



6th Framework Programme
Anticipating scientific and technological needs

NEST

New and Emerging Science and Technology

REFERENCE DOCUMENT ON

“Tackling Complexity in Science”

2005/6-NEST-PATHFINDER INITIATIVES

October 2005

This document complements the NEST 2005-06 work programme, by providing more detailed guidance to those who may wish to submit proposals on the above PATHFINDER initiative.

This is a version of the reference document referring to the “Tackling Complexity in Science “ initiative of the call FP6-NEST-2005-Path, with the call deadline on 15 February 2006.

There are no major changes with respect to the 2003/04 version. The most important change is in the change in focus for Coordination Actions (see appropriate section of this document), given that a general coordination action for the initiative was funded in the first call.

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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.

The first NEST-PATHFINDER Call on “Tackling Complexity in Science” was successful at setting up a diverse but highly complementary group of projects, giving an impetus to European efforts in the area. The call was also successful in setting up a Coordination Action to ensure the articulation of these projects with each other and with the broader Complexity research community in Europe (see:

ftp://ftp.cordis.lu/pub/nect/docs/nect_pathfinder_projects_en.pdf for details on projects funded under the first call for proposals)

The current call seeks to maintain the same strategic orientation, while taking into account the outcome and lessons learnt from the earlier call. *It will support cross disciplinary research on complexity as well as collaboration between the field of “Complex Systems Science” and specific areas of science where complexity is a key issue.* It will promote the creation of new interdisciplinary partnerships between researchers within the field of complex systems and researchers in a range of other fields, as well as the extension and generalisation of successful techniques for dealing with complexity from one area of research into others.

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 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 involves:

- A series of 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.
- One or more networking actions (using the CA instrument - co-ordination action), 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, problems should 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 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 are 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.

International co-operation (partners outside the EU and associated states) are particularly welcome. However, it should be noted that partners from countries with highly developed Science/Technology capabilities (US, Japan, Canada, Australia...) will normally not be able to receive funds from NEST.

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 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 one of the other the PATHFINDER initiatives.

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

Proposals for **Co-ordination Actions** need to take into account, and articulate with, the already established NEST – PATHFINDER STREP research projects and Coordination Action, funded under the first call of this initiative. New coordination actions, funded under this call, should focus on promoting collaboration in *particular* scientific areas or approaches to complexity. They may, for example, involve providing access to the large amounts of relevant data available in the community at large, promoting short stays of senior scientists, and supporting advanced training activities such as Summer Schools to promote the use of the techniques of Complex Systems science in other areas of research.

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.

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.

SPECIFIC SUPPORT ACTION(S)

Proposals for Specific Support Actions linked to the development and implementation of the initiative are also encouraged. These may include for example, activities to assist in the mapping and developing more detailed definition of the fields in question, assessing future development prospects and trends in the fields.

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.

Both the Coordination Actions and the Specific Support Actions do not support research and technological development *per se*. SSAs differ from CAs actions in that they may involve a single participant and be of relatively limited duration. SSAs should promote the NEST objectives in general, and the “Tackling Complexity in Science” initiative in particular.

7. PRESENTATION OF PROPOSALS

Proposals will be presented as individual FULL PROPOSALS for research projects (STREPs) or Co-ordination Actions (CAs) or Specific Support Actions (SSAs). 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 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). STREP project lifespan should normally be up to 3 years, and a community grant of up to €2 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.