E.C. Nest Contract n. 012380

General Integration of the Applications of Complexity in Science

Co-ordinate actions

NEST-2003-Path-1
Tackling Complexity in Science

WP 6 – Deliverable 6.2

Final report describing all the events under the present workpackage, and summarizing their measured impact based on post-tracking.

Due date: months 2 to 36
Submission date:

Start date of project: 2005-07-15 Duration: 36 months

Organisation:
GENO – GENOPOLE EVRY - ILE DE FRANCE - EVRY FRANCE

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)	

Targeted Thematic Actions, or Think Tanks, have three different flavors.

1. Fostering new research opportunities

The goal is to pave the way for new scientific investigations, and to couple researchers from fields that had remained sparsely or not connected thus far. To this end, the TTA-1 gathers a team of 4-7 active and imaginative researchers, and 2-3 young collaborators in case it is foreseen that they will undertake a new project based on the TTA outcome (in this specific case, a "double triplet" may be initiated). The initial presentations are made in public. The synthetic document will be improved towards a publishable paper. The essence of this document is given in public in the last afternoon of the action in the form of conclusions. Following this initial deliberate action, it is hoped that the action will stimulate those in related fields to work on new projects or on new aspects of their current research. European relays to the TTA could be planned in advance: for instance, a TTA-1 may constitute the first week of a meeting (e.g. Thematic Institute or Workshop) in case this type of initial focusing is desired.

The chosen themes must represent a finely tuned compromise between ambitious speculation and a pragmatic realism that relies on established facts. Two quite different examples of themes for a TTA-1 in Biology could be: renewing the concept of a cell by examining candidate organising principles or coupling them in new ways; taking inspiration in novel and specific concepts from the Life sciences to imagine new and useful operators for biomimetic algorithms.

2. Assessing the field of Complex Systems

The goal is to assess the merits of various potential paths within some field of the Complex Systems paradigm, and to make recommendations to program officers with respect to subsequent European scientific policy. To this end, the TTA-2 gathers a team of 5-8 researchers. Program officers may optionally participate to the team when useful. The initial presentations and final conclusions are made in public. The synthetic document will be improved towards a white paper or a roadmap, and made available to program officers. Examples of issues that could be tackled with TTA-2s include the relevance and timeliness of engaging into certain proactive initiatives.

3. Assessing policies

The goal is to respond to precise problems/needs encountered by business/economic/politic policy makers. To this end, the TTA-3 gathers a team of 5-8 Complex Systems researchers and policy makers. Policy makers must be present mostly during the first day to raise their questions, and the last day for an informal discussion around potential solutions. Generally, no public session is scheduled. The synthetic document will evaluate potential solutions to the problem.

In proportion to the funding that was attributed to WP6, six Think Tanks have been held, bringing together the leading thinkers, both established and young, and devoted to fostering new research opportunities.
The results of these think tanks have been gathered into documents that are available upon request. They are described below. Post-tracking results are summarized, except when they are meaningless because the event is too recent.

Think Tank 1 :

Date: 5-9 June 2006
Place: Epigenomics Project, Genopole, Evry, France.
Type: TTA-1.
Title: Synergistic combinations of theories of ion condensation, water structure and membrane organisation have important implications for cellular dynamics

7 Participants:

- Jerry Manning (Rutgers, New Jersey, USA)
- Vic Norris (Univ. Rouen, France)
- Max Berkowitz (Univ. North Carolina, Chapel Hill, USA)
- Alfons Geiger (Univ. Dortmund, Germany)
- Camille Ripoll (Univ. Rouen, France)
- Frank Mayer (Univ. Göttingen, Germany)
- Daniel Borgis (Univ. Evry, France).

Topics:
The think-tank had the objective of bringing advances in physical chemistry to bear on complex problems in system biology. Five leading specialists from across the disciplines were brought together to investigate how ion condensation, water structures and membrane composition might interact to control certain biological processes in the recent context in which cells are increasingly seen as highly structured. The format adopted was that of a series of keynote lectures followed by intense discussions over the following five days. The first major outcome was the realisation that the theory of ion condensation had to be extended from charged 1-D filaments to 2-D surfaces. The second outcome was the identification of an important problem in biology that might well be resolved, at least in part, by invoking ion condensation. This problem is the nature of control over cell cycle events in bacteria and, in particular, the mechanism responsible for triggering chromosome replication.

Post-tracking summary:
Many of the scientists involved in this think tank remained in contact until now, one reason being the small size of this event, that favored tight relationships. They often expressed that this think tank represented an exceptional week in their life as scientists, because it allowed them to do their “real” job as scientists, be creative, rather than do paperwork and routine work.
A road map for future actions was laid down in which 'immediate' tasks were defined to be accomplished soon after the meeting whilst longer term tasks, dependent on these immediate ones, were also defined. The contacts between the participants initiated by this think-tank have led to ongoing collaborations and progress continues to be made as shown in the publications that have appeared or that are in preparation. Many of the tasks the group set itself have now been performed and a new vision of an important biological problem is emerging.

Think Tank 2 :

Date: 25-26 July 2006
Place: Institute for Scientific Interchange, Turin, Italy.

Type: TTA-2.
Title: GIACS Think Tank meeting

12 Participants**:**

- Mauro Gallegati (U. Politecnica delle Marche, Ancona, Italy)
- François Képès (Genopole, Evry, France)
- Andrzej Nowak (Warszawski U, Warsaw, Poland)
- Felix Reed-Tsochas (U. Oxford, UK)
- Michael Ghil (ENS, Paris, France)
- Markus Kirkilionis (U. Warwick, UK)
- Norman Packard (ECLT, Venice, Italy)
- Peter Richmond (Trinity College, Dublin, Ireland)
- Massimo Salzano (U. degli Studi di Salerno, Fisciano, Italy)
- Gérard Weisbuch (ENS, Paris, France)
- Sorin Solomon (ISI, Turin, Italy)
- Alessandro Vespignani (ISI, Turin, Italy).

Topics:
A theory of complex systems has been developed from the forties, relating simple elementary processes to collective functional properties in physics, biology and the social sciences. More recently, application to design and business have been developed. A major turning point around year 2000 is the availability of huge set of data which complex systems methodology allows to transform into useful knowledge.

A list of promising research avenues would include:
• From model systems to real world systems.
• Inverse dynamics especially in biological networks, but also in many other fields such as markets or crowds when data become available.
• Distributed processing in the industry and services, starting with the Internet, data processing etc. find solution which are distributed, scalable and adaptive.
• A nearly unchecked field is policy design: defining a policy and checking its consequences by what/if simulations; policy implementation taking into account the adaptivity of both measures and constituency.

Dissemination**:**
A white paper on Complex Systems totaling 66 pages, dated November 13, 2006, has been written on the basis of the discussions held during this think tank, with a direct written contribution from several of the above-mentioned participants. It was edited by Sorin Solomon and Gérard Weisbuch. It is available on the GIACS resources web page at: http://www.giacs.org/roadmap

Post-tracking summary:
This think tank was set up to assess the field of complex systems and resulted in a white paper and roadmap. The posterior events were mostly occupied by the collective editing of this large document, under the supervision of Sorin Solomon and Gérard Weisbuch. The white paper was well received in the community, has been widely distributed, and has been used in various settings to further progress in complex systems funding, understanding and publicity.

Think Tank 3

Date: 8-9 Feb 2008
Place: Institute for Scientific Interchange, Turin, Italy.
Type: TTA-3.
Title: Complexity Science Support to Citizenship, Environment and Policy Making

Topics under the general heading of Complexity science and Social policy: Healthcare delivery, Education, Energy policy, Challenges to society from the internet, Migration, and Spread of infections.

13 Participants:

- Italy, ISI: Sorin Solomon, David Brée, Mario Rasetti.
- UK, University of Warwick: Robert MacKay, Robin Ball, Frances Griffiths, Markus Kirkilionis, Jonathan Cave
- USA, Boston University: Andrei Ruckenstein, David Campbell, Calin Belta, Jo Restuccia, Strom Thacker

Dissemination: A report (pdf) is available.

Think Tank 4

Date: 27-29 May 2008
Place: Epigenomics Project, Genopole, Evry, France.
Type: TTA-1.
Title: Systems Biology. Statistical semantics of genomes: From sequence to function

This think tank was targeted to promote the most rapidly growing area of bioinformatics and statistical analysis of biological macromolecules, that is, the identification of the sites of high information value and a study of their distribution along a genome and the investigation of the relation of such sites to the coding regions within the same domain (statistical semantics of genomes).

25 Participants: see Table 6.1.

Topics:

- Correlations between sites locally, along chromosomes (e.g. solenoid models), and between taxa. Evaluation of the significance of higher order correlations
- Identification of nested structures (like the so-called pyramids) and a theory of their classification
- Distribution of strings of high information value along a genome and a systematic comparison between related taxa
- Hidden Markov and other models for the distribution of informative sites along genomes.

Table 6.1 Participants at the Fourth Think Tank Forum

France:
- École Polytechnique, Palaiseau: Valentina Boeva
- Evry: Pierre-Yves Bourguignon, François Képès, Bernard Prum
- INSA de Lyon: Lilia Brinza
- Institut Curie, Paris: Loredana Martignetti, Andrey Zynovjev
- Institut Jacques Monod: Klaus Scherrer
- Institut Pasteur, Paris: Thomas Rolland
- Université Paris 6: Alessandra Carbone, Linda Dib, Anthony Mathelier

Germany:
- Max Planck Institute, Leipzig: Fatihcan Atay, Nihat Ay, Nils Bertschinger, Jürgen Jost, Thomas Kahle, Eckehard Olbrich, Johannes Rauth
- University of Göttingen: Bukhard Morgenstern

Israel, University of Haifa: Alexander Bolshoy

Russia:
- Institute of Biophysics, Krasnoyarsk: Michael Sadovsky
- Institute of Genetics, Moscou: Vsevolod Makeev, Andrey Rubinov

Sweden: Göteborg University: Kristian Lindgren

UK:
- Cranfield University: Jeremy Ramsden
- Oxford University: Gerton Lunter
- University of Leicester: Alexander Gorban

Think Tank 5

Date: 18-23 August 2008
Place: ETH, Zürich, Switzerland.
Type: TTA-1.
Title: Challenges and Visions in the Social Sciences.
The think-tank wanted to gain a better understanding of socio-economic systems as complex adaptive systems and to identify questions, methods, and instruments to make a substantial scientific progress in this area in the future. Specifically, it aimed at identifying future trends in the social sciences, and problems that will have to be addressed. The hope was to come up with visionary ideas of what will be the important topics over the next 10 or 20 years, and to formulate a list of hard, ambitious, and important problems to be addressed by collaborative, international research projects. Contributions could be methodologically or problem oriented, but were always of interest to a wider scientific community.

9 Participants: Douglas Heckathorn, Anders Johansson, Pietro Speroni di Fenizio, Jörg Reichardt, Dirk Helbing, Lars-Erik Cederman, Andreas Diekmann, Frank Schweitzer, and Didier Sornette.

Topics:

- Empirical and Experimental Challenges
- Modeling and Simulation Challenges
- Practical Challenges
- Challenges of Interdisciplinary Research.

Dissemination: A report (pdf) is available.

Think Tank 6

Date: 15-19 September 2008
Place: ECCS'08, Jerusalem, Israel.
Type: TTA-1.
Title: Complexity Science in the 21st Century: keeping purpose in a random world.

The randomness of our environment is the very source of our lives but also the potential source of confusion and death. Maintaining our identity in an ever-changing environment requires understanding and exploiting the potential of continuous changes small and very large, ubiquitous and very rare. Sustainability becomes the name of the game: how to bridge over the stream of failures produced by the frequent adverse events using the leverage of the successes allowed by the rare beneficial ones. Life, society, humanity and the entire universe are the product of it. Sustainability is not stationarity nor stagnation.

This Think Tank was divided in three sessions. The format of the Think Tank was a compromise between learned pre-design conferences and free-for-all open unstructured discussion. The sessions were organised in talks of 40 minutes by leading authorities and were followed by a free format round table. Because of the heterogeneity of the fields covered by particpants (economics, physics, biology, genetic…), the talks were interrupted after 15 minutes to allow for 5 minutes of comments and requests for clarifications from the other panel members. Thus, while maintaining in great lines the flow of the talk, the speaker was able to adapt it to the frame of mind and reactions of the Think Tank colleagues.

22 Participants: 22 researchers have participated from many different countries (Israel, United States, Italy, France). Four of them were financed by GIACS WP6 (François Kepes, Ken Buetow, Mirta Gordon, Jean-Pierre Nadal).

The 22 participants: Abeles Moshe (Israel), Aharon Itzhak (Israel), Belmaker Haim (Israel), Buetow Ken (United States), Chaitin Gregory (United States), Cohen Dan (Israel), Derrida Bernard (France), Ebstein Richard (Israel), Gallegati Mauro (Italy), Gazit Ehud (Israel), Gordon Mirta (France), Havlin Shlomo (Israel), Lord Hunt Julian (Great Britain), Kepes François (France), Nadal Jean-Pierre (France), Pietronero Luciano (Italy), Segré Daniel, Solé Ricard (Spain), Solomon Sorin (Israel), Soreq Hermona (Israel), Tishby Naftali (Israel), Vignes Annick (France).

Dissemination: A report (pdf) is available.