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General Integration of the Applications of Complexity in Science

Co-ordinate actions

NEST-2003-Path-1
Tackling Complexity in Science

WP 13 – Deliverable 13.2
Draft of the Report on "tackling Complexity in the Sciences" presented

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Organisation:
ISI Institute for Scientific Interchange, Torino
HUJ Hebrew University of Jerusalem

Revision 0

Project co-funded by the European Commission with the 6th Framework programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

In order to ensure that the view of complexity offered by GIACS is not biased, two draft versions of the expert group report *Tackling Complexity in the Sciences* were prepared in November 2006, one written by Prof. Solomon the other by Prof Weisbuch. However, each contributed heavily to the report and editing of the other's report. The tables of contents of both reports are given below. Both draft reports are available at: http://www.giacs.org/roadmap.

Draft for Complexity Expert's Road-Map, edited by Prof. S. Solomon

CONTENTS (contributions due to other Scientists are explicitly indicated*):

1. A first look at complexity
- *From Reductionism to the Multi-Agent Complexity Paradigm.
- *Complex Multi-Agent-Models
- *Beyond the Soft vs. Hard Science Dichotomy
- *Multi-Agent Complexity is intrinsically Interdisciplinary
- *Popular books

2. Complexity Mechanisms and Methods
- *LINK to 'More Concepts' (by Gerard Weisbuch)
- *Multiscale Structure of the Complex Multi-Agent Method
- *Irreducible Complexity
- *New Causal Schemes (parallel, asynchronous dynamics, Markov webs)
- *New Ontological Schemes (Network vs tree, dynamical ontology, postext)
- *New Experimental platforms (distributed, electronic, NAtlab, avatars)
- *Logistic Systems
- *Power laws and dynamics of their emergence
- *Multi-Agent Modeling of Reaction-Diffusion Systems

3. Autocatalytic Growth
- *The Birth of Macroscopic Objects from Microscopic 'Noise'
- *The A(utocatalysis)-Bomb
- *The Logistic Bomb: Malthus-Verhulst-Lotka-Volterra-Montroll-May-Eigen-Schuster systems
- *Autocatalysis and localization in immunology B-Bomb
- *Multi-Agent Simulation of the Emergence of Immune Funct.
- *Autocatalysis in a social system; The Wheat Bomb
- *Microscopic Simulation of Marketing; The Tulip Bomb
- *Stochastic logistic systems yield scaling and intermittent fluctuations
- *Why Improbable Things are so Frequent?

4. Complexity in Various Domains
- *Short First Tour of complexity examples
- *Physics
- *Complex BIOLOGY
- *The Complexes of the Immune Self
- *COMPLEX IMMUNOLOGY
- *SOCIAL SCIENCE
- *COGNITIVE SCIENCE
- *Social Psychology
- *'Minority GAME'
- *Economics
- *ECONOPHYSICS
- *Spatially distributed social and economic simulations
- *"MANAGEMENT quotations on complexity'
- *COMPLEXITY OF RISK
- *'INFORMATION Complexity'
- *The Social life of computers
- *DESIGN to EMERGE
- *Making the Net Work
- *The Introspective Internet
- *Networks
- *NETWORKS Dynamics and Topology
- *Network manipulation and Novelty Creation
- *Some Directions for the Future

5. Methodological Issues

6. Conclusions and Recommendations
- *Organizational Recommendations

References

Draft for Complexity Expert's Road-Map, edited by Prof. G. Weisbuch

CONTENTS

1 Introduction
- 1.1 From components to global properties
- 1.2 A historical perspective
- 1.3 Concepts and methods
- 1.4 Caveat: To be transversal or not
- 1.5 Domains of application

2 Social Sciences
- 2.1 Social systems
- 2.2 Economics

3 Biology
- 3.1 Theoretical biology
- 3.2 Systems Biology
- 3.3 Cognitive Science
- 3.4 Engineering emergence in self-assembling systems
- 3.5 Epidemic modeling and complex realities
- 3.6 Bio-inspired strategies for new computing architectures and algorithms paradigms

4 Information and communication technologies
- 4.1 Optimization and Complexity
- 4.2 Networks, especially computer

5 Complex systems, Business and Society
- 5.1 Econophysics and Finance as a success story
- 5.2 Present challenges
- 5.3 Supply Networks Management
- 5.4 Credit networks and Systemic Risk
- 5.5 Collective Evaluation and Trust-based Networks
- 5.6 Penetration of CS science in the business world

6 List of contributors and experts
- 6.1 Editor
- 6.2 Contributors to specific parts of the document
- 6.3 Participants to think tank meetings

7 References