

## **SIXTH FRAMEWORK PROGRAMME**

### **New and Emerging Science and Technology (NEST)**



**Contract for:**

### **COORDINATION ACTION**

<h3><b><i>Annex I – Description of Work</i></b></h3>
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Project acronym: **MATHFSS**

Project full title: **Shaping New Directions in Mathematics for Science and Society**

Proposal/Contract no.: **15661**

Related to other Contract no.:

Date of preparation of Annex I: **June 15, 2005**

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## Project Summary

This proposal aims to the engagement of the mathematical research community in the process of identifying future research opportunities through a collaborative two-year project of major European mathematical research centres. The role of Mathematics as a rapidly evolving methodological basis for many scientific and social domains is particularly stressed. The objectives of the project are the following:

1. Designing curricula and finding ways to train researchers into emerging specialties of Mathematics, linked especially with Systems Biology, Neuroscience, Risk Assessment, and Digital Content Security.
2. Identifying future research opportunities on the interface between Mathematics and suitable areas of Medicine and Social Sciences.
3. Promoting the collaboration of several European research centres on Mathematics into a joint multidisciplinary effort to draw up innovative research programmes.
4. Foster the exchange of information, resources and needs between researchers in pure and applied Mathematics and targeted users from industry.
5. Facilitate contacts between the working mathematical community and scientific policy makers from member states and from the European Union itself.
6. Ensure a widespread dissemination of the information gathered by the participants during the period 2005-2007 about the development and prospects of the chosen emerging disciplines.

These objectives will be achieved through the organisation of coordination activities such as training seminars, round tables, setting up of expert groups, and launching of a public information plan by the Consortium, including the publication of a middle report and a book of conclusions.

## Objectives of the Project and State of the Art

### Objectives of the project

1. Designing curricula for doctoral studies into emerging specialties of Mathematics, linked especially with the following topics:
  - Systems Biology,
  - Neuroscience,
  - Risk Assessment, and
  - Digital Content Security.
2. Identifying future research opportunities on the interface between Mathematics and suitable areas of Medicine and Social Sciences, by means of specialised training seminars in which the participation of young researchers will be sought.
3. Promoting the collaboration of several European research centres on Mathematics into a joint multidisciplinary effort to draw up innovative research programmes.
4. Foster the exchange of information, resources and needs between researchers in pure and applied Mathematics and targeted users from industry, related especially to the four main topics of the project, by means of participation at round tables, mailing of information and personal interviews.
5. Facilitate contacts between the working mathematical community and scientific policy makers from member states and from the European Union itself, by means of reports about the achievements of this project.
6. Ensure an effective and widespread dissemination of the information gathered by the participants during the period 2005-2007 about the development and prospects of the chosen emerging disciplines, through the Internet, at broadly advertised public events, and by means of a final book of conclusions.

### State of the art

This project covers several broad emerging areas within life sciences and social sciences in which the development of new mathematical methodology is increasingly significant.

- *Systems Biology* covers many attempts to think of biological systems at different scales at once. This trend represents a shift in attention from the analysis of elements of a given biological system to detailed measurements of their interactions, and attempts to understand the systems behaviour when all these data are properly gathered. It can be viewed as a further step beyond the human genome project in that, taking as granted that a list of genetics parts has been provided (in particular identification of all

genes and proteins), one now turns to a detailed study of many of life's elements interactions.

The systems approach is based on the idea that Biology has reached the point where it is useful to view it also as an informational science. Some expect that progress in Systems Biology will lead to a revolution in medicine, opening the way for a predictive, preventive and personalized medicine.

The challenges that the shift of paradigm towards Systems Biology poses to mathematicians and computer scientists are considerable. Indeed, the structure of data gathered at different scales are very different from one another in nature and in organization. Finding efficient ways of integrating them is a hard theoretical problem. At the same time, progress on other facets such as developing new ways of dealing with geometric data, e.g., images and 3D-descriptions of conformations, will be required.

- *Systems Neuroscience* is a research field of utmost societal interest. It aims at elucidating the mechanisms responsible for the encoding of sensorial representations in the brain and their further processing by cognitive functions. Therefore, it seeks to establish scientific foundations that allow to build links between Medicine and Psychology. This has been traditionally pursued through Psychophysics and Electrophysiology, but recently quantitative approaches typical of Physics and Mathematics, encompassed within the subfield of Computational Neuroscience, have gained importance in this field. Indeed, it has increasingly become clear that the comprehension of the machinery of the brain will necessarily implicate interdisciplinary approaches, notably from quantitative and computational perspectives. The current project proposal follows this methodological line by using mathematical analysis and computational modeling in order to understand the cortical mechanisms of selective attention and working memory.

Selective attention and working memory are closely related cognitive functions whose precise common and specific physiological mechanisms are still largely unknown. In addition, they are implicated in some very frequent mental conditions (schizophrenia, attention-deficit disorders...) of very difficult treatment. It is important to gain further knowledge about what mechanisms participate in these brain functions, not only to advance our basic understanding about them, but also, in a much longer term, in order to eventually design more appropriate and effective medical treatments. At the core of these cognitive functions there are interesting mathematical problems, whose understanding is of fundamental interest both for Mathematics and Neuroscience. Indeed, from the mathematical perspective, models are essentially large systems of non-linear first order ordinary differential equations. A number of reasonable assumptions can typically be made in order to reduce the number of dynamical equations, so that the model can often be qualitatively described by as few as two coupled ordinary differential equations with complex nonlinearities. Identifying a biological interest for these dynamical systems can foster renewed mathematical research to understand their conceptual aspects and parameter dependencies.

- Risk has become a wide subject embracing many areas from Economics, through finance and insurance to various forms of physical risk. One of the hardest issues in risk is measurement. At one end, one has the difficulty of capturing possible events, their

probability and their effect. At the other end, one needs measures, or metrics which are useful in decision making in real situations. Insurance is a major user and contributor of risk ideas. Insurance products need to be designed on the basis of risk. They exist to protect customers, but also expose the company to risk, either from the event itself or the need to manage large capital reserves to meet claims.

*Risk measures* come in different shapes and sizes, some such as the value at risk (VAR). Measures recognise extreme exposures of companies. The most sophisticated are based on some underlying models of utility, preference and the theory of markets and often have an axiomatic foundation. That is to say, a good measure is one which satisfies certain stochastic and non-stochastic principles, which imply some kind of rationality. There are different measures in different “sectors” of risk: credit risk, market risk, reinsurance risk, interest rate risk, liquidity risk and so on.

*Operational Risk* is simply defined as every type of risk which does not fall into some standard category risk, as credit or market risk. The name started in the banking area and has been used to cover issues such as human error and other types of non-standard exposure. However, as it is more recognised on the financial side of risk, the term is taking over as the prime term for the day-to-day management of all risk exposures of companies and institutions or otherwise. Under this more general portfolio comes the whole of reliability with its many sub-branches, such as maintenance, survival models, extreme events, robust product design, product risk, climate risk, geo-political risk, and so on. Stochastic modelling is becoming more prevalent in reliability with complex Markovian and Markov renewal type models, with covariates to provide complex predictors of failure. These can be used, for example, in predictive maintenance schemes to prevent costly failures.

- The recent *digital revolution* and widespread access to telecommunication networks (Internet, wideband wired and wireless networks, etc.) have produced a proliferation of digital media content which can be efficiently accessed and distributed. This proliferation has raised new concerns in terms of security: copyright protection, access rights management and privacy protection. In parallel, advances in computer science (processing power, new algorithms, etc.) and signal processing have permitted to easily process and modify these media contents. On one hand, this ease in processing has raised other problems in terms of security, for instance content authentication or plagiarism detection; on the other hand, these advances may lead to more efficient solutions to old and new security problems.

Beyond this, the digital revolution has been the enabler of e-commerce applications. However, as many recent experiences have shown, without a careful consideration of the above mentioned security issues, no real business cases can be achieved. Not only the digital revolution has produced new business opportunities, but it is also affecting the traditional ways in which information has been exchanged in the society so far.

## List of Participants

Partic. role	Partic. no.	Participant name	Participant short name	Country	Date enter project	Date exit project
CO	1	Centre de Recerca Matemàtica	CRM	Spain	Month 1	Month 24
CR	2	Institut des Hautes Études Scientifiques	IHÉS	France	Month 1	Month 24
CR	3	Emmy Noether Institute at Bar-Ilan University	ENI	Israel	Month 1	Month 24
CR	4	European Institute for Statistics, Probability, Operations Research and their Applications	EURANDOM	The Netherlands	Month 1	Month 24

CO = Coordinator

CR = Contractor

## Relevance to the Objectives of the Specific Programme

This project aims to the engagement of the mathematical research community in the process of identifying future research opportunities around emerging specialties through a collaborative project of high-quality centres. It addresses specifically each of the following purposes of NEST Support Actions:

- Promotion of interaction with the research community.
- Engagement of the research community in the process of identifying future research opportunities.
- Analysis of methodological and technical issues associated with the NEST research domain.

Indeed, the evolution of innovative research topics is difficult to predict on the sole basis of bibliographic data bases or other statistical devices, such as already existing contracts between academia and industry. These are more likely to reflect established trends than future possibilities, since many involve uncertainty and lack of organisatory curricula.

This project will gather information and opinions from the most advanced researchers in four selected topics, by means of seminars at the partner centres, enriched with round table discussions. Representatives from industry and political authorities will be invited to participate at some of the meetings and debates. In addition, the Advisory Committee of the project will undertake actions aimed at securing the awareness of selected industry managers and scientific policy makers. Targeted actions will include the following:

- Preparation of a mailing list containing names and addresses of people from relevant places in the research administration of several high-level institutions, including at least one from each participant's country, as well as industry managers from whom a positive reaction of interest is expected.
- Preparation of a short dossier with information about the project, to be mailed to the list.
- Interviews with some of the people who react to this mailing.

The conclusions of the project will be drafted into reports by expert groups nominated within the project. These reports will have two effects related to NEST Support. On one hand they will serve to assess the current dynamics of scientific change in cutting-edge topics. On the other hand, more importantly, they will provide valuable information for the planning of priorities in future programmes.

## **Potential Impact**

### **Contribution to policy developments**

The detection of emerging research directions is essential for the preparation of future calls of the European Commission and for the assessment of incoming research projects. Thus, the reports emanating from this Coordination Action should serve as a grounding basis for subsequent targeted actions.

Instead of conventional applications of existing mathematics, the project will shape a short path between new and sophisticated mathematics already present in Europe and applications of major potential. The activities described in this project will mark the way into effective involvement of mathematicians in multi-disciplinary domains of relevance to medicine, industry, and social sciences. The importance of mathematical activity in these domains will continue to be made evident to scientific directors, as well as to industry partners.

The project will have an effect on the involvement of mathematicians in other science or industry domains, which in turn can create new ideas for NEST. In the long run, this action should give rise to a new generation of researchers with the required combination of mathematics and scientific skills and knowledge in important shortage areas.

Since the partners are sharing their work with other ERCOM institutes all over Europe, the European added value is clearly given. A critical mass is guaranteed, especially because the project concentrates on very relevant topics. Mathematics in Europe is at the forefront, and sudden applications to other fields abound. Expert groups are needed to foresee the next directions, and gathering these is in the working plan for the present project.

### **Risk assessment and related communication strategy**

No potential risks for citizens are associated with this project.

## Project Management and Dissemination Plans

### Project management

The project will be managed by a **Steering Committee** consisting of the directors of the four partner Institutes (currently, professors Manuel Castellet, Jean-Pierre Bourguignon, Mina Teicher and Frank den Hollander). The Steering Committee will be responsible for the administrative aspects of running the project and its interface with industry representatives and policy makers. This committee will meet once every year.

An **Advisory Committee** will be appointed, which will lead the project on all scientific matters, such as advice on participants to the different activities, selection of topics for sessions, organisation of the interface with industry and policy makers, etc. This committee will include the Key Researchers of each subproject (professors Enric Nart, Mikhail Gromov, Mina Teicher, Henry Wynn and Jef Teugels). It will be chaired by Mina Teicher, whose own specialisation is in Mathematical Morphology with applications to Neuroscience and Cryptography. She has been advisor to projects on Risk Mathematics and Biological Systems, and is currently Vice President of Research of Bar-Ilan University.

The Advisory Committee will meet whenever it is needed for the successful development of the project. It will be allowed to increase its membership at the initiative of the Key Researchers. One of its main tasks will be to build up **Expert Groups**, which will be in charge of elaborating the project reports.

A web site for this Action will be maintained at one of the partner institutes (IHÉS). The web site will contain public information about the Consortium and its activities related to this project. It will also (and mainly) serve as a place where the reports emanated from each activity will be posted and made available to the public. Special care will be devoted to the final report, where a summary of events will be included together with a detailed list of conclusions and recommendations. Upon acceptance of the report by the Project Office, this material will be edited and published in the form of a soft-cover book, to be distributed by the European Mathematical Society. Acknowledgement of the full support of the European Commission to this project through a NEST Coordination Action will be made clearly visible in the book, by including the Sixth Framework Programme logo on the cover, or any other signs advised by the Project Office, in addition to a statement in the preamble.

The coordinator's institution will be responsible for accounting, organising the annual meetings of the Steering Committee, and preparing contractor reports. An interim report will be submitted to the European Commission every six months, in order to keep the Project Officer informed of the developments. A middle-term report will be prepared after twelve months and will be made public through the Internet and in printed form at public events linked with the project. Financial statements and audit certificates will be included in the final report, to be written at the termination of the project.

### **Plan for using and disseminating knowledge**

A dissemination plan of the information gathered by the participants during the period of execution of the project, aimed at the mathematical community at large as well as to selected target groups, will be organised through the following means:

- Every participating organisation has its own network of contacts and ways of spreading information (bulletin boards, periodicals, yearly activity reports, etc.). These resources are shared by other ERCOM institutes, and the Consortium has in fact its own common means of spreading announcements and reports.
- The dissemination mechanisms of the European Mathematical Society (e.g., the EMS Newsletter) will also be available and treat this project with priority.
- A number of young researchers will be invited to apply for participation at the workshops planned within the project, and a variable amount of funding will be offered to them. This procedure needs announcements and calls for applications.
- The project includes several round tables with scientists, industry leaders and policy makers. One of these will be included in the programme of the International Congress of Mathematicians (ICM 2006), to be held in Madrid in August 2006. This will guarantee a privileged visibility of the project at a very suitable time in the middle of the 2005-2007 period. This event will include a public presentation of the project, addressed to a broad audience, and a round table led by the Advisory Committee of the project.
- The final report (excluding financial statements and other administrative content) will serve as a draft for a book containing summaries of results of workshops and round tables, together with a detailed report from each expert group and a list of conclusions. This book will be distributed by the participating centres and through the channels of the European Mathematical Society. It will also be made available to the public through any resources of the European Commission that are found to be appropriate. It will be sent to research administration offices of several countries.
- Adequate mass media coverage will be attempted, on the occasion of the ICM 2006 and through eventual contacts by partner institutes.

### **Raising public participation and awareness**

The MATHFSS team will prepare a brief project presentation in English, of approximately two or three pages. It will be written in a style which is accessible to non-specialists, avoiding technical language, mathematical formulae and acronyms as much as possible. Photos, diagrams, and other illustration material may be included. Publication of this document will be done via the NEST web page.

Other actions will be undertaken following the advice given in the *Guide to Successful Communications* issued by the European Commission. These will include maintenance of a web site, brochures at European academic institutions, and, above all, a public presentation (aimed at non-specialists) and a press release in Madrid in August 2006 in the framework of the International Congress of Mathematicians.

## Detailed Implementation Plan

### Introduction

The planned activities include:

- eight seminars distributed among the four partner centres, promoting especially the training of young researchers and the participation of representatives from industry;
- six round table discussions on focused topics;
- a special event at the International Congress of Mathematicians (ICM 2006, Madrid);
- creation of interdisciplinary expert groups;
- creation of a publications data base;
- maintenance of a web site;
- mailing of information to industry managers and policy makers;
- preparation of a programme for doctoral studies on each project topic, and
- publication of a final report in book form.

### Work planning and timetable

The four topics will be developed in parallel for the full duration of the project. The seminars are aimed at exposing young researchers to emerging specialties of highest potential. Therefore, the time planning of the events has been fixed so as to ease the participation of young researchers at all events, or at least to those events which build up complementary training blocks.

The financial contribution of the project to the seminars will be devoted to facilitating the participation of promising young researchers and to enhancing the role of each event as a forum for discussion of prospects on emergent mathematical specialties.

An abridged calendar of seminars and further details follow.

ENI	Neuroscience	February 2006	Including round table
EURANDOM	Risk Assessment	March 2006	Including round table
IHÉS	Systems Biology	May 2006	Including round table
CRM	Neuroscience	September 2006	
ENI	Neuroscience	February 2007	Including round table
EURANDOM	Risk Assessment	March 2007	Including round table
CRM	Data Security	June 2007	Including round table
IHÉS	Systems Biology	September 2007	

**Compositionality and Synchronization**

Emmy Noether Institute, February 2006

*Coordinator:* Mina Teicher*Tentative list of speakers:*

Moshe Abeles (Bar-Ilan)  
Markus Dietmar (Freiburg)  
Tamar Flesh (Weizmann)  
Michael Hermann (Leipzig)  
Jürgen Jost (Leipzig)  
Tomer Shmiel (Bar-Ilan)  
Alessandro Treves (Trieste)  
Rafael Yuste (Columbia and Madrid)

**Risk Measures and Risk Management**

EURANDOM, March 2006

*Coordinator:* Jef Teugels

Risk measures have become major tools in describing risk. In particular, such measures have a growing impact on activities in insurance, re-insurance and finance. In order to calculate a premium, an insurer uses one or more of such measures to get some quantitative estimates of the risk he is running when taking decisions. A similar situation arises in finance when the solvency of a financial agent has to be guaranteed. As such, risk measures provide a key instrument to assess and manage risk. Currently there already exists a plethora of such measures; some of them enjoy great popularity while others might be considered to be too hard to be practically useful, often because of their mathematical intricacies. Deciding which risk measure should be used in a specific situation is a major assignment and should be based on sound statistical data and on verifiable stochastic models.

*Workshop objective:* To bring together leading experts from industry and academia in order to instigate discussions about the relevance and/or the applicability of risk measures.

*Workshop topics:*

1. Axiomatic aspects. General desirable properties such as coherence, convexity, consistency, etc.
2. Performance of specific risk measures such as Value-at-risk, expected shortfall, volatility, etc.
3. Applications of risk measures in (re-) insurance and finance
4. Optimization and statistical aspects: Practical determination and
5. Estimation of risk measures
6. Credit risk
7. Interest risk and interest rate models

**Systems Biology from a truly interdisciplinary point of view  
with a mathematical twist**

IHÉS, May 2006 and September 2007

*Coordinator:* Mikhail Gromov

Systems Biology is an emergent field that aims at system-level understanding of biological systems. Remarkable progress in molecular biology has led to a complete map of the building blocks of life. The next major challenge is to understand the interactions between the myriad of sub-cellular components.

What does it mean to understand at "system level"? Unlike molecular biology which focuses on molecules, such as sequence of nucleotide acids and proteins, Systems Biology focuses on systems that are composed of molecular components. Its ambitious goal is the quantitative study of biological processes as integrated systems rather than as isolated parts. The essence of system lies in dynamics and it cannot be described merely by enumerating components of the system. In Systems Biology, traditionally separated scientific disciplines, including Biology and its many components, Physics, Mathematics and Computer Science, are unified by quantitative models.

Based on the know-how that IHÉS has accumulated in organizing already two very successful truly multidisciplinary conferences (the first two "Entretiens de Bures", cf. the proceedings published by World Scientific on *Pattern Formation* and *Folding and Self-Assembly of Biological Macromolecules*), the Institute wants to contribute to this new frontier with the specific aim of developing (**May 2006**), and later consolidating (**September 2007**), the interface between Mathematics and Systems Biology through the organisation of two workshops, with an emphasis of real exchanges between experts from different sciences. Among the non-European contacts, one can single out the name of Leroy Hood, founder and director of the Institute for Systems Biology in Seattle.

*Workshop topics:*

- (1) understanding of structure of the system, such as gene regulatory and biochemical networks,
- (2) understanding of dynamics of the system, both quantitative and qualitative analysis as well as construction of theory/model with powerful prediction capability,
- (3) understanding of control mechanisms of the system, and
- (4) understanding of design patterns of the system.

## **Mathematical Neuroscience**

CRM, September 2006

*Coordinator:* Antoni Guillamon

*Workshop objectives:*

- Gather scientists working on the field of Neuroscience from a mathematical point of view.
- Discuss the mathematical problems arising in Neuroscience and propose common research topics and challenges for the near future.
- Discuss new mathematical approaches to address questions posed by the experimental results.

*Scientific Committee:*

Albert Compte (Alicante)  
Antoni Guillamon (Barcelona)  
Horacio Rotstein (Boston)  
David Terman (Ohio)

*Tentative list of speakers:*

Bard Ermentrout  
Nancy Kopell  
John Rinzel  
Mina Teicher

**Medical Applications to Neuromathematics**

Emmy Noether Institute, February 2007

*Coordinator:* Mina Teicher*Tentative list of speakers:*

Paul Bourgine (ENS, Paris)  
Miriam Neufeld (Sheba Hospital)  
Amir Zilberstein (Bar-Ilan)

**Mathematical Methodologies for Operational Risk**

EURANDOM, March 2007

*Coordinator:* Henry Wynn

There are many methods which have been developed in what might be called the “hard” or physical end of risk which need to be exposed to a wider community. Historically some originated in risk assessment of large installations such as nuclear power stations. Others stem from product reliability such as accelerated life-testing. A third, extreme-value theory, arises from the study of extreme events. Another, very important area of risk methodologies is survival analysis, which arose first in medical statistics but is now also extended to reliability more generally, e.g., material failure.

The relationship with the financial end of operational risk is brought into sharp focus where a physical event (storm, flood, terrorist attack, infectious disease, etc.) impacts on the financial well-being of a company and its stakeholders: customers, suppliers, workforce, partners, insurers, etc.

A holistic approach to risk management, which is advocated by many writers and, indeed, is inherent in the emerging regulations, should draw on the best and most relevant mathematical and statistical areas whether from the financial perspective or the physical. Soft scoring methodologies, although valuable, are not sufficient where science, technology, economics, the environment and geo-political instability may all effect citizens and companies.

*Workshop objective:* To bring together different mathematical methodologies related to operational risk.

*Workshop topics:*

1. Reliability: especially system reliability, coherence, failure bounds, algebraic methods in reliability
2. Measures of robustness: redundancy, robust system design
3. Failure models of risk: reliability modelling and extreme values, competing risk, survival models and general regression-type models
4. Stochastic process models: claims modelling and Poisson processes modelling, Levy Processes, monitoring and signal processing models, boundary crossing approximations
5. Compartmental models: Markov and Markov-renewal models, maintenance programmes, epidemiological, dynamic cash flow models, screening models

## **Cryptography and Digital Content Security**

CRM, June 2007

*Coordinator:* Enric Nart

The recent digital revolution has enabled new business opportunities, such as e-commerce, and it is also affecting the traditional ways in which information has been exchanged in the society so far. This scenario has raised new concerns in terms of security, which have been separately addressed by scientists and engineers in two fields:

- Number theorists have concentrated on the investigation of hard mathematical problems suitable for cryptography, while cryptologists have worked on the development of secure cryptographic protocols based on these mathematical problems.
- Signal processing researchers concentrated on information embedding (e.g., robust watermarking) and authentication (e.g., fragile watermarking and physical coherence) tailored to content characteristics (e.g., audio, image or video).

Most scientists of one particular field have been rather unaware of the progress made in the other field. This seminar pretends to fill this gap. In a one-week seminar, specialists of both fields will present the basic features of different topics to a general audience. This will be followed by a one-week workshop dealing with more specific research issues.

*Seminar and workshop topics:*

- Public-Key Cryptography
- Information Embedding and Steganography
- Intellectual Property Protection
- Authentication and Data Integrity
- Biometrics

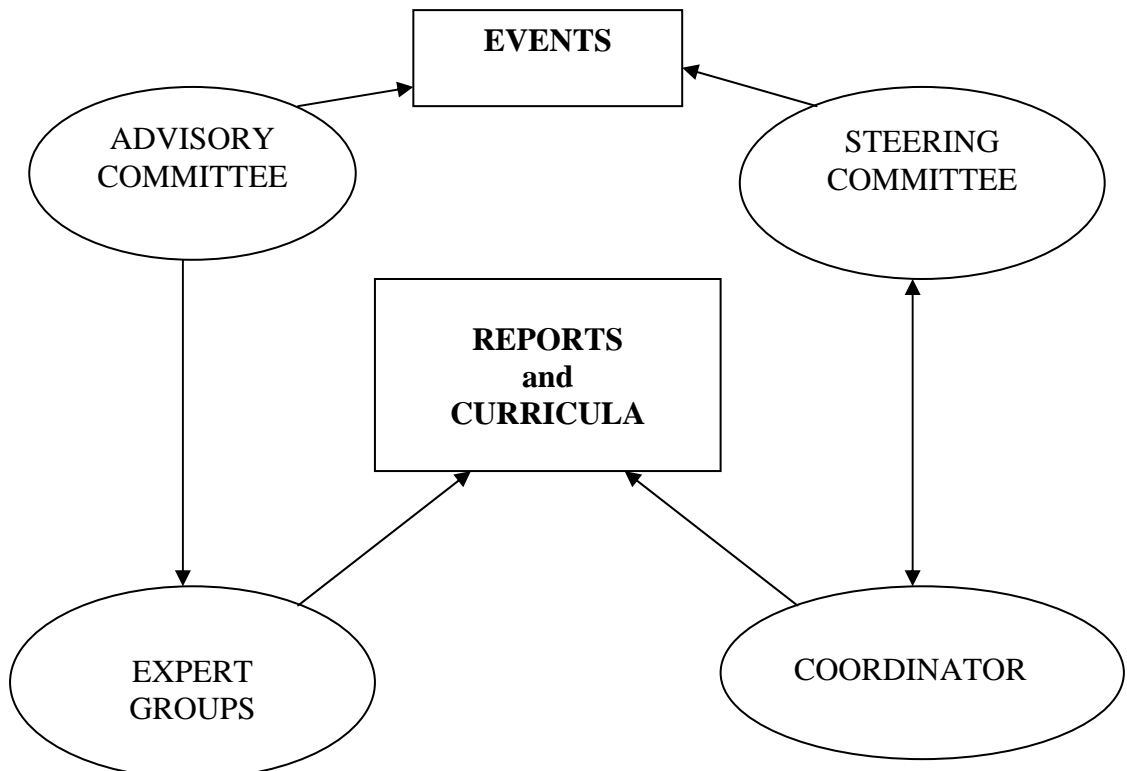
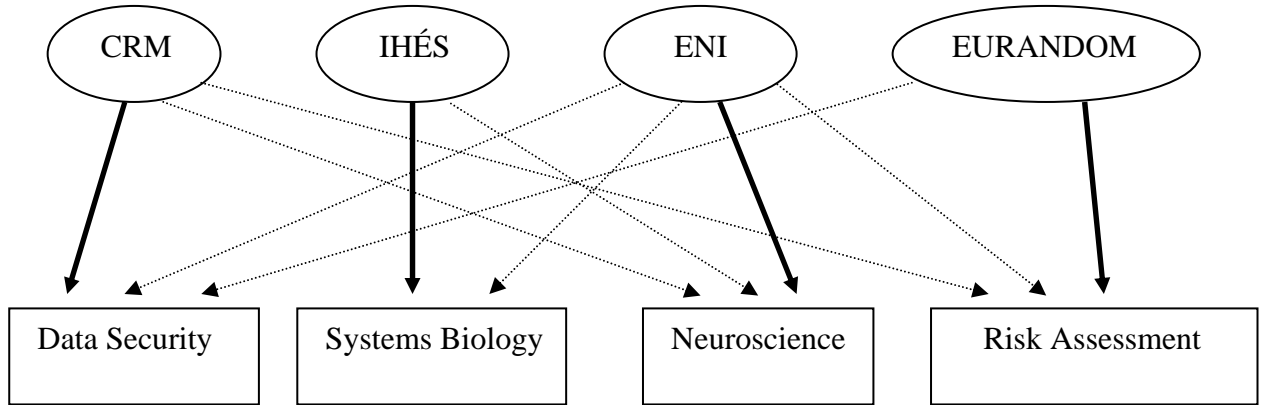
## **Round Tables**

In connection with some of these workshops, there will be a one-day round table discussion between representatives of academia and industry at large or policy makers. On each of these occasions, the participants will:

1. distil from the contributions and discussions the major unsolved problems with an indication of their importance,
2. formulate an educated estimate of the expected difficulty,
3. outline a potential procedure for treatment,
4. discuss the problems in relationship to EU policy and regulation, and
5. indicate how the obtained results will be passed on to the industrial partners.

A special round table will be held on the occasion of the International Congress of Mathematicians (ICM 2006) in Madrid, covering all the topics of this project. This round table is expected to be one of the milestones of the project, which will be fundamental to achieve visibility among the world mathematical community. It will be organised together with a public presentation of the project, addressed to a broad audience.

**Graphical presentation of the components**



## Work package list

Work-package no. <sup>1</sup>	Workpackage title	Lead contractor no. <sup>2</sup>	Person-months <sup>3</sup>	Start month <sup>4</sup>	End month <sup>5</sup>	Deliverable no. <sup>6</sup>
WP 1	Data Security	1	12	0	24	D4, D7
WP 2	Systems Biology	2	13	0	24	D5, D7
WP 3	Neuroscience	3	14	0	24	D6, D7
WP 4	Risk Assessment	4	15	0	24	D7
WP 5	Management	1	6	0	24	D1-D3 D8-D10
	TOTAL		60			

<sup>1</sup> Workpackage number: WP 1 – WP n.

<sup>2</sup> Number of the contractor leading the work in this workpackage.

<sup>3</sup> The total number of person-months allocated to each workpackage.

<sup>4</sup> Relative start date for the work in the specific workpackages, month 0 marking the start of the project, and all other start dates being relative to this start date.

<sup>5</sup> Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.

<sup>6</sup> Deliverable number: Number for the deliverable(s)/result(s) mentioned in the workpackage: D1 - Dn.

## Deliverables list

Deliv. no. <sup>7</sup>	Deliverable name	WP no.	Lead part.	Deliv. date <sup>8</sup>	Nature <sup>9</sup>	Disse. level <sup>10</sup>
1	Project presentation	5	1	6	O	PU
2	Middle project report	5	1	12	R	PP
3	Publications data base	5	2	12	O	PU
4	Syllabus for doctoral studies on Data Security	1	1	24	O	PU
5	Syllabus for doctoral studies on Systems Biology	2	2	24	O	PU
6	Syllabus for doctoral studies on Neuroscience	3	3	24	O	PU
7	Book based on workshop results, round table conclusions and expert group reports (draft)	1 - 4	1	24	O	PU
8	Final project report	5	1	24	R	PP
9	Final plan for using and disseminating knowledge	5	1	24	O	PP
10	Report on raising public participation and awareness	5	1	24	R	PP

<sup>7</sup> Deliverable numbers in order of delivery dates: D1 – Dn

<sup>8</sup> Month in which the deliverables will be available. Month 0 marking the start of the project, and all delivery dates being relative to this start date.

<sup>9</sup> Please indicate the nature of the deliverable using one of the following codes:

**R** = Report

**P** = Prototype

**D** = Demonstrator

**O** = Other

<sup>10</sup> Please indicate the dissemination level using one of the following codes:

**PU** = Public

**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).

## Workpackage description (full duration of project)

<b>Workpackage number 1</b>	<b>Start date or starting event:</b> October 2005			
<b>Activity type:</b> coordination				
<b>Participant id</b>	1	2	3	4
<b>Person-months per participant:</b>	6	0	3	3

### Objectives

Designing curricula and finding ways to train researchers, especially doctoral students and post-doctoral fellows, into the specialty of Digital Content Security.

Promoting collaboration of mathematical research centres to draw up innovative research programmes on this topic, in connection with scientific policy makers.

Foster the exchange of information, resources and needs between researchers in Digital Content Security and targeted users from industry.

### Description of work

Planned meetings:

#### **Cryptography and Digital Content Security**

CRM, June 2007

This meeting will include a Round Table Discussion.

An expert group will be in charge to follow up the development of this topic during the period 2005-2007.

### Deliverables

A report on the results of the meeting and the conclusions of the round table.

A final report by the expert group.

A syllabus for doctoral studies on mathematical methods of Digital Content Security.

### Milestones<sup>11</sup> and expected result

The key moment of this workpackage will be the meeting in June 2007. Due to the proximity of this time to the end of the Coordination Action, the expert group will work just after the meeting on the conclusions and recommendations to the European Commission.

<sup>11</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## Workpackage description (full duration of project)

<b>Workpackage number 2</b>	<b>Start date or starting event:</b> October 2005			
<b>Activity type:</b> coordination				
<b>Participant id</b>	1	2	3	4
<b>Person-months per participant:</b>	0	11	2	0

### Objectives

Designing curricula and finding ways to train researchers, especially doctoral students and post-doctoral fellows, into the specialty of Mathematics for Systems Biology.

Promoting collaboration of mathematical research centres to draw up innovative research programmes on this topic, in connection with scientific policy makers.

Foster the exchange of information, resources and needs between mathematicians and biologists working on aspects of System Biology, and targeted users from industry and health organisations.

### Description of work

Planned meetings:

#### **Systems Biology from a truly interdisciplinary point of view with a mathematical twist**

IHÉS, May 2006 and September 2007

The first meeting will include a Round Table Discussion.

An expert group will be in charge to follow up the development of this topic during the period 2005-2007.

### Deliverables

A report on the results of the meeting and the conclusions of the round table.

A final report by the expert group.

A syllabus for doctoral studies on mathematical aspects of Systems Biology.

### Milestones<sup>12</sup> and expected result

An important moment of this workpackage will be the meeting in May 2006. Due to the proximity of the second meeting (September 2007) to the end of the Coordination Action, the expert group will work during this meeting on the conclusions and recommendations to the European Commission.

<sup>12</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## Workpackage description (full duration of project)

<b>Workpackage number 3</b>	<b>Start date or starting event:</b> October 2005			
<b>Activity type:</b> coordination				
<b>Participant id</b>	1	2	3	4
<b>Person-months per participant:</b>	6	0	8	0

### Objectives

Designing curricula and finding ways to train researchers, especially doctoral students and post-doctoral fellows, into the specialty of Mathematical Neuroscience.

Promoting collaboration of mathematical research centres to draw up innovative research programmes on this topic, in connection with scientific policy makers.

Foster the exchange of information, resources and needs between mathematicians working on aspects of Neuroscience and targeted users from industry and health organisations.

### Description of work

Planned meetings:

#### Compositionality and Synchronization

ENI, February 2006

This conference will include a Round Table Discussion

#### Mathematical Neuroscience

CRM, September 2006

#### Medical Applications to Neuromathematics

ENI, February 2007

This conference will include a Round Table Discussion.

An expert group will be in charge to follow up the development of this topic during the period 2005-2007.

### Deliverables

A report on the results of each conference and the conclusions of each round table.

A final report by the expert group.

A syllabus for doctoral studies on the topic of Mathematical Neuroscience.

### Milestones<sup>13</sup> and expected result

The main events of this workpackage will be the workshops held at the Emmy Noether Institute of Bar-Ilan University and at the CRM, Barcelona.

A doctoral course on Mathematical Neuroscience is planned at the CRM during the academic year 2005-2006. The material and the conclusions of this course will be collected at its termination and will serve as important ingredients in the final report.

<sup>13</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## Workpackage description (full duration of project)

<b>Workpackage number 4</b>	<b>Start date or starting event:</b> October 2005			
<b>Activity type:</b> coordination				
<b>Participant id</b>	1	2	3	4
<b>Person-months per participant:</b>	1	2	1	11

### Objectives

Finding ways to train researchers, especially doctoral students and post-doctoral fellows, into the specialty of Mathematical Methods for Risk Assessment.

Promoting collaboration of mathematical research centres to draw up innovative research programmes on this topic, in connection with scientific policy makers.

Foster the exchange of information, resources and needs between researchers in Risk Management and targeted users from industry or public organisations.

### Description of work

Planned meetings:

#### **Risk Measures and Risk Management**

EURANDOM, March 2006

#### **Mathematical Methodologies for Operational Risk**

EURANDOM, March 2007

Both meetings will include a Round Table Discussion.

### Deliverables

A roadmap report on the results of the meetings and the conclusions of the round tables.

### Milestones<sup>14</sup> and expected result

The two seminars are scheduled at convenient times to serve as milestones of this subproject.

Decision makers will work in connection with other members of the Steering Committee at the planned meetings.

<sup>14</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## Workpackage description (full duration of project)

<b>Workpackage number 5</b>	<b>Start date or starting event:</b> October 2005			
<b>Activity type:</b> management				
<b>Participant id</b>	1	2	3	4
<b>Person-months per participant:</b>	3	1	1	1

### Objectives

This is the management workpackage. It aims to

- coordinate the decision-making structures of the project, in connection with the Steering Committee,
- collect the information emanating from the project and publicising it, and
- typeset and submit all contractor reports.

### Description of work

- Secretarial assistance at each of the participating centres
- Organisation of committee meetings
- Accounting of the overall budget
- Auditing
- Preparation of reports
- Web site maintenance

### Deliverables

- Project presentation
- Web site for the Coordination Action
- Publications data base
- Middle project report
- Final project report
- Final plan for using and disseminating knowledge
- Report on raising public participation and awareness

### Milestones<sup>15</sup> and expected result

The meetings of the Steering Committee will serve as decision-making events. One meeting per year is planned.

The second meeting will be held six months before the end of the project, with the aim of assessing the conclusions of the seminars and debates organised so far, and confronting these with the work of the expert groups. The reports at the end of the project and the syllabus of each topic will be prepared after the guidelines agreed during that meeting.

<sup>15</sup> Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

## Project Resources and Budget Overview

### Coordination Action Effort Form

	Partner 1 CRM	Partner 2 IHÉS	Partner 3 ENI	Partner 4 EURANDOM	TOTAL PARTNERS
Coordination activities					
WP 1 Data Security	6		3	3	12
WP 2 Systems Biology		11	2		13
WP 3 Neuroscience	6		8		14
WP 4 Risk Assessment	1	2	1	11	15
Total coordination activities	13	13	14	14	54
Management activities					
WP 5 Management	3	1	1	1	6
Total management activities	3	1	1	1	6
<b>TOTAL ACTIVITIES</b>	<b>16</b>	<b>14</b>	<b>15</b>	<b>15</b>	<b>60</b>

### Overall budget

#### Coordination activities

Workshops and round tables	181,000 euro
Meetings of expert groups	29,000 euro
Editing and printing	8,200 euro
Secretarial support	14,300 euro
Database maintenance	4,500 euro
<b>Total coordination activities</b>	<b>237,000 euro</b>

Management activities **6,000 euro**

Indirect costs **48,600 euro**

**Total 291,600 euro**

## Management level description of resources and budget

A breakdown of budget items at each partner institution is appended as a separate document.

Workshop costs include in each case:

- Travel, accommodation, and subsistence expenses of speakers
- Travel, accommodation, and subsistence expenses of organisers
- Support for young participants
- Publicity costs
- Catering
- Other costs

Round table costs include the following. Since each round table will be organised in connection with a conference or seminar, it is assumed that some participants will already be present in the organising institution. Additional invited participants will be representatives from industry and scientific policy makers.

- Travel, accommodation, and subsistence expenses of additional invited participants
- Publicity costs
- Other costs

A suitable working force will be hired to assist in the organisation of the joint round table planned during the ICM 2006 in Madrid.

The costs for expert group meetings will be distributed among the partners, according to their principal specialty, as specified in the Coordination Action Effort Form. Each expert group is expected to have 5-6 members and will, in principle, be chaired by one of the Key Researchers of this Action. One joint meeting of the Key Researchers of all four topics is planned in Barcelona three months after the start of the project. At least another meeting will be organised for each thematic expert group in order to draw conclusions at a suitable moment during the project.

Consortium management costs include additional secretarial support or technical support, assuming that additional hours of work will have to be paid to the staff of participating institutes, or auxiliary people will have to be hired, to undertake tasks such as typesetting and editing reports. Management costs also include audit expenses.

The final book of conclusions will be assembled and edited at the coordinating institution (CRM), in close collaboration with the Key Researchers. Typesetting and printing expenses have been counted as coordination costs.

Although this Action will be carried out at four member institutes of ERCOM, the events and activities planned within the project are not part of any ongoing programme of activities of the ERCOM committee or of the European Mathematical Society. Thus, the amount of funding allocated to this project at each partner centre is disjoint from other budgetary amounts of these centres, and no secretarial working force financed by the European Commission through this Action will overlap with other activities at the partner centres.

## **Other Issues**

There are no ethical nor gender issues associated with the subject of the Action.

The Action aims to an active involvement of mathematical researchers into the design of priority areas of future calls of the European Commission. It is essential that the full potential of mathematical methods and their interconnection be recognised and made effective into all domains of natural sciences, social sciences, and technology.

The training system at university level in most countries of the Union is based on standard curricula and it takes emerging topics into account only gradually and sometimes experimentally. This Action specifically aims to provide recommendations for new curricula at an advanced or postgraduate level, based on current trends in the applications of mathematics and built on the conclusions of the debates that are planned within this project. These conclusions will be made available to scientific policy makers of the countries and of the Union itself. In fact, a number of representatives will already be involved in the meetings scheduled in the project.

## Appendix A – Consortium Description

The project will be carried out by four partner teams of international scope. Each of the teams is located in a research center, which will serve as a host institution.

- **Centre de Recerca Matemàtica, CRM, Bellaterra, Spain**  
(Manuel Castellet, Director)
- **Institut des Hautes Études Scientifiques, IHÉS, Bures-sur-Yvette, France**  
(Jean-Pierre Bourguignon, Director)
- **Emmy Noether Institute at Bar-Ilan University, ENI, Ramat-Gan, Israel**  
(Mina Teicher, Director)
- **European Institute for Statistics, Probability, Operations Research, and their Applications, EURANDOM, Eindhoven, The Netherlands**  
(Frank den Hollander, Director until October 2005, to be succeeded by Onno J. Boxma)

These institutes are members of ERCOM (European Research Centres on Mathematics), a consortium of leading mathematical research centres spread over the North, South, East and West of Europe. The mode of operation of ERCOM institutes is special in the sense that they all have a small permanent faculty, and host large flows of outstanding researchers coming from many other institutes for short or longer periods, in order to concentrate on specific research projects in all areas of mathematics and its applications (in particular, applications to Biology, Disease Control, Informatics, Biomathematics, Engineering, Economy, Neuroscience, and other topics of major interest to the society). This character of ERCOM gives to its members easy access to state-of-the-art techniques, methods and ideas carried out in Europe, and enables interdisciplinary breakthroughs.

The project is divided into four subprojects, each focused on an emergent topic. Nevertheless, intense cross-relationships and joint actions are planned. Above all, doctoral students will be encouraged to undertake a training programme involving more than one subproject, in fact the four of them in the most prominent cases. While researchers associated with this project will act on several subprojects, the Key Researchers are the following:

- 1) Identifying new opportunities in Mathematics for Cryptography and Data Security:  
**Enric Nart, CRM**
- 2) Identifying new opportunities in Mathematics for Systems Biology:  
**Mikhail Gromov, IHÉS**
- 3) Identifying new opportunities in Mathematics for Neuroscience:  
**Mina Teicher, ENI**
- 4) Identifying new areas for Mathematical Risk Assessment:  
**Henry Wynn and Jef Teugels, EURANDOM**

### *Curriculum vitae of Enric Nart*

Enric Nart is permanent Professor at the Department of Mathematics of the Universitat Autònoma de Barcelona (UAB). He has published more than 30 papers in Number Theory and Arithmetic Geometry. He has spent several years in Germany at the universities of Regensburg and Münster, and has spent several months at different research institutes like the Max-Planck-Institut für Mathematik in Bonn, the Institut des Hautes Études Scientifiques in Paris and the Fields Institute in Toronto. His latest research is focused on finite fields and their applications to coding theory and cryptography. He is responsible of the research project "Arithmetic Geometry and applications to Cryptography" (BFM-2003-06092), from the Spanish MCYT, and participates in the Marie Curie Research Training Network "Arithmetic Algebraic Geometry" (MRTN-CT2003-504917).

### *Curriculum vitae of Mikhail Gromov*

Mikhail Gromov is permanent Professor in Mathematics at the Institut des Hautes Études Scientifiques (IHÉS) since 1982 and Jay Gould Professor at the Courant Institute of Mathematical Sciences (at New York University). His academic background includes Ph.D. from the University of Leningrad. Before he was recruited by IHÉS, he held professor positions at the State University of New York at Stony Brook and at the Université de Paris VI.

Gromov is considered one of the most eminent geometers of our time, creating whole new directions of study in the areas of geometry, analysis and algebra. His current research is at the interface between Mathematics and Molecular Biology.

He is the author of many books and articles, including *Partial Differential Relations* (Springer 1986) which summarizes pioneering work done in Leningrad, and which builds on ideas of John Nash on partial differential equations. His book *Metric Structures for Riemannian and Non-Riemannian Spaces* (Birkhäuser, 1999) describes a significant part of his work on Metric Geometry.

He is a member of the Académie des Sciences de Paris, the American Academy of Arts and Sciences, a foreign associate of the US National Academy of Sciences, and holds a honorary doctorate from the Université de Genève. He is the recipient of the Wolf Prize (1993), the Balzan Prize (1999), the Kyoto Prize (2002) and the Nemmers Prize (2004).

He was co-editor of the Proceedings of the *Premiers Entretiens de Bures: "Pattern Formation"* and the *Deuxièmes Entretiens de Bures: "Folding and Self-Assembly of Biological Macromolecules"*.

### *Curriculum vitae of Mina Teicher*

Mina Teicher, Vice President for Research and Development of Bar-Ilan University (in charge of Technology Transfer), is a Professor of Mathematics and Computer Science, specializing in Algebraic Geometry with applications to Brain Research, Computer Vision and Cryptography. She is a world leader in topological methods in Geometry and Morphology, and lectured in the major centers and universities. She heads a research group of 20 graduate students and post-doctoral fellows, building the world first research center on the topic.

Her academic background includes Ph.D. from Tel-Aviv University, a postdoctoral position in the Institute for Advanced Study in Princeton; extended visiting and lecturing positions in Columbia University in New York, Max-Planck Institut für Mathematik in Bonn, Scuola Normale Superiore in Pisa, Tata Institute for Fundamental Research in Bombay, Mathematics Research Institute in Kyoto, Hong-Kong University, and others. She received prestigious awards such as Rothschild, Landau Prize, Delek Prize, Bathsheva de Rothschild Award, and Minerva Center. She won international and national grants such as the first rated European Network in Exact Science, Israel Academy, NATO, INTAS, American-Israeli Binational Science Foundation, and Israel Science Foundation Center of Excellency.

She is the director of the Emmy Noether Research Institute for Mathematics and was the Chairman of the Department of Mathematics and Computer Science. She was and is a member in a long list of international and

national committees, including the Council for Higher Education of Israel, the Executive Committee of the European Mathematical Society, National Steering Committee for Brain Research, Forum Academia-Industry of the Israel Government, Helsinki Group for Advancement of Women (an EU committee), Fachbeirat of the Max-Planck Institut für Mathematik, Advisory Board of the German Science Ministry, as well as the Italian Science Foundation and the Board of Foundation for Advancement of Mathematics of Columbia University in New York and the Board of the Wolf Foundation.

### *Curriculum vitae of Henry Wynn*

Henry Wynn is Professor of Statistics and Convenor of the Department of Statistics at London School of Economics. He is a distinguished statistician with a strong track record of research in statistical theory and applications. His areas of interest are experimental design and algebraic statistics. He has wide applies statistics experience, particularly in industrial statistics and risk related areas. He moved to the London School of Economics in 2003 after founding a successful research group at the University of Warwick and much of the activity continues with his newly created Decision Support and Risk Group at the London School of Economics. He is an Honorary Fellow of several societies and holds the Guy Medal in Silver from the Royal Statistical Society. He is (part-time) scientific co-Director of EURANDOM with special responsibility for the statistics programme. He has considerable EU experience.

### *Curriculum vitae of Jef Teugels*

Professor Jef Teugels, KU Leuven, expertise in probability, statistics and classical analysis. His areas of interest are extreme value theory, risk theory, renewal theory, and categorical data analysis and a wide range of applications ranging from insurance to environmetrics. At present he is involved as senior scientist at the Centre of Statistics at the KU Leuven and scientific advisor and project leader of the Re Insurance project at EURANDOM.

He is well known internationally, was president of the Bernoulli Society and board member of the International Statistical Institute as well as member of editorial boards of a.o. the Journal of Applied Probability, Stochastic Processes and its Applications, Applied Stochastic models in Business and Industry and Insurance: Mathematics and Economics and as a member of the advisory board of the Wiley Series in Statistics.

### *Short presentation of CRM*

The CRM is a research institute in mathematics for visitors and postdoctoral fellows. It was created in 1984. Since 2002 it is a consortium between the Catalan Government and the *Institut d'Estudis Catalans* (National Catalan Academy), with its own legal status. Apart from the contribution of these institutions, funding for CRM activities is obtained through applications to several research programmes of the Catalan Government, the Spanish Government, and the European Commission.

The main goal of the CRM is to promote research in mathematics at the highest level. To achieve this aim, the CRM invites outstanding mathematicians for research visits, hosts research fellows, awards postdoctoral grants, carries out research projects, organises lectures, seminars, advanced courses and conferences, and disseminates research results through its publications series, some of them managed by Birkhäuser.

The activity of the CRM in the past four years is summarised as follows: 25 postdoctoral researchers for a total of 270 man-months, funded by Marie Curie grants (6), EPDI (1), Spanish Government (11), and by European Research and Training Networks (7); 190 invited researchers in periods varying between a few weeks and a year, for a total of 707 man-months; organisation of 11 international conferences (Euro Conferences and Euro PhD Conferences), 7 advanced courses (Euro Summer Schools), 4 international workshops funded by the European Commission under the High Level Scientific Conferences programme; every week some ten lectures are offered by visitors and fellows, many of them as part of seminars and series of lectures organised by the local research groups of the universities of Barcelona; several series of publications: *Preprints* (about 30 every year), *Quaderns* (compiling specialised activities), and *Advanced Courses in Mathematics CRM Barcelona* (published by Birkhäuser Verlag).

### *Short presentation of IHÉS*

The Institut des Hautes Études Scientifiques is an institute of advanced research in mathematics and theoretical physics with an interest in epistemology and the history of science.

It was created in 1958 through the initiative of a single person, Léon Motchane, a Russian industrialist with a passion for science. IHÉS is situated in the domain of Bois-Marie in Bures-sur-Yvette (Essonne), south-west of Paris. Today, financial support comes from various sources, private and public, French and foreign.

It is a private foundation in the public interest with the mission of supporting fundamental research in mathematics and theoretical physics. In recent years more and more instances where facts or theories developed at the theoretical level have led to major changes in technologies or overall approaches to certain problems. The Institute started an activity in Molecular Biology with precisely the ambition of bringing together scientists with different backgrounds for a wide range of problems going from extremely theoretical to practical optimisation of bio-chips experiments.

IHÉS is offering its visitors and permanent staff an ideal environment to pursue their research: scientific buildings, including library, conference room and computer facilities as well as cafeteria and housing complex. Each year the Institute invites between 250 to 300 visiting mathematicians, theoretical physicists, computer scientists, and more recently biologists. Coming from universities, research centers and other institutions worldwide, their typical length of stay is about ten weeks. However visits vary from a few weeks to up to one to two years. Over the past twenty years IHÉS has served some 4,000 researchers. Visiting researchers represent a wide selection of nationalities and ethnical groups: during the last decade, the Institute welcomed 2,187 scientists coming from 50 countries.

### *Short presentation of ENI*

The Emmy Noether Institute is a Research Institute in Mathematics, focusing on Research in Algebra, Geometry, Function Theory and applications.

It was created in 1992 by the Max Planck society of Germany (via the Minerva Foundation) and Bar-Ilan University, which jointly support the Institute financially. Other funding for ENI activities is obtained through applications to several research programs of national and international funding bodies.

In 1998 it passed an evaluation process by an international committee assembled by the Minerva Foundation and the ENI was declared "A Center of Excellency".

The ENI is located on the campus of the Bar-Ilan University (BIU) and enjoys services, library, computing services etc. of the University. It has a very wide activity in different interdisciplinary fields.

The activities of the ENI are the following: it invites outstanding mathematicians for research visits, hosts research fellows, awards postdoctoral grants, carries out research projects, organizes lectures, seminars, advanced courses, summer schools and conferences, and disseminates research results through its publications series, distributed by the AMS, and other journals.

### *Short presentation of EURANDOM*

EURANDOM is a European research institute for Statistics, Probability, Stochastic Operations Research and their applications. The mission of EURANDOM is to foster research in the stochastic sciences and their applications. It achieves this mission by helping talented young researchers find their way to tenured positions in academia and industry, by carrying out and facilitating research through postdoctoral and graduate appointments, visitor exchange and workshops, and by taking initiatives for collaborative research at the European level.

For young researchers EURANDOM is a stimulating environment with a broad perspective on stochastics. For senior scientists EURANDOM offers the opportunity to cooperate with colleagues as well as these young talented researchers.

Workshops, seminars and an extensive visitor programme are part of the scientific activities of EURANDOM.

Risk has been prioritised as an area of research in EURANDOM, via its Reinsurance programme. There have been several workshops and training sessions and another is currently being planned for May 2005. In addition to the academic community these sessions have been attended by staff from financial companies.

EURANDOM very much values its links with industry. It has 4 industrial grants, one of which is on reliability methods. Workshops at EURANDOM have a strong tradition of good presentations, lively discussion and ground-breaking research.

The activity of EURANDOM in the past 6 years (1998-2004) is summarised as follows:

- Postdoctoral researchers and PhD students. Since the start in 1998 some 60 postdocs were contracted; about 80% of the junior staff leaves EURANDOM for tenured positions in academia or industry. At any time 25 junior researchers are working at the institute.
- Invited researchers. 225 visitors stayed at EURANDOM for a period from a few days up to 3-6 months (in total 490 visitor weeks). In average: 40 visitors for 80-100 weeks per year.
- Workshops. EURANDOM has an outstanding record in running workshops and seminars. On average there are around 12 workshops with a total (international) attendance of 300-400. In 2004 two larger workshops were run by EURANDOM with respectively 70 and 120 attendees. The first of these was funded by an EU grant (MODA). Workshops have also been funded by EU thematic networks under FP5 and in the context of a Network of Excellence (PASCAL) under FP6. The workshops are very international which reflects the mission of EURANDOM and its the make up of its community of post doctoral fellows (at present 24 postdocs and PhD's from 12 countries). In total 2,500 researchers participated in workshops at the institute.

### **Sub-contracting**

No sub-contracting of tasks is planned.

### **Third parties**

No part of the work is foreseen to be carried out using financial resources or resources in kind provided by third parties.

### **Funding of third country participants**

No participants established outside the EU Member and Associated states will be funded through this Action, except possibly for keynote speakers at workshops or round tables. In such cases, the Project Officer will be timely informed by the coordinator.