A Proposal for a Model to Support Decision Making in Urban and Regional Development and Management

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Abstract: - Decision making in urban and regional development and management (URDeMa) issues is a difficult task to perform due to several constraints. The negotiation stage between the several parties involved in URDeMa decision-making is highlighted as a critical point for the whole process. Formal and informal processes and tools adopted for decision-making in URDeMa issues are reviewed to investigate their capabilities and limitations. The requirement for a computational tool that will assist at the high-level the decision-making process by facilitating the negotiations between stakeholders is identified. A conceptual framework for the development of a model that would support such a tool is presented in detail. Issues regarding input's form and methodology of collection, theoretical context of the model's operation, mode of implementation, and exploitation of results are analysed. The benefits of the development of such a model are explained and the issues that require further research are identified.

Key-Words: - Urban and Regional Development; Decision-making; Negotiation; Conceptual Model; Fuzzy Theory

1 Introduction

Urban and regional development and management (URDeMa) decisions are almost always the cause of much debate - and in most of cases of disagreements too - between a great number of stakeholders who are either directly or indirectly, both affected and affecting the decision making process. The interdisciplinary nature of such decisions involves, among others, public services, urban planners, designers and contractors, landowners, professional chambers and organizations, industry partners, the mass media and press, and the public as the end-user of the urban environment. In most of the cases, these stakeholders have competing agendas and interests with regard to URDeMa decisions, and therefore the urban planners and decision makers have to reach compromising solutions that fulfil the various stakeholders' requirements up to an acceptable level. Resolving this issue can be a formal or informal process that may include to various degrees the use of solid data and computer systems or cognitive approaches such as knowledge and experience exploitation, verbal discourses, etc. However, at present, there is no widely accepted systematic technique to support URDeMa decisions in an indisputable way. This shortage results to time- and resource-consuming negotiations between the stakeholders involved towards reaching optimum

URDeMa decisions. To overcome this hindrance it is more efficient for the urban planner to aim to obtain the best, in depth, knowledge and information about the stakeholders' perceptions for the case under study and then incorporate them in a proper way and balance to the suggested solution. In this way less need for compromising shall be required and negotiations shall be significantly facilitated. This paper presents the conceptual background for the development of a model that can assist the urban planner to reach URDeMa decisions based on collective input from the main stakeholders that affect the decision making process. The paper is structured in the following way:

- Current approaches for URDeMa decisionmaking are presented and discussed to prove the demand for a model to support this process.
- A proposed model is presented with regard to the following issues:
 - Input requirements and collection method
 - Basic characteristics and operational mode
 - Impact on the decision-making process and benefits gained
 - Applicability and concurrent use with other decision-making tools.
- Issues requiring further research towards development of the model are highlighted.



Figure 1. Decision Making Processes and Tools in Urban and Regional Development and Management

2 Current Approaches for Making Decisions on Urban and Regional Development and Management Issues

URDeMa decisions are made based on both formal and informal processes that involve to a different degree various tools from checklists to sophisticated software. Figure 1 roughly presents the main types of these tools and associates them with the type of process with which they are usually used.

The main tool used especially in formal URDeMa decision-making is Geographic Information Systems (GIS). This is because resource problems at a local or global level and planning and management for urban and regional development have an obvious spatial dimension, which is required to be integrated with the rest of the parameters, data, and knowledge considered in the URDeMa decision-making process; GIS provides such an integration platform [1]. Moreover, GIS is a very important tool because it can visualize problems and associate them with the spatial factor, which is very significant for URDeMa decisions [2]. Visualization is achieved either in a detailed level with the allocation of problems to specific areas described by maps or in a higher level with the integration of GIS and CAD systems with virtual reality to achieve effective planning based on simulated, real-life conditions. Ligett et al. present such an application – the Urban Simulator - and prove why and how the planning process is significantly facilitated and accelerated, while the associated costs are reduced and the final outcome is more efficient and comprehensible to the

public [3]. Apart from visualization and spatial allocation of URDeMa issues, GIS can be used more directly for decision-making through integration with decision maps [4]. A decision map as defined in [4] is "an advanced version of conventional geographic maps which is enriched with preferential information of the decision maker(s) relatively to a set of conflicting evaluation criteria and is especially destined to visual spatial decision making".

GIS are also integrated with multi-criteria methodologies, fuzzy theory concepts, dynamic modelling approaches, etc., to achieve the development of integrated tools for URDeMa decision-making [1].

Apart from GIS, computer aided URDeMa decisionmaking is achieved also with other Information Technology (IT) tools. For example, Kumar and Mukund present in [5] a system based on data warehousing and data mining to aggregate and organize data and eventually use them for decisionmaking in a comprehensive and effective way. Another example is ECOSIM, which is a system that provides to urban planners the interface for displaying information on data monitoring, data bases, simulation models, and other tools that assist the decision making process [6]. ECOSIM integrates data acquisition and monitoring systems, GIS, and dynamic simulation models in a flexible clientserver architecture that uses hypertext transfer protocols for communication of information and use of tools by urban planners [6].

Formal URDeMa decision-making is not associated exclusively with computer systems or IT. The

Participatory Urban Decision Making process supported by the United Nations Centre for Human Settlements (Habitat) is a comprehensive process implemented in four phases, i.e. [7]:

- Preparatory and stakeholder mobilization
- Issue prioritisation and stakeholder commitment
- Strategy formulation and stakeholder commitment
- Follow-up and consolidation

The tools to implement these phases are generic and easily modifiable to fit any specific case context [7]; hence the whole approach for conducting participatory urban decision-making is based on flexible tools rather than solid data and sophisticated computer aided techniques. Such tools comprise checklists, indicators, discourses between the various stakeholders, public discussions, etc. The Participatory Urban Decision Making process is a formal process that relies to the building of consensus among stakeholders with regard to URDeMa decisions.

Negotiation models are another form of formal noncomputing approaches used for URDeMa decisionmaking. Regan et al. present such a model focused especially on the environmental aspect but fully extendable to the whole range of URDeMa issues [8].

Informal processes are actually ad hoc processes, which can include anything from group decisionmaking and unstructured negotiations between stakeholders, to implementation of political agendas and interventions of special entrepreneurial interests. Informal processes are not as systematic as formal ones and the outcome of decision-making based on the former process type can be highly disputable concerning quality and proper implementation.

The abovementioned approaches – both formal and informal – present limitations, which render URDeMa decision-making incomplete. The most important of these limitations are:

- The dependence of computer aided URDeMa decision-making on large amount of data. These data are generated at various levels (e.g. local, state) and sectors (e.g. and infrastructure, health) involved in urban planning and management. Current approaches still fail to compile the vast amount of data required and produce comprehensible indices for decision-making [9].
- The Boolean foundation (0/1) of GIS and other simulation models that prevent from incorporation of imprecision, human cognition, perception and thought processes in a traditional computer-aided decision-making process [1]. Considering the complexity and the variability

of conditions related to URDeMa issues a certain level of flexibility is required to deal with them, which is hardly provided through data elaboration and computational models use but is rather achieved by cognitive approaches.

- The problematic diffusion of data, information and knowledge to urban planners through webbased applications. Professionals do not exploit e-sources at the highest possible level due to several reasons (e.g. limited use, accessibility problems, etc.). Moreover, additional alternatives available for many years already, such as desktop multimedia conferencing are proving to be of limited practical utility for an efficient decision-making process [10].
- Group decision making and negotiation models are prone to number and status of stakeholders, attitudes and behaviours of group members, interests and conflicting agendas, lack of will for consensus and many other factors that limit the particular approaches from facilitating decisionmaking.

Current approaches for URDeMa decision-making should not be devalued due to the abovementioned limitations; on the contrary they should be adopted – upon preference of the decision maker – but only after ensuring shared understanding by the stakeholders on the URDeMa issues in a formal and simple way. A description of a model to assist in this task is discussed in the following sections.

3 A Model to Support Decision-Making in Urban and Regional Development and Management

URDeMa decision-making is a very complicated and multifaceted process due to the involvement of a great number of stakeholders and issues that require careful consideration for reaching the optimum result. A critical point to facilitate the decisionmaking process is the achievement at the very early stages of a shared understanding between the involved parties about the key features (e.g. criticality) of the issues involved for a case in hand. Recording the evaluations of the stakeholders for these features and comparing them in a simple and easy way would reveal areas of different level of disagreement between the involved parties; this would lead to the reduction of the negotiation time and efforts, because discussions should focus only on the risky areas for potential disputes among the stakeholders. In this way the decision-making process would be significantly facilitated by: a) the acceleration of negotiations and b) the acquisition of better knowledge from the involved parties on what to expect during negotiations.

Recording and comparing the stakeholders' evaluations of key features (RCSE) shall be a formal process to produce accurate and widely accepted results. This process requires a computational tool that will be easy to use by stakeholders and understood both in terms of methodology as well as in terms of produced results. More particularly, the steps to perform the described process are:

- Formal recording (i.e. in a numerical way) of each stakeholder evaluations on the key features associated with the parameters of important issues for consideration in the decision-making process.
- Computational elaboration of the provided input for assessing overall judgments for each key feature.
- Representation of the assessments in a formal and user-friendly form (e.g. a diagram).
- Comparison of the various assessments to reveal areas of agreement and disagreement.

RCSE is the last step of a more comprehensive approach that involves (in sequential order):

- Identification of the stakeholders
- Identification of the critical issues to consider in the decision-making process
- Identification of significant parameters related to each issue for consideration

Concerning these steps many approaches already exist for implementation (e.g. the process described in detail in [7]); therefore, in this paper the focus is on the RCSE process. For the sake of completeness the comprehensive approach as described above is presented in Figure 2. The following subsections provide more details for each step of the RCSE process, which graphically is presented in Figure 3.

2.1 Input collection

Recording the stakeholders' evaluations of key features of significant issues of URDeMa issues can be achieved in a direct or indirect way. The difference lies not only in the way the input (i.e. the evaluations) is obtained but also in the content of this input. For example, a direct approach is to ask a stakeholder with the use of a questionnaire to evaluate using an appropriate scale, e.g. the possibility/probability of occurrence or the significance or the criticality, etc., of an identified issue. An indirect approach, on the other hand, is to analyse data drawn from respective indicators (e.g. social, economic, environmental, etc.) and conclude about the stakeholders' evaluations. Both approaches are appropriate, however the direct one can be more efficient because it is focused on the particular stakeholders, issues and conditions with regard to the case in hand at a given time and is simpler to apply. Therefore, the approach suggested here is to use a Likert - type questionnaire to collect from the stakeholders their evaluation of key features such as criticality, significance, possibility/probability of occurrence, etc., of the several parameters, which are identified as significant for each respective issue. Regardless of the number of the questions, which is anticipated to be very large, it is obvious that once this information is recorded in the proposed formal way, it can be supplied as input to an appropriate model for comparing the attitudes between the various stakeholders on the same URDeMa issue.

2.2 Model's key characteristics and outcome Once the input, i.e. the stakeholders' evaluations of significant parameters of URDeMa issues, is supplied to the model the following results are





anticipated:

- The stakeholder's overall assessment for each key feature of a single URDeMa issue (level 1)
- The stakeholder's overall assessment for each key feature for all URDeMa issues concurrently (level 2).

where wide divergence is noticed. Focusing and insisting on disagreements facilitates and accelerates the negotiation process in URDeMa decisionmaking; this is because negotiating becomes more structured since negotiation issues are ranked with the criterion of divergence among stakeholders and,



Figure 3. Recording and comparing the stakeholders' attitudes (RCSA Process)

Assessments of key features for groups of URDeMa issues shall be also possible to obtain if intermediate levels of analysis are required (e.g. specific areas of issues such as environmental, social, etc.).

To obtain such results the model is required to provide with a systematic way for carrying out the abovementioned assessments, which are based on subjective evaluations. The theoretical framework that satisfies most this requirement is fuzzy theory. This is because fuzzy theory lacks the limitations of Boolean logic and may reflect more accurately human judgment and very complicated situations. Therefore, the evaluations of the stakeholders are used to structure specific fuzzy sets for each key feature of each parameter and the aggregation of the parameters for the assessment of an issue's key feature is carried out in the fuzzy theory context.

The final outcome for each issue is in a numerical form and this facilitates comparison between the results of the various stakeholders. However, these results may easily be presented graphically to facilitate even more the comparison process. The comparison between the assessments for an issue's key features clearly indicates the level of consensus between the stakeholders and clarifies these issues as a result, resources (e.g. time) are managed more efficiently.

4 Conclusion – Future Work

The proposed model responds to the requirement of facilitating the URDeMa decision-making process by assisting shared understanding and focus on the issues of disagreement between the various stakeholders involved. It is applied at the first stage of the decision-making process to indicate issues where special considerations will be required due to conflicting views of the stakeholders involved. In this way, it also indicates, indirectly, the tools that will be required to further stages of the decisionmaking process since particular types of issues are related to particular types of tools (e.g. land issues require use of GIS tools). The proposed model works complementary to these tools as it sets the general framework of the negotiations between the involved stakeholders.

Several issues require in depth research for the proposed model to become a fully operable computational tool:

- The identification of the variables of the model. These variables are the critical issues and their parameters to consider in the decision-making process; identification of them is a laborious process due to the complexity and different conditions from case to case.
- The clarification of the key features for the parameters and the representation of them as fuzzy sets.
- The exact method to carry out the assessments of the key features at the different levels mentioned in section 2.2.
- The appropriate presentation of the outcomes that will facilitate shared understanding and comparison between the different views of the stakeholders.

Resolution of these issues will conclude the model and consequently provide with a decision-making tool that will be beneficial for urban and regional development and management.

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