Krassimir Markov, Vitalii Velychko,
Lius Fernando de Mingo Lopez, Juan Casellanos
(editors)

New Trends in Information Technologies

I T H E A
SOFIA
2010

Krassimir Markov, Vitalii Velychko, Lius Fernando de Mingo Lopez, Juan Casellanos (ed.)

New Trends in Information Technologies

ITHEA®

Sofia, Bulgaria, 2010

ISBN 978-954-16-0044-9

First edition

Recommended for publication by The Scientific Concil of the Institute of Information Theories and Applications FOI ITHEA

This book maintains articles on actual problems of research and application of information technologies, especially the new approaches, models, algorithms and methods of membrane computing and transition P systems; decision support systems; discrete mathematics; problems of the interdisciplinary knowledge domain including informatics, computer science, control theory, and IT applications; information security; disaster risk assessment, based on heterogeneous information (from satellites and in-situ data, and modelling data); timely and reliable detection, estimation, and forecast of risk factors and, on this basis, on timely elimination of the causes of abnormal situations before failures and other undesirable consequences occur; models of mind, cognizers; computer virtual reality; virtual laboratories for computer-aided design; open social info-educational platforms; multimedia digital libraries and digital collections representing the European cultural and historical heritage; recognition of the similarities in architectures and power profiles of different types of arrays, adaptation of methods developed for one on others and component sharing when several arrays are embedded in the same system and mutually operated.

It is represented that book articles will be interesting for experts in the field of information technologies as well as for practical users.

General Sponsor: Consortium FOI Bulgaria (www.foibg.com).

Printed in Bulgaria

ISBN 978-954-16-0044-9

C\o Jusautor, Sofia, 2010

USING THE GROUP MULTICHOICE DECISION SUPPORT SYSTEM FOR SOLVING SUSTAINABLE BUILDING PROBLEMS

Filip Andonov, Mariana Vassileva

***Abstract**. The article discusses the implementation of decision support systems in the selection of the type of sustainable development building that best suits the criteria of all the participants in the decision making prosess – investors, clients and the local government.*

***Keywords**: green building, decision support systems, sustainability*

Introduction

With the depletion of non-renewable sources of energy and growing environmental problems more and more technologies turn to innovative eco-friendly solutions. Green building tries to increase the effectiveness of the resources used – energy, water and materials and lower the negative impact on human health and the environment during the entire life-cycle of a building. In order to achieve this architects and engineers are searching for better location, design, structure, maintenance and disposal. The maximum energy efficiency and minimum impact on the environment and landscape can be achieved by creating eco-settlements designed using sustainable technologies.

Research shows that Bulgaria is among the countries with the lowest energy efficiency in buildings, especially in those, constructed before 1989 [1]. According to data from the Yale university, Bulgaria is on 56th position in the world by energy efficiency for 2008 [2]. Increasing this position will lead to:

1. reducing the negative impact of increasing energy prices for domestic users and increasing the comfort of the households;
2. creating new market opportunities for energy efficient facilities as well as new jobs;
3. achieving sustainable development [3].

The goal of this project is to develop a working model to support all participants/parties involved in the process of creating sustainable homes/eco-settlement in the decision making process regarding the most suitable technology for satisfying their needs and goals with the help of the decision support system Group Multichoice.

When developing sustainable building projects the choice is not limited between traditional technologies (reinforced concrete and bricks) with one technology for energy efficiency or one alternative building method (using wood for example). There are many existing options for alternative buildings, satisfying in various degrees the needs and criteria of the parties involved – investors, architects, prospective residents, municipal authorities and the general public. Thus such a project involves more than one decision maker (DM) and a number of perspectives to the problem. The participants have different criteria and usually contradicting goals.

Method applied. Description

In essence the problem is to find the most suitable building technology among a list of existing technologies, evaluating the alternatives by a set of contradicting characteristics with meaning for the model. Describing the problem in this way makes it a discrete multicriteria problem. There are several participants involved, therefore a group decision support method should be used. For the current example Group Multichoice system [4] is used. This system gives flexibility with regard to the problem solved, the degree of competence of the participants, the

methodology used, the type and number of the criteria, the size of the expert group and the way they express their preferences. The process of solving the problem can be divided into the following steps:

- determining the alternatives, criteria and their type;
- entering the values of the criteria with regard to the alternatives;
- selecting the method for solving the individual multicriteria problem and selecting the aggregating method;
- entering the DMs' preferences in the way the selected methods require;
- evaluating the result.

The last three steps are repeated until achieving a result, satisfying all participants or until the aggregating method stops.

Alternatives

For populating the set of alternatives several traditional and alternative construction methods were evaluated.

Table 1. Construction methods. Evaluated in the model

Number	Description	Code
1	Reinforced concrete and bricks	concrbrick
2	European type assembly house	european
3	Finnish type wooden house	finnish
4	Reinforced concrete underground house	underconcr
5	Wood and clay house	woodcley
6	Wood and straw house	woodstraw
7	Stone house	stone
8	Recycled tyres and compressed earth house	earthtires

Participants

The main participants or parties involved in the problem of choosing the technology for building new eco-settlements are basically three – prospective customers, investors and municipal authorities.

For the purposes of the current project a potential buyer and an architect (investor representative) were interviewed. For establishing the perspective of the municipal authorities the following documents were used: First National Action Plan for Energy Efficiency 2008 - 2010, and Directive 2006/32/EC of the European Parliament and the Council. The role of these documents was to identify the weights of the criteria, meaning their subjective assessment for the importance of every criterion, used in the decision making process.

Criteria

The criteria used to evaluate the alternatives are not the same for all participants. The values of the criteria for all alternatives are estimated on the basis of the average market prices for the last quarter of 2009 and consultations with an environmental expert.

Table 2. Criteria, used by prospective customers

No	Code	Description	Best value (min/max)	Type
1	price	Selling price	min	quantitative
2	maintain	Maintenance cost of the structure	min	quantitative
3	efficiency	Energy efficiency	max	quantitative
4	ecoimpact	Environmental impact	min	qualitative
5	landscape	Impact on landscape	min	qualitative
6	meteo	Susceptibility to weather influences	min	qualitative
8	comfort	Comfort	max	qualitative
9	light	Light	max	qualitative
10	humidity	Optimum humidity	max	qualitative
11	health	Impact on human health	max	qualitative

Table 3. Criteria, used by the investor

No	Code	Description	Best value (min/max)	Type
1	laborforce	Number of workers	min	quantitative
2	constrcost	Cost of construction	min	quantitative
3	price	Selling price	max	quantitative
4	edu	Costs of training staff	min	quantitative
5	materials	Costs of materials	min	quantitative
6	health	Impact on human health	max	qualitative
7	comfort	Comfort	max	qualitative
8	safety	Worker safety	min	qualitative

Table 4. Criteria, used by municipal authorities

No	Code	Description	Best value (min/max)	Type
1	ecoimpact	Environmental impact	min	qualitative
2	landscape	Impact on landscape	min	qualitative
3	laborforce	Number of workers	max	quantitative
4	roads	Impact on road infrastructure	min	qualitative
5	waste	Amount of building waste	min	quantitative
6	efficiency	Energy efficiency	max	qualitative
7	publicity	Public acclaim	max	qualitative

Results

After entering the data, the AHP method was selected for individual solving. The main reason to use AHP was that the participants do not have any experience with the applied methodology and the basic concept of this weighing method is relatively easy to understand, the method-specific data is easily extractable from the DMs and that makes them more confident in the result they obtain by applying it. Table 5 shows that despite the fact that the three participating sides have different criteria and preferences, they reach consensus on the first step of the interactive process and identify recycled tires and compressed earth structure as the winner. When using an interactive method for group decision support, the solving process can be interrupted on every step and the

currently preferred alternative is declared winner if all participants agree on that. In this case they have found a solution satisfactory for all of them and the process stops.

Table 5. Rankings of alternatives for participants on step 1

Position	Customer	Investor	Municipal authority
1	earthtires	earthtires	earthtires
2	woodclay	finnish	woodcley
3	finnish	woodstraw	woodstraw
4	woodstraw	european	underconcr
5	underconcr	woodcley	finnish
6	european	underconcr	european
7	stone	stone	stone
8	concbrick	concbrick	concbrick

Aknowledgement

This research is partially granted by Bulgarian National Science Fund, Ministry of Education and Sciences in the frame of the project "Automated Metadata Extraction for e-documents Specifications and Standards", contract N D002(TK)-308/ 19.12.2008.

Conclusion

In conclusion it should be noted that the methodology used is applicable for introducing and popularizing modern sustainable technologies in construction, unjustifiably neglected by the general public in Bulgaria, despite their proven qualities and benefits due to the fact that there is no sufficient information about them or to lack of social prestige associated with these.

Bibliography

1. Naniova, C. "The Demonstration Project for the Renovation of Multifamily Buildings: a joint initiative of the Bulgarian Ministry of Regional Development and Public Works and UNDP Bulgaria" Sofia, Bulgaria. UNECE First Workshop on Energy Efficiency in Housing 2009
2. http://epi.yale.edu/Bulgaria
3. National program for energy efficiency to 2015, www.mee.government.bg
4. Andonov F., 2009, INTERACTIVE METHODS FOR GROUP DECISION MAKING, KDS 2009
5. First National Action Plan for Energy Efficiency 2008 - 2010, and Directive 2006/32/EC

www.strategy.bg/FileHandler.ashx?fileId=482

6. Directive 2006/32/EO of the European Parliament and Council, www.seea.government.bg/documents/EE_Kraino_Potreblenie.doc

Authors' Information

Filip Andonov *– ass. prof. NBU, 02/8110610, fandonov@nbu.bg*

Major Fields of Scientific Research: Decision support systems, group decision support, multi-criteria analysis

Mariana Vassileva *– assoc. Prof., phd, IIT-BAS, mvassileva@iinf.bas.bg*

Major Fields of Scientific Research: Decision support systems, multi-criteria optimisation, multi-criteria analysis