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Socially inspired decision making tools: from the Economy to Management Engineering

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1. Introduction

"*For a few minutes, forget our profession's usual focus on mostly technical, highly specific problems, and consider a new answer to an old question: how can we design organizations that work well? No, this isn't about tools for planning and budgeting, or models of how an organization's objectives can be optimally attained. The design of the organization itself is the subject of a new spin-off field from mainstream OR/MS: computational and mathematical organization theory (CMOT).* Since this launch of CMOT as an offspring from TIMS and OSRA, agent based simulation (ABMS) has established itself as a useful approach to solve complex problems in many fields: project management, supply chain models, natural resources management and personal and impersonal exchange organization (Edmonds *et al* 2007, López *et al* 2008). If one surveys the past CIO Proceedings, it is clear that ABMS is far from being a popular approach to solve problems in "Ingeniería de Organización". The intention of this paper is to help in filling the gap between ADINGOR's culture and the new movement in OR decision tools: CMOT (ABM).

2. From OR to Economics and all the way around: from the Economy to Management Engineering

Economics has been seen for most academics in the last century as the science that tries to solve the problem of assigning scarce resources among competing alternatives. Just a case in the realm of Operational Research and Mathematical Programming. Even today an Operations Research Call for Papers for an Special Issue on Computational Economics was open till March this year, just showing that this is an alive academic trend, within OR. The majority of the attendants to this Conference favour this trend.

Many of the engineering of distributed systems, heuristic agent learning and decision tools are imported from mechanisms observed in the biological world. Humans have a remarkable capability to perform a wide variety of physical, mental and social tasks with simple measurements and information and following informal rules of thumb. Ideas from the social sciences are less explored than biological theories, as a source of self organization computational techniques. One of the reasons is this prevalent view of Economics that has restricted the models to the extreme of a caricature of what Economics should be: a science devoted to explain the working of the Economy, i.e. the activity of wealth creation, exchange and distribution. This human activity (experiment) has been with us for centuries. The other

reason is that it was not possible till the last decade to build and to simulate with distributed intelligence models.

Software and management engineers are recently working with distributed systems where the physical landscape is populated by social agents in uncertain environments. However no formal cross fertilization has been made between software and management engineering. What can we learn from these experiments that the Economy has provided for centuries to solve the core problem in management engineering: scarcity and choice? Under what conditions can we extend and replicate these happenstance or laboratory experiments with human subjects to artificial agents?. Can we consider CMOT the twenty first century extension of OR?

3. What is really new in the ABMS approach to OR problems?

Why ABMS? Is it just a new technique or even a fade, or is it the missing link in the methods we need for Management Engineering? In the paper we argue and hopefully answer to some of the following questions, all relevant in OR as decision making tools.

What really makes complex a decision problem? What kind of science is Organization?. What should policy makers at the firm or the national level know about the complexity that they try to model? Can artificial markets "compute" the zeros of the system of equations that would define a market in an efficient and cheap way?. If so can we design the system to be self-adaptive with decentralized spontaneous order? What are the implications of agents being human and consequently being bounded rational? Organization is a question of personal exchange where the agents are no objects. Objects "do things for free, social agents for money". That means that if we want our models to be far away from the ***what if*** goal, then genetic learning and selection are not a realistic way to accommodate agent's behaviour. Is there a way to embed social and individual learning?. How can system dynamics, feedback with ABM? These considerations were originated in previous works, some from the authors, in auction design, industrial and innovation policy issues, bargaining in strategic games with asymmetric information, natural resources management and manufacturing.

4. Conclusions. Achievements and challenges of ABMS

Besides the specific answers to the above questions, related conclusions and references in the paper, the books quoted below will provide the reader with a wide spectrum of successful applications of ABM in engineering and natural resource management. For an interesting range of ABMS applications to ME/OR problems, see Macal & North (2006) and North & Macal (2007). We will finish the paper discussing the challenges of ABMS to successfully solve ME problems.

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