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6. Towards a Definition of Information Systems in Planning (*)

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Introduction

The windmill announced the feudal production and social system; the steam machine brought with it manufacturing and corresponding social systems (capitalism and socialism); we are now beginning to realize that the computer - best symbol of the information technologies - is plunging us into the Information Era (Alain Touraine, Daniel Bell started by calling it "the post-industrial period", Manuel Castels calls it "the informational mode of development").

Like in the previous stages of society, new branches of natural and social sciences, as well as engineering, are emerging in response to the new reality. Disciplines as diverse as Economy, Sociology, Mathematics, Psychology, Biology, Electronics, Law, Ethics, Gnoseology, Geography, and Management, are the source of new information-related fields such as Information Economics, Information Ethics, Artificial Intelligence, Human-Computer Interaction Cognition, Computer Engineering, Informational Law, and Informational Planning. As usual, the new fields frequently overlap and support each other.

Informational Planning -- or Information Systems in Planning -- is a discipline whose cognitive object or domain is the study of the information technologies (IT) with relevance to the institutional and planning processes, and the relationships between those IT and these institutions and planning processes.

At MIT, DUSP, our Planning Support Systems (PSS) research cluster has identified 3 broad areas of inquiry and methodological development that impact PSS: Analytical Methods and Urban Models; Knowledge Representation and Information Management; and Organizational and Institutional Implications of Information Technology.

The body of knowledge comprised by Informational Planning is vast and complex, and its boundaries are still in motion, as is characteristic of young fields. No single individual can claim to excel in all its components and facets. My approach is therefore to define a "core" literature that covers the fundamental across the three areas, and then a more focused view, or "cut", that provides the emphasis and depth appropriate to my particular interests and background.

1. Analytical Methods and Urban Models:

This component of Informational Planning provides the foundation for building information processing tools that are used for tackling complex planning questions, experimenting with different assumptions and approaches to open-ended planning problems, often focused in understanding urban phenomena. This area draws contributions from decision analysis, spatial analysis, system dynamics, operational research, mathematical programming, search space analysis, graph theory, game theory, among others.

Some of these are well defined domains, like graph theory, or mathematical programming. Others are either not yet so well defined, or recent research is in the process of redesigning the domain.

Spatial analysis techniques (aggregation / desegregation, overlaying, buffering, etc.) provide a qualitative framework for investigating spatial relationships and building computer models based on those relationships; advances in GIS technology expanded the depth and scope potential of this analytical method.

System dynamics, introduced by Forrester as a methodology for urban analysis and modeling, fell out of grace because of the shortcomings of the models it generated; but the challenge of representing time-based complex relationships (such as positive and negative feedback's) remains, and so does this research domain.

Game theory, introduced by Emile Borel's "La theorie des jeux" (1921) and consecrated with Von Newman's (and Morgenstern's) "Theory of Games and Economic Behavior" (1944), has grown into a serious research domain impacting on urban planning, by providing the framework to represent complex adversarial and collaborative relationships, which are at the base of computer simulations of urban and regional scenarios.

Although my background includes components such as graph theory, mathematical programming and basic queuing theory and operational research, in the past 8 years my research focus has been, and is, on heuristic methodologies (for search space analysis, for instance), rather than deterministic processes; and on trade-off modeling, rather than optimization.

My own cut in this area includes therefore components such as *theory of heuristic search* (breath-first, depth-first, best-first, beam search, A*, etc.); *taxonomy of urban models*; *heuristic multi-weighted population computer models* (e.g. Krueckenberg & Silvers model); *trade-off housing computer models* (e.g. Bertaud model); *adversarial strategies* (e.g. minmax theorem); *decision-making conceptual models*.

These components provide the framework to research issues such as: heuristic strategies for path optimization (path cost minimization); the relationship between information technology and the conceptualization and development of urban models; the attributes of successful urban and regional models at different aggregation levels; modeling the relationships between information-acquisition, information-supply and decision-making; the choice of search strategies as a function of each type of decision space; the attributes and formalism of trade-off models versus optimization models; etc.

2. Knowledge Representation and Information Management:

This is the component of Informational Planning that deals with how you structure, store and manipulate information within a system, from raw data to chunks of knowledge, in order to better serve a planning process (decision-making, policy-making, informing the public, transfer of expertise). This area is concerned with information dimensions such as: accessibility, portability, accuracy, consistency, reliability and sustainability.

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Technological advances enabled more informed actions by planners, but also exposed them to information overdose. Good information system design and sound information management techniques can make a difference, but what is good and sound is very much domain-dependent: the best way to represent and manage business-relevant data, for instance, is not necessarily the best way to handle planning-relevant data.

At the same time, planners functions (e.g. regulation implementation and enforcement) are faced with the challenge of private agents well equipped and familiarized with the most sophisticated information technologies, a challenge that computer engineers and information management experts are not equipped to answer, because those agents have individually both technical expertise and political, administrative and policy knowledge and acumen.

This is why technologically oriented sciences became a mandatory component of informational planning, which in turn is extending and changing these sciences to respond to the planning problematic.

Knowledge representation and information management draws from scientific traditions as diverse as psychology, calculus, logic, artificial intelligence, remote sensing, computer science, and management of information systems (MIS). Knowledge representation itself has emerged recently as a solid sub field of artificial intelligence, but traces of at least one formal representation, formal logic (predicate calculus) can be found as long ago as Aristotle, although the idea of using calculus to represent and manipulate ideas may be attributed to Leibniz.

Modern advances in all of these traditions brought more contributions that are relevant to Information Systems in Planning. The relevant sub-areas include: human-computer interaction cognition; expert systems; meta-rules; symbolic pattern matching; machine learning; regular grammars; semantic networks; frame-based systems; object-oriented representation; hypermedia and multimedia systems; metadata; data-base management systems; data base design; data flow systems; geographic information systems.

My background comprises elements of all the above mentioned sub-areas, with emphasis on expert systems, human-computer interface, and data base management systems. In recent years, my research focus within this area has been on *computer-human interface* (cognitive models of user interfaces, intelligent graphic interfaces), *intelligent decision support systems* (theory of inference / predicate calculus, expert systems and other knowledge-based systems, geo-referenced multimedia browser systems), and *object-oriented representation and programming* (object-based data models, encapsulation of procedural knowledge, theory of attribute inheritance). My cut in this area, for the purpose of the general examination, follows my current research focus.

3. Organizational and Institutional Implications of Information Technology:

This vast component of Informational Planning is concerned with how the evolution of information technology impacts on the way planners think, work and interact; on the role and functioning of organizations, from state agencies to NGOs (non-governmental organizations); on the relationships between planning institutions and processes, and the people affected by

them; and on the urban growth dynamics and spatial form. Since Planning is a science of social intervention, it follows that this area is also concerned with how to best use information technology (IT) to improve planning processes and institutions, and what kind of IT, and IT development research strategies, best serves planning processes and institutions.

Information technology is far from being simply a tool, that planners can master and use; it is also a powerful driving force transforming our society, that planners must understand and find the means to influence, where and when is possible and convenient. Information was always a source of power; now it is also an increasingly important source of wealth, a commodity with unique attributes, a form of capital with different laws of consumption and reproduction.

The Industrial Revolution, brought about by the *steam machine era's* technology, dramatically changed social systems, the mode of production, and the nature of the nation-state, expanding its regulatory power and its means to control resources and territory.

The Information Revolution is introducing no less dramatic changes, from the mode and organization of production to the form and function of government, changes whose nature became the object of intense research and debate. This is a complex research domain, given that the effects of the impact of IT in society, and therefore in cities and regions, vary according to their interaction with the economic, social, political and cultural processes that shape the way IT is produced and used.

This area draws on fields such as sociology, anthropology, management, organization behavior, political science, political economy, and law. In some cases, like political science (theory of the state), it corresponds to a specialized view within a well defined body of knowledge; in other cases, like law, it gave birth to a new branch (informational law).

My research focus within this area is on: *aspects of political economic impact of information technology* (redefinition of mode of production, mode of development; changes in transaction costs) ; *information technology and citizen privacy*, within different cultural contexts; *Information technology targeting citizen empowerment* (use of IT to develop new tools and models of participation to facilitate citizen control over planning processes and institutions); *impact of IT in government agencies' practice and structure* (organizational and IT needs of government agencies concerned with local or regional planning based on spatially disaggregated land use and demographic data).

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