



6th Framework Programme
Anticipating scientific and technological needs

NEST

New and Emerging Science and Technology

REFERENCE DOCUMENT ON

“Tackling Complexity in Science”

2003/4-NEST-PATHFINDER INITIATIVES

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This document complements the NEST 2003 work programme, by providing more detailed guidance to those who may wish to submit proposals on the above PATHFINDER initiative.

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Please note that there is a National Contact Point (NCP) for NEST in your country who can offer personalized services. The mission of NEST NCPs is to inform, advice and support potential applicants in the preparation, submission and follow-up of NEST proposals.

For contact details: <http://www.cordis.lu/nest/ncp.htm>

1. RATIONALE

Though no commonly accepted definition of *complexity* exists, it is realized that widely different systems, composed of many interacting units, generate under certain conditions a characteristic common phenomenology, the most prominent signature of which is the emergence of new patterns transcending the characteristics of the individual units. Such systems are ubiquitous in many branches of natural and human sciences as well as in technology.

In the mean time, the world with which we have to interact is in itself becoming ever more *complex*. Modern technology and systems mean that the number and type of interactions amongst people have also multiplied.

The promise of the *science of complexity* is to provide, if not a unified approach, at least *common tools* to tackling complex problems in various scientific domains.

This PATHFINDER initiative is intended to encourage the development and transfer from one area of science to another of solutions and approaches to concrete complex real-world problems. Such solutions should at the same time hold the promise of being further generalisable. The initiative aims to build cross-national as well as cross-disciplinary links to support the development of European competencies which will have payoffs for science, for society and for the economy in the longer term.

2. OBJECTIVES

The specific objectives of this PATHFINDER initiative are therefore to:

- Promote the development of techniques for the successful tackling of specific but important, complex real-world problems.
- Encourage the *transfer* of such techniques for tackling of complex problems from one of area of science to another, where particularly promising and appropriate.
- Help identify, coordinate and consolidate the community, working on such problems by providing one means of interaction and exchange of ideas and information.

3. ORGANISATION OF THE INITIATIVE

Due to its limited resources, NEST is aimed at early stage funding of emerging research areas. The organization of this initiative reflects these parameters. It will involve:

- A series (approximately six to ten) focused research projects (using the STREP instrument – specific targeted research projects), aiming to promote highly interdisciplinary research that will make real advances to the solving of important scientific questions where complexity is a key issue.
- A networking action (using the CA instrument - co-ordination action), whose function will be to develop a wider “community of knowledge” across Europe, to exchange knowledge and experience and promote a wider understanding of the implications of research across the various relevant disciplines, as regards to complexity and tackling complexity.

In its management role, the Commission, for its part, will work to build links between this initiative and other research programmes and associated activities, at national, European and international levels.

4. WHAT KIND OF RESEARCH WILL BE PURSUED?

As required by the overall NEST mandate, research supported by this initiative needs to be highly interdisciplinary, innovative and with the promise of having a high impact, both scientific and otherwise, in the long term.

In accordance with the overall philosophy of the current PATHFINDER initiatives, the transfer of techniques from one domain of application to another is particularly sought. Furthermore, such solutions should preferably be generalisable further to other areas of application as well.

Examples of scientific domains where the identification of problems is encouraged are biology (e.g. complexity in cellular signalling and regulation processes, bio-complexity), social sciences (e.g. emergence and robustness of social institutions) and the environment (e.g. predictability and distribution of extreme events in nature). Proposals that offer real prospects of bridging the gap between the physical sciences, and the social and other natural sciences in an effective manner are particularly encouraged.

Projects are expected to take a practical, problem-solving, approach, grounded in observation and experimental data. At the same time, as specified in the work programme, it is expected that problems be tackled from a complexity-inspired approach, taking into account issues such as emergence, robustness, predictability, and the consideration of such complex systems from the point of view of networks, or networks of networks.

Projects should be brought forward by highly interdisciplinary teams, bringing together competences from two or more areas of application. Furthermore, if possible the team should have the necessary competencies to be able to generalise the results further if the approach is successful.

The initiative is designed to encourage researchers to come forward with novel ideas and approaches. The aim is to create a portfolio of ambitious “*beacon projects*” which, by seeking interdisciplinary opportunities at the limits of scientific knowledge, expand the knowledge base in significant ways. The projects selected in the initiative will be expected to maintain a degree of cooperation and interaction throughout their lifetime in order to optimise the out come and added value of the initiative.

The research should identify and address “*well-posed problems*” – research challenges that promise significant scientific advance at the frontiers of knowledge and the interface between disciplines, but which are also methodologically tractable given the current state of knowledge.

Problems brought forward should not be of a completely “open ended” nature, but should be challenging ones that can be answered, or where significant steps can be taken towards answering them, in the framework of the time allowed for the project.

The proposals selected will be those considered to have the highest “value-added” and long term impact in terms of advancing science.

5. WHAT KIND OF RESEARCH WILL NOT BE PURSUED?

In accordance with NEST mandate and the work programme, the initiative is not intended to support research of limited interdisciplinary nature, nor of limited long-term scientific impact. Moreover, projects should not be of a type that would fit well within the existing Thematic Priorities of the Framework Programme.

Specific examples of areas which will not be considered here include:

- Research of purely theoretical nature and/ or tackling complexity in isolation of possible real-life problems and applications.
- Complexity research whose main goal is Information and Communication Technology (ICT) related (such proposals should consider submission to the Future and Emerging Technologies (FET) initiative of the Information Society Technology (IST) programme). This includes dealing with complexity in the Internet, computer programming or telecommunications systems. Modelling of specific complex systems within the framework of solving specific problems in other areas of science is of course allowable.
- Complex problems of a purely industrial or engineering nature (for example as applied to the production of specific complex products or services).
- Projects dealing with purely financial applications without putting them in to the wider context of the social sciences (for example, projects aiming at statistical analysis of stock trading)
- Collaborative research of a weakly interdisciplinary nature bringing together groups or researchers from different sub-branches of the same field (e.g only within Physics, only within Chemistry, etc).
- Proposals which because of their particular focus or centre of gravity could be considered to fall into the PATHFINDER initiatives on *Synthetic Biology* or *What it means to be human*.

6. WHAT IS THE FUNCTION OF THE CO-ORDINATION ACTION?

The co-ordination action (CA) will be expected to provide a degree of coordination and interaction between the research projects ultimately selected in the initiative and to facilitate their interaction with the broader scientific community. Furthermore, it should seek to network the research community in Europe in relevant fields around the theme, and act as a forum for the development and exchange of ideas.

The approach should be broad and inclusive, bringing ideas to bear beyond the range of the work in individual projects. The CA should therefore consider innovative ways of building interaction and communication across diverse fields. It could consider how the broader interdisciplinary research agenda might develop in the future, and also address the question

of how outcomes from this initiative might lead to practical applications of the knowledge generated.

The CA instrument may involve various different types of activity, including meetings, seminars, studies, exchanges of personnel, etc. Thus, depending on the proposals submitted, the strategy adopted and the specific work it carries out, it could be configured in a number of different ways. For example, it could organise think tanks, interdisciplinary meetings, workshops or seminar series on key topics etc.

A high level of public interest might be expected in this field of research, and this suggests that it will be important to involve a wider range of actors than those involved in the research projects, or indeed the research community more broadly.

The CA also provides the research community with a means to generate ideas for further development of research and related activities within the institutional environment of the European Research Area, including European and other programmes for training, mobility, infrastructure development, etc.

7. PRESENTATION OF PROPOSALS

Proposals will be presented as individual FULL PROPOSALS for research projects (STREPs) or co-ordination actions (CAs), to meet the deadline 14 April 2004. They will be evaluated individually, according to the standard FP6 evaluation criteria for these instruments. A guide for proposers, and guidance notes for proposal evaluation will be published on the NEST web-site.

A pre-proposal check service will be provided up to three weeks before the deadline. This will enable brief feedback to be given to proposers, in order to help them assure the eligibility and judge the relevance of their proposals. This service is to assist proposers; it does not contribute to the official independent evaluation (peer review) of proposals, once they are submitted. The timely submission of such a pre-proposal is strongly encouraged.

When drafting, proposers are encouraged to be concise and address the specific evaluation criteria in their proposals:

- **Relevance:** the specific objectives of the proposal and the cross-disciplinary dimension should be clearly set out. It should be shown how the proposal meets the requirements set out above, including ambitious goals and the broader spirit of the PATHFINDER initiative on “Tackling complexity in science.”
- **Excellence:** The research should be presented in the context of an assessment of the current state of the art in the relevant fields, demonstrating the specific advances that are to be sought and how these derive from advances in the various disciplines and from the cross-disciplinary work involved. The projects should be grounded in data and observation, and the feasibility of the methodology should be clearly demonstrated
- **Impact:** the specific benefits of the work in terms of scientific advance (empirical and theoretical) should be presented and justified, broader potential impacts and applicability in the short or long term should be set out. Projects need to have a clear

area of application and concentration, addressing concrete real-world problems where complexity is a key issue.

- **Consortium:** The full range of competencies necessary to complete the work, at an appropriate level of experience, should be demonstrated. Consortia should be profoundly interdisciplinary and preferably demonstrate competence in two or more areas of application, while ideally having the ability to generalise further the applicability of the results.
- **Financial aspects:** the requirements for, and the use of, funds should be sufficiently detailed for the independent evaluators to assess the feasibility and cost-effectiveness of the use of resources (personnel and equipment). Project lifespan should be of a timescale of up to 3 years and a community grant of €1.5 million.
- **Management:** The organisation of the work, including the ways in which cross-disciplinary effort will be achieved, should be set out. Any relevant ethical considerations should be stated, as well as the ways these will be addressed in the course of the project.