast, long distance communication that we now take for granted.

But how does all of this relate to spatial technologies, geographic information, and the city? While Verne did not explore changes in urban form, I would hold that his story of a shrinking world in the Industrial Age has many lessons for us in terms of connectivity and accessibility in human spaces, as we now experience another phase change in the Information Age. A hundred years after "Around the World in Eighty Days", I can not identify an equivalent work of literature that so well defines spatial connectivity in the Information Age. Spatial connectivity has changed enough that some sort of sequel is in order. We can now easily circle the globe in three days using regular air schedules (less than 24 hours in a Concorde). I won’t try to convert £30,000 in 1872 into 1996 dollars, but $2,500 should get you anywhere you need to go. The array of telecommunications available is even more impressive; voice and data transmission over surface and satellite connections allow one to communicate from and to any location on earth. In short, like Phileas Fogg, we all now have opportunity to become gentleman (gentleperson?) adventurers, able to travel to or communicate with any person or location on Earth given enough resources.

In theory, if we really do have the ability to travel to or communicate with any person or location on Earth, we could live anywhere we wanted to live. In reality, of course, we don’t have unlimited resources, and in fact, resources vary widely by individuals, by groups, and by societies. I am operating under the hypothesis that our future urban form is going to be based on accessibility, much like the past urban forms have been determined by their transportation systems. The major question to be posed in this paper is how the concepts of accessibility and connectivity must expand to fit a world where more and more spatial interaction occurs over the telecommunications networks rather than the transportation networks. Telecommunications costs are becoming elastic over greater distances. With equal costs and equal time for one mile, ten miles, a hundred miles, and one thousand miles, many traditional aspects of spatial interaction in urban hierarchies such as distance decay, intervening opportunity, and activity spaces become less important, irrelevant, or distorted from the present norm. Accessibility and connectivity as determinants of human settlement patterns must reflect both linear and nonlinear network links.

Much of spatial and locational analysis is based upon functions of accessibility. Accessibility is defined in Johnston's Dictionary of Human Geography (1994) as "the ease by which one place may reached by another". Measures of accessibility include geodetic distance, topological distance, route distance, travel time, and travel cost. Accessibility may be applied between two sites or as a measure or index of a site to its situation, or may also be used to show the relationship between a location and some aspect of the space around the location (ie. accessibility to job opportunities). The transportation technologies available to the individual or group and the connections of the transportation network at each place also factor into the accessibility equation. As transportation techniques have improved and diffused from foot and wind oriented transportation, through
steam and hydrocarbon driven transport, to copper and silicon based telecommunications, accessibility between places has improved.

Another component in the general definition of accessibility is the existence of barriers. These barriers may include socio-economic status (ie. one can not afford a car) or belief (the Pennsylvania Amish won’t use cars or phones). In reality, there are not many true barriers, but many impedances to accessibility. An impedance is a resistance factor. An example of impedance is that while many urban dwellers can afford cars, traffic, parking, and other factors can make many of those people resistant to auto ownership. There are impedances to all modes of transportation and telecommunication. When impedances become very high (close to one), they become barriers.

The advent of telecommunications as a major factor in our activities and interaction creates a number of problems with the general model of accessibility. The general measures of accessibility: distance, time, and cost are irrelevant on the Internet. In real terms, if you hook into the Net, it is as easy, fast, and cheap to send e-mail to another continent as it is to send it next door. In a wired world, there are both real places where people live and time and space are constraints, and virtual places where people can come together without the constraints of space (time constraints are whether the parties are all simultaneously awake). So what is a modern definition of accessibility?

A modern definition of accessibility is not from place to place, but rather from a person or persons in a place to other persons and places. To develop an index of accessibility, one would need to define a set of activities and interactions for a person or group of people and tie each of those activities and interactions to various spatial and non-spatial (telecommunications-based) transportation technologies. Accessibility is a measure both of the ease of interaction between locations and a measure of the socio-demographic-cultural-behavioral aspects of the individuals or groups interacting. In order to develop new tools for site location, activity analysis, transportation analysis, etc., geographers need to include non-spatial transportation activity into measures of accessibility. One can not analyze the effects of spatial technologies on the disadvantaged in the center city and rural periphery without an understanding of the impedances and barriers to their use.

Accessibility is a multiobjective function. The accessibility of one location to another location is a weighted sum of spatial and non-spatial network accessibility factors. The spatial factors describe the connectivity and impedances in the surface transportation systems (roads, railroads, waterways, and air routes). All of these spatial networks are subject to the general rules of spatial interaction such as distance decay. Non-spatial factors describe the telecommunications links between places. While there are still some distance effects in telecommunications such as long distance toll calling, the costs of such tolls have been steadily dropping to the point where they may soon disappear or at least become so low as to be a minor factor. In terms of the gentleman adventurer on the global network, we can describe network accessibility as the combination of network connectivity (both spatial and non-spatial), knowledge, resources, and initiative.

Network connectivity may be physically represented by the network infrastructure. For the spatial network, this is the road, rail, water and air connections. These network connections are a major part of our current urban structure. Our future urban structure will continue to be strongly effected by these networks, especially by the system of airline hubs and local, regional, national, and international delivery systems. The airline connections will facilitate the decentralization or transfer of service and information processing locations, allowing fast face-to-face meetings where telecommunications will not suffice. An example of this trend is in the growth of the Salt Lake City metropolitan area around a combination of skilled labor and a worldwide airline hub (Wysocki, 1996). Improvements in the logistics of package delivery systems have created a fusion of spatial and nonspatial networks. The spatial component is the combination of public (Postal Service) and private (Federal Express, UPS, DHL, etc.) carriers that can cheaply and efficiently deliver packages same-day, overnight, or within a few days to any location. The nonspatial component of this network are the mail order (really phone order or net order) catalogue stores that use the delivery carrier network to provide all of the necessities and luxuries of life. This remote shopping system should facilitate exurban settlement, just as the Sears- Roebuck
catalogue facilitated rural living a hundred years ago.

The non-spatial network infrastructure includes the line connections, the line speed, and the line capacity of the telecommunications network. This includes connections of copper wire, coaxial cable, and glass fiber, but can include non-linear cellular or satellite connections. With that network, speed and capacity impedances may limit the types and quality of the communication and information available. There are also carrier impedances. Are network connections worldwide, regional, or only local? What information mode impedances exist on the networks? What does one need to communicate, and how does one communicate? Is text, voice, graphics, or video, or some combination of modes required? Does the task need real-time interactive communication or is batch-mode communication sufficient?

We are now seeing the equivalent of the historic railroad wars among communities, with small towns in the Midwest lobbying and granting incentives for fiber optic lines instead of steel rails (Woutat, 1992). In terms of urban forms and competitive advantage, it is the suburban and exurban lands that have the advantage in telecommunications infrastructure. It is much more difficult to pull lines through old urban neighborhoods with antiquated housing, especially with lower indigenous demand for the services to drive the installation.

Knowledge is the second component of accessibility; both in knowing what is available and in knowing how to use what is available. Using our spatial transportation network provides few roadblocks - almost anyone can learn to drive. Our more complicated multimodal transportation and computer based telecommunications systems can present more barriers. They pose a number of problems, especially for the non-technically educated population in the center cities and rural backwaters. Can one learn to use the computers, terminals, user interfaces, etc., and conversely, can the service providers simplify net access so that computer literacy, or literacy in general is not required? What are the learning curves? How may the language barriers be overcome for non-English speakers and non-Jargon speakers?

Of perhaps greater concern is how the unskilled and low skilled ex-industrial workers may gain employable skills in the Information Economy. Telecommunications can aid in spatial mismatch problems only if there are jobs that can be done remotely. A problem more germane to geographers is how GIS technology may be used to represent and build multimodal trips and how the "geography of the net" may be presented in some meaningful way. In a GIS, these network connections can be represented as nodes and links. The nodes represent both the location and the connectivity impedances of individuals, groups, and places. The links represent the connectivity between nodes on the network and the weighted impedances of those links.

One can visualize many layers in the global network; one layer for each mode of transportation and telecommunication, and different layers for different carriers and cargo (ie. information, package delivery, bulk freight, etc.). Part of the knowledge required for full access to the "information highway" is a mental map of the virtual geography. Searching and indexing information on the Net can be a barrier. How does one find what is out there? In the spatial world, you can represent the entire space in one world map; in the virtual world, there is no such representation.

Resources, both financial and temporal, are the third component of accessibility. For the urban poor, resource constraints include computer terminal purchase costs, access charges, use charges, line extension and hookup costs, etc. There is also the question of time available - if one is working full time for subsistence wages, there is little time available to learn about new technologies. Phileas Fogg had independent means, but time constraints structured his entire existence. In modern times, our activity schedules constrain our interaction. In location decisions, our modern adventurer must balance his or her financial and temporal resources against their activity requirements and preferences. The task is to overlay the types of amenities, employment, and connections available at each location upon the costs, speed, and convenience of the various modes of spatial and nonspatial travel to fit one’s activity schedule. Another interesting application of GIS could be to collect, process, and visualize some index of local accessibility, perhaps as a synthesis of activity spaces on a network (Miller, 1991) and spatial / nonspatial connectivity.
Initiative is the final component of accessibility. One must have the initiative to use what is available or to locate where one can maximize the mix of jobs, amenities, and lifestyle. Impedances to initiative can include religious, ethnic, cultural, or subcultural biases against mobility or against using or learning to use new technologies. The center city and rural peripheries concentrate many of the groups that hold to such biases against change, novelty, mobility, or education. There are also political constraints for some locations (mainly foreign) including travel restrictions, government censorship of information, government distortion of information, government monitoring of communications, and embargo of information goods, and services.

It is difficult to predict the impact of emerging technologies on urban patterns and socio-economic structures. As an example, Castells (1989) in "The Informational City" does a good job of extrapolating an Information Age society from the Reagan - Cold War era. The fall of the Iron Curtain and the subsequent de-emphasis of military expenditures made much of that analysis irrelevant. Based upon technological trends, possibilities in urban development include decentralization of urban functions, breakdown of urban hierarchies, emphasis on amenities for location decisions, loss of unskilled and low skilled jobs, and stratification of individuals, groups, and locations by access. Given these trends we will see (are seeing) the creation of Information Age relict populations in the urban centers and rural peripheries. If we propose public policies for mitigation of these problem populations based upon accessibility deficiencies, our priorities should be limited to applying resources to build connectivity (extending infrastructure) and to further education (in basic skills in telecommunications use and in job skills in an Information Economy), for without knowledge and connectivity, any other resource allocation (such as location subsidies or "a computer in every pot") will go for nought.

In conclusion, I would venture to say that there needs to be much more work on how this definition of the aspects of accessibility in the information age effects the future of urban structure. In particular, if we are to continue to use spatial models in generating and evaluating urban policy for site location, service districting, etc., we need to develop metrics for accessibility. I would explore this area in terms of my own work in group spatial decision support for urban planning. In order to collaboratively generate feasible policy alternatives, the parties and interest groups must agree on the objectives and constraints of the problems. While distance and travel time are easily measured, measures of accessibility are more subjective. From a practical standpoint, how could GIS be used to facilitate the measurement of accessibility in our urban neighborhoods? How could such a system overcome the barriers of language and literacy we face in collecting data in the urban cores of our cities? Could we use GIS as a tool to promote consensus between the neighborhoods and city hall on measures of current conditions so that the planning staff might be able to model future needs and solutions? Spatial technologies may be the driver of urban change in the information age, but could also be the key to developing the tools to manage the effects of those changes.

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Improving Accessibility to Spatial Information on the Internet

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Recent advances in telecommunication and information technology have greatly enhanced our way of accessing and working with spatial related information. Being a high-speed and world-wide information network, Internet has fundamentally changed our ways of spatial interactions and information transformations. Yet recent surveys show that rapid development of the Internet has also caused problems of inequality in accessing information. (See the results of User Survey of WWW at http://www.cc.gatech.edu/gvu/user_surveys/.) Those who can access and be able process information timely will be empowered with tremendous advantages over those who lack the access (Armstrong, B. 1995; Shostak, 1996). This, according to Castells (1989) will inevitably lead to polarization and re-segmentation of information society, which in his own terms is the rise of dual city. In fact, the polarization is far more popular and significant than what Castells realized in 1989. Different accessibility to information, in our view, will likely result in differentiation of new social strata. The root of this re-segmentation, however, is along the dimension of information, which is far beyond the traditional view of social segmentation (e.g., by income, employment, ethnic group etc.).

This new form of polarization, which is also one of the topics of this research conference, has already been noticed by many scholars. To us, the polarization consists of two distinctive segments of population: on one hand, there exists a group of people who can keeping track of information development and is frequent visitors to or live in cyber-city (society) (Batty, 1995; Mitchell, 1995; Also see following addresses--http://www.unet.com/manchester/, http://wwwcsif.cs.ucdavis.edu/virt-town/town-graphic.html); And on the other end of the spectrum, people, who either are afraid of or have difficulties in accessing information, are left out, while still keep the traditional lives of industrial society (Armstrong, M. 1995). These two groups, of course, will intersect with other social strata defined in traditional ways.

There are, perhaps, two reasons causing this dual-structure. One is attributable to the level of physical access to digital information. Those who cannot afford a computer and do not have access to a computer certainly cannot process any digital information. The other is attributable to the inertia of traditional life. Those who have the access but do not want to use it, or fear to use it will also be left behind. This group of people are usually those of aging, female, high schools students etc. who are laymen about information technology and reluctant to access information. And this is the group of people for whom we intend to improve their accessibility with specific reference to geographic information.

The inertia of traditional life is particularly a problem for accessing geographic information, not only because of the complexity of finding information (combinations of graphic and textual information), but also because of inability in processing geographic information on-line. In this paper, we address this issue while developing some GIS tools over the Internet. These tools will help to enhance general users’ ability of getting and processing geographic information, thus reduce the second cause of the dual-structure of information city.

GIS is one of most powerful tools dealing with spatial information. However, its usage over the Internet is limited to querying and acquiring geo-referenced data or images. To our knowledge, no GIS tool is available for processing geographic information on the World Wide Web(WWW), a multimedia-based method of integrating information on the Internet. There are two distinct problems associated with processing geographic information on the Internet. One is the accessibility of information to a GIS package, and the other is users’ accessibility to GIS functions or tools on-line (on the Internet). Although these two issues are interrelated, they follow quite different strategies in processing geographic information. To link on-line spatial data to a GIS package, one would either improve his own GIS packages compatibility to other data forms or to integrate other forms of data into the package. The former is similar to what is now the industrial buzzword of OGIS or open GIS (Kevanny,
1995). The latter falls under data integration into a GIS environment. To process geographic information on-line, the data model and tools must be platform free, and be able to apply GIS tools to the readily available geographic information. In this study, we limited our work to on-line geographic information processing. Our approach is similar in spirit to one of the goals of open GIS: an end user does not have to know GIS, but the process may relate to a GIS model. Thus, people will never get into a GIS package but still be able to perform GIS or other spatial modeling. A set of tools is a side bar while accessing geographic information on the Internet. An end user may have no knowledge of GIS or might have refused to use GIS as a package, but he or she may be delighted to use one of these tools to solve his or her own spatial problem.

To implement this strategy on the Internet, we use JAVA, a flexible and powerful computer language designed for programming on the Internet. First, we develop stand alone prototypes of GIS tools on the World Wide Web (see http://www.geog.buffalo.edu/~gelin/GeoView for an example). Then, we demonstrate how to apply these tools on the Internet. Besides enhancing general accessibility to geographic information on the Internet, there are several potential applications of these tools. For instance, GIS tools on Internet will help to expand GIS education to students in community colleges and high schools, where up-scale computer hardware and software are often not available.

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The Bridge Project: Developmental Paths

Seymour J. Mandelbaum

A. Introduction

In 1994, the National Telecommunications and Information Administration announced a program of grants to promote "the widespread use of advanced telecommunications and information technologies in the public and non-profit sectors," and to "help develop a nationwide, interactive, multimedia information infrastructure that is accessible to all citizens, in rural as well as urban areas."

The first round of projects under this Telecommunications and Information Assistance Program (TIIAP) are now largely concluded and the second (1995) round is underway. In this second round, I am responsible for the evaluation of "The Bridge Project" in the four "communities" joined together in the Philadelphia/Camden Empowerment Zone. (The Camden EZ process has been so slow that we are not sure that the Bridge will ever extend across the Delaware.)

The Bridge design is grounded in an intriguing (because contingently conflicting) combination of an ideological commitment to the democratization of access to knowledge and to the "empowerment" of the residents of small areas as a strategy of inner city economic and social development. The partners in developing the Bridge -- including the Free Library, WHYY (the regional public television station), LibertyNet (a freenet serving non-profit organizations), and the Philadelphia agency largely responsible for managing the EZ process -- will create (with their own resources and a healthy dose of federal dollars) a set of information centers providing computer access to both a specialized EZ menu and the general resources of the Internet. Individuals -- supported by an instructional program and staff -- may use the computers with or without individual e-mail accounts.

I propose three complementary options for the Fall conference in Baltimore:

1. Several months ago, I asked Phillip English at NTIA whether the central staff had prepared a synthetic assessment of the 1994 projects: what had been demonstrated? what new uncertainties had been created? (I wanted to build my evaluation plan upon that synthesis.) The 1994 projects were still preparing their final reports so that my query was premature. I assume, however, that by September, NTIA will be ready and eager to report. I hope you will create a panel to comment on its synthesis. I would certainly be delighted to participate in such a panel.

2. Our first information centers will open in April. By late July, I will be prepared to post an expanded research memorandum that reports on the attributes of the initial group of residents to use the Bridge resources and the character of their first experiences. I will also be able to describe in a preliminary way the interaction of the new information resources and the discursive practices of EZ committees and non-profit organizations acting within the Zone.

3. Finally, I would like to use the Bridge experience to reflect on a large issue posed by the call to this conference: the articulation and assessment of developmental paths.

B. Developmental Paths

From the beginning of the Bridge Project, I described the partners as engaged (borrowing Albert Hirschman’s term) in a "developmental journey" in which they would repeatedly and in no particular order anticipate the dynamics of unfamiliar futures, encounter unforeseen contingencies, choose and assess directions and havens, and select mistakes to be rectified. We would necessarily be attentive to the measurement of performance on
prescribed dimensions. Principally, however, we should be concerned with the intelligence of our course; with the ways of becoming.

In various forms, participants in our discussions repeatedly evoke the image of a "journey" to an indeterminate destination. "It's a process," someone insists. "We're learning." "Take one step at a time." "Be adaptive!" There is nothing arcane or abstruse about this image. Indeed, it is precisely because it is so common and so compelling that it is so difficult; so hard to specify consensual criteria for intelligent navigation. The developmental scenario -- the rhetorical form within which we navigate -- is an eclectic discursive practice that stretches from the past into the future accommodating historical explanations, experiential craft, abstract models, forecasts, and ethical claims. In contrast to the professional "tools" of experimental design and output measurement, the norms of speaking and acting within scenarios do not appear as a superordinate discipline: they emerge within the journey as modes of collaboration rather than providing a universal compass at the outset of the voyage.

The difficulties of crafting discursive tools of developmental intelligence are accentuated by the plurality of voyages. There is to be sure a dominant developmental journey. NTIA has impressed us into a narrative in which a new "infrastructure" must or should be "accessible" to everyone. Frequently at our meetings, someone will adopt the federal agency’s image of a revolutionary epoch: those who don’t quickly learn how to navigate in cyberspace will be "left behind." We may disagree among ourselves about particular configurations, the pace of change, the strategic importance of adults or children as agents of change, and the appropriate historical sequence in which to locate our moment and shape our expectations. We agree, however, that ours is an attempt to modify the ordinary diffusion pattern -- as it appeared, for example, in the spread of telephones, broadcast and cable television, and VCR’s -- so that the residents of low and moderate income neighborhoods participate broadly and quickly in the resources of the Internet as a communication medium and as a vast library.

There are, however, other communication-centered journeys that are not dominated by the revolutionary image of a distinctive new technology. The Internet is not like the familiar interpersonal, telephone, radio and television systems: successful use is linked to practices of reading and writing rather than listening and speaking; to understanding the ways in which intellectual structures make information tractable. A voyage designed to democratize literacy and knowledge requires a scenario that wrestles with their social patterning and the dynamics of inequality; with the formation of opinion and mind.

Some voyages at the table are, however, only incidently about communication. For some of the participants in the project, ours is an exploration in community and the design of political institutions: the scenario in which this voyage operates begins (in the most familiar version) with the Grey Areas program and Model Cities. Set within this history, it is possible to believe that a shift in the dynamics of public communication networks may influence power, participation, communal discipline, and governmental competence; difficult to imagine that the forms of political interaction will be dramatically transformed by access to the "information superhighway."

The partners who have imagined the Bridge Project meet regularly either face-to-face or remotely, and have created at least a temporary organization -- centered on a "project" -- both to navigate these multiple journeys and to define the norms of intelligent navigation. The (quite unsurprising) dynamics of our conversations -- illuminate the remarkable difficulties of the large framework evoked by the call to the Baltimore conference.

The call radiates a wonderful intellectual confidence. The questions are written in an artificial present that extends into the past and future. In that moment, we are asked to describe the ways in which changes "affect" populations and alter spatial relations; to monitor and interpret "processes" or "trends" that stretch across time and to forecast the "impacts of changing spatial technology on the city." There isn’t a great deal of difference in that present between knowledge claims centered in the construction of pasts and those designed to create contingent images of possible futures. The language of the call encourages a confident belief that "technology" or "technologies" -- the usage varies -- shape social relations (rather than v.v.) but that their "impact" can be modified or mitigated by the application of an intellectual apparatus such as GIS. If communication networks are "infrastructures" or "highways" it appears so sensible and so familiar to ask how they influence spatial
arrangements and how their impact is represented in our mapping tools.

When we actually gather together, I suspect that this confidence will fade. Talking empirically, we will shift to the past tense in a way that emphasizes the discontinuity between our factual knowledge and our forecasts; between what we know about the diffusion of the telephone and what we expect or desire for the diffusion of e-mail. We will find it difficult to attribute linear causal relations to the elements of systems and systems of systems that we recognize as heuristic constructions tearing apart and reordering tangled phenomena. (Does technology shape "the city" or is that mysterious idealization - in one of the several meanings we give to the term -- a cluster of interacting technologies?)

Even before we meet, however, reading the call from the perspective of my Bridge experience may, I hope, encourage us to wonder who is asking the questions in the text and who is answering; who is listening and who is acting. Is there a set of projects and are there forms of collective action within the interorganizational field that will shape a synthetic discursive practice? How will we both maintain and cultivate several developmental journeys simultaneously?

Those are the questions I would like to engage in Baltimore.

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**Biography:**

Seymour J. Mandelbaum is Professor of Urban History in the Department of City and Regional Planning at the University of Pennsylvania. His teaching and writing span urban history, planning theory, and communications. He is -- most recently -- co-editor of a collection of essays, Explorations in Planning Theory (CUPR Press, June, 1996). His current work deals broadly with the processes of "making and breaking planning tools." He’s particularly engaged in the evaluation of an NTIA-financed project to extend Internet access in the Philadelphia/Camden Empowerment Zone. After a long planning period, the three computer laboratories supported by the project will open this summer. He’s written a "pre-data" essay, "The Intelligence of Citizens," for presentation at the joint ACSP/AESOP meeting in Toronto at the end of July and will report in Baltimore on the first months of the new labs.

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The Intelligence of Citizens

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This is a draft of a paper scheduled for delivery at the ACSP- AESOP Joint International Conference, Toronto, Canada, July 25- 28, 1996.

I. The Bridge Project

Fair warning. Some readers may be intrigued by the title of this essay and look forward with anticipation to a comparative report on the IQ’s of the citizens of various nations or a sophisticated statistical account of the influence of the median IQ (of the median voter?) on income redistributive policy, economic development or environmental regulations. Those readers will be disappointed.

Other readers -- perhaps of a different political bent -- will be modestly alarmed by the title and its resonance with The Bell Curve. I think I can quickly allay those apprehensions. The title echoes an essay I wrote a long time ago on "The Intelligence of Universities." I reflected there on the ways in which the design of universities encouraged a remarkable "silence" about the dynamics of instruction in the midst of torrents of (sometimes) brilliant talk and set-out proposals for the creation of an information system that might discipline an "organized anarchy."

In the same way, this essay reflects on the stylized practices of citizens and the design of the political institutions in which their roles are shaped. The reflection is grounded in a critical tradition that distinguishes intelligent from unintelligent practices and designs and that enunciates a principled preference for intelligence. It is also grounded, however, in the less judgmental but equally important notion that the survival of human beings depends upon their individual and collective ability to monitor themselves and their external worlds and to make sense of their observations. Programs to alter monitoring or sense-making practices and designs in the name of "intelligence," are often painful, intruding imperially on a cognitive space that is already filled and devaluing precious social relations. Framed in the critical tradition, we are pushed to be more or less intelligent; in the tradition of systems theory, to alter the domains or forms of intelligence.

Intelligence is distributed in complex patterns across the array of political regimes: it is not confined to democracies nor is it the exclusive property of professional guilds. Even in severely authoritarian polities, some governors attempt to understand the individuals, groups and communities they lead, assess policy instruments with an eye to their consequences, and free themselves from the paradoxical tendencies to minimize the human capacities of their adversaries and to exaggerate the importance of every sign of dissent.

The pathologies of intelligence are legion and appear in quite similar forms in very different settings. Both liberal democrats and tyrants are vulnerable to narcissism: they look out at the world and see only themselves. In both command and market economies, the processes that make bureaucracies dependable often render them slow-of-foot and blind to change. Barriers to frank communication in the networks that link governors to epistemic communities and their own intelligence agencies often make some compelling messages unimaginable or (more simply) unspeakable.

Since Domesday (and perhaps even earlier) the crafts and tools of management, planning, measurement and analysis have been shaped and reshaped to enhance the intelligence of governors and to struggle with the pathologies that accompany every prosthetic innovation. Governors have often recognized, however, that their intelligence is connected to that of "their subjects" or -- more commonly, since the great revolutions of the eighteenth century -- their "fellow citizens." The links have been represented in two stylized modes, distinctive in their ideal forms and intentions but often entangled in hybrid practices. In one, intelligent citizens mobilized
as wily adversaries and demanding clients compete with the governors and exacerbate the ordinary difficulties of collective action. Framing relations in this way, governors have sometimes chosen to attack the forms and credibility of popular intelligence; at other times, to coopt or overwhelm it. In the second mode, the image is reversed: popular competence enables governors and complements their own intelligence since widespread popular ignorance makes it difficult to articulate and defend intelligent collective choices. When governors value popular intelligence in this mode, they encourage vast investments in civic education and the cultivation of citizen voices.

This paper is occasioned by my current involvement in a project designed to connect the residents of the Philadelphia/Camden Empowerment Zone to the resources of the Internet. "The Bridge Project" -- as the effort is called -- is centered at LibertyNet, a regional server at the University City Science Center, that principally links non-profit organizations to the Internet and provides a distinctive Delaware Valley information menu through its home page. The Bridge is financed by some institutional cost-sharing and a major grant from the Telecommunications and Information Infrastructure Assistance Program of the National Telecommunications and Information Administration.

The federal program under which the Empowerment Zone is financed is the latest in a long series of efforts to encourage inner-city economic development through the "revitalization," "renewal," or "empowerment" of targeted neighborhoods. Even before the creation of the Bridge, the public talk of the newly designated Empowerment Zone was rich with allusions to information technologies, life-long learning, and the relations between knowledge and power. The processes of planning and building the Bridge and other complementary systems have started to ground those images in tangible artifacts and in the software and crafts of the Internet; in shared experiences and in memories of both discovery and frustration.

If we were meeting a few months later, I probably would have presented a paper reporting on data: who enrolled in our classes? who had used the Internet and how had they used it? have we made any impress on processes of either deliberation or mobilization? have we reached individuals who were not already well-served by a great array of information services? Alas: this essay is written just as we are coming to the end of a long planning process and before the flow of evaluative data has reached my computer.

I have chosen, therefore, to reflect on the images of political intelligence that run through the loosely coupled community of public officials, advocates and scholars who have combined to shape the image that we are at a decisive moment in a long communications revolution. This community frames the arguments within which the Bridge is embedded and will, inevitably, powerfully influence the reading of my evaluation report.

My choice of topic has the advantage of integrating my current work into a critical concern of planning theorists. It has the disadvantage of presenting a distorted view of the Bridge Project. I strongly suspect that political intelligence plays a more important role in the talk of the policy community that has shaped the NTIA program than it does in conversations in the committees of the Empowerment Zone or amongst the partners who have come together to shape the Bridge Project. Later, data-rich papers and my evaluation reports will address our varied images of the uses and limits of Internet access in the Zone; the varied roles -- consumers, neighbors, parents, workers, entrepreneurs, lovers -- in which the residents of the Zone represent themselves and respond to new information technologies.

Even within the domain of "citizenship," my focus is not exhaustive. I am tempted -- imperially -- to assert that intelligent citizens must meet their obligations, defend their rights and those of their fellows, and respect the commonweal. I have settled, however, for a much more modest conception of my topic. Like governors, both "good" and "bad" citizens may be intelligent.

II. A Bi-Polar Conversation

As I (re)enter the communication policy community -- on and off line -- I am struck by two dramatically
different themes: one is driven by a deep sense of the historical failure to realize grand hopes of public intelligence and an apprehension of failures yet to come; the other by a remarkably optimistic account of a new world in the making. I’m writing this paper as a preface to the evaluation reports, trying to define a set of expectations for the intelligence of citizens that will survive the cross-currents of this bi-polar policy conversation.

The first theme is built around a perception that something is terribly wrong with the "intelligence of citizens" in the nations represented in this conference. The reported symptoms of failure are varied: banal political debate, volatile public opinion, widespread distrust for government, popular ignorance and gross incivility. In every country represented in Toronto, substantial portions of the population do not regularly engage complex political texts in their native language. Only a murky line distinguishes those who have never been "documentary literates" and those with adequate skills who find no reason to read and write as citizens. Many of those with secondary school educations and beyond know very little of the overtly "common knowledge" upon which political judgements rest: they cannot distinguish major policy positions, locate phenomena in social or physical space, reconstruct recent public events, or recognize the generalized implications of their own preferences.

To be fair (and historically aware), the level of popular intelligence may be higher than at any prior historical period but (even if true) that optimistic reading of the path of change would barely influence the profound sense that vast investments in education and communication had failed to create a deeply informed citizenry or a widely shared civic ethos.

The explanations proffered for these failures are varied and contested: some blame the schools for popular ignorance; others the economic structure of the media, the "logic" of communication technologies, the behavior of journalists, the inherent nature of the modern State or the discretionary practices of governors (including professional planners) eager to control events and to limit the stressful claims of a pluralistic polity.

The gloomy historical judgment is extended into the future by a foreboding that the new information technologies are likely to widen the gulf between information haves and have nots; that the already vast and rapidly growing flow of messages across the globe will devalue the precious springs of local knowledge; that the crafts of manipulation will dominate those of intelligence. Set within this frame, the promises of a technological cornucopia overflowing with communication networks and devices is horrific: how will robust common understandings and the intelligence that builds upon them survive in a regime of virtually unlimited channels in which immediacy overwhelms memory and reflection?

While even the friends of the new information technologies sometimes betray a Luddite strain in reaction to these apprehensions, that depressed shadow is usually overwhelmed by an ardently optimistic (even manic) belief in the possibilities -- indeed, the moral necessity -- of public intelligence. In the last one hundred fifty years, that belief has provided a distinctive political interpretation to a long series of technological and organizational innovations largely grounded in "necessities" far from the political realm. I entered the planning conversation when the technology of the moment was cable television and the glorious image of a "wired city" linked by a high capacity, broadband network that would overcome the barriers of space and social difference. Looking backward, similar images of social transformation had marked the growth of public schools and libraries, fast and inexpensive printing, and telegraphic, telephonic and radio networks.

In the present moment, that optimism centers on computer networks, the remarkable architecture of the World Wide Web, and the powerful image of an "information superhighway." The Internet -- as fact and symbol -- endows popular intelligence with a sense of technological realism; with heroes, investment strategies, policy choices, and demonstration programs. If not today then tomorrow, these great webs promise to replace the hierarchical structure of virtually every other medium with a protean form that can adapt to any organizational design, cognitive style, or communication mode; create endless links on and off the main trunks with no discernable delays; transform congestion from a structural to a temporary problem so that access to the busiest
centers is virtually unlimited.

Like its pessimistic complement, the optimistic theme is composed of several different and conflicting strands. One strand is marked by a passionate belief in the essential wisdom of "the people." The populace may require tutoring in public schools, Methodist chapels, party cells, community forums, labor colleges and the like in order to succeed in controlling their worlds. They don’t, however, have to be taught what is good or what is necessary. Indeed, it is the governors who characteristically lose this vital sense of a practical reality and must be persuaded to trust the wisdom of ordinary folk.

The optimistic view of the necessity of public intelligence does not, however, require this populist faith. Liberal and radical intellectuals in the nineteenth and twentieth centuries often assumed that most citizens were confused about their own interests, fickle in their opinions, and uninformed about their worlds. (Evidence the Marxist struggles with "false consciousness," and the liberal analyses of self-destructive individual rationality.) There is, however, no ethically credible choice for a democratic polity but to overcome the "unintelligence" of citizens. If the promises of widespread literacy, extensive education, and the communication cornucopia are still unrealized that only calls for additional effort. There is no alternative but to redesign polities to encourage intelligent and consensual deliberations; to reconcile local and cosmopolitan orientations by balancing the rapid universalization of access to the Internet with local community networks; to empower ordinary people who will attend to public affairs and choose wisely among complex alternatives when they are not manipulated by disdainful, exploitative or sometimes simply impatient governors.

During the period when I was deeply involved in what I came to call the "cable wars," I posted on my office wall a copy of an RCA advertisement dating from the early 1930’s announcing that radio would dramatically transform American education. The advertisement reminded me of the seductive quality of transformative images that draw us toward the design of the technical systems that are amenable to our control and away from the much less tractable construction of the institutions that encourage or thwart intelligence; towards the tools that are new and plastic and away from those that are deeply embedded in tacit practices and secure niches.

The talk surrounding the multi-faceted Internet is particularly seductive. The image of an information "infrastructure" permits us now to design shared public arrangements while assigning "structures" to a later time or a more private realm. The quantitative measurement of memory, access, speed, and content assimilates communication policy into a familiar rhetoric in which information and knowledge -- like money -- can be counted and redistributed.

As long as arguments about intelligence are centered on the form or capacity of communication and information processing technologies, it is enormously difficult to avoid the bi-polar tugs of intense optimism and despair. That RCA advertisement and my memories of the cable wars support, however, a very different planning sensibility: focused on institutions more than physical artifacts, wary of delaying attention to structures, and suspicious of the calibration in bytes of intelligence and the just distribution of knowledge.

III. Three Principles

I’ve articulated my application of this sensibility to the talk of the community concerned with the political meaning of the new information technologies in three principles, each one somewhat more contentious that its predecessor. My exposition of those principles leads to a conclusion setting out expectations for the expansion of the intelligence of citizens.

1. Citizens and Polities: The first principle is simple: there are no citizens -- whether intelligent or not -- where there is no polity. That principle is consistent with the most capacious definitions of polity or citizen though I am perfectly content to restrict it for now to liberal republics in which governors are subjected to the discipline of popular elections, individual and communal rights limit the coercive capabilities of the state, and both governors and citizens distinguish -- albeit often with difficulty -- between public and private domains.
Let me offer a few illustrations of this principle. You cannot be a citizen of the world. You could not be a citizen of Europe until the transnational institutions were articulated into a polity. In the United States, it would be impossible to be a citizen of most central city neighborhoods, ecosystems, metropolitan regions, or television broadcasting markets. In the United Kingdom, you can no longer be a citizen of London. In all of these situations, you may, of course, advocate the creation of a new polity or the restoration of an old one but you cannot be a member of a political entity that does not exist. You may attempt to model the exemplary behavior of citizens in the polity to which you aspire but observers may sensibly wonder whether or not to trust the model. How will the "first Europeans," act when they confront the conflict of peers rather than of shadows? How will the citizens of a new neighborhood polity engage their old collegial relations in the city or state?

2. A Useful Craft: The first (rather obvious) principle establishes a foundation for a more contentious claim: whatever the generally defining attributes of "intelligence," as a practice it is circumscribed by the role of citizens in a polity. Where major decisions are made by judges interpreting abiding principles and common law traditions, the intelligence of citizens does not depend upon the sort of general information and theories associated with the articulation of policies embedded in statutes. Where a polity is governed by "aristocracy tempered by riot" -- to borrow Eli Halevy's characterization of England in 1815 -- then the intelligent (non-aristocratic) citizen understands the crafts and limits of rioting. Symmetrically, citizens who only know how to riot are unintelligent if they enjoy a variety of much more effective alternatives or if rioting has done its work and must be complemented by the capacity to sustain the attention of a group or to negotiate across group boundaries. In a polity in which coalitions are formed prior to elections and complex policy choices are merged in generalized ideological postures, intelligent voters will attend to symbols and character rather than the details of issue pledges unless one very specific policy option is of such commanding importance that it cracks the ordinary frame of ambiguous coalition-building. In the very same polities, there are, however, often strong incentives for relatively small groups to develop a very sophisticated view of policy choices after or outside of the electoral process in order to shape legislative, administrative, and judicial agendas and the flow of decisions.

The roles of citizens are not inscribed on tablets of stone for all to read. Particularly in those circles in which a wide-ranging and information-rich popular intelligence is seen as a moral imperative, the institutional arrangements that limit the ways in which citizens search for knowledge are represented as subtly coercive, eroding the legitimacy of even overtly democratic regimes. Even if you accept that moral argument, the second principle should not be dismissed. In effect, changes in the search for information must be sustained by shifts in the ways in which citizens relate to one another and to the governors: popular intelligence must be a useful craft for those who bear its considerable costs.

3. Governors and Citizens: Since the revolutions of the eighteenth century, the term "citizen" has been a weapon used to erase distinctions between "governors" and "subjects" and between social "estates." (Theorizing about social choice in the tradition in which Tore Sager writes is an attempt to legitimate governance without relying on governors.) "Citizen" has lost some of its emotional charge over the last century but the spark is easily rekindled: evidence the debates over European citizenship, "professional" rather than "citizen" legislators, the rights of resident "aliens," and the moral claims of distinctive cultural or linguistic communities within a liberal polity. Indeed, my use of the term "governor," may appear to be either old-fashioned or provocatively anti-democratic; a challenge to Lincoln's resonant conception of "government of the people, by the people and for the people."

In the countries represented in this conference, innovations in communications and information technologies and in the design of political institutions over the last two centuries have amplified the rhetorical hegemony of the "citizen." We assume that citizens will be repeatedly asked about their political opinions as if they were legislators; that radio and television will bring citizens into the affairs of state with a remarkable (and overtly unedited) immediacy. We have (in various ways) institutionalized a suspicion of official secrets, private meetings, and ex parte administrative communication; multiplied the opportunities for "public participation," "coproduction," "consensual" group processes and direct mediation among "stakeholders." Vast government
printing houses and now home pages on the World Wide Web have provided citizens with an elaborate documentary account of political inquiry and deliberations.

My third principle holds that the first step in describing the intelligence of citizens as a useful craft is to distinguish between the roles of citizens and governors. In Lincoln’s Gettysburg triad, what do the citizens acting as governors do and what sort of intelligence does their work in that role require?

A short (and necessarily inadequate) answer to that question for liberal republics might start with the simple recognition that the governors are not a homogenous class nor, even in the most centralized regimes, are they members of a single (albeit complex) organization. The governors of a modern state are embedded in interorganizational fields with an intense (though rarely neat or coherent) division of labor, multiple and contested integrative links, and fuzzy boundaries. The work of the state depends upon a great deal of specialized knowledge: the sensible operation of housing programs cannot be expected to depend upon the housing ministry’s understanding of foreign affairs or forest management; a local councilor should be able to manage land use disputes without grasping the distributional impact of international trade policy.

The intelligence of the governing field, in contrast, depends upon at least three critical elements: the existence and capacity of monitors signalling when issue domains should be sensibly attached or uncoupled; a principled regard for the procedural rules that sustain the predictability and legitimacy of civil associations; and a process of collective choice that is grounded in public deliberation.

These three elements of field intelligence take many institutional forms even within the restricted set of liberal republics. The technical support for legislative deliberation varies widely both across and within nations. In some polities, rule-regarding behavior is maintained by privately initiated litigation in the courts; in others, that path is rarely used. In all liberal republics, the roles of integration and deliberation are supported by an independent press and by networks and career paths that link government agencies to epistemic and professional practice communities. The degree of independence and the character of the intercommunal relations are, however, quite different from one national (or transnational) polity to another.

The most distinctive element in this triad is the notion that collective choice is grounded in the deliberation of the governors. Whether or not individual governors attend closely to opinion polls, the testimony of citizens at public hearings, or the latest scientific inquiry, the intelligence of the field requires that they develop ways of sustaining a conversation with one another at the same time as they address their public constituencies. The norms of intelligent deliberation among the governors and the address to citizens are contingently -- maybe congenitally -- in conflict. The success of internal deliberations depends upon the ability to limit the political agenda and to resist the intrusion of ephemeral issues; the address to citizens upon an expansive and timely openness to their aspirations and fears. Internal deliberations depend upon a willingness to be persuaded and to invest in the act of persuading one’s peers; a civil tongue, prudence, and stable public standards of logic and evidence; a discursive practice that allows familiar or passionate issues to be reframed or reorganized. While those qualities may appear in the public address, they often yield in that open arena to the discursive tasks of mobilization and the affirmation of shared values.

IV. Expectations

The rhetoric of "citizens" (and "citizenship") tends, as I have already observed, to obscure the difference between citizens and governors. It also encourages the representation of citizens as a normatively homogenous group -- "one person, one vote" -- in which distinctions are suspect. If, however, the governors are arrayed in complex, inter-organizational fields, it would be quite remarkable if the corpus of citizens were not similarly structured; if their roles and intelligence did not take on the form of those fields.

And, indeed, they do. The complaints about the failure of communication innovations to transform public intelligence are not centered on the difficulties of mobilizing citizens who share a well-bounded common
interest: they want a site to be developed, to close family planning clinics, or to secure changes in the tax code. In liberal republics, citizens read the signals emitted by the governing institutions and mobilize "special interest groups" to influence executive agencies, courts and legislatures where the signs are propitious. Promised money or control, they will cooperate in the creation of homeowners associations, empowerment zones, and community development corporations to command the new resources and to shape their uses. Assured that central planners cannot be moved, they will hang back. (At times, of course, citizens misread the signals and are either frustrated when their efforts are in vain or amazed when they triumph against "impossible" odds.)

We usually expect that the "local" knowledge of these groups will be superior to that of the governors: the residents of a neighborhood will, for example, know more about their own values and the state of the housing stock than the central planners. We are properly suspicious of criticisms of popular knowledge that are grounded in a snobbish preference for a particular accent or adherence to arcane bureaucratic or legalistic protocols.

Sometimes, of course, that expectation is mistaken and looms as an obstacle to communication. The members of the ephemeral communities of interest created by proposed public actions characteristically do not share a deep understanding of themselves, their immediate worlds, and their recent history. Acting as individual clients of the state, citizens (and the groups they form) often do not know enough to co-produce a desired service: parents do not grasp the dynamics of education well enough to complement or rectify the work of public school teachers; neighbors do not have the insight or skill to cooperate with police officers in maintaining the moral order of their shared space.

Electronic mail, bulletin boards, new information displays, and vast libraries of official documents delivered to personal computers may reduce the costs of creating and informing these groups, multiplying their number and allowing them to speak with an intelligence that matches that of the governors. The experience to date with "community networks" and electronic forums is, however, so modest that it is difficult to assess their prospective impact on the canniness of groups in reading and responding to government signals, their ability to sustain informed leaders and shared memories, and their adaptive response to the congestion of the public arena. We don't know whether a new physical "infrastructure" will increase the robust durability of temporary interpersonal networks.

Those three qualities -- canniness, informed leadership, and the response to congestion -- are serious goals for an intelligence program focused on special interest groups and the coproduction of services. The enthusiastic advocates of the information superhighway are likely, however, to find them too modest. The critics of the banality of the political culture may even see them as pernicious extensions of adversarial democracy, a game of mutual escalation without any change in outcomes. Is there room for a grander conception of the intelligence of citizens: is there a useful craft for citizens that matches the three critical elements in the intelligence of the political field?

The third principle suggests a rather straightforward positive answer: the forms of field intelligence within governments encourages the creation of inter-organizational networks within civil society. These networks never span the full social range of large polities and federal systems; nor do they attend to the entire political agenda. The leaders of many industrial, labor, religious, environmental, ethnic, and professional associations, elite business commissions and conferences, community leadership circles, and, above all, political parties do, however, (variously) cultivate the three critical elements that characterize the governing field. They are also subject to dilemmatic tugs between their internalized deliberative practices and an open address to their members and prospective members. Like the governors themselves, they sometimes try -- as in the great debate over health care in the United States -- to present a simple and aggressive public message while negotiating privately in a complex and inflected voice; sometimes to speak in public in a tone of sweet reason while privately defending every bastion aggressively.

These networks are already very communication-intensive. Their external campaigns and internal deliberations
are sustained by a constant flow of mail, facsimile, and telephonic messages; by newsletters, advertisements, seminars, conferences, magazines, and press releases. The new information technologies are such congenial extensions of the common practices of these networks that I find it difficult to imagine that they will transform the intelligence of those who are already so deeply engaged in the crafts and dilemmas of citizenship.

Whether or not these limited expectations are correct, I suspect that most critics of liberal republics are not likely to see these interorganizational networks as agents of the democratization of political intelligence. Indeed, they are often represented as a dangerous extension of a political practice dominated by special interests. Is there any use to the sensibility that seeks to extend the intelligence of "all the citizens" of liberal republics outside the framework of interests, networks, and political classes?

The third principle suggests a modest but important role for such broadly based intelligence. A polity in which large numbers of potential voters do not understand major policy choices and the political process narrows the electoral advantage of intelligent governors and imposes a burden of unintelligent claims upon post-electoral (or, better, inter-electoral) governance. The notion that citizens as voters should be intelligent enough not to frustrate intelligent governance doesn’t have the grand resonance of the populist sensibility: it doesn’t rest the intelligence of the polity on the wisdom of the people or eradicate the ideologically troubling distinction between citizens and governors. It has, in compensation, the advantages of its rhetorical poverty: it doesn’t require that voters allocate enormous resources to making gross distinctions between candidates and parties nor that they imagine themselves grandiously as legislators attending to the entire political agenda.

The institutional implications of that modest but important role were understood in roughly similar terms by republican theorists from Machiavelli to Madison. They characteristically argued that the intelligence of ordinary citizens was limited by their inability to overcome the blinders of passion and faction. Popular intelligence was, of course, also limited by simple ignorance but that was so intractable a feature of the social system that it barely merited serious attention. In real places, it was possible to imagine ways of arranging the "springs of government" to enable republican institutions to survive and prosper despite the popular blinders. Only in utopia could republics be founded on widespread popular knowledge or virtue.

In contrast, in the nineteenth and twentieth centuries, we have cultivated the definition of the intelligence of both governors and citizens in terms of the capacity to use formal information and knowledge in shaping political action. Across the globe, states depend upon that cognitive intelligence for both day-to-day management and strategic policymaking: calibrating weapons, setting tax rates, mapping land uses. (And, it follows, to be vulnerable to the pathologies of those epistemic forms. Only when counting is your constant practice can you be deceived by statistics or tempted to lie with them.) Passion and faction -- the old enemies of intelligence -- are transmuted into preference and interest where they serve as compelling though not uncontroversial foundations for ethical choice. The new enemy -- ignorance -- is dangerous but tractable; a practical flaw that can be remedied rather than a moral failing built into human nature.

The shift in the understanding of intelligence makes it difficult, however, to operationalize the third principle in a way that allows us to assess consensually how much popular knowledge is enough to empower intelligent governors without overburdening citizens or confusing their political role. Indeed, is such a measure possible or must we depend upon the diffusion of a magical sense of democratic efficacy to encourage citizens to "overinvest" in information lest their failure to keep up with the news alters the course of events?

In contemporary states, we are all regularly brought face-to-face with taxes, regulations, subsidies, crimes, punishments and collective disputes. Repeated electoral campaigns mobilize large numbers of us to vote and remind non-voters that they are also parties to public affairs. The long hours of civic education in our school years yield at least trace memories of shared heroes and travails. The fortunes of great industries depend upon their ability to represent phenomena as "news" and to command popular attention to those representations. Even in circles of "alienated voters," political images and information are ubiquitous: denial is, after all, also a way of worldmaking. At the other extreme, it would be quite remarkable if some social circles of citizens did not take
the complex political agenda as a challenge to be mastered, as if ignorance or confusion not only threatened the commonweal but were personally embarrassing.

The pattern of highly generalized political engagement changes over time but it is impervious to dramatic or sudden transformations because it is so densely grounded in the organization of the economy, polity and civil society. A long history of institutional critique attests to the robustness of the pattern: we are variously warned that only a restoration of democratic "habits of the heart" or a redesign of work will suffice to enlarge the generalized intelligence of citizens. A similarly long history of reform schemes to promote citizen deliberation -- from early radio listening circles to James Fishkin’s recent and well-publicized assemblies -- demonstrate how easy it is to create new models of heterophilous deliberation. They also demonstrate, however, how difficult it is to diffuse them broadly, encroaching on the dominance of established communication patterns and representational forms.

Finally, while the pattern of political engagement has been repeatedly altered by shifts in the technologies of communication, there have been no great gales of destruction and replacement. Both print and radio flourish in the era of television. The apparatus of virtual communities -- electronic mail, news groups, listservers and the like -- do not replace the investigatory and interpretive crafts of professional journalists. Like "underdevelopment" or "poverty," "ignorance" is constantly created and renewed. In the first year of the Bridge Project we have been occupied by the detailed logistics of establishing computer centers and training programs. Our essential success or failure, however, will depend upon our ability to address illiteracy and the habits of mind that make the labyrinth of texts impenetrable; to encourage a new communal sense of the problematic forms and uses of knowledge and deliberation. Our conversations about those issues are marked by a new vocabulary and (often) an assertive claim that this computer world transcends old limits. The themes that run through those conversations, however, resonate with old debates over literacy, libraries, and the forms and uses of popular education.

All of which is to say -- in conclusion -- that we should not expect that democratizing access to the Internet will transform the general intelligence of citizens. Intelligence, alas, is too complex a social practice to respond to the simple increase in communication or the reduction of its cost.

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Knowledge Production and Use in Community-Based Organizations: Examining the Impacts and Influence of Information Technologies

Laxmi Ramasubramanian

I. CONTEXT

In April 1995, the American Family Mutual Insurance Company in Milwaukee settled a discrimination case by agreeing to invest $14.5 million in central Milwaukee. The plaintiffs in the case, the National Association for the Advancement of Colored People (NAACP) had argued that the company was underserving the predominantly African American community residing in Milwaukee’s north side. While the case never went to trial, the plaintiffs and their attorneys had gathered a significant volume of statistics and analyses to support their claims. Through this settlement, the community will receive financial compensation through programs which will subsidize interest rates for home purchases and home improvements. The settlement will also provide for financing cost assistance, emergency home repair assistance, and home ownership counseling in addition to providing financial relief for individual victims of discrimination.

Part of the compelling evidence that made the case against the insurance company successful was the display of geographic maps of the area such as maps that showed the number and spatial distribution of insurance policies sold in the city over a five year period. While the company had argued that it had sold many policies to homeowners in majority African American zip codes, the analysis demonstrated that the company’s best policies were clustered in largely white census tracts. Mapping the analyses based on census tracts revealed information that was not evident in analyses based on zip codes since zip codes tend to be so large that they mask differences between predominantly white and black neighborhoods (Ramasubramanian, 1995).

The NAACP v. American Family Mutual Insurance Company example demonstrates that having access to relevant information plays a vital role in identifying the issues and placing them within a problem solving framework. Second, it demonstrates that information plays a significant role in making comparisons and analysis of trends possible which in this case were required to establish the case for discriminatory behavior against the insurance company. Third, it demonstrates the power and potential of spatial analysis and maps by forcing all parties involved in the debate to address the reality and the gravity of the situation. Finally, this example demonstrates that computer-based information technologies are useful and perhaps integral for spatial mapping and analysis, storing large volumes of data, and for looking at different types of data such as demographic information and financial information simultaneously.

The NAACP v. American Family case is by no means an unique example. Over the past five years, the use of computer-based information technologies to support socio-political arguments has become increasingly popular. It is anticipated that analyses developed using computer-based information technologies will have profound implications for people everywhere because many users believe that they can be used skillfully to identify issues, make comparisons, analyze trends, facilitate policy analysis, make service delivery more efficient, and foster community participation.

II. STATEMENT OF THE RESEARCH PROBLEM AND RESEARCH GOALS

The use of information technology and resulting analyses promises many benefits to individuals and communities in our society (e.g., Naisbitt, 1994; Negroponte, 1995). Potential users believe that technology and data acquisition are important assets to increase individual and organizational effectiveness. While many individuals, groups, and organizations appear to be eager to use information technology, our understanding of the role that computer-based information technologies play in facilitating problem solving and decision making is limited because we are still unclear about what happens once an individual or group learns about a situation or understands an issue using analyses developed using computer-based information technologies. For example, in the NAACP v. American Family case, several questions remain unanswered. At the individual level, do we not know much about the residents most affected by the discriminatory practices. Did they initiate this inquiry?
If they did, how did they begin the process of analysis? Do they feel more in control of their lives now more than before? At the organizational level, the example also does not tell us how and why the community groups bringing the complaint against the insurance company used information-based analysis? Why did they use maps in particular? Did they ask the questions and analyze the problem themselves or did they leave the analysis to consultants or technicians outside the organization? And finally, at the societal level, a larger question remains unanswered, -- What implications do information-based analyses have for long term systemic change in Milwaukee’s north side?

At the same time, it seems obvious that information technologies and the decisions made using them are going to affect the lives of many people in our cities and communities who have not directly been involved in creating these technologies (Sclove, 1995). Information technology and analyses derived using them are likely to directly and indirectly influence many policy and planning decisions which in turn may have positive or negative consequences for the community and the general public. What particular implications will these decisions have on people with limited financial and technical resources who live in our central cities? The research agenda I propose suggests taking a closer look at community-based organizations using or planning to use information technologies for answers to these questions.

III. RATIONALE FOR STUDY

Why should we look at community-based organizations in order to understand the impacts of information technology use on our cities and communities? Two major reasons have been critical in determining this focus. First, community-based organizations in many cities have taken over the major responsibility of serving city dwellers with limited incomes or other special needs, addressing diverse tasks such as service provision, advocacy, technical assistance provision, and education. As we attempt to understand how spatial technologies affect spatial interactions in cities and how these changes affect different geographically or socially defined urban population groups (two of the main themes of the conference), it may be beneficial to look at these themes within the context in which these interactions are mostly likely to occur.

Second, there is some evidence which suggests that small groups such as community-based organizations are likely to invest in these technologies as they seek creative ways to gain control over decision-making processes about issues that affect them (Ramasubramanian, 1995). Looking at community-based organizations, therefore, allows us to explore some institutional and organizational issues as we discuss "changing conditions of access and improving urban access conditions for disadvantaged populations", a sub-theme of the conference.

IV. SIGNIFICANCE OF RESEARCH

Information technology, its development and its use, is a relatively new phenomenon. At present, the only point that everyone seems to agree about is the fact information technology use is spreading rapidly in the developed and developing world (e.g., Naisbitt, 1994; Negroponte, 1995). Corporations and governments are creating information-based economies and global approaches to management while analysts continue to make contradictory predictions. Some industry analysts, for example, predict that the emerging information technologies will create new jobs, while others warn that they will cost people their jobs. Similarly individuals and organizations who advocate for the use of information technologies argue that their use will foster global communication while their opponents insist that information technology and its use will foster the development of tribal enclaves.

Information technology offers potential for great public benefit in the areas of education, health care, business, commerce, and environmental management, and community. Recognizing its potential, governments, corporations, and communities are investing heavily in these technologies. However, as exemplified in the NAACP v. American Family Insurance company case example, it is likely that information will become the centerpiece of the "Civil Rights" debate in this decade as corporations continue to use racial and economic demographics to locate and provide services (King, 1994).

The research agenda being proposed will address the linkages between information technology use and community development. Researchers and academics have long argued that information is a complex source of power (e.g., Forester, 1988). At the same time, Gaventa (1993) argues that information is as much an asset as
land, labor, or capital in an information society. He proposes that production and control of knowledge
maintains the balance of power between powerful corporate interests and powerless individual citizens in a
society that is becoming increasingly technocratic, relying on expertise of scientists to transcend politics.
According to him, a knowledge system that subordinates common sense also subordinates common people.
Will our information-based society supported by sophisticated technologies put information in the hands of
citizens and community groups, thereby contributing to their self-development and empowerment? Or will it
subordinate common sense, further alienating ordinary people from decision-making spheres?

This research will inform and educate architects, planners, environment-behavior researchers, and policy
makers about the role that information technology applications can play in making decisions that will ultimately
affect our physical and the social environment. This research is significant and valuable because it will fill gaps
in our understanding of the complex issues surrounding the adoption and use of information technologies,
discuss the role of information technologies in developing and sustaining community control of data,
information, and knowledge, and assist community advocates in making assessments about the appropriateness
and usefulness of technology-based analyses for community-based planning and decision making. Finally, this
research will contribute to the emerging debate around the appropriate domains of knowledge production and
knowledge use.

V. A COMMENT ON ACCESS AND EMPOWERMENT

Access has multiple interpretations. Some of us talk about access in specific terms for example, access to
technology or access to data. Further, access is also discussed in the context of opportunity (e.g., access to jobs,
educational resources, social services, etc.). This researcher proposes that full and equal access is possible only
when the following four components are available to individuals and organizations. They are:

- technology (hardware and software that can be upgraded to keep pace with technological developments,
  and that is user-friendly);
- data and information (e.g., public information at federal, state, and local government level with
  information about demographics, health care, education, properties, housing markets, investments, etc.,
  and information about the skills and abilities of people in the community and the physical and social
  conditions in that community);
- skills (e.g., computing, data gathering, data analysis, community organizing, problem solving, coalition
  building, consensus building, and problem seeking); and,
- a critical world view (a way of thinking about the use of information technology and computer-mediated
  communications for problem solving and decision making in their communities).

Most initiatives to increase access provide the technology, some work on developing data standardization
measures, and data sharing mechanisms. Still fewer initiatives provide access to technology, and data, while
putting some rudimentary skills in the hands of end users. However, very few initiatives address what this
researcher believes to be the most important barrier to access -- the lack of a critical world view which enables
end users to think about ways they can use information technology and computer-mediated communications in
day-to-day problem solving and decision making (Ramasubramanian, 1995a).

An example will illustrate the benefits of having this critical world view. The Repairers of the Breach is a
non-profit advocacy organization in Milwaukee that works with the homeless and those at risk of becoming
homeless. This organization runs on a shoestring budget and, until recently has been staffed by volunteers.
Since 1992, this organization has been concerned about the displacement of low-income people and people of
color in the neighborhoods of central Milwaukee. In order to confirm what they have documented through
anecdotal evidence, members of this organization, with technical support from the University of
Wisconsin-Milwaukee have begun to monitor displacement and gentrification trends by looking at city data
about home ownership, property transactions, and demographic shifts. Building on work done in late 1993 and
early 1994, the organization has developed an innovative research agenda.

This organization intends to use GIS to facilitate community-based research and analysis in order to:
create a comprehensive, computer-based, socio-economic profile of the areas they serve in Milwaukee;
customize this profile to include qualitative data and information of particular relevance to people who are homeless or at risk of becoming homeless; and develop the skills of neighborhood residents to gather, analyze and use data and information about their neighborhood in their every day problem solving and decision making (Ramasubramanian, 1995).

Members of this organization currently have a sophisticated understanding about the use of spatial mapping and analysis and other information technology concepts. Their efforts provide a glimpse of how a group of people who are typically considered disenfranchised can use the potential of information technology. The fact that the members of this organization aspire to establish a community-based information network and a community computing center to serve their constituency is one indicator of individual and organizational empowerment. As we think about access and how accessibility in the city is impacted or influenced by information technology, it may be useful to ask the following questions.

1. How do community-based organizations use data and information to make decisions about shaping their physical and/or social environment? What role (direct and/or indirect) do analyses derived using information technologies play in: a) defining or redefining the problem that needs resolution; b) determining the line or lines of action that need to be taken; and c) in developing policies and programs.

2. To what extent and under what conditions can the use of information technologies and analyses derived using them enable community-based organizations take on a position of leadership regarding an issue/s concerning the physical and/or social environment?

3. How do individuals participating in a community-based decision making process about the physical and/or social environment define and describe empowerment? What contributes to those feelings? To what extent can those feelings be attributed directly or indirectly to the use of information technology and analyses derived using them?

Biography

Laxmi Ramasubramanian is an architect and a city planner. She has a Bachelors and a Masters degree in Architecture from her home country, India, and a Masters degree in City Planning from the Massachusetts Institute of Technology. She is currently pursuing a Ph.D. in the School of Architecture and Urban Planning at the University of Wisconsin-Milwaukee. Her research interests center around community development and empowerment in general, and information technology applications in neighborhood and community environments in particular. She believes that her strength lies in placing the theory and practice of information technology use within the context of solving real world problems.

Laxmi’s dissertation research looks at information technology use among community-based organizations and examines its impacts and influence on participatory decision making and ultimately on individual and community empowerment. Laxmi has received a doctoral dissertation grant from the U.S. Department of Housing and Urban Development and has recently returned from attending the NCGIA 1996 International Young Scholars Summer Institute in Geographic Information held at Berlin.

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Information and Spatial Technologies and the Inner City

David S. Sawicki

Democratizing Information

DAPA’s overriding goal is the democratization of information—providing a fact base to poor people, poor communities, and their collaborators who have been historically denied access to that vital information base, and helping to build the capacity of community residents. This is a revolutionary idea, and one that is sometimes controversial among traditional governmental agencies. Several trends in American society make the "democratization of information" almost a necessity. They are: devolution, the change in the locus of initiation for local programs, the change in the locus of computing power, and the need for a fact base for local program planning and management. No matter what the outcome of the forthcoming presidential elections, one thing is sure: there will be more bipartisan support for devolving social programs to the local level. In order to be able to handle these responsibilities, local actors will need an information base upon which to act. Targeting teen pregnancy programs is nearly impossible without first capturing and processing the data that give detail on the most at-risk populations, where they are located, what works to change behaviors, and how resources can be most effectively used at the local level. Second, the responsibility for local initiatives is moving to go way beyond simply relying on local governments. There are new collaborations between non-profits, community development corporations, neighborhood and metropolitan-wide community groups, business groups, and community foundations. The new theme has become "government participation in citizen initiatives," and collaboration among these groups, and between these groups and local governments. Third, the locus of computing power and data access is broadening. The use of information technology and spatial analysis is widespread. However, the level of skill required to turn raw data into information useful for policy analysis remains in the hands of a small, trained group of professionals. This remains true despite the fact that hardware and software have become so much cheaper and easy to use that the pool of potential policy analysts has grown dramatically. To democratize information fully, the locus of applications must move closer to the citizenry. Finally, local leaders of all types are recognizing the need for a much improved information base to help them in designing strategies and implementing them effectively and efficiently. The traditional measures of city or county well-being are being replaced by more localized, neighborhood measures because it is at that scale that problems get attacked. And information provided by single purpose agencies is deemed inadequate as problems are now viewed as multi-dimensional, and incapable of being understood from one dimension (e.g., police arrest data in the absence of school or social service data). Information resources, then, must collect data from dozens of governmental and non-governmental agencies. But this kind of data and information agency has never existed in metropolitan areas until quite recently. The Atlanta Project’s Data and Policy Analysis, along with a handful of other organizations like it in other cities, has pioneered the way.

Goals and Objectives of DAPA

As stated above, DAPA’s overriding goal is democratizing information to poor communities and their collaborators. More specifically our objectives include: providing information, spatial and non-spatial data, data interpretation, base maps, intelligent (analytical) maps, policy analyses and policy research to:

- TAP collaboration centers, their staffs, and their volunteers
- corporate sponsors
- other TAP team members
- non-profits working in poor area’s in Atlanta
- university faculty who share TAP’s mission
- governmental units needing local data and analysis
- media reporters
other poverty research organizations, both local and national

The Four Functions of DAPA

We can roughly divide our activities into four categories: support for operations, support for planning and community development, policy analysis, and policy research. We will briefly describe the four: Support for operations. These tasks are usually small. Someone needs to know how many of this kind of person or household resides in a specific geographic area, or they need a data table or map. Support for planning and community development. We are moving as much analytical firepower into the hands of those doing neighborhood planning (including community development corporations) as is possible. DAPA staff have attached three electronic databases to digitized parcel maps for over 200,000 land parcels in the poorest part of the metro area. Each land parcel is described by over 100 fields. These include tax-delinquency, building condition, ownership, assessed value, frontage, land use, zoning, code violations, and much more. We are using the GIS tool with neighborhood and community development corporation leaders to query the database, make maps, and help plan for housing, development and community renewal. Policy analysis. DAPA is asked often to comment upon a proposed project or a piece of legislation under development. We use our inventory of databases and reports to inform those who raised the question. We also tap a national network of researchers and publications to bring the experiences of other organizations to bear on our situation. Policy research. Many problems in poverty or urban policy are complex, and differ from one geographic area to another. On some topics DAPA does leading-edge policy research, joining with other research organizations to understand the problems at a deeper level. An edited list of clients and projects is available from the author.

Microcomputer Technology at DAPA

DAPA possesses advanced data processing and geographic information systems capability as well as a vast library of relevant information we are able to offer clients. DAPA uses microcomputer technology which includes: tape and CD ROM readers, color printers and plotters, a large digitizing tablet, and a substantial collection of software, including a geographic information system. But, more importantly, we have a highly-qualified technical staff, composed mostly of graduate students, and a valuable collection of both geographic and attribute data. In addition to the land-parcel geographic information system described above, now worth well over $200,000, DAPA has in its library all of the U.S. Census data products from the 1990 census. Some additional examples of its other database holdings follow:

- over 1 million crime records
- birth and (linked) death records with detailed characteristics of mother
- juvenile justice system data
- data on 60,000 Atlanta Public School students
- addresses of all businesses by type
- locations of all social service providers

Most importantly, DAPA’s data can be summarized for city neighborhoods, clusters, police beats, or other geographic areas of interest to local citizens and policymakers.

Proposed Research Activities That Could Enhance Inner-City Redevelopment

My approach will be to divide my proposals into two types. The first are ideas that could enhance, expand, and support the work of organizations like DAPA in the inner cities of the United States. These organizations are capable of bringing profound changes to the delivery of human services to disadvantaged populations, and aiding in the redevelopment of inner-city neighborhoods. Operational parcel-level GIS’s can play an important role in the latter. The second set of proposals are more broad-ranging research ideas that focus on jobs and inner-city poverty and the role of new technologies in either aiding or exacerbating those problems.
Support For Enhancing Local Spatial Data and Policy Analysis

We should begin by noting that The Urban Institute has completed the first (planning) phase of its "National Neighborhood Indicators Project." The Institute is currently developing a number of proposals for funding various activities subsumed under the NNIP umbrella. The emphasis of the Institute’s effort is, however, on indicators, not necessarily on helping to support ongoing activities of DAPA-like organizations. Clearly, we need some dialog with the NNIP project leaders. That said, to enhance the ongoing local efforts, we need to do the following:

- Analyze the efforts of the (say four) most successful community-based spatial and policy analysis organizations, and develop a model for self-sustainability. This is difficult since their avowed mission statement is analysis in support of poor communities.
- Develop an incentive system which encourages community groups and their analytical arms to post electronically (locally and nationally) success stories which highlight their work with spatial and information technologies. "Success" in this context means effective implementation after analysis, that helps to make people’s lives better. Collected cases might, in fact, lead to a book.
- Develop an issue-based index to data. For example, a community worried about crime might search the index and be pointed toward cases where police call data were manipulated to help make improvements in neighborhood security.
- Work towards the development of a prototype neighborhood database which uses administrative data along with independent survey research to supplement the decennial census, which is the only rich data source available for small geographic areas. Without intercensal small-area data it is difficult to judge change and to develop intercensal rates because a timely estimate of the denominator is missing (e.g., how many teenage girls were at-risk to becoming pregnant given there were 150 teenage births in this neighborhood?).

Support For Research on the Effects of Changing Spatial Technologies and Spatial Structure on Poor Communities

From my perspective, three issues stand out in the discussions about inner-city poverty and its relationship to space. They are:

- There are too few employment possibilities at a reasonable location, wage, and skill level, to permit the urban poor and near-poor to lift themselves out of poverty. The urban poor are concentrated in the nation’s central cities. Without income, the places where these poor reside sink into disrepair.
- The concentration of poverty is in itself a problem, especially for children. Locked in schools with peers of similar circumstances, in families often without education and resources, and in neighborhoods without successful role models, children at very young ages become attached to unconventional and unproductive life styles.
- There is a growing consensus among urban scholars that almost forty years of failed urban policy prove that the ghetto cannot be improved comprehensively. Policies and practices, as well as "natural" market forces, that concentrate the poor in spatially separate neighborhoods within metropolitan areas must be challenged.

The question I ask for NCGIA is this: what role might research on spatial information technologies play in solving these problems? Before answering my own question, let me share a few well-established personal prejudices:

- The mismatch between appropriate jobs and unemployed and not-in-the-labor-force (NILF) people is somewhat overrated as a cause of joblessness. There are other important factors, most more difficult to measure than physical accessibility.
- Information technology in the hands of undereducated people not placed in a rich learning environment is
not worth much. The topic of haves and have-nots on the information superhighway is overplayed. Most importantly, the poor are have-nots in wealth, health, and education; secondarily, they may not have access to the superhighway.

What follows is a list of possible opportunities that occur to me. For each, there is often some existing research or demonstration. Space does not permit me a full literature review. However, I would enjoy discussing them at the September conference.

- Poor minorities do not generally participate in a rich job information network. Artificial networks must be substituted. Analyze and offer ways to improve electronic job networks and ways to improve poor people’s access to those networks.
- Up to date, geographically-specific as well as SIC- and SOC-specific employment data and information seldom exists for metropolitan areas. The smallest reporting unit is the county. White and a few others have used the state labor department’s ES202 unemployment insurance dataset very creatively for monitoring changes in the patterns of job growth and decline in a metro area. We need to build upon his success and help clone it in other metropolitan areas. It sounds easy, but there are many roadblocks, both technical and political.
- Scholars disagree on whether immigrants harm the chances of U.S. citizens for employment and higher wages. Frey has shown that metros with large immigrations experience high out-migrations of their less-educated. Sawicki and Moody have shown that high in-migration to Atlanta has created a very competitive job market for native (not moving in the last five years) less-educated black males, who do very poorly in the job market. We hope to extend this research to other metropolitan areas including those with high out-migration, immigration, and in-migration.
- In the Atlanta case (above), we observed that less-educated in-migrants to Atlanta chose residential locations that were much closer to new entry-level jobs than did Atlanta natives. We hope to extend this research to other metropolitan areas including those with high out-migration, immigration, and in-migration.
- New logistics technologies (e.g., ubiquitous bar-code readers and inventory software) are changing the way goods and services are produced and delivered. This results in shorter product life cycles, smaller order quantities, more agile manufacturing, less face-to-face interaction, more telecommuting, and just-in-time production. Logistics systems must move, store, and control more materials and information than ever before. These changes have serious implications for the locations of manufacturing and service producers, and for the types of people they employ. Central cities could suffer as historic sites for transfer terminals and personal interaction are made outmoded by modern technology. Research on the interface between changing logistics technology, changing processes of production and its location, and their impact on employment and jobs seems essential.
- Michael Porter has been espousing the idea that the United States could be made more competitive if we recognized clusters of industrial activity as has been done in some successful examples in Italy, Germany, and Japan. The intent is to exploit the positive externalities, consumption interdependencies and economies of scale, to link together different firms in a cluster that becomes more competitive than if the individual firms were spread out. There are two major obstacles to operationalizing what appears to be a good idea. First, Porter has not offered much concrete advice on how to identify and define these clusters. Second, the roles of space and scale are undefined: do we mean located adjacent to one another, or within 50 miles? Changes in logistics technologies as described above could play a big role in delineating "clusters of the future." This promising area deserves attention.

Conclusion

In my role as technical advisor to The Atlanta Project I have witnessed the positive contribution that a data shop well-supplied with GIS technology could provide to local groups trying to make improvements to the lives of those in poverty. Thus my approach was to sketch what we do and recommend that we join others in trying to get as many of these organizations established as we can around the country. On the other hand, these attempts
are mostly in the vain of "gilding the ghetto," whereas most now agree that to make meaningful change we
must integrate the entire metropolitan area. I believe this is a political problem, important to, but removed from
the NCGIA research agenda. What is important to that agenda is the creation of new jobs, their locations, their
skill requirements, and their accessibility to those currently not employed or underemployed. Thus my second
set of ideas relate to research on spatial technologies and jobs for the next century.

Notes

1. Three articles describe the work of organizations like DAPA in more detail. See David S. Sawicki and Will
Craig, "The Democratization of Data: Bridging the Gap for Community Groups." Forthcoming in the Journal of
the American Planning Association; David S. Sawicki and Patrice Flynn,"Neighborhood Indicators: A Review
of the Literature and An Assessment of Conceptual and Methodological Issues." Journal of the American

2. See The Urban Institute’s "Democratizing Information: First Year Report of the National Neighborhood

3. See, for example, David Rusk’s latest book, Baltimore Unbound: A Strategy for Regional Renewal.
Among other duties it would be empowered to oversee a plan of regional housing integration. The governing
board would be elected from pie-shaped districts, centered on the city’s core. Rusk is among a cadre of the best
urban policy scholars in America who have given up on ghetto-enrichment as a stand-alone strategy for solving
the problems of urban poverty and its attendant side effects. See also Anthony Downs, New Visions for


5. See, for example, William H. Frey, "The New Geography of U.S. Population Shifts: Trends Toward
Balkanization," In State of the Union: America in the 1990’s edited by Reynolds Farley, New York: Russell

Participation of Disadvantaged Black Men in Atlanta." Forthcoming in Economic Development Quarterly.

7. This topic is contained in a recent proposal to the National Science Foundation I helped develop. The
principal investigator is Professor Donald Ratliff. The senior author of the "Urban Logistics" section was
Professor Amy Helling.

8. David S. Sawicki, "Deja-Vu All Over Again: Porter’s Model of Inner-City Redevelopment," with Mitch

Draft Version 5/13/96 David S. Sawicki

Biography

David Sawicki, a Georgia Tech Professor of Planning and Public Policy was named Senior Advisor for Data
and Policy Analysis (DAPA) of The Atlanta Project (TAP) in the summer of 1992. First alone, and then with a
small student staff, he established DAPA as a prime source of spatial data and policy-relevant information for
those working with poor communities within The Atlanta Project area of 500,000 in Atlanta. Over time, the staff has grown as has its list of responsibilities and clients. DAPA is now part of a national seven-city consortium, housed at The Urban Institute. The project title is the "National Neighborhood Indicators Project." The Institute will try to clone DAPA-like organizations in other poor communities in the United States. Dr. Sawicki is the lead person for the Atlanta (TAP) NNIP site, and a consultant to The Institute on their national NNIP activities. In this brief research note he will attempt to accomplish two things. First, he will reflect on his recent experience at DAPA and propose how modern spatial and information technologies could be used to aid inner-city redevelopment. Second, based on his experience in poor communities, he will propose several research agendas centered on changing technologies and their impact on poor communities.

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In this age of information, high-speed computers, and global transactions, one might speculate that cities are becoming less important places, that urban agglomeration becomes obsolete as advances in global telecommunications allow for significant labor, management, and resource dispersal. Within this scenario we are reminded of Third World women deftly operating sewing machines or carefully assembling electronic equipment, creating fashions and appliances for Western markets. All the while, the executive -- cellular phone, laptop computer complete with fax -- manages the office from home, a world away.

Despite speculations that cities are becoming less important places, some cities have become extremely important, earning them the title of "global" or "world" cities. While manufacturing in Detroit and other once powerful U.S. industrial centers fracture, reassembling off-shore in Mexico and other developing countries, cities like New York are expanding. New York, Tokyo, London, and a handful of other world cities are emerging as specific geographic control sites in a dynamic international economic order. In fact, it is precisely because of the geographic dispersal and complex organizational forms promoted by telecommunications, that agglomeration of command and control functions take shape within select urban regions (Sassen, 1991). This paper explores the influence of new spatial technologies on the social and spatial structure of the global metropolis.

Spatial Technologies and Urban Spatial Form

The world city thesis posits that corporations are expanding beyond national boundaries, establishing worldwide networks of production and distribution (Hamnett, 1994). These broad processes are clearly evident: CEOs in companies, once catering exclusively to domestic markets, announce plans and strategies to garner large portions of new sales from international clients; corporations, once vertically integrated in the Fordist era, downsize, subcontract, and then reorganize production strategies to maintain maximum flexibility, often utilizing telematics to integrate all stages of the work process (Mitchelson and Wheeler, 1994). Operating within this global arena, access to financial information becomes crucial. International exchange-rates, interest rates, and price trend differences offer both new threats, and new opportunities (Cohen, 1981).

Faced with growing competition, many corporations employ subcontracting strategies to transfer the risk of maintaining overhead expenses and wages during periods of reduced labor demand (Law and Wolch, 1993). Other corporations reduce labor costs by decentralizing specific service and support tasks. Jamaica, for example, has emerged as a key location for overseas office work because of its high literacy rates and English speaking populations (Sassen, 1984). Key operators earn the equivalent of US$1.67 (January 1994 exchange rates) compared to workers in the United States who earn US$7-10 per hour (Mullings, 1995, 174). Pelton refers to this off-shore production as ‘electronic immigration’ in which the labor and skills of (often female) workers is imported from cheap ‘tele-colony’ locations around the globe via telecommunication networks (Pelton, 1992, in Graham and Marvin, 1996, 153).

Rapid advances in telecommunications, transportation, and computer technologies have been crucial to this global restructuring. These advances integrate select cities into an expansive ‘networked economy’ of instantaneous information, service, capital, and labor flows (Graham and Marvin, 1996, 162). Select world cities emerge as sites for corporate headquarters, foreign investment, and the production of legal, financial, managerial, technical, engineering, accounting, and consulting services needed to control complex and widely dispersed international operations. Cumulative concentration of financial and technological ventures, specialized labor, cultural facilities, and transportation infrastructure in these large cities, operates to sustain them as business and control centers atop a dynamic urban hierarchy (Graham and Marvin, 1996, 32). While a
handful of the world’s largest cities have benefitted most from advances in telecommunications, other cities have been completely bypassed (Graham and Marvin, 1996). Geography and history remain critical influences in the uneven development of electronic spaces.

Yet global restructuring processes are impacting more than just the largest metropolitan centers. Other urban spatial forms are developing to take advantage of growth in spatial technologies. The emergence of urban settlements straddling international borderlands, for example, reflects selective integrative processes at work to link these border frontiers into the circuitry of the global networked economy (Batten, 1995, 313). Other cities are developing into constellations of linked urban resources. Network and corridor cities evolve when two or more independent cities work together to achieve scope economies through reciprocity and knowledge exchange, aided by fast and efficient transport and communications infrastructure (Batten, 1995). Examples include the Stockholm-Upsala corridor and the Randstad Holland urban network.

Spatial Technologies and Social Polarization

The practice of global control -- the work of producing and reproducing the organization and management of a global production system -- has a number of structural outcomes. The concentration of advanced producer services and the occupational and income distributions that characterize these services, have contributed to employment growth at both the top and the bottom ends of the wage continuum (Sassen, 1986; 1991). At the top end, growing numbers of highly paid professionals are offered full-time, prestigious opportunities in business, law, finance, and management services. These professionals generate demand for a wide range of low order consumer services at the bottom end of the occupational hierarchy, supporting restaurants, retailing, cleaning, and the entertainment industries (McDowell and Court, 1994, 1398; Sassen, 1991). As the multiplier effect would have it, these often casual, part-time, and low-wage jobs generally outnumber the high-skilled professional jobs by a factor of two or three to one (Graham and Marvin, 1996, 142). Thus, global restructuring is not only creating opportunities for white collar information technicians and managers, it is also creating new spaces and economic opportunities for a large influx of immigrants from developing countries. The metropolis increasingly represents a world city, not only in terms of its linkages to the global economy, but also in the multi-ethnic, multi-cultural composition of its population (Castells and Mollenkopf, 1991, 400).

Diverging occupational opportunities contribute to the development of an unequal and polarized class structure within the global metropolis. Knox (1995) points out that while advances in telematics, especially telemedia, may have a homogenizing effect -- functionally integrating labor markets, consumer preferences, political institutions, and economic organizations -- these technologies also give rise to new cleavages. Labor, for example, continues to be fragmented along lines of race, gender, age, immigration status, and region (Knox, 1995).

Related to processes of social polarization are processes of spatial polarization. The largest and most affluent urban regions, already well equipped with telecommunications infrastructure, are best positioned to take advantage of continued corporate centralization and the growth of new industrial spaces. The less equipped and more peripheral urban regions, on the other hand, become increasingly locked into competition with less developed and newly industrializing countries over the spoils of decentralization (Graham and Marvin, 1996, 170). While the advantaged core cities and high technology zones increase their attractiveness for further technological investment, the disadvantaged periphery falls further and further behind.

Access to information technologies is also increasingly polarized. The physical hardware and technical skills needed to utilize information technologies become one criteria for access. It is not just a matter of the "haves" moving forward, while the "have-nots" stand still, however. Neighborhoods and entire counties are being bypassed by infrastructure development (Piana, 1995). Civil rights and consumer groups have cited patterns of "electronic redlining" in which neighborhoods with high concentrations of poor people and people of color are being excluded from plans to offer new on-line services and products, in favor of more affluent communities (Piana, 1995). At the same time, these marginalized communities experience diminishing access to existing
urban services, products, and public resources (Graham and Marvin, 1996).

Participation in spatial technologies, information flows, and the profits associated with telematics increasingly shape social, economic, political, and cultural developments. Marginalization and a polarization of access to these technologies, however, means that only a small and select portion of society fuels these developments, shaping their social priorities. Effects of limited input into the evolution of telematics are evident in the products produced. For example, when 5th graders were given the opportunity to use CD-ROM encyclopedias to research "famous Americans", many came back empty-handed. While the average entry for famous white males was 28 inches of text, very little information was available on people of color, whose entries averaged only 5 inches of text (Piana, 1995, 20).

On the other hand, telematics and GIS also provide an ability to integrate society, to promote inclusion across time, space, and socio-economic barriers. A Boston neighborhood in Dorchester County plagued by gang violence and crime, for example, set up a community network. The network allows residents to share community news, organize crime watch activities, participate in a local food co-op, and post job listings. The project is fostering neighborhood cohesion and communication (Ross, 1995). Residents in the Brooklyn neighborhoods of Greenpoint and Williamsburg are involved in a project to develop a database with block-by-block information on toxic emissions and respiratory health problems. The GIS is being developed to give residents political power against local industrial polluters, to help develop recycle and pollution abatement programs, and to draw financial resources to clean up their communities (Liebman, 1995, 27). LatinoNet, a national electronic clearinghouse for issues affecting Hispanic Americans, was launched in November, 1994. The purpose of this network is to "empower the Latino community" in the areas of cultural, legislative, and civil rights. LatinoNet provides news and information on employment, education, health care, public policy, and the arts (Lewis, 1995).

These projects, while successful, have not been priorities for the corporate and commercial entities dominating electronic space. Academics can provide an important voice in a dialogue which encourages community-oriented projects, free public access to the Internet, and social equity in the development and production of spatial information. GIS are already used extensively for environmental impact reporting; their use could be extended to provide analyses of social impacts and to ensure social equity. GIS has enormous potential to serve as an organizing framework for communication and inclusion.

**Further Research**

I bring a number of research interests to the Baltimore conference on Spatial Technologies, Geographic Information, and the City. The first is an interest in the relationship between telematics and new urban spatial forms: world city urban structures, corridor and network city clusters, and urban growth along international borderlands. A second research interest involves the relationship between spatial technologies and the new spaces and economic opportunities developing for immigrant workers: downgraded manufacturing employment within urban centers, retail and personal service jobs within the affluent neighborhoods of technical and professional workers, and 'electronic immigration' resulting from off-shore production. I am also interested in investigating the link between global restructuring and female labor force participation. The literature on world cities and telecommunications does not seem to adequately address how these broad processes are associated with the feminization of the labor force and consequent restructuring of gender divisions of labor. I am particularly interested in how spatial divisions of labor continue to be defined along lines of gender, race/ethnicity, and immigrant legal status.

Finally, and certainly most important to my dissertation aspirations, I am interested in exploring how GIS can be used to model broad economic and social processes associated with global restructuring and the expansion of telematics. Webber (1996), in his conference research notes, points out that we can no longer regard cities as unitary phenomenon, separate from the larger socio-economic systems in which they are entangled. Feminist geographers, exploring new concepts of space and place, define places (cities) as differentially located nodes in
a network of relations -- unbounded, unstable, and spatially discontiguous (McDowell, 1993, 312). I am interested in exploring how developments in network analysis might supplement the more traditional census-type regional analysis to model information flows and issues of accessibility. Certainly GIS contains the tools to model these urban relations. The difficulty, of course, is determining the finite sets of attributes and spatial features to adequately represent so much complexity. I believe, however, that the efforts expended to meet this challenge will be well worth the rewards. Success would allow researchers to both test and contribute to urban social theory, help empower politically and economically marginalized groups, and contribute to sound and effective urban policy.

References


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**Biographical Sketch**

Lauren Scott is a first year Ph.D. student at San Diego State University. Her broad interests include GIS, urban spatial data analysis, immigration, and gender.

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Outline:

1. Metropolis in the 21st Century: Toward a new conceptual framework for future research
   1.1 Urban Forms: Technopolis, Ecumenopolis, Anthropopolis
   1.2 Urban Processes: Macro (societal), Meso (institutional), Micro (individual)
   1.3 Urban Policies: Economic Efficiency, Environmental Sustainability, Social Equity

2. Comments on the three proposed conference themes
   2.1. Spatial Technologies and Accessibility
   2.2. Accessibility and the Truly Disadvantaged
   2.3. GIS and the modeling of new cities

It is a general consensus among social scientists that a technological revolution of historic proportion is dramatically transforming all the fundamental dimensions of human society. Technological impacts on the spatial forms and dynamics of cities all over the world can serve as the quintessential example for this technological revolution. Yet the recent literature is full of conflicting arguments and untested speculations about the effects of these technologies on urban societies. Although similar conference and projects have been conducted before (Brotchie et al., 1985, 1987; 1991), I believe that the proposed Baltimore conference is timely and much needed as some broader theoretical issues have not been thoroughly discussed and some of the technological advances were not anticipated. The following are some of my research notes prepared for the Baltimore conference. My primary intention here is to present an outline for a new conceptual framework and discuss a preliminary research agenda related to the three conference themes. The new conceptual framework proposed here is a synthesis of existing theoretical frameworks with a very strong flavor of theoretical pluralism. It is just a rough outline at this moment. Hopefully, I can further elaborate this framework based upon the feedback from the participants of this conference. Empirical evidence from my on-going research on Texas cities will be provided at the conference.

1. Metropolis in the 21st Century: Toward a new synthesis of conceptual frameworks

The voluminous recent urban literature on world cities, especially North American cities, is replete with assertions that a major reorganization of the spatial structure of cities is underway. A series of distinctive new urban forms is emerging from a complex interplay among social, economic, political and cultural forces. It has been argued that these new forms are characterized by the continued decentralization of both population and employment, the increasing levels of social diversity and spatial polarization, the emergence of an elite inner city (gentrification), and the deepening spatial separation between jobs and labor (spatial mismatch). These new urban forms have been attributed to the various societal, institutional, and individual decision making processes. Numerous policy proposals have been made for various different development scenarios for cities in the 21st century, ranging from going back to the pedestrian-based more compact urban form to stimulate the development of completely footloose electropolis.

In order to weave all these different aspects of urban studies into a coherent research agenda, we need to develop and articulate a new, eclectic, and inclusive conceptual framework. I believe that the new theoretical framework should have three integral components: 1). It should enable us to describe the new emerging urban forms in more comprehensive ways; 2). It should empower us to explain the underlying processes contributing to the emerging new urban forms; 3). It should offer us new insights to prescribe effective urban policies to redirect the underlying processes to promote the most desirable urban forms.

1.1 Urban Forms: A metropolis in the 21st century will be a tale of three different, but interrelated, cities. The
specific urban forms will be determined by the interplay of the following three components:

A. Technopolis: Indeed, new world making always starts with the new word making. Scholars have used a variety of different names to refer to this emerging technopolis, ranging from electropolis and wired cities to city of bits, computational city to virtual and on-line community. Technopolis, narrowly defined, refers to the constellation of massive transportation, telecommunications, and information networks to move goods, people, and information; it is a combination of wheels, wires, and air waves. Technopolis, especially the city of bits, or the on-line virtual community, has attracted lots of attention in recent years, but our knowledge of the wired cities remain to be futuristic prophecies as presented in Mitchell’s City of Bits. Concerted research efforts are needed for this emerging new urban form. The three themes of this conference may serve as an excellent start for us to gain more knowledge of this emerging new urban form.

B. Ecumonopolis, also known as sustainable city or ecological city. Daunting urban environmental problems have made the urban community to rethink of its slash/burn policies in the past. The development of Ecumenopolis, with the goal of seeking harmony of human being with their surrounding urban natural environment, has increasingly become an integral part of urban policy for urban development all over the world. The technopolis should be developed in harmony with urban natural environment and ultimately to become an ecumenopolis.

C. Anthropopolis. The central component of metropolis of the future will be the people residing the cities. To make future cities to become anthropopolis is to make future metropolis to become truly the city of/for people. The concept of anthropopolis emphasizes the satisfaction of human needs and the quality of urban life as the ultimate goal for all the future endeavors. We should strive the make the technopolis and ecumenopolis to serve this goal. Transportation networks, communication networks, and natural environmental should be designed in the way to stimulate the kind of life we would like to live (Do we know for sure?). The goal of developing an anthropopolis is to make all human activities, i.e., where we work, where we live and shop; and where we go to entertain ourselves, as enjoyable as we can. The telecommunication and computer technologies have played an increasingly important roles in all these activities, and yet we are not sure to what extent they are substitutive, complementary or synergistic to traditional means of conducting these activities.

With these three interrelated metropolis in mind, we should make concerted research efforts on the optimal urban forms for the cities in the next millennium. Do we want the relentless urban sprawl to continue, as facilitated by the development of new transportation, communication, and information technologies? Or should we go back to a more compact pedestrian-oriented urban forms as proposed by some leading urban planners in order to better fulfill the ideal sense of community, sustainability, and social equity?

1.2 Urban Processes: The processes contributing to the formations of urban forms are extraordinarily complex, and numerous different theoretical perspectives have been developed during the past two decades to explain these diverse urban processes. I believe that the new urban process theory should take a more holistic approach to synthesize these diverse approaches. The hierarchical theory I am proposing can be broken down into the following three levels:

A. Micro level processes: This is the individual level process using a behavioral approach from theories and concepts of neo-classical economics. Most traditional urban modeling efforts follow into this category.

B. Meso level processes: At this intermediate level, attentions should be paid to the roles and behaviors of various institutions in both private and public sectors. We need to examine how various institutions have shaped urban development trajectory and thus result in different urban forms.

C. Macro level processes: At this level, we should bring the general societal trends into consideration, putting urban development into perspectives of political economy, economic transformation, long wave rhythms, and world systems.
1.3: Urban Policies: I believe the future policy goals should strive to achieve balance of the following objectives:

A. Economic Efficiency: To develop policies to intervene at the individual, institutional, and societal levels to make the technopolis the most economically efficient at both the intra and inter-urban levels to facilitate the flows of goods, people, and information.

B. Environmental Sustainability: To develop policies to intervene at the individual, institutional, and societal levels to make the ecumenopolis the most environmentally sustainable, with plenty of safe water, clean air, and diversified natural habitat.

C. Social Equity: To develop policies to intervene at the individual, institutional, and societal levels to make the anthropopolis truly socially equitable so that the metropolis will become a city for everybody, with equal access to all different kinds of information and services and equal share of environmental burdens.

2. Comments on the three conference themes

2.1. Spatial Technologies and Accessibility
If spatial technologies, as defined in the call for papers for this conference, include new transportation networks, communication, and information technologies, then the concept of accessibility needs to be redefined both conceptually and operationally. Presently, most measures of accessibility are distance-based, exclusively for the transportation networks. With ubiquitous availability of various communication and information technologies, traditional measures of accessibility may no longer apply. Because of the complexities in the spatial configurations of the new communication and information technology, the accessibility has become more elusive and fluid; thus it would be very difficult, if not impossible, to measure. We need new concepts and measurements to describe the spatial effects of new communication and information technology.

The second point I want to make is: we need to define access to what? Traditionally, we are concerned with access to jobs and services, now more with information. How should we measure people’s access to information and to extent the access to information is measurable? We also need to differentiate the physical accessibility (via physical transportation/comunication networks) vs. social accessibility (via various institutional and interpersonal networks). Recent works in the social science literature has revealed that physical accessibility won’t succeed unless it is hooked to the right social networks.

The conjectured changes in urban accessibility brought about by the increasingly widespread use of communication and information technologies in the literature remain to be speculations without a sound conceptual justification, not to mention about the urban land use changes at different geographic scales in response to the changes in access brought about by modern spatial technologies. Empirical studies are also lacking in examining the relationships between transportation and communication, to what extent they are substitutive, complementary, or synergistic in affecting the new urban development? The first step to achieve a satisfactory answer to these questions is to conduct an inventory of communication and information infrastructure. We have detailed road maps, but we do not have a thorough knowledge on the telecommunication/information network maps. Maybe we need a project Alexandria II to map out the distribution of various telecommunication and computer networks. Without a complete inventory of telecommunication and information infrastructures, our knowledge of accessibility will remain to be partial and speculative.

2.2 Accessibility and the Truly Disadvantaged
It is common knowledge now that the emerging information society is witnessing an increasing polarization between the haves and the have-nots, and the information-rich and the information-poor. Geographically, those disadvantaged population are predominantly trapped in inner cities and various suburban pocket locations. But the formation of the new underclass or the truly disadvantaged is a complex process. Lack of accessibility is one
factor, but some social science studies have revealed that the formation of urban underclass is more than an accessibility issue. At this moment, we do not know to what extent the accessibility has contributed to their status compared to other factors, such as education, segregation, and discrimination, etc. Some recent empirical work indicated that more access to information may not necessarily mean a better life for them, which should prompt us to consider both positive and negative effects of information on the lives of urban residents.

2.3. GIS and the modeling of new cities
With the recognition that GIS technology so far is more successful as a data inventory and information management tool rather as a spatial analytical and modeling tool, the GIS community, in collaboration with quantitative geographers, regional scientists, and modelers from various substantive fields, has made concerted efforts to integrate GIS with sophisticated analytical and modeling techniques. Numerous technical breakthroughs have been accomplished during the past five years. However, as far as the GIS-based urban modeling is concerned, I would say that GIS remains to be an improved means for unimproved ends. The models that have been implemented using GIS are conceptually still those developed during the 60s and 70s, i.e. various modified versions of Lowry-Garin model, shift-share analysis, mathematical programming techniques, etc. Although they may be useful under certain circumstances, few, if any, has confessed the cardinal sins of those urban models and discussed ways to reconceptualize them to capture the new dynamics of urban reality. Simply implementing a Lowry model using ARC/INFO doesn’t add any substance to the model itself.

Undoubtedly, GIS will continue to play a very important role in modeling the new cities and stimulate new representations of urban reality. New urban realities demand new urban conceptual models. Maybe the outline I presented in this note can serve as a guideline for the design of new urban models: to incorporate the processes at the individual, institutional, and societal levels to achieve the goals of economic efficiency, environmental Sustainability, and social equity for metropolis of 21st century in which the technopolis, ecumonopolis, and anthropopolis are synergistically and artfully integrated.

Last, but not least, I would like to emphasize that our future research efforts be tied more closely to urban policies. There are have been growing disparity between what we purport to describe and manipulate using sophisticated theoretical and methodological frameworks in virtual reality and our ability to say anything really meaningful about what actually happens in urban reality. Just as Gunnar Olsson put it so aptly 20 years ago: "what the analysis yielded was not more knowledge of the phenomena the model was speaking about: what it revealed was instead the hidden structure the model was speaking within." The new research agenda must strike a balance between the sophistication of our techniques/methods and the real world phenomena we are talking about. We need new frameworks, new models, new concepts, but we must strive to translate these new structures and models into meaningful policies and languages that society can appreciate and understand. Rigorous conceptual frameworks should be coupled with meticulous empirical analysis and realistic policy implications. Otherwise, our research efforts may become another self-indulging academic exercise.

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Tenacious Cities

M. M. Webber

Some thirty-odd years ago I wrote a series of essays proclaiming the demise of the traditional city. They were contending that, largely because modern transportation and communications systems were rapidly reducing the friction of space, communities of interest were congealing among persons who were in close touch but geographically distant. They observed that social and economic activities that are the defining functions of urbanized society are no longer conducted in cities alone.

With most specialized organizations now freed from locational constraints and able to interact with others anywhere, the organized complexity that is urban society no longer resides in cities exclusively. In turn, the concept of "urbanism" and the concept of "city" are no longer coterminous. Built city and socio-economic processes are increasingly independent of each other. Further, just because certain social and economic problems are manifested in city settings, they are not necessarily caused by physical, spatial, or societal conditions there. Their sources may lie within the larger national and international urban systems that are coming to dominate social and economic life.

Conceiving the city as essentially a massive communications switchboard, the essays argued that a city's spatial form matters primarily as it affects accessibility among partners to interaction and transaction. Hence, spatial dispersion of urban settlements is perfectly okay, they said, so long as there are ubiquitous road networks and plenty of cars and phones. Modern spread-city allows high levels of accessibility, high standards of living, and high industrial and commercial efficiency all at levels comparable to those of concentrated cities of an earlier day. The essays said that both trends -- the emergence of spread-city spatial patterns and the globalization of urban society and the -- suggest that the age of the traditional city is coming to an end.

Dispersing Urban Functions

It’s now all too apparent that improvements in transportation and communications systems are indeed permitting intimate relations among distant persons and firms. We’re all aware of the integration of the national economy and the further integration of the global economy. Urbanites around the world have been moving their residences and workplaces to the metropolitan edge and into what we used to call hinterlands. Spatial dispersion combined with functional integration is a hallmark of our age. Every major metropolitan area in the world is building low-density suburbs at its edge, rather in the style of Phoenix. Even those that were founded long before automobiles and telephones arrived -- even Paris, London, Tokyo, Sao Paulo, and Holland’s Randstaad -- are being remodeled to resemble Los Angeles.

The signs of huge increases in long-distance intercourse are everywhere -- in ground and air travel; long-distance freight movements; telephone conversations; worldwide Internet connections; data transmissions; capital movements; worldwide distribution of books, television shows, and music; and the internationalization of virtually all manufactured products. Nearly everyone living in modern times is alert to the global connections that tie even the most local of institutions and activities into the worldwide urban system.

That degree of integration makes it difficult any longer to regard an individual settlement as a unitary phenomenon -- to see a city or metropolis as somehow separable from all those with which it’s entangled. The importance of a territorially defined settlement is expressed, increasingly, in the roles its inhabitants play within the larger system of social and economic relationships, no longer only as it serves its residents. In turn, these extensive interconnections belie Census-type definitions of the metropolis as a territorially defined unit. They compel us to look to the larger socio-economic system in which local actors are integrally engaged.
And yet, despite growing ease of interaction over distance and the eroding requirements for propinquity --

despite John Doe’s choice of an amiable exurban environment rather than short commuting time; despite the
ability of business firms to distribute their offices and factories globally while maintaining real-time
communication with their branches, suppliers, and customers worldwide; despite the spatial dispersion of
participants in specialized communities-of-interest; despite the erosion of geography -- metropolitan areas have
not disappeared. Indeed, they continue to grow. To be sure, they grow mostly at their farthest edges and
virtually all within the metropolitan commuting shed. More notable still, old-style central business districts
survive, and many of them prosper. Although they suffer traffic congestion and other associated costs of high
density, they still attract new establishments, even establishments that might flourish in exurbia equally well.
Although a lot of new development is occurring in such unlikely places as Montana and Arizona, most growth
continues to coagulate around established older settlements.

Why is this so? What’s the magnet that continues to attract firms and families into high-density, old-style, urban
settlements? Why do metropolitan areas continue to prosper? What is it that seems to make some people and
some organizations immune to the space-lubricating effects of modern transportation and communication
technologies? (Or, to put the question that concerns me most directly, what was wrong in those long-ago essays
of mine?)

The Persisting Power of Propinquity

The metropolis is a massive communications switchboard, all right. It exists only because interdependent
persons and groups have to be accessible to each other and because the cost of overcoming space has not yet
reached zero. If location theorists have it right, and if time and dollar costs were zero, there’d be little reason for
urban settlements to exist. People and firms would be in immediate contact with friends and associates even
though they were in distant places. They could choose to locate in pleasant surrounds and without suffering the
costs that attach to high density. With near-zero time and money costs of transport and communications, we
could expect settlements to be scattered over the landscape or, more likely, clustered in environmentally
attractive sites. But costs -- especially travel costs -- are not yet anywhere near zero, so people are still settling
in large metropolitan areas.

That’s partly because we still lack a magic wand that can bring us face-to-face in a flash. Moreover, information
received in one’s physical presence continues to be more highly valued, more credible than either printed or
electronically transmitted data appears to be. And then, the informality of the conversational situation is likely
to encourage exchange of more content than one might gain from a programmed transmission. Conversation
after an hour in the bar or exchanged over a pillow is likely to be far richer than any exchanged over a fax line.

Face-to-face interaction typically calls for physical movement, for getting the two faces to the same place. A
great many other transactions and interactions continue to require travel as well: tasks at workplaces that
involve handling physical materials are merely the most obvious of activities immune to electronic media.
Although telecommuting seems to work out for a small percentage of employed persons, the numbers remain
small. Few employers are willing to release employees from supervision; and then, many information-based
jobs require face-to-face exchange if they’re to be conducted either efficiently or effectively.

More telling still, contemporary economic activities are increasingly specialized. The metropolis is the

gathering place of growing arrays of business and consumer services that are ever-more narrowly focused.
They’re localized there because they’re interdependent and because they need to be physically accessible to their
suppliers, customers, and each other at tolerable travel and shipping costs. The complex interplay among
specialized firms is encouraged by the access that proximity affords; overcoming distance inevitably involves
some time and monetary cost.

Firms that process physical objects can never rely entirely on electronic information systems alone; and freight
shipments always carry some level of time loss and monetary expense. Those whose work involves
manipulating primarily words and numbers can and do employ the electronic media and are more footloose as a result, albeit constrained by some need for direct contact. The advantages of information received face-to-face and the added attractiveness of chance encounters continue to make urban centers and the resulting agglomeration economies enticing.

Surely the social dynamics of interpersonal relations must be contributing to the tenacity of the agglomerated urban pattern as well. It’s no doubt true that many people enjoy the sheer psychological and cultural stimulation that accompanies urban life lived at rather high densities. Many habitual New Yorkers contend they’ll never leave Manhattan with its crowds and visible vitality, no matter what the glories of the suburbs. So long as their numbers remain high, Manhattan will remain attractive to the many small consumer and business services that rely on proximate workers and buyers. So long as their numbers remain high, so too will Manhattan’s land values. Besides, most people still live out their entire lives in the locales where they reside. For all of us, some portion of our lives is delimited to our local environs. Daily life is largely local, even as our vocational and avocational activities may engage us in affairs of the larger world.

Further, so long as workers must commute to work and until the allegedly universal law of the 30-minute commute is repealed, workers’ homes will need to be physically accessible to workplaces. Despite extensive highways and widespread auto ownership, it looks as though most people must still live within the orbit of the metropolis where jobs still tend to cluster.

Automobiles and telephones made it possible for millions to live on the outskirts of the metropolis while remaining accessible to jobs, friends, and the many services they rely on—- including those that are spatially dispersed. The auto-highway system stands as the best transport mode yet invented; there are now more licensed drivers in America than there are cars; and impending improvements promise even greater ease and speed of movement and greater accessibility as well. Telephones and their new electronic recent descendants stand, of course, as the best communication systems ever, especially so in America where everyone has ready access to them. Both cars and phones reflect the culmination of an historically long series of cumulating technologic improvements, all of them one-directional in their effects -- all working to reduce the costs of overcoming geographic space and making for ever-greater locational freedom. The compounding effect of each invention has made for the recent exponential rate of improvement -- improvements marked by the arrival of the computer, the silicon chip, fiber optics, and the rest -- together promising to make long-distance communication ever easier and cheaper. Advances in new light-weight materials combined with modern electronics and new batteries portend greatly improved automobiles and, soon, automated highways. Advances in the Internet portend communications capabilities that even the most venturesome futurists are probably unable to foresee.

But, in an important sense, none of this is news. People have always been able to interact with others across geographic space. What’s new is the speed and ease of interaction and transaction across extensive space for virtually everybody and, hence, the level of integration of activities at a local place into the worldwide economic and social systems.

Diversifying Settlements

I suppose no town has ever been an isolated island-economy. Even the mobile Pigmy village periodically comes in contact with neighboring tribes where some level of exchange occurs. It’s probably true that inhabitants of every city throughout history have traded with others elsewhere. But it’s probably also true that the relative degree of independence has been declining over time. As ease of intercourse has increased, external connections have as well. In turn, the proportion of activities in a local settlement that is aimed internally, that directly serves local participants, is constantly falling. The counterpart of that trend is the constantly rising degree of integration into what has become the worldwide urban system. That system has displaced the local city-based society and economy, making it difficult any longer to deal with the city or metropolis as the object of attention. City settlements continue to grow, but they grow because they are parts of the larger, the global, urban system.
Insofar as our concern is for the geometric shape of urban settlement patterns, the picture is pretty clear. Settlements can now be had in various forms -- high density, low density, mixed land uses, segregated land uses, highly centered, highly subcentered, highly noncentered, even with "neotraditional villages" in some places. Within any given metropolitan settlement many or all these variations might occur. Transportation and communication technologies are highly tolerant of diverse consumer preferences and of diverse land use patterns these days, and many forms are emerging. Similarly, diverse environmental aesthetics are now feasible, matching the preferences of different population groups and reflecting site planners’ design capabilities. Beautiful and amiable built environments can be had in any of the varieties of potential land use patterns.

Insofar as our concern is for the large-scale, e.g., the national, pattern of urban settlements, that too is now flexible. Settlement size can be large or small, settlements can be concentrated or scattered, and establishments can choose among those options and yet enjoy comparably efficient operations. They can locate in Wall Street in New York, Main Street in Smalltown, Montana, or Orchard Road in Singapore, as they wish. That’s so because, wherever they go, they can stay in touch with whomever they need to be in touch, for they will still be well-connected inside the worldwide urban system.

Insofar as our concern is for the economic vitality and the livability of urban settlements, the internal geometric shape and the national distribution pattern is important primarily as it affects accessibility among the people who live and work there. Individuals’ lives are enriched to the degree that they have access to the array of opportunities that are open to them. What matters most to individuals is accessibility to jobs, schools, doctors’s offices, recreational activities, friends, and kin. Manufacturers care most about their access to a labor force, suppliers, consumers, and to the many specialized business services they rely upon. To the degree that anything like a collective community remains within the metropolitan area, the commonly valued ingredient is not merely interaction among its members. The metropolitan community survives and thrives depending on the access of its many specialized activities to others elsewhere, to available capital, and to the world’s cultural resources.

Despite the attention urban planners and geographers assign to spatial pattern, it should be clear that little, if any, value resides in spatial distribution per se. If there are desirable attributes associated with locational pattern, they are overwhelmingly the consequences for conducting social and economic activities. The attribute that matters most is accessibility -- the ease with which individuals and groups can reach and deal with each other. It continues to amaze me that so much attention is directed to describing and prescribing geographic pattern, rather than to its explaining and tracing its consequences. I was amazed by the planners’ and geographers’ preoccupation thirty-odd years ago. I continue to be amazed today.

References


Biographic Note

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APPENDIX: C

CONFERENCE PROGRAM
Spatial Technologies, Geographic Information, and the City

Program

Sunday, 8 September

5.00-7.30
Registration

6.00-7.30
Opening reception (Maestro Room)
Welcoming remarks by members of the Conference organizing committee

Monday, 9 September

9.00-10.15

Plenary Session: Perspectives on "Spatial Technologies, Geographic Information, and the City" (I)
Ron Abler, Susan Hanson, Ken Dueker

10.15-10.30
Coffee break
10-30-12.00

**Plenary Session:** *Perspectives on "Spatial Technologies, Geographic Information, and the City" (II)*
Mike Batty, Helen Couclelis, Kingsley Haynes

12.30-1.30

Lunch

2.00-3.30

Break-out groups -1:
A. Spatial technologies and changing urban accessibility
B. Impacts on urban populations
C. The role of GIS

3.45-5.15

Break-out groups- 1 (continued)

5.30-6.30

**Plenary Session:**
Reports from Break-out groups
Discussion topics for Tuesday

7.00-

Informal walking tours of Downtown Baltimore & Restaurant hunt

**Tuesday, 10 September**

8.30-10.15

Break-out groups - 2:
(Themes to be arranged Monday evening)

10.15-10.30

Coffee break

10.30-12.00

Break-out groups - 2 (continued)

12.00-2.00
Free lunch hour
2.00-3.30

Plenary Session:
Reports from Break-out groups -3

3.30-3.45

Coffee break

3.45-5.30

Break-out groups - 3
Towards a national research agenda on spatial technologies, geographic information, and the city

7.00-8.30

Conference Dinner

Wednesday, 11 September

8.30-10.15

Plenary session:
Round-table discussion: Towards a national research agenda

10.15-10.30

Coffee break

10.30-12.00

Plenary session:
Plans for a book from the Conference
Plans for dissemination of results and follow-up