



6<sup>th</sup> Framework Programme  
Anticipating scientific and technological needs

## **NEST**

New and Emerging Science and Technology

REFERENCE DOCUMENT ON

# **“Measuring the Impossible”**

**2004/2005 NEST-PATHFINDER INITIATIVES**

**December 04**

This document complements the NEST 2004/2005 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, advise 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**

Measurement is at the heart of scientific work. Ever since Galileo the process of scientific discovery has gone hand-in-hand with the development of methods and techniques for measurement and analysis, influencing decisively the opportunities for scientific progress.

In the past, we have always focused our attention on the development of instrumentation techniques due to the increasing demand for measurement and control of physical variables. Since the accuracy of control is necessarily dependent on the accuracy of measurement, the objectives dictated the accuracy as well as the cost and the level of human effort required. However, science, business and government now present challenges to measurement which are intrinsically more complex, problematic and subject to interpretation:

- Many phenomena of significant interest to contemporary science are intrinsically multidimensional and multi-disciplinary, with strong cross-over between physical, biological and social sciences.
- Products and services appeal to consumers according to parameters of quality, beauty, comfort, etc., which are mediated by human perception.
- Public authorities, and quasi public bodies such as hospitals, provide citizens with support and services whose performance is measured according to parameters of life quality, security or wellbeing.

Thus, the practical challenge facing scientists is often to “measure the impossible”: to go beyond the existing science of measurement, and the assumptions which surround it. However, in many cases the response is empirical and of limited application.

## **2. OBJECTIVES**

The objective of this PATHFINDER initiative is to give an impulse to more fundamental advances that will underpin future measurement methods and techniques, by supporting interdisciplinary research and novel investigative methods that could present prospects for significant advance in the scientific basis for measurement of phenomena which are intrinsically multidimensional, and which are mediated by human interpretation and perception. This should assist Europe in the creation of high-value products and services of the future and assuring the highest quality of life for its citizens.

This initiative will promote the creation of new, interdisciplinary partnerships between researchers within the field of measurements and researchers in a range of other fields, and cross-fertilisation of research relating to complex measurements across different fields of science, by means of ambitious, multidisciplinary projects. The research supported will have concrete and tangible objectives, addressing specific complex problems, using new or emerging methodologies and techniques.

Projects must address measurements which are holistic and multidimensional in nature, and which involve complex issues of interpretation, and/or mediation by human perception. They should in particular aim to make important advances in linking measurements of physical attributes and quantities with issues of interpretation and perception, including where appropriate cultural and other contextual issues, in ways that are likely to significantly improve understanding and create new openings and anticipate a broad potential impact on the science and technology of measurement.

### 3. ORGANISATION OF THE INITIATIVE

Due to its limited resources, NEST aims 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) of focused research projects (using the STREP instrument – Specific Targeted REsearch Projects), aiming to promote highly interdisciplinary research that will make real advances in the scientific basis for rigorous measurement and evaluation of phenomena which are intrinsically multidimensional, and which are mediated by human interpretation and perception considering scientific questions where this is a key issue.
- A networking action (using the CA instrument - Co-ordination Action), whose function will be to provide a mechanism for the research projects funded under the MtI initiative to cooperate and interact with each other, 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 this measuring topic.
- A series of actions (using the SSA instrument- Specific Support Action) to support the development and implementation of this PATHFINDER initiative. 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 field.

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.

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 outcome and added value of the initiative.

The research should identify and address “*well-posed problems*” – measurement 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. Experts from different disciplines with their best scientific expertise and knowledge, have to come together with an open mind to find common language and layout for handling the problem in question.

Problems brought forward should not be “open ended” in 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. It should be concrete in its objectives with some likelihood of success.

The proposals selected will be those considered to have the highest “value-added” and long term impact in terms of advancing science. Projects supported should not only reflect important measurement challenges, but also methods and approaches that have broader utility and significance. Projects should also aim at providing a highly transferable methodological output. The assessment of proposals will take into account the extent to which they address urgent scientific questions and/or exploit really novel or emerging opportunities for **understanding measurement problems associated with human perception and interpretation.**

Measurement problems generally reflect not only questions of how to assess the “state of the world” but also of how uncertainties should be understood and managed. They are also often defined by requirements for decision making (industrial design choices, policy choice, etc.). Projects should therefore take full account of the contextual aspects (social, institutional, economic, political, etc.) of the measurement.

International co-operation (partners outside the EU and Associated states) is welcomed. 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.

Examples of research reflecting some known real problems are:

- New consumer sensitive products and markets involve subjective elements: consumers now judge by appearance and design as well as by technical performance. The measurement challenge is to predict consumer reaction to products by providing a “hard” physical measurement of process of thoughts and perception that underpin the “soft” measurement of, for example, product perception. “If you can’t measure it, you cannot improve it”. It is possible to measure parameters like the human emotion of pleasure and thus to match customer “pull” with technology “push”.

Examples of attributes which require measurement include, among others, car comfort or smell of a new car; ambience design or the feel of fabric or its texture. Note that these are not about fashion. Clearly fashion does affect customer choice but the envisaged attributes should be of a more fundamental level than fashion and do not vary with time.

- Definition of measurement systems that are required to match human senses, both individually and, more challenging still, working together. Human perceptions are informed by human “sensors” which are difficult to model or match by the current set of sensors. There is a belief that these measurements are applicable to a variety of measurement problems. The new understanding emerging from neuroscience and biometrics has an obvious contribution to “measuring the impossible” and should be exploited. Looking at human beings as measurement instruments has already led to interesting results.

- Technological challenge shifts to sophisticated value-added services. The quality of the service, as perceived by subscribers, is no less important than the service itself. The development of a comprehensive attempt to scientifically measure various quantitative parameters is necessary.

Price differentials are minimised in several sectors. Factors such as quality of performance experienced by the customer become critical differentiators. There can be a significant gap between what is perceived as acceptable speech by a user's mobile and what the current performance measures indicate.

- In Forensic Science, several methods are based today on experience rather than on measurements with a wide range of philosophical issues involved. There is a need both to find technologically sophisticated ways of analysing and comparing evidence in ways that do not exist today. Examinations of fingerprint, tool mark or handwriting, but also in paint and glass particle and textile fibre comparisons, the essential content of a laboratory report is in fact an examiner's subjective interpretation of direct observations, the so-called qualified opinion.

In Forensic Science the basic concept of measurement uncertainty is thus not as straightforward as in many other fields. A lot of basic methods development is still needed.

- In the area of medicine which is moving increasingly towards a focus on prediction and prevention rather than on diagnosis and cure, measurement of human health status and disease risk is crucial. The understanding of complex processes of disease development will allow measuring the individual disease probability (with the corresponding policy, legal and ethical issues associated).

In the emerging field of personalised medicine, the determination of individual characteristics and propensities to benefit from medical treatment depend on complex genetic factors and attributes that may not be fully understood and may incorporate elements of subjective appreciation on the part of medical staff.

- The understanding of how public policy proposals (democratic procedures, taxes, ethical regulations, etc.) benefit citizens has given rise to a fast-growing field of what is called "happiness economics" including "neuro-economics" which links behaviour responses to cognitive and cultural factors. This raises a large number of potential measurement challenges and the prospect that they may have a better scientific grounding in the future.

## **5. WHAT KIND OF RESEARCH WILL NOT BE PURSUED?**

Projects which are concerned with exploring empirical correlations, which aim to refine existing measurements, or improve the resolution of existing measurements and instruments, or which follow established and well-understood methodologies, will not be considered for funding.

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

- Research resulting in incremental development of existing capacity through advances in technology, in order to achieve smaller uncertainty, and/or broadened range;
- Development of improved measuring instrumentation (uncertainty, smaller, more intelligent and integrated); Calibration of devices and/or inter-comparisons;
- Primary measurement standards research (i.e. optical frequency, redefinition of the kg, clocks & pulses, etc).
- Research of limited interdisciplinary nature, or of limited long-term scientific impact.
- Research where the central objective is to create information technologies and/or decision analysis technologies.

In accordance with the NEST mandate and the work programme, this initiative is not intended to support projects that would fit well within the existing Thematic Priorities of the Framework Programme.

Other specific examples of areas which will not be considered here include:

- Research of purely philosophical / theoretical nature and/or tackling this issue in isolation of possible real-life problems and applications.
- Chemical and physical analysis combined with empirical psychometric studies
- Research associated with Marketing, or other areas that could be used by companies to “manipulate” the customers. Research intended to be kept confidential is not to be considered for funding.
- Proposals which because of their particular focus or centre of gravity could be considered to fall into the PATHFINDER initiatives on *the other Pathfinder Initiatives*.

## **6. WHAT IS THE FUNCTION OF THE OTHER INSTRUMENTS?**

### **CO-ORDINATION ACTION (S)**

Proposals for the Co-ordination Action (s) associated with this PATHFINDER initiative should aim to build extended networking within the EU on a cross-national and cross-disciplinary basis to help advance the science of measuring complex, holistic quantities and quantities across all relevant areas.

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.

Proposals for the Co-ordination Action(s) associated with this PATHFINDER initiative should involve the extended EU “Measuring the Impossible” science community and could, for example, stimulate the collaboration between metrologists and industrialists with a variety of other scientific disciplines including Medicine / Biology / Neurophysiology / Computer Vision / Mathematics / Psychology / Sociology.

The approach should be broad and inclusive, bringing ideas to bear beyond the range of the work in individual projects. Thus, although not excluding the proposals submitted, the strategy adopted and the specific work it carries out 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 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, promoting short stays of senior scientists, and supporting advanced training activities such as Summer Schools to deal with all the domains where high-order emotions and perceptions (such as feeling, beauty, quality), human values and personal sense are of importance. Without such a stimulus, progress will be slow and centred on specific sectors, and opportunities for sharing of expertise and the development of more generic approaches will be lost.

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 ACTIONS (S)**

Proposals for Specific Support Actions linked to the development and implementation of existing PATHFINDER initiatives 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.

These new measurement challenges may well imply a need to re-think assumptions about how” measurement systems” work, and how uncertainties are treated. It is understood that such questions could be addressed in projects, where this is relevant. They could also be addressed in Specific Support Actions.

Specific Support Actions do not support research and technological development per se. They differ from Co-ordination actions in that they may involve a single participant and tend to be ‘one shot’ actions of relatively limited duration.

Activities that do not serve the NEST objectives and the “Measuring the Impossible” topic in particular, or that would take place anyway without Commission support will not be welcome.

## 7. PRESENTATION OF PROPOSALS

Proposals will be presented as individual FULL PROPOSALS for research projects (STREPs), Co-ordination actions (CAs) or Specific Support actions (SSAs), to meet the deadline April 13, 2005. 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 four weeks before the deadline (March 16). 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 ambitious goals of the proposal, the cross-disciplinary dimension and the novel investigative methods should be clearly set out. It should be shown how the proposal meets the broader spirit of the PATHFINDER initiative on “*Measuring the Impossible*.” New ways of thinking in order to cope positively with such a challenge are welcome.
- **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 solid measurement grounds and the feasibility of the methodology should be clearly demonstrated.
- **Impact:** the specific benefits of the work in terms of scientific advance should be presented and justified, broader potential impacts and applicability in the short or long term should be set out. In addition there will be benefits leading to innovation in human friendly products and processes.
- **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.
- **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). Indicatively, STREP and CA project lifespan should be normally three years, and in exceptionally and duly justified cases, up to 4 years with a community grant in the range of 1.5 to 2.0

Meuro. The maximum EC contribution for SSAs will be around 0.2 M€ with a timescale up to 2 years.

- **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.