Mathematical Modelling and Analysis
Abstracts of the 9th International Conference MMA2004, May 29-31, 2004, Jūrmala, Latvia

DECISION ENGINEERING IN COMPLEX SOCIAL-ECONOMICAL SYSTEMS USING SOC

ROMA ŠIUGŽDAITÉ[1] and SAULIUS NORVAIŠAS[2]

Institute of Mathematics and Informatics

Akademijos 4, 2600, Vilnius, Lithuania

E-mail: [1]`roma.siugzdaite@ven.lt`, [2]`saunor@ktl.mii.lt`

Complex systems exhibit behavior that differs from the sum of the individual component behaviors. P. Bak defines systems with large variability as complex. Systems or projects at any scale do not function as isolated projects or segments, but rather as a network that serves to move people, material, energy and information from one place to another. Complex systems theory can help us to explain this variability and the sometimes-unpredictable behavior of pavement networks.

In this paper we involve self-organized criticality (SOC) theory to analyze urban as well as electricity production data. SOC is the name for the tendency in many large interactive systems to evolve toward a critical state in which events in the system follow a simple power law. Self-organized criticality is the only model or mathematical description that has led to a holistic theory of dynamical systems.

In theory of adaptive decision-making the main task is to find values of dynamical parameters to satisfy local optimum criterion. In contrary, for the long-term strategies there is important to search for the systems global optimal solution. In this case we have to take into consideration the main features of SOC systems such as resistance not only to inner non-linear interactions but also to outer influence, positive innovations and destructive perturbations. We assume that the systems criticality simplifies the long-term optimal solutions finding. We show that complex systems in SOC state are maximally adaptive. Meanwhile external changes of the system, which is taken out or didn't reach SOC state, can determine system loss or total collapse.

Decision making in energetics we perceive as a policy of investment in long term development of energetics economy, considering the structure of generators instead of total dynamic characteristics of energy capacity. Generators rank distribution law unambiguously identifies the energetic systems structure. Ideally the system of generators should be in self-organized critical state that reflects naturally formed urban system state. Because of lack of data accessibility we couldn't verify presence of this consistent pattern in various countries except in Lithuania. Accordingly we consider it as operating ad hoc hypothesis.

Proposed model offers not only geographical urban and energetics system characteristics (structure distribution) and dynamics, but also integral characteristics that selfsame important in decision-making. When we have real system deviance from SOC state, taken decision must re-establish this state. That allows us to answer both questions 'what capacity and how many generators' and 'where to build them'. The same rule is valid for urban development. Hence SOC method is combined method that enable identify both parameters of system geometry and system dynamical characteristics.

REFERENCES

[1] M. Batty. Multi-Agent Approaches to Urban Development Dynamics. In: *CASA project, Complex Systems Management Centre, 2003*, 2003, .

[2] R. Siugzdaite and S. Norvaisas. Energetics as self-organized system: Methodological aspects. *Nonlinear Analysis: Modelling and Control*, 2002.