

Toward Sustainable Development in Cities: A Case for New Spatial Decision Support Methods in Urban Planning

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1 ABSTRACT

In the current environment of rapid global change the role of sustainable development in cities become even more important. In addition to the traditional concerns of combating sprawl, congestion, and pollution we also need to rethink our carbon footprints and the settlement impacts of a contracting global economy that is sure to change the very paradigm in which we plan.

If traditional methods (and their underlying assumptions) are becoming increasingly suspect, it is clear we need not only to consider new ways to define the problems we face but also seek better ways to solve them. This includes the infrastructure of cities. Manuel Castells' "network society" (Re: M. Castells: *The Information Age*, Oxford 1998) suggests that the world is no longer hierarchically organized or territorially arranged, but functions on a new "borderless" network of economy and society. This reality has not been fully brought down to the city scale in terms of how day-to-day planning is undertaken.

A city's network of connections and interactions is particular to its range of activities for a given population, location and land-use profile. Traditional development models continue to struggle with capturing how that particular environment will react to changes. Planners must not only consider community characteristics, environmental impacts, but also consider spatial behavior itself (Re: Reginald G. Golledge, Robert J. Stimson: *Spatial Behavior*, New York 1997).

It is fair to say that for sustainable development we need new management and planning tools to better define appropriate measures and policies. Despite best efforts many transport and land use policies implemented at the local level have not helped to improve conditions.

Land use and transport are two essential ingredients of urban sustainability and policy making, any decision taken in one area directly impacts the other. Current work on sustainable mobility suggests a need for new management and planning tools to define appropriate measures and policies. Such tools generally consist of analytical frameworks, mathematical models and economic evaluation constructs. In many instances, the resulting transport and land use policies that have been implemented at the local level have not helped to improve conditions. There are also examples where they have failed to maintain existing levels of sustainability.

The point here is that traditional planning methods will need to change to keep up with profound changes in the culture and economy of cities. Possible alternatives are not so far away. (Re: Ian Bracken: *Urban Planning Methods*, 2007). One such area of potential help is threshold analysis.

The purpose of this paper is to underscore the increasing need for policy makers to understand that a relevant decision making process requires a support of proper methods of urban research and coordinated strategic actions. Introducing the new methodology policies will keep policies "under review" and help them remain relevant to changing circumstances.

2 INTRODUCTION

In the current environment of rapid global change, population growth, changing economies and social preferences, cities face enormous problems. The ability to achieve stable sustainable development is an ongoing and difficult challenge. The role of transportation and mobility in cities become even more important. Cities located near target markets with well-developed infrastructure (particularly transport and communications), and being physically attractive or having a unique cultural identity usually take advantage of regional or national development priorities and globalization.

The purpose of this paper is to underscore the increasing need for policy makers to understand that a relevant decision making process requires a support of proper methods of urban research and coordinated strategic actions. Introducing new methodology will keep policies "under review" and remain relevant to changing circumstances.



Fig. 1: Cities of San Francisco, Athens, Amsterdam, Gdansk

3 TOWARDS SUSTAINABLE DEVELOPMENT OF CITIES

Sustainable development is often used as one of the „magic terms“. In the most countries sustainable development is related to two major problems: poverty and degradation of natural environment. Solution to the first problem requires actions to restructure domestic economies and improving social conditions of living, second requires a reversal in the deterioration of natural resources (Re: J.Kozłowski: Towards Planning for Sustainable Development, 1999). There are many conflicts seen between these two problems especially when economic growth relies on the exploitation of natural resources.

The development does not need to be necessarily equated with growth and is often understood as realization of specific social and economic goals calling for stabilization, reduction, change of quality or creation of new uses, buildings, elements. When there is no growth the development may occur. When there is a need for progress there will be a need for development. Sustainable development must consider the lowest economic, ecological and social costs. The complexity of urban environment and unpredictability of planning indicate a need to establish principles and working tools effectively addressing the environmental threats. New planning tools must consider contemporary urban growth and development patterns, then the role of transport and mobility in cities as a backbone of the city structure.

3.1 Urban Growth and Development Patterns

Urban growth is a result of a combination of many factors: geographical location, natural population growth, rural-to-urban migration, infrastructure development, government policies, corporate strategies, and other major political and economic forces, including globalization very differently in the countries and regions of the world (Re: UN-Habitat report: “State of the World’s Cities 2008/2009, Harmonious Cities”).



Fig.2: Berlin, Alexanderplatz

The population and urban growth change urban development patterns in space. The biggest average annual rate of population growth of 2.5 per cent characterizes developing countries, while nearly half of the cities in the developed world grew less than 1 per cent annually. Urban growth patterns are different for countries and continents. For example in Asia urban populations of large cities are shifting or relocating to suburban locations or satellite towns linked to the main city through transport networks. In Latin America and the Caribbean - the most urbanized regions in the developing world, one-fifth of the region’s urban residents live in cities of 5 million populations. In North America, the patterns of growth and decline are not homogenous. One-fifth of cities declined in size while similar number of cities grew at the high rate between 1990-2000. European cities except large metropolitan areas, in general, are not growing any more.

3.2 The Role of Transport and Mobility in Cities

Today urban mobility is a key concern in cities of both developed and developing nations and impacts the livability of cities. Motorized urban transport has become a hot topic among policymakers, planners and environmentalists who are seeking ways to minimize its negative effects, like traffic congestion or air pollution. New travel and activity patterns require new approach to traditional transportation planning methods that need to keep up with profound changes in the culture and economy of cities. (Re: Ian Bracken: *Urban Planning Methods*, 2007).

Effective and reliable transport systems are crucial for the functioning of the post-industrial economies, yet such systems generate significant negative externalities like air pollution, noise vibrations, energy consumption, and emission of greenhouse gases and loss of open space. It is proved that reducing CO₂ emissions from the transport sector is much easier than cutting those from the building sector. However it is promising, that any new approach that involves a change in vehicle technology or a shift to different mobility technologies and techniques can be implemented in a relatively short time. Transport, therefore, is a very important element in our race toward sustainable life on earth. Documents of EU: The Green Paper ‘Towards a new culture for urban mobility’, Report on ‘Action Plan on Urban Mobility’ and reports and analysis of UN: ‘State of the World’s Cities 2008/2009, Harmonious Cities’ laid the emphasis on the steering transport policy towards sustainable mobility.

3.3 Urban Mobilty Land Use and Transport

Land use and transport are two essential ingredients of urban sustainability and policy making, any decision taken in one area directly impacts the other. These two main components together with social, environmental and economic factors are combined in a planning and the decision making process. Planning for sustainable land use and transport requires an integrated view of the interactions between them. Land use and transport with those interactions are often used as the first fundamental levels of planning, modelling the future city development that in consequence implicit social, economic and environmental outputs. This is the easiest way to plan and measure the changes in the urban environment. Ian Bracken discribing aspects of spatial organisation in formulating the city planning policy indicates three directions of analyses that should be undertaken: patterns of locations of particular types of urban activities in the area, flows between different parts of the indicated area, effects upon the environment caused by these locational patterns and flows of people and goods (Re: Ian Bracken: *Urban Planning Methods*, 2007).



Fig. 3: Portland, Oregon

A city’s network of connections and interactions is particular to its range of activities for a given population, location and land-use profile. This is also true for transport connections and mobility in the city. The fuel efficiency of public transport, improved regulations, construction of environmentally friendly mass transit systems are the most immediate sustainability gains of today urban transport and mobility policy (Re: M.Jenks, R.Burgess: *Compact Cities - Sustainable Urban Forms for Developing Countries*, London, 2008). The processes of economic, technological and social change, globalization and internationalization of the cities has a dramatic impact on the nature of production, capital flows, trade, passenger travels and activity patterns (Re: Reginald G. Golledge, Robert J. Stimson: *Spatial Behavior*, New York, 1997). Furthermore, we are experiencing increased mobility, new waves of international migration, changing structure of households, increased life expectancy, and better public participatory in decision making. Democratic and social changes affect decisions and the nature of behavior of modern urban society. The changes of transportation technology, time and cost of travel have shrunk time-distances. Innovations in computer and telecommunications technologies became new electronic challenges in the information age.

4 SPATIAL DECISION SUPPORT METHODS

Urban planning reflects the diversity of the spatial development. There is a debate about their relevance and application within the rapidly changing and increasingly complex environment. A permanent wide gap between the conceptual models of spatial behavior and the practical planning tools which have succeeded in developing theoretical advances. With the new theoretical backgrounds there should be much more attention paid to translate the very latest theoretical notions into practical tools. A number of developments in travel behavior analysis have introduced many new concepts and models.

4.1 New Planning Paradigm?

Traditional planning methods need to change to keep up with profound changes in the culture and economy of cities. There are many parallel and analogous developments in urban planning that reveal interesting methodologies, mixed land use, travel patterns, demand estimation and forecasting (Re: Ian Bracken: Urban Planning Methods, 2007). Regarding urban planning as a continuous adaptive process that requires involvement of many actors in the society, planning process must integrate three components: activities engaged by planners in order to intervene in the urban system, policies, that communicate or guide this activities and outputs or consequences of these activities that should influence the revision of policies. Policies are crucial for decision making process. Planning process is essentially a matter of continuous implementation of policy and adaptation, places plans, policy documents and programs in the role of “means” not “ends”. Day-to-day decision making often lead to longer term inefficiencies and conflicts.

Understanding planning policies is to know the loss and benefits of implementing them. All policies vary across space, formulated and enacted can have different effects in terms of the time span. Formulating policy packages requires the implications of the different packages to be analyzed through simulate on models. In practice the simulation models can be used to support the formulation of policy packages and strategies for sustainable mobility.

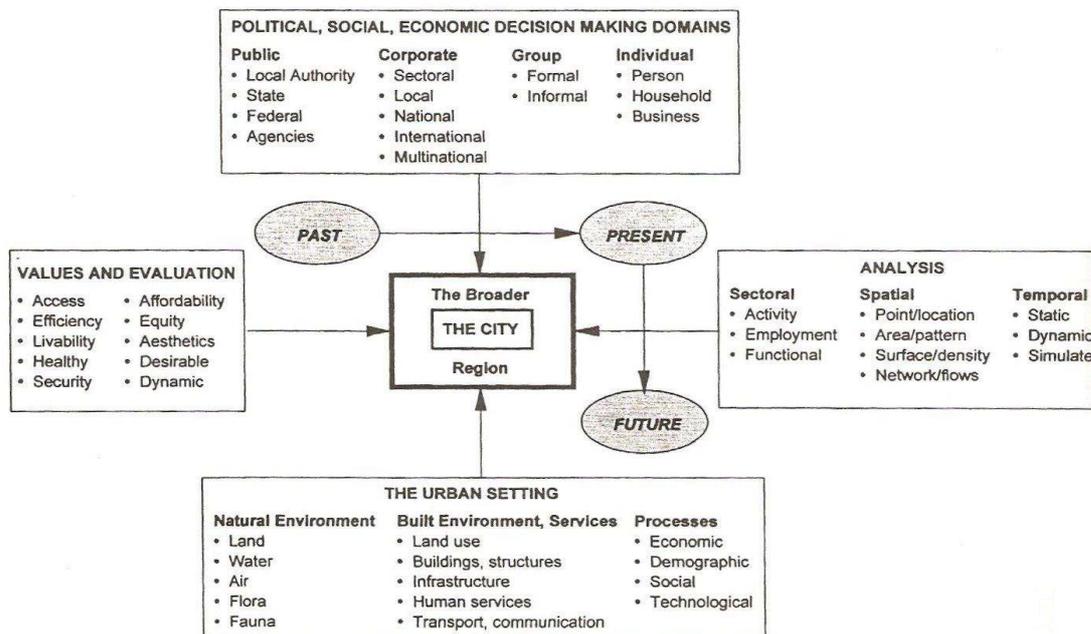


Fig. 4: A spatial-analytic framework for evolution and performance of a city (Golledge, Stimson, 1997)

4.2 Support Methods in Decision Making Process

Decision making process is defined (Golledge, Stimson, 1997) as a set of strategies that guide decision making behaviors such that they appear to cover many possible scenarios. In all problem-solving disciplines like spatial planning are more than one alternative approach can be used to achieve answer or solution to a problem. It is good to choose the best theory or model, still in restricting situations, practice or economy may dictate that a particular type of model is selected a priori for considered outcomes.

Decision making process on the macro level is more complex. In the city as a system multitude of past, present and future decisions create and share dynamic environment. There is a complex set of trends,

concerns, processes that need to be addressed to planning for the future development, growth and management of a city. A spatial analytical and decision making frameworks should be appropriate to investigate the city and to evaluate its potential evolution over time. These can be achieved by implementing strategic planning and developing strategies, plans, policies and projects. Executive decisions made by the city authorities are based on facts as objectively verified statements and values – statements of preferences, currency of politics (Golledge, Stimson, 1997). SWOT analysis can be very useful. Methods of supporting spatial decision process are based on complex and interdisciplinary analyses taking into consideration the existing factors. Decision making support methods usually use computer programs, individually designed algorithms and available data. Such tools generally consist of analytical frameworks, mathematical models and economic evaluation constructs. There are decision-simulation models (integrated models of urban land use, transport and economic factors), optimal location models (threshold analysis), simulation models (scenarios, Decision Support Systems – DSS, AIS, GIS). Decision Support Systems (DSS, AIS, GIS) are designed to bring a knowledge base and data to solve specific problems.

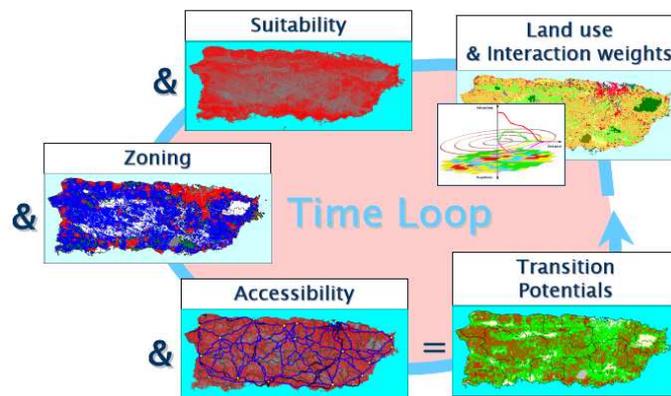


Fig. 5: Xplorah Model.

Xplorah is an example of decision-simulation model designed for Puerto Rico, an analytical instrument supporting integrated spatial planning. Xplorah is based on a Decision Support System (DSS), developed for Public Policy Research Center of the Rafael Hernández Colón Foundation (RHCF) and Graduate School of Planning (GSP) by the Research Institute for Knowledge Systems- RIKS. Xplorah as an integrated tool makes use of quantitative models to describe physical, economic, social and environmental processes, but also makes the feedback loops linking them. The primary goal of the system is to explore the effects of (alternative) policy options on the quality of the socio-economic and physical environment.

ORION is a decision-simulation model popularized in the city of Wrocław, Poland. The ORION model (Optative Repartition in an Opportunities Network) was created by Tadeusz Zipser and developed by his research group. Orion is an operational model derived from the paradigm of spatial decisions. Observed spatial patterns of urban development confirm that structural solutions are generated by complex system. It is assumed that the urban system consists of two subsystems: territorial and human activities. Model is based on elements of the subsystems allowing a simultaneous allocation of the various activities in city or region.

Among other methods supporting spatial decision process, defined as decision-simulation models is ILUMASS (2002–2006) funded by the German Federal Ministry of Science and Education. The objective of ILUMASS was to implement a fully microscopic model of urban land use, transport, and environment, developing and testing individual microscopic models and the interfaces between them.

Threshold analysis developed by Boleslaw Malisz in the 1960's in Poland are simple methods of optimal allocations activities in the city that considers rational use of all options, natural and man-made. Discussed first are the spatial limitations that arise during the process of development of city structures. Malisz's method helps select the best solutions that limit barriers and impede the process of planning with the lowest threshold costs.

5 CONCLUSION

Current work on desirable sustainable development suggests a need for new management and planning tools to define appropriate measures and policies. Such tools generally consist of analytical frameworks,

mathematical models and economic evaluation constructs. In many instances, the resulting transport and land use policies that have been implemented at the local level have not helped to improve conditions.

Traditional models continue to struggle with capturing how that particular environment will react to changes. To stay relevant in a changing paradigm, models need to consider new modes of movement that often involve uncertain assumptions. Planners must not only consider community characteristics, environmental impacts, but also consider spatial behavior itself (Re: Reginald G. Golledge, Robert J. Stimson: *Spatial Behavior*, New York 1997).

Spatial decision support methods are very useful in the process of urban planning, they can bring a knowledge base and data, describe physical, economic, social and environmental processes, and support the formulation of policy packages and strategies. A relevant decision making process requires a support of proper methods of urban research and coordinated strategic actions to find suitable answers while there is scientific or technical complexity. Processes of spatial changes fuelled by economic and demographic developments supply and demand both in terms of quality and quantity can be represented in models. Planning tools can better define appropriate measures and policies on urban sustainability and climate change. There is no model or method that can replace human decision process and there is no one universal tool that can be applied to variety of places. Complexity of environment requires a change of traditional planning methods. Using various methods and models can provide better urban research and coordinated strategic actions.

6 REFERENCES

- I. Bracken: *Urban Planning Methods*, Routledge, London, 2007
- M. Castells: *The information age: Economy, Society, Culture, Vol. I: The Rise of the Network Society*, Blackwell Publishers, Oxford, 1996
- R. Golledge, R. J. Stimson: *Spatial Behavior, A Geographic Perspective*, Guilford, New York, 1997
- M. Jenks, R. Burgess: *Compact Cities - Sustainable Urban Forms for Developing Countries*, Routledge, London, 2008
- A. Kaczorowska-Fudala: *Applying Threshold Analysis to Stimulate the Sustainable Renewal of Cities*, CURE, Gdansk, 2005
- A. Kaczorowska-Fudala: *Toward Sustainable Mobility in Cities: A case for new Spatial Decision Support Methods*, IFHP Congress: *Urban Technology, Climate Change and Energy Efficiency*, Berlin, 2009
- J. Kozłowski, G. Hill: *Towards Planning for Sustainable Development, A Guide for the Ultimate Environmental Threshold (UET) Method* Sydney, 1999
- X. Wang, R. v. Hofe: *Research Methods in Urban and Regional Planning*, Springer, Berlin, 2007
- T. Zipser, T. Ossowicz, J. Slawski, J. Brzuchowska, E. Litwinska: *Model symulacyjno-decyzyjny Orion*, KBN, Wrocław, 1994
- State of the World's Cities 2008/2009, *HARMONIOUS CITIES*, UN-HABITAT Report, <http://www.clc.org.sg/pdf/UN-HABITAT%20Report%20Overview.pdf>
- Peter Wagner and Michael Wegener: *Urban Land Use, Transport and Environment Models, Experiences with an Integrated Microscopic Approach*, http://www.spiekermann-wegener.de/pro/ilumass_e.htm
- Xplorah, the Spatial Decision Support System for Puerto Rico, <http://www.riks.nl/projects/Xplorah>