



“Greek Large Scale Research Infrastructures”

***A first Attempt to establish a
Roadmap for the next 10+ years
as a service
to the
Greek Scientific Community***

Initiated and supported by the GSRT



“Greek Large Scale Research Infrastructures”

DISCLAIMER

“The proposed infrastructures are the product of consultation

In response to the GSRT call (30/5/2005)

and

they are not
approved yet by the state”



“Greek Large Scale Research Infrastructures”

“There is an urgent need to increase Public investments to provide access for scientists and engineers to the latest and best S&T infrastructure, as well as to update infrastructure currently in place”



“Greek Large Scale Research Infrastructures”

Many thanks to the people that contributed to the report

- | | | |
|-------------------------------|---|-----------------------|
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And a large number of anonymous colleagues who voluntarily helped to complete this work

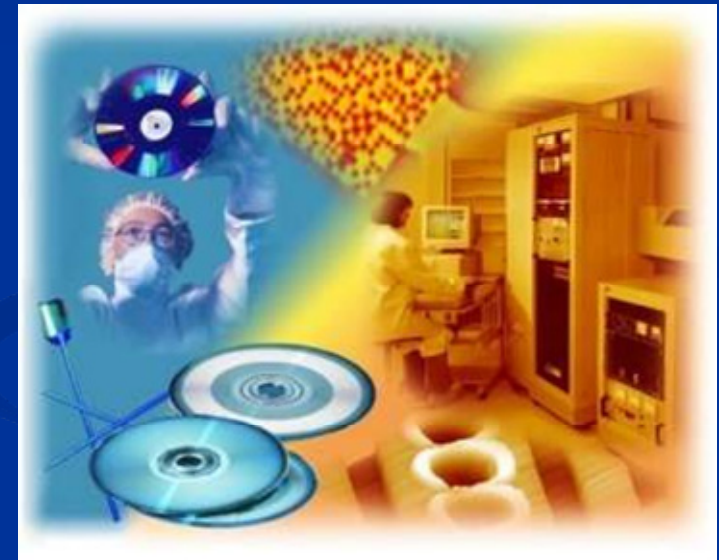


“Greek Large Scale Research Infrastructures”

“Exploring new scientific areas whether in uncharted wilderness or at the frontiers of knowledge requires not only vision, daring and ingenuity but also the necessary tools and the right kind of equipment.

Often new territory is accessible only with new tools; and sometimes even a seemingly unstoppable rush of discovery must halt to await novel means of seeing, manipulating and analyzing natural phenomena”

(NSF- Facility Plan , September 2005)





“Greek Large Scale Research Infrastructures”

■ *DEFINITION*

Infrastructure for this report is defined as:

“centers, which offer facilities, resources or services of a unique nature, that have been identified by research committees to conduct top-level activities in a field”

Examples : Nuclear Reactor, Tandem, Aristarchos, etc



“Greek Large Scale Research Infrastructures”

General Criteria

- comply with the general definition given above;
- be **new** infrastructures or major **upgrades** of existing ones



“Greek Large Scale Research Infrastructures”

Scientific / Strategic criteria

- correspond to a **real need** for the development of the field in Greece
- be supported by the appropriate scientific community at National and European level, be of **pan- Hellenic** and **European** interest
- be **multi-user** facilities offering an **open access** (physical or virtual) for scientists from all over Greece and outside
- be relevant at **international** level



“Greek Large Scale Research Infrastructures”

Technical and financial criteria

- be timely and mature
- be technologically feasible
- open new possibilities or offer improved technological performance
- have estimated construction and operating costs and commitment of major stakeholders
- Additional criteria
 - To take or be part of National and International Collaborations
 - To be recognized at an International level as “Center of Excellence”
 - The minimum level of new/existing infrastructure cost must be at least **5,000,000 €**



“Greek Large Scale Research Infrastructures”

Setting up the Roadmap

- Working towards a Greek Roadmap, and in accordance with the ESFRI working groups, three dedicated Roadmap Working Groups (RWG) were formed. Their task was to present their report- **based on the applications submitted**- and advise the GSRT for further actions in the following areas:
 - **Physical Sciences :** Chair Dr. Niarchos, Director , NCSR “Demokritos”
 - **Biological and Medical Sciences:** Chair Dr. G. Kollias, Director “Fleming”
 - **Social Sciences and Humanities:** Chair Prof. J. Kallas, U. Of the Aegean



“Greek Large Scale Research Infrastructures”

Setting up the Roadmap

The objective was to identify **new** Research Infrastructures (RI) of pan-Hellenic /European interest (or **major upgrades** to existing ones) open to use by and corresponding to the needs of the Greek/European research communities, covering all scientific areas, regardless of possible location.

In such a Roadmap each plan/proposal should be described in terms of:

- **The science case**
 - **The concept case** (including the technical case, cost analysis)
- and
- **The maturity of the project**

Each Working Group has grouped the submitted proposals which fulfill most of the criteria.



“Greek Large Scale Research Infrastructures”

Setting up the Roadmap

- The **PS Roadmap Working Group** selected nine (9) areas:
 - Materials Research and Devices Science Center (MRSEC)
 - Hellenic Center for Electron Microscopy (HCEM)
 - Micro-Nanoscience and Nanotechnology Center (MN²C)
 - Marine Research and Technology (MART)
 - Center for Natural Disasters (NADIS)
 - Center for Converging Technologies (C²T)
 - Astroparticles/Astronomy (KM3NET and ARISTARCHOS)
 - Cyber Infrastructure (CI)
 - Laser Facilities (ALI)



“Greek Large Scale Research Infrastructures”

Setting up the Roadmap

- **The Biological and Medical Sciences selected four (4) areas:**
 - Functional Genomics in model Organisms (**FUNGEN**)
 - Biomedical Imaging (**BIOIMAGE**)
 - Analytical Methods for studying biological reactivity and/or materials (**BIOANALYSIS**)
 - Translation Research and Clinical Trials (**TRANSBIOMED**)



“Greek Large Scale Research Infrastructures”

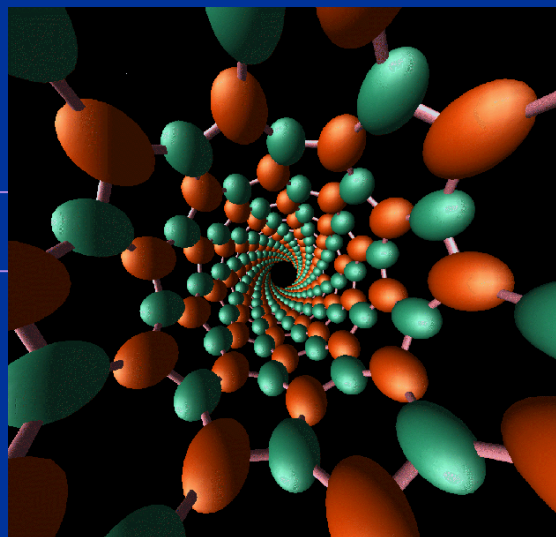
Setting up the Roadmap

- **The Social sciences and Humanities selected two (2) areas:**
- European Research Infrastructure for Conservation and Analysis (**EURICA**)
- Socioeconomic Data GRID (**SDG**)

The Facility: Materials Research and Devices Science Center (**MRSEC**)

Short Description

The mission is to develop new materials in the form of **bulk, single crystals, powders, thin films and devices** based upon them, and in order to do so we will employ a team of materials scientists, physicists, and chemists who carry out collaborative research on a variety of problems.



Logo:

Background: Materials Science and Engineering is an interdisciplinary study which combines metallurgy, physics, chemistry, and engineering.

What's New? Current materials of interest include magnetic, superconductors, ferroelectrics, organic crystals and diamond coatings, Si based components, and hybrid materials based on the categories above.

A facility that will provide with the highest scientific standards materials and devices on demand.

Impact Foreseen

A high level service to the Greek scientific Community

Foreseen costs

Cost of construction:	20 M€
Running cost per year:	0.8 M€

The Facility: Hellenic Center for Electron Microscopy (HCEM)

Short Description

The purpose of the center is to study the relationship between materials **nano-structures** and **macroscopic properties**. New materials continuously emerge that require structural and chemical investigation at atomic level.

A few examples are: photonic materials, materials for aerospace applications, smart and functional materials, meta-materials, biomaterials and materials for energy storage, polymers etc to name a few.

Background: Materials Science and Engineering is an interdisciplinary study which combines metallurgy, physics, chemistry, and engineering.

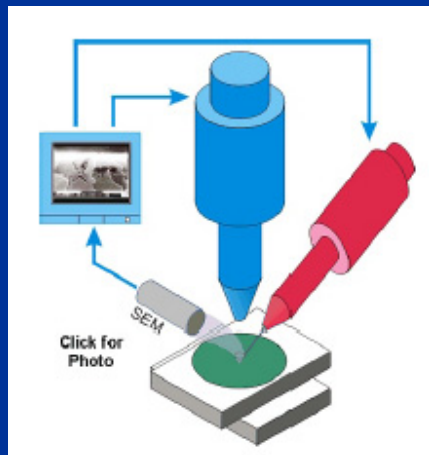
What's New?

State-of-the-art electron microscopes (SEM, TEM, environmental SEM, Focused ion Beam (FIB), etc) complemented with atomic microscopes like (AFM, STM, MFM, etc) will be the reference for the Greek community but also can be the reference center for SE Europe and Eastern Mediterranean Countries.

Impact Foreseen

High level expertise cannot be achieved without a central facility and its satellites at various large, numbers of users, at Research Centers/Universities.

Logo:



Foreseen costs

Cost of construction:	13 M€
Running cost per year:	1 M€

The Facility: Micro- Nanosciences and Nanotechnology Center (MN²C)

Short Description

The vision of the center is to promote interdisciplinary research across traditional academic boundaries in order to reach a synergetic integration of basic science, design, manufacture and application of nano- and microscale systems, covering the complete chain from molecular level to microsystem or micromachined components.

Background: The use of nano-related approaches for the development of novel diagnostics, imaging techniques, electronics, energy conversion devices and environmental friendly products based on nanoparticles, semiconductor materials and nanoradiopharmaceuticals, promises to lead to a new era.

What's New?

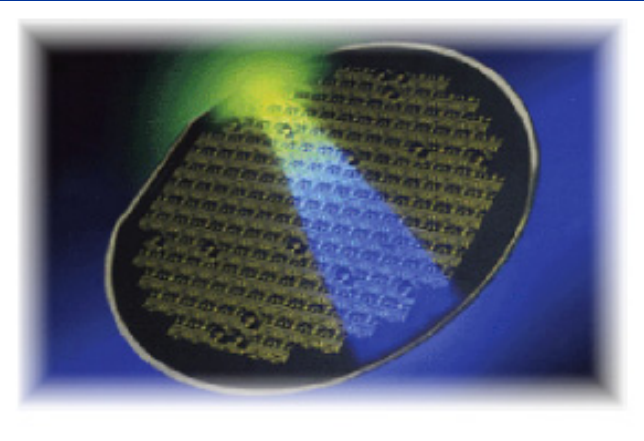
The facility proposed -in a distributed- type format-based on application :

Si, III-nitrides, III-arsenides, carbides , semiconductors and Carbides,nanocoatings and flexible electronics and nanoparticles

Impact Foreseen

Access by researchers and industry in a state-of-art facility

Logo:



Timeline and foreseen costs

Cost of construction:	31 M€
Running cost per year:	3,3 M€

The Facility: Marine Research and Technology (MART)

Short Description

The proposed facility will provide the state of the art infrastructure to support on-going and future underwater research with emphasis on deep waters by building of a **new state of the art Oceanographic Research Vessel (R/V)** with multi-discipline fully equipped facilities including a state of the art multi-beam able to provide over-side and laboratory with approximately 60 m long, 12 m wide loaded draught 4 m, with diesel propulsion modern controls.

Background: Greece has been very active with marine science and technology. Centered around NCMR activities their contributions to science ,technology and social life are well recognized.

What's New?

The new R/V will serve increased national and Cooperative international research activities in the Mediterranean and Black sea with extension to other near-by seas(Red Sea, Arabian Gulf, etc). The mapping of the sea floor, the seismic activity (fault lines) the potential resources (fisheries, **methane hydrates** and other hydrocarbons) as well activities related to cultural heritage are just a few scientific and economic activities of the proposed lab.

Impact Foreseen

Scientific and geopolitical presence in the SE Mediterranean

Logo:



Foreseen costs

Cost of construction:	15 M€
Running cost per year:	1 M€

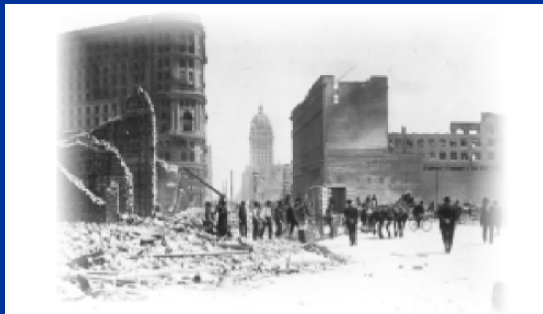
The Facility: Natural Disasters (Tsunami and Seismology) (NADIS)

Short Description

The performance of scientific research and the operation of the **Early Warning System (EWS)** in the frame of the proposed center is expected to have a quite positive impact for the education of staff of civil protection and other services as well as for the systematic information of the general public as regards the tsunami hazard and the countermeasures.

Complementary to this is the **Seismological monitoring activity** for the entire region of SE Europe.

Logo:



Background: The dramatic experience of December 2004 in Indian Ocean made it clear in Europe that the mitigation of tsunami risk should be seriously taken into account and in Europe it is now widely recognised that the Mediterranean Sea is the most risky area.

In Greece and the rest central and east Mediterranean Sea, including major part of the Balkans, the highest seismicity is observed in the entire western Eurasia that is from Caucasus to the Atlantic Ocean and from Africa to the North Pole.

What's New?

- (1) advanced marine survey methods to explore tsunamigenic sources ,
- (2) new expert systems and GIS tools for the hazard evaluation and description,
- (3) new signal transmission technologies for the operation of EWS's and (4) multimedia, internet and other means for the information and education activities.

From 46 stations to the 100 stations all over the SE Europe and Eastern Mediterranean area, is the ultimate goal of the Proposed LSI.

Impact Foreseen

Full coverage of sea and ground warning system

Foreseen costs

Cost of construction:	15 M€
Running cost per year:	1 M€

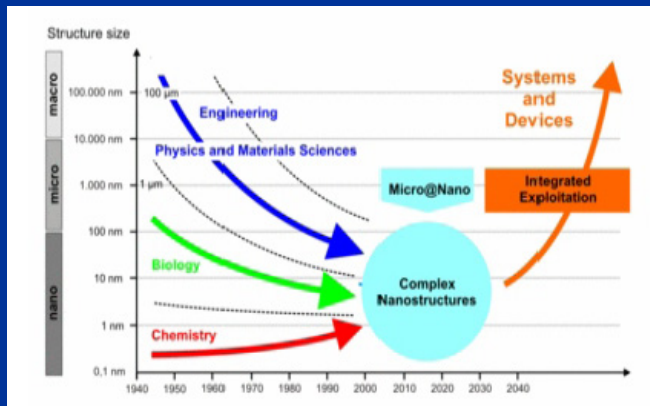
The Facility: Center for Converging Technologies (C²T)

Short Description

The new center is based on “Revolutionary advances at the interfaces between previously separate fields of science and technology, ready to create key transforming tools for NanoBioITCognitive (NBIC) technologies”.

Developments in systems approaches, mathematics, and computation in conjunction with NBIC, will allow us for the first time to understand the **natural world, human society, and scientific research as closely coupled complex hierarchical systems.**

Logo:



Background:Convergence of diverse technologies is based on material unity at the nanoscale and on technology integration from that scale. The building blocks of matter that are fundamental to all sciences originate at the nanoscale.

What's New?

In the proposed center emphasis will be given to the C²T center towards

life sciences, energy and environmental applications.

It is based also on the culture of the scientific community as one way into the future and it is supported by the multidisciplinary projects going on within the center, but also with outside groups.

Impact Foreseen
Interdisciplinarity at its best

Foreseen costs

Cost of construction:

24 M€

Running cost per year:

12M€

The Facility: Neutrino Detector (Km³NET) and ARISTARCHOS) (ASTRON)

Short Description

- a) KM3Net The centre is a world leading activity. The construction and operation of such an activity can only take place at the European level. The unique features of KM3NET will make it a leading instrument in its field.
- b) **ARISTARCHOS** The telescope is the largest observing center in the Balkan and the Eastern Mediterranean area and it is anticipated to attract the attention of many scientists from the region and from all-over the world.

Background:

Neutrino detectors have opened a new window for observations and a new field in astroparticle science, that of neutrino astronomy.

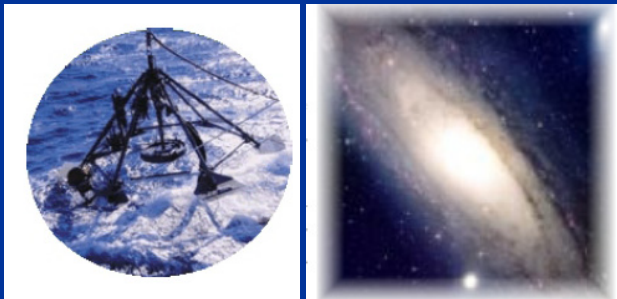
What's New?

The Cubic Kilometer Neutrino Telescope (KM3Net) will consist of thousands of optical sensors distributed in a volume of about one cubic kilometer in the depth of the Mediterranean Sea. The sensors detect the light which is produced in the water by charged particles originated from neutrinos and the earth

Impact Foreseen

The Km3Net has created interest to Astroparticle physicists, marine biologists, e-science and computer grid technologies, to name a few.

Logo:



Foreseen costs

Cost of construction: Km³Net (preparatory phase)	10 M €
Cost of Construction (ARISTARCHOS)	10 M€
Running cost per year:	21 M€

The Facility: Cyber – Infrastructures (CI)

Short Description

The proposed facility will cover the needs of the Greek scientific and industrial community. It will host large scale computing facilities (mainframes/supercomputers, grid/clusters) and storage devices in the peta-bytes (NAS/SAN). The facility will be organized and operated based on the last world standards for security and aims to be the facility also for the SE Europe.

Background:

Achieving many important objectives in science and technology, it is necessary to have access to a new generation of computing, communication, analysis and information technologies. These resources, many of which are now in development, are collectively known as “cyberinfrastructure” (CI)

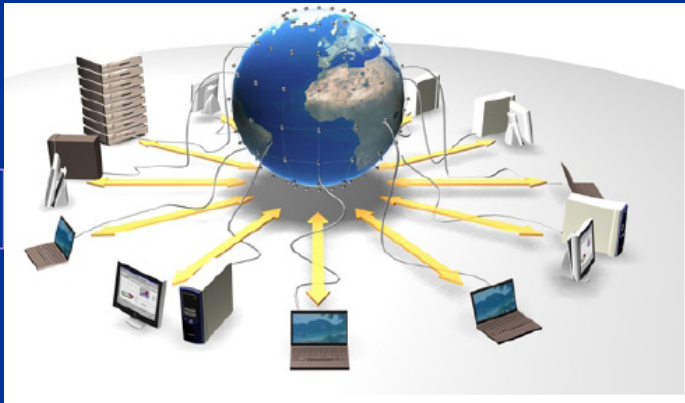
What's New?

Single site operated and remotely accessible large scale computing facilities (mainframes/supercomputers, grid/clusters) and storage devices in the peta-bytes (NAS/SAN)

Impact Foreseen

All-fields from experimentalists to theoreticians and modelling, will have access to a state-of-art infrastructure

Logo:



Timeline and foreseen costs

Cost of construction:	8 M€
Running cost per year:	0,5 M€

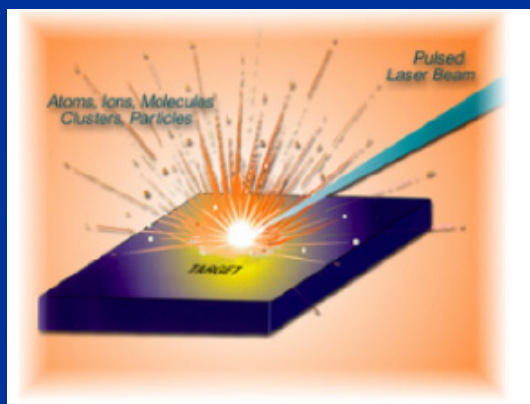
The Facility: Advanced laser Infrastructure (ALI)

Short Description

ALI will act as a distributed infrastructure including besides ULF-FORTH other laser laboratories in Greece, such as those in ITPC-NHRF (Athens), ICEHT-FORTH and Univ. of Patras (Dept. of Physics), Univ. of Ioannina (Dept. of Physics) NTUA (Dept. of Physics) and NCSR "D" (IMS).

It is based on the core infrastructure, ULF-FORTH- a multi-disciplinary scientific laboratory dedicated to laser-based science, supporting high quality basic and technological research

Logo:



Background: Laser spectroscopy and laser ablation are widely used techniques in materials research. Atomic interactions –reactions can be studied using ps/fs lasers.

What's New?

ALI will be the premier infrastructure dedicated to the fundamental study of laser-matter interaction in a new and unsurpassed regime of laser intensities and frequencies extending to the fs

Impact Foreseen

In addition to basic sciences study of technologically important photonic, semiconducting etc materials.

Timeline and foreseen costs

Cost of construction:	10 M€
Running cost per year:	1 M€

The Facility: Infrastructures for functional analysis of model genomes (**FUNGEN**)

Short Description

The center aims to the collaboration over the three continents, Europe, America and Asia. In addition, the importance of building and maintaining national mouse clinics or research topic-based phenotyping laboratories are recognised as necessary institutions, where special research problems can be analysed and phenotyping deepened.

Background:

The mouse is the central model organism used for understanding physiology and pathobiology of diseases affecting man, for the comprehensive functional annotation of the mammalian genome and for the development of new therapies

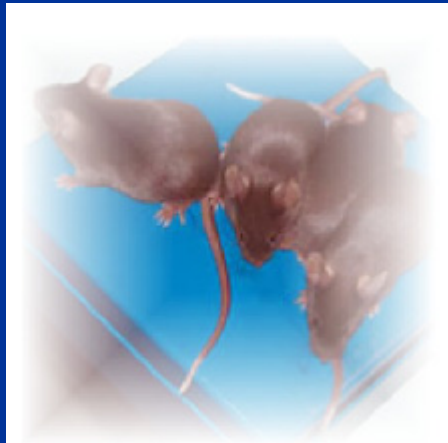
What's New?

Enhancement of the strengths of research productivity by Greek laboratories in this area is extremely sound at the European level and worldwide.

Impact Foreseen

Synergies created at National and International Level

Logo:



Timeline and foreseen costs

Cost of construction:	15 M€
Running cost per year:	1,2 M€

The Facility: IMAGING IN BIOLOGICAL AND BIOMEDICAL RESEARCH(BIOIMAGE)

Short Description

The aim of such research infrastructures will be to accommodate needs for (1) acquiring structural or functional images of living organisms. This includes the use of new imaging devices in the medical and/or biological domain covering a large range of scales from the organ to cellular and sub-cellular resolution; (2) application of methods/algorithms to extract quantitative and pertinent information from complex biomedical images, and (3) novel applications of bio-medical imaging in biology and medicine.

Logo:



Background: Biomolecular imaging has not only gone far beyond its earlier capabilities, it has also surpassed other traditional methods of cellular research. Now we have the means to delve into systems-scale questions, observing many different molecules - and the structures they comprise - simultaneously and in real time.

What's New?

A non-exclusive list of potential participants with expertise or existing infrastructures in these areas are at FORTH, Heraklion, the NCSR "Demokritos", the Medical Institute of the Academy of Athens and the Medical Schools in Athens, Patras and Thrace

Impact Foreseen

Synergistic approach to Bioimaging in Greece

Timeline and foreseen costs

Cost of construction:	10 M€
Running cost per year:	1,2M€ ₂₅

The Facility: A TRANSLATIONAL RESEARCH AND CLINICAL TRIALS (TRANSBIOMED)

Short Description

Improving human health, scientific discoveries must be translated into practical applications. Such discoveries typically begin at “the bench” with basic research in which scientists study disease at a molecular or cellular level then progress to the clinical level, or the patient's “bedside.”

The **proposed infrastructure** thus aims to harmonize national requirements that pertain to the conduct of clinical research, facilitating compliance with pertinent regulations and policies and ultimately creating a more effective framework for the development of sound clinical research at the National level.

Background: Scientists are increasingly aware that this bench-to-bedside approach to translational research is really a two-way street. **Basic scientists** provide clinicians with new tools for use in patients and for assessment of their impact, and **clinical researchers** make novel observations about the nature and progression of disease that often stimulate basic investigations.

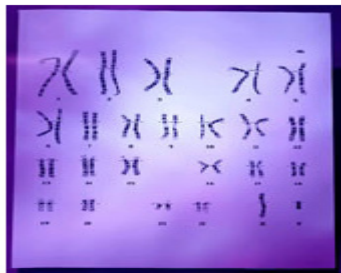
What's New?

Translational research has proven to be a powerful process that drives the clinical research engine. However, a strong research infrastructure could accelerate this critical part of the clinical research enterprise.

Impact Foreseen

Synergies at National Level

Logo:



Timeline and foreseen costs

Cost of construction:	5 M€
Running cost per year:	↑ 6 M€

The Facility: Evolving Analytical Methods for studying biological (BIOANALYSIS)

Short Description

The center will coordinate technologies

Used for bionalysis, such as:

- Bioinformatics
- Gene discovery and genome analysis (genomics)
- The structure and function of primary gene products (proteomics)
- The analysis of metabolites in biological material (metabolomics)
- Gene expression profiling in different contexts and through time (transcriptomics)

Background:

The last decade has seen rapid and continuing advances in technologies supporting analysis of the molecular basis of biological phenomena. These technologies are enabling vast amounts of information to be generated and are promoting the emergence of new areas of research within the biological sciences.

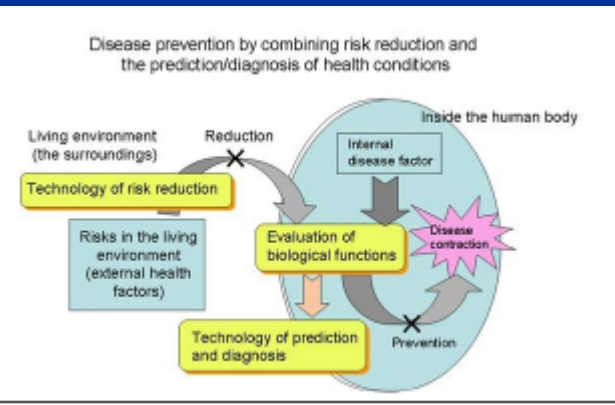
What's New?

In Greece there are Institutes that maintain an internationally competitive position in several of the platform technologies needed to support research in these areas and high standard proposals are expected to be generated.

Impact Foreseen

Training and synergies

Logo:



Timeline and foreseen costs

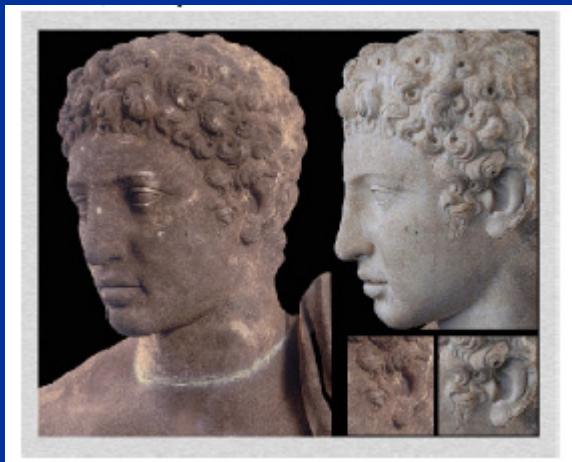
Cost of construction:	10 M€
Running cost per year:	1,2 M€

The Facility: European Research Infrastructure for Conservation and Analysis (**EURICA**)

Short Description

The proposed network of complementary institutions will provide unique facilities and expertise to support frontline research and enhance the use of novel methods for the preservation of our cultural heritage. The interdisciplinary nature of the network is expected to act as a catalyst for developing new collaborations between the participating scientific-technological and cultural heritage communities that will promote the exchange of knowledge and introduce innovative approaches and methods.

Logo:



Background: Cultural heritage research faces challenging problems, which require detailed knowledge of materials composition but also in-depth understanding of complex physical and chemical processes involved in the making as well as the deterioration of archaeological, historical and artistic objects. For example, advanced materials characterization and processing techniques must be utilized for encountering the complexity of problems involved in objects, which are unique and valuable.

What's New?

Conservation scientists and conservators, archaeologists and historians, curators and other scholars may be beneficiaries of this knowledge.

Impact Foreseen

Physical methods at the service of conservation and analysis

Foreseen costs

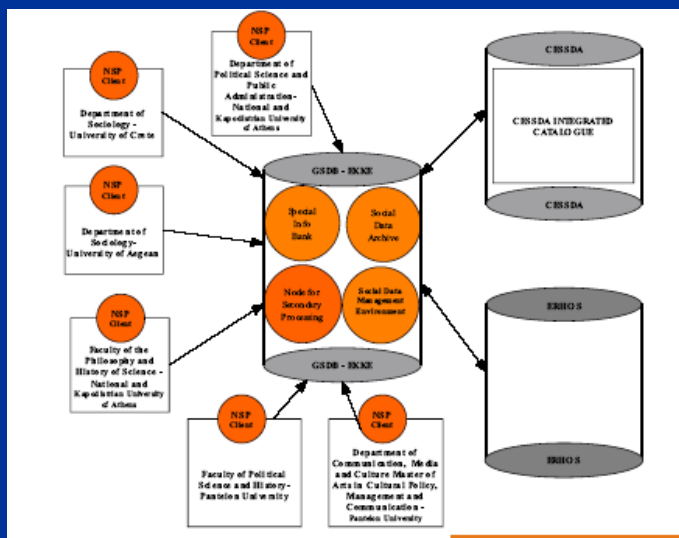
Cost of construction:	4 M€
Running cost per year:	1 M€

The Facility: Socioeconomic Data Grid (SDG)

Short Description

The project will **built and maintains a grid for socioeconomic data production, processing and dissemination**, which will be used by socioeconomic data producers, providers and consumers. The development of the GRID will be based on existing Greek and European social research infrastructures and research organization networks.

Logo:



Background:

In a global society and in a united Europe comparative socioeconomic research is a very important issue. To support comparative research, a data-sharing infrastructure is needed. This infrastructure has the form of a GRID. Each node of the grid will be a local data provider, which will be responsible of gathering, integration and harmonization, preservation and dissemination of the data.

What's New?

Integration of the existing Greek social research infrastructures, and links with EU

Impact Foreseen

Necessary Data for policy making at any level

Timeline and foreseen costs

Cost of construction:	2 M€
Running cost per year:	1 M€

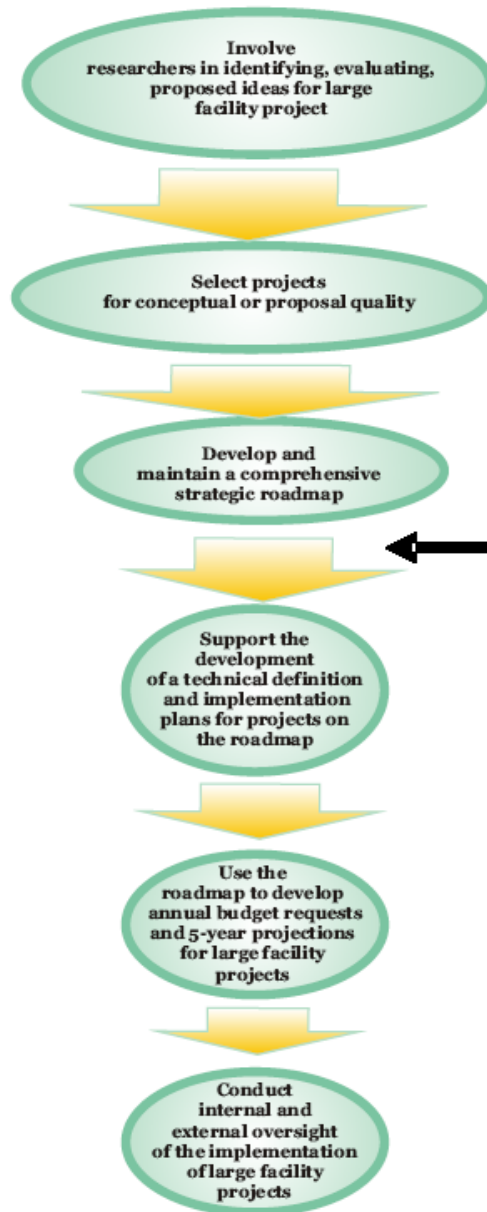
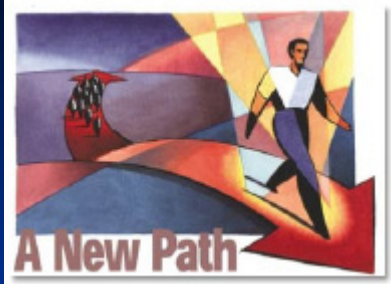
Proposed Roadmap



MRSEC = Materials Research and Devices Science Center
HCEM = Hellenic Center for Electron Microscopy
MN²C = Micro Nanoscience and Nanotechnology Materials Center
MART = Center for Marine Research
NADIS = Center for Natural Disasters
C²T = Center for Converging Technologies
ASTRON = Network of Greek Telescopes (Aristarchos *KM3Net)
CI = Cyber- Infrastructure

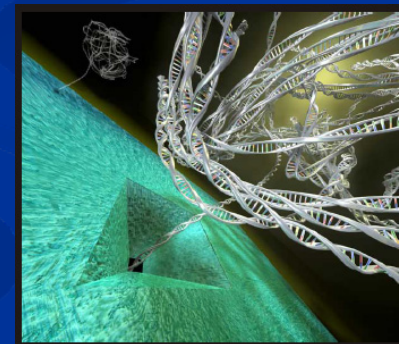
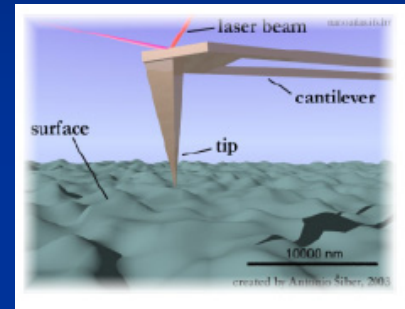
ALI = Advanced Laser Infrastructure
FUNGEN = Functional Genomics in Model Organisms
BIOIMAGE = Imaging in Biological and Biomedical Research
BIOANALYSIS = Evolving Analytical Methods for Studying Biological Reactivity and/or materials
TRANSBIOMED = A Translational Research and Clinical Trials Infrastructure
EURICA = European Research Infrastructures for Conservation & Analysis
SDG = Socioeconomic Data Grid

Conclusions - Suggestions



A six step process is adopted by the ad-hoc group for the establishment and Implementation of the Greek Roadmap for LSI

We are Here



CONCLUSIONS and SUGGESTIONS

- From the process used we have singled out **15 LSRI** (Large Scale Research Infrastructures), which we consider of first priority covering most of the activities of all the players in Greece
- The group suggests that the Greek Government provide the means- financial and administrative - to the Greek scientific community to have access or participation to EU large scale infrastructures currently **CERN** and **ESA**- and extend it to **ESRF**-Synchrotron since a very large part of the Greek scientific community has expressed strongly their need to do first-rate experiments at ESRF (physicists, chemists, biologists, material scientists, medical doctors, environmentalists, etc
- It is also advised that the Greek Government should consider involvement in the ESFRI proposed infrastructures , **INFRAFRONTIER, XFEL, ELI, FAIR and PRINS** (see ESFRI roadmap)
- The group also feels that other **very important areas of the Greek S&T system** are not represented in the proposed list due to the missing information since **the performers did not respond to the GSRT call of 2005**. Areas such as **energy, environment,telecommunication and medical** to mention just a few are missing and it will be a good idea that GSRT in the first attempt **to update** the Roadmap **to include them**.

On behalf of the dedicated scientists

Dr. D. Niarchos, Demokritos 20/3/2007

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