



**Eastern Macedonia & Thrace
Institute of Technology**



Research Roadmap

2014 - 2018





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2014 - 2018





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President's Message



Dear reader, welcome to the Eastern Macedonia & Thrace Institute of Technology's Research Roadmap for the period 2014 – 2018. We initiated a strategic planning and roadmapping process in response to the challenging educational and research conditions in Greece that are a result of the economic crisis; we decided that some well-made plans could help turn these challenges into opportunities. This roadmap outlines our vision in research, highlights our existing strengths, and the methodology for overcoming what we think are our weaknesses. The institute is in a unique position here in Greece; with the help of the regional governor, we've been able to establish some of the finest research infrastructure in the country, but we need to ensure that this infrastructure is effectively exploited for the benefit of society in the region. Our long-term vision is to become a Centre of Excellence in education and research; this strive towards excellence will raise our standards, redefine us as a research-driven educational institute and allow us to take our destiny into our hands. The roadmap addresses the grand challenges in society identified by the region, our approach to working with them and will act as an important resource for our research leadership. It will also ensure that our current and future partners can gain an insight into where we're going as a united institute. Implementation of this roadmap will improve our reputation through higher standards; ensure application of research output to assist the community, enhance the expertise of existing staff, and lead to the recruitment of new personnel needed to fully exploit our research potential. Quality of education, pockets of excellence, collaborations with industry, our facilities, and capabilities to innovate through research, are the tools we will use in order to accomplish our mission.





Vision

The long-term vision is to have the institute recognised as an educational and research Centre of Excellence with the ability to:

- attract high-quality research students;
- attract and keep hold of experienced research personnel of the highest distinction and potential;
- undertake multi-disciplinary research activities;
- expand on existing regional, national and international collaborations;
- exploit the research output for the benefit of society;
- improve upon the established research services and facilities;
- provide leadership, follow best practices in research management, support and research-motivated education and training.





Mission

Our mission is to deliver world-class research, to educate and train young people to be leaders, innovators and entrepreneurs that can have influence in the region and further afield. We focus on specific fields for high impact research performed by well-experienced personnel using our resources. Our mission can be realised through:

- our determination to succeed and being reactive in positioning ourselves for success, and united in our push towards greater national and international recognition
- a supportive culture that welcomes and values the individual, and supports the fulfilment of their talents.
- an international perspective that places research in an international context, and searches out talent from around the world.
- an innovation mind-set that encourages creativity, innovation and entrepreneurship to solve problems in the region.





Excellence
in Research

Excellence in Research is at the core of our mission, and our vision for upgrading of the institute to a Centre of Excellence will ensure that it becomes an internationally engaged, research-intensive institute with the ability to make a major contribution to addressing societal challenges. We recognise that there's a lot of work to be done to make our vision achievable, but there are many benefits; the establishment of a Centre of Excellence will boost competitiveness and support the creation of jobs and new sources of growth through innovation. New knowledge, technologies and innovations can turn societal challenges into an opportunity for the region, and for Europe. For example, the digital economy can bring benefits through enhanced productivity, efficiency and innovation. New opportunities through innovation can lead to new growth sources by entry into new markets. For innovation, economic growth, and job creation, Greece needs access to the best researchers, the best research groups and the best research-facilities. Additionally, being an excellent performer in research can help raise the profile and awareness of the institute, providing potential for enhanced international collaboration so that we can get the brightest minds work together for greater impact on societal challenges.





Excellence
in Innovation

Research is one of the key drivers of innovation. However, investing in innovation is a big decision; although R&D successes are eagerly advertised, failures are scarcely reported. As a result, a large amount of useful information is lost. Although speed in moving ahead with new technical ideas is an attractive concept, by itself, it can invoke poor decision-making and result in ill-fated products. Entrepreneurs need to see things from the right angle. In the western world, rapid commercialisation has become inevitable for those wanting to be competitive. Entrepreneurs are forced to take risks and address the fears of the market in order to gain advantage. Policy makers can contribute to innovation by approving more funds, and we're fortunate to have the support of region in this matter, but we, as educators and researchers, have a key role to play, to ensure the creation of a new generation of entrepreneurs and encourage them to act by providing them with the necessary tools and results.





Background & **M**ethodology

The president of the institute set up a committee to work closely with heads of the departments and faculty members to establish this roadmap. The committee has taken their requirements and conducted a gap analysis in order to identify and foster the means by which the institute can meet emerging research opportunities, with the particular goal of increasing and maximising research income. At the same time, this committee will attempt to advise on the development of tools and processes to identify, document and enhance the impact of research conducted across the institute and more specifically for opportunities in the enterprise and innovation area. For this roadmap, each department developed a vision and set of activities according to their needs. This roadmap reports on their plans, details previous achievements and highlight challenges encountered. The roadmap can be considered a living, breathing document that includes short- and long-term goals, and will be adapted to the ever-changing situation. Now that this document has been completed, the committee's mission will be to:

1. ensure we will go from vision to reality
2. engage all the departments to work in the same direction
3. motivate faculty members
4. promote international research
5. ensure that talented students, researchers and academic staff are recruited

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- A. Ch. Mitropoulos, President
- Etienne Vansant, Head of Hephaestus Lab
- D. Bandekas, Director of the Electrical Engineering Dpt.
- N. Theriou, President of Special Account & Research
- A. Christoforidis, Director of Petroleum & Mechanical Engineering Dpt.

Hephaestus Lab members

- Dr. J. W. Nolan
- Ph.D. Candidate N. Vordos
- D. A. Gkika





Why do we want to do research?

There are primarily two answers to this question: number one is intellectual ambition — fundamentally, research is linked with human aspiration, the desire to develop ourselves through attainment of knowledge. The second is to solve problems in society. These two answers need balancing because solving problems, particularly those in society doesn't necessarily mean undertaking fundamental research but also requires engagement with markets and public opinion and turning our research into products.





This gap analysis aims to identify and correct gaps between the desired levels of what we think are the correct trends to achieve our vision, and the real situation. The difference between these two items is the so-called gap. The analysis contains specific action steps needed to close this gap. As indicated by the dates below, we expect to close these gaps during the next four years

Gap Analysis

Trends	Triggers	Potential gap	Action	Date
Strategic target	Current Situation	Track the gap Future Situation		
Understand the needs of and strengthen the collaboration with the SME's	There are contacts but these are not explored fully	Dedicated leadership pursuing links with SME	Commitments from SMEs and the institute	2015
Invest in areas of research strength	Lack of substantial research funding	Collaborative research, proposal scouting, search for other revenues	Foster key international partnerships, participate in the European Research Area, seek new sources of revenue	2018
Improve Scientific Journals	Few people involved	Motivation	Provide training, skills & competence to make the difference	2016
Increase faculty members who are research active	Lack of participation in good publications	To become an institute which is research active	Recognize research achievements, promote research activities	2018
Develop a research-driven education program for students	Evaluate current educational programs	Outline research opportunities, create a researcher mentality	Develop an advisory board	2015





Gap Analysis

Trends	Triggers	Potential gap	Action	Date
Roles and responsibilities of researchers	Absence of clear duties	Redefine administrative support in research	Planned program	2014
Availability of mentors to support and guide	Lack of managers/mentors	Attract talented people	Promotion, coordination, career days to raise awareness	2016
Ranking	Lack of dissemination	Change of general attitude, increase awareness	Promotion of the institute, interaction with other stakeholders, improve research output	2018
Fund raising	Government policies	Increase awareness	Seek out new paths towards revenue	2014-2018
Engage Experts	Establish a council	Inspire the external members	Foster key international partnerships	2016
Celebrate achievements	Absence of rewarding success	Develop Awards	Create a program that rewards excellence, achievements, collaborations, mentorships	2015
To increase the number of women involved	Hesitancy of women to prove their worth	Creation of AWIS	Recognition of their work	2014





Research Strengths

Research Infrastructure.

During the 2009-2012 period, the institute invested more than €10,000,000 to acquire new research infrastructure. This was done through the National Strategic Reference Framework with support of the region. The institute's new infrastructure includes the following:

- Proteome analysis
- Atomic Absorption
- Atomic Force Microscope
- Audio Magneto Telluric
- Contact Angle Analyzer
- Gas Chromatography Combustion Isotope Ratio Mass Spectrometry
- Gas Chromatography-Mass Spectrometry
- Ground Penetration Radar
- Langmuir Blodgett Film Deposition
- Mercury Porosimeter
- Nitrogen Porosimeter
- Scanning Electron Microscope with EDS
- Small/Wide Angle X-Ray Scattering Apparatus
- Transmission Electron Microscope
- Ultra Microtome
- X Ray Diffraction
- Data Collect
- Device simulations
- Electric e-mat analysis
- Magnetron Deposition
- Metal Deposition
- Non ion Rad
- Optical fiber splicer
- Optical Time Domain Reflectometers
- Optoelectronic Device Characterization Laboratory
- Portable thermographic system
- Remote Measurement System
- CNC DMG CTX 510 Eco
- CNC AGIECharmilles ACTSPARK FW-1P
- Electrical Energy Analyzer VIP SYSTEM 3/ MK3
- Exhaust Gas Analyzer testo 300M-1/ XL-1
- HUKSEFLUXTM THERMAL SENSORS
- Infrared Camera Flir E300
- INSTRON 8801 Testing Device [INSTRON]
- Instrument for measuring the thermal conductivity factor
- LASER Cutter Pantograph with extra PLASMA torch CNC EDA XL 1200
- OFFICE MILL OM-2A
- Optical and Contact Coordinate Measuring Machine TESA MICRO-HITE 3D
- PHOTRON FASTACAM SA3
- POLYTEC RSV-150 Remote Sensing Vibrometer [POLYTEC]
- Robotic Arm KAWASAKI RS030
- ROMER OMEGA R-SCAN & 3D RESHAPER





International Collaborations

As part of its strategy to improve standards at all levels, the institute has pursued international collaborations with some of the finest academics and universities from around the globe. Some of these academics have agreed to work with the institute on a daily basis by participating in the institute's Board of Regents. Prof. N. Katopodes from the University of Michigan is the President of the Council, Prof. Leonard C. Feldman (Rutgers University), Prof. Schuyler Korban (University of Illinois) and Prof. George J. Moridis (Lawrence Berkeley Laboratory) are members of the council. Other major collaborations include those with:

- Centre National de la Recherche Scientifique (CNRS), France
- University of Antwerp, Belgium
- University of Alicante, Spain
- Lomonosov Moscow State University, Russia
- Fraunhofer Institute of Technology, Germany
- Texas A&M, US
- CERN
- University of Oxford, UK
- National Centre for Scientific Research 'Demokritos', Greece

Working with such experienced and distinguished personnel has demonstrated the potential well of knowledge available and helped us raise our standards in management, education and research.



JOURNAL OF Engineering Science and Technology Review

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Kavala Institute of Technology

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The institute is dedicated to achieving the highest standards in research and the promotion of knowledge, and is actively involved in a variety of areas, including computer science, chemistry, chemical engineering, and material science. The institute publishes two English-language scientific journals in relevant fields:

- The Journal of Engineering Science and Technology Review, is edited by Prof. D. V. Bandekas and is indexed by SCOPUS, ACS, DOAJ and EBSCO.
- The International Journal of Economic Sciences and Applied Research(IJESAR) which is edited by Prof. A. Karasavoglou.

These journals contain:

- original scientific work (research articles)
- announcements (review articles)
- letters (letters to the editor)

Access to both journals is open access; it is free of charge to access the journals and their content online.



AWIS

ASSOCIATION FOR WOMEN IN SCIENCE

Kavala GR

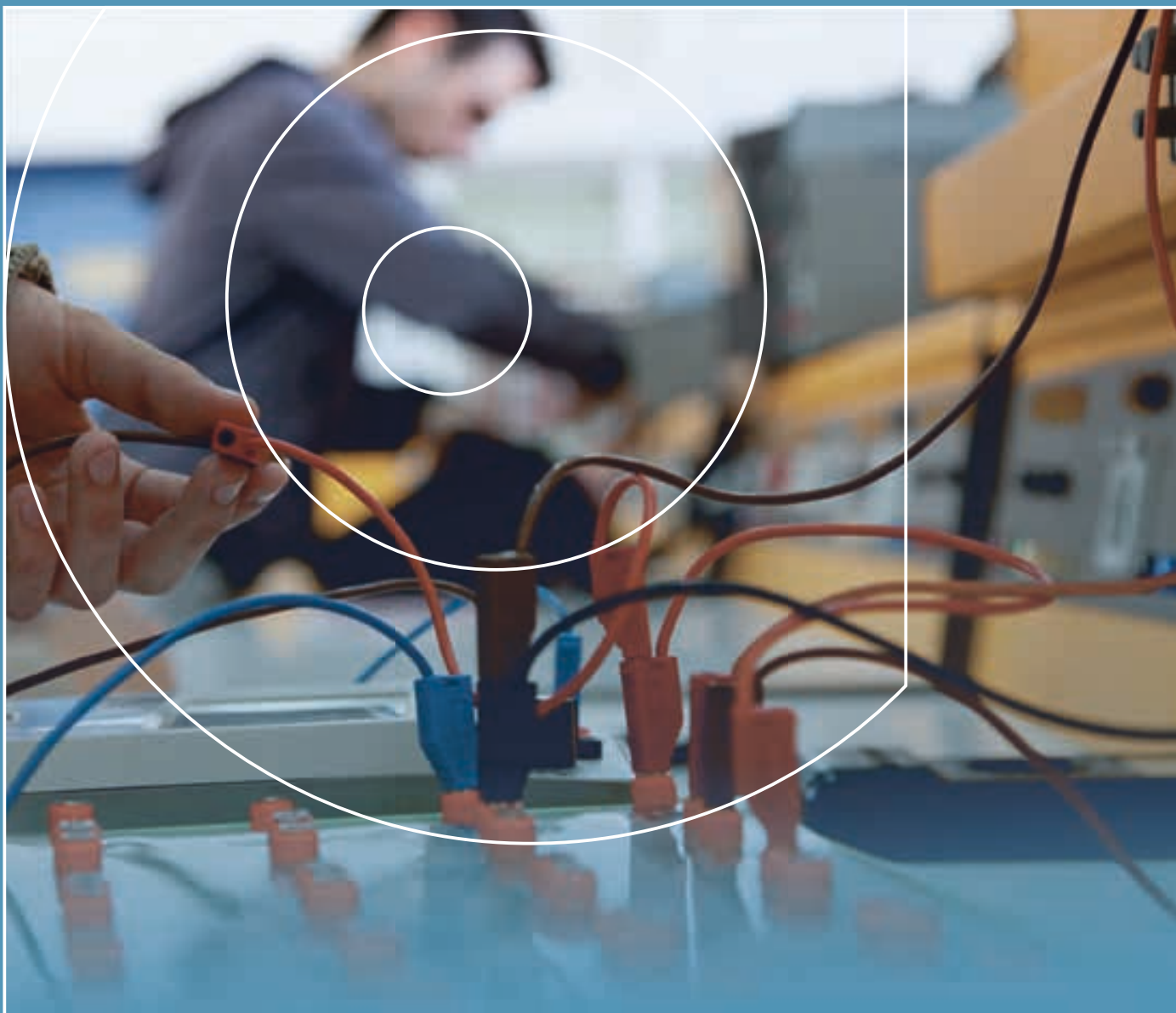


Kavala Section of Association of Women in Science

AWIS

In the past number of years women have become more active in science, however they are under-represented in the various core areas and don't always get the same opportunities as their male counterparts despite how much they have to offer. The institute has established a collaboration with the Association for Women in Science (AWIS) to rectify imbalances between women and men, and integrate a gender dimension in research and innovation programming. The Women in Action theme is leading to a better understanding of men's and women's needs, behaviors and attitudes that contribute to the scientific quality and societal relevance of produced knowledge, technologies and innovations. Such initiatives can also lead to the production of goods and services better suited to potential markets.





Collaborations in the Region

Over the years the institute has built close ties with regional companies, including SMEs. This level of collaboration varies from sending the institute's students to these companies for work experience, to closer ties for development of regional policies. At last count, the institute has collaborated with over 2,500 companies based in the region. Additionally, the institute has worked closely with regional authorities, to develop the region's smart specialization strategy and to gain an understanding of how it can appropriately address the needs of society. The regional governor has also greatly assisted the institute during the planning and provision phases of the institute's recent infrastructure upgrade.





Entrepreneurship Mindset

The key to success in business is the mindset that permits entrepreneurship to be viewed as a journey rather than a distinct outcome. People with fixed mindsets can view their skills as a fixed attribute, while people with a growth mindset see them as being flexible. These two mindsets react very differently to failure and success; a fixed mindset can attribute failure to a lack of innate ability, and become pessimistic about it, in the process, becoming much more risk averse and self-conscious. On the other hand, entrepreneurs with growth mindsets are better suited for the startup process, as they learn from their experiences and don't attribute failure to a fixed trait. This means they can analyze problems more deeply and bounce back more successfully. Research and technology organizations have a key role to play in encouraging entrepreneurs to act by providing them with the tools necessary to overtake the speed limitations and minimize the risk.





This means that students learn how to conduct research and how to apply it.

They are provided with the skills and attitude needed to work independently and think analytically - important skills for a future career. Research opportunities are available for interested undergraduate/graduate students, and postdoctoral fellows. Each student is offered maximum opportunity to learn and to acquire professional competence. All members of the faculty and staff are encouraged to achieve professional fulfilment. Two M.Sc. programmes in Oil and Gas Technology and Innovation Technology and Entrepreneurship train scientists and engineers in a variety of complex areas, with continuous education from 10 to 100 hours that include corresponding theories and practice.



Hephaestus Advanced Lab

Eastern Macedonia & Thrace
Institute of Technology

**Petroleum
Engineering**
Division

1



**Electrical
Engineering**
Division

2

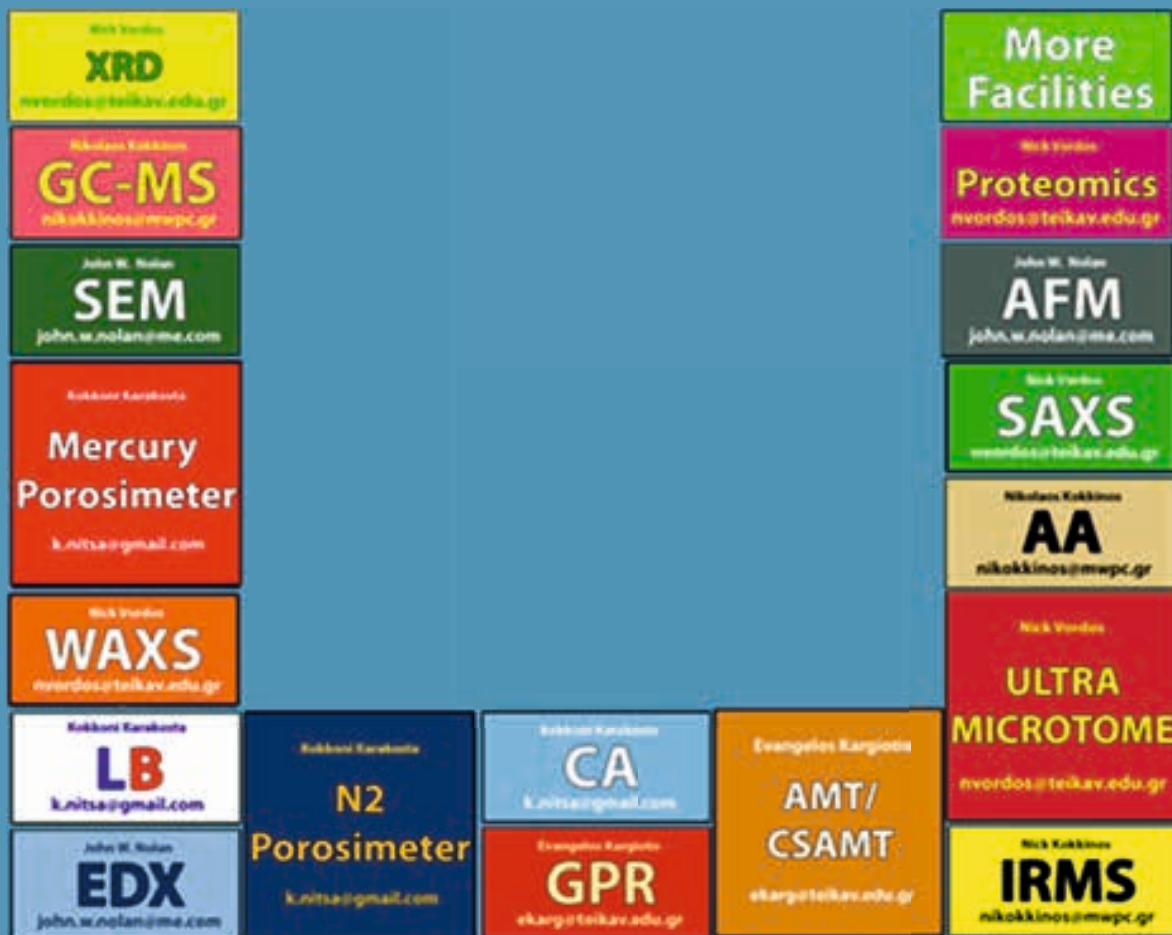
3
**Mechanical
Engineering**
Division

hephaestus.teikav.edu.gr

Hephaestus Lab was established in 2008 to house and utilise the institute's new advanced research infrastructure. It is a collaborative effort from both our researchers and our supporting partners, to provide advanced materials characterization, to generate new ideas, and provide cutting-edge services. The lab's philosophy for facility usage is an open-access lab-ware system where 24/7 access is provided to potential users. Research is focused in:

1. Material science that covers the area of porous materials (synthesis and characterization), nanotechnology, biotechnology, and oil & gas reservoir engineering;
2. Electrical engineering that specializes on remote electrical measurements;
3. Mechanical engineering that covers metrology, robotics, and renewable energy systems.





Material Science - Chemical and Petroleum Engineering

Petroleum Engineering Division

As highlighted in the image below, the value chain of the oil and gas industry consists of three areas: upstream (exploration and production), the midstream (transportation, storage and marketing) and downstream (refining and processing). Hephaestus Lab offers services in all three areas.



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Mass Spectrometry

The lab offers research services in the following areas:

Developing methods with analytical techniques:

Plasma emission spectroscopy with mass spectrometer (ICP-MS) Liquid chromatography with mass spectrometry (LC-MS-MS)

- Gas chromatography GC-TCD, GC-FID
- Gas chromatography with mass spectrometer (GC-MS)
- Gas chromatography with combustion with mass spectrometer using isotope ratios (GC / C / IRMS)

**Checking residues of organic compounds -
Determination of biomarkers -
fingerprinting**

- Organic Archaeometry: Chemical investigation of organic residues in archaeological findings - recognition of the raw material, the source and exact composition of the findings, study our cultural heritage.
- Analysis and characterization of organic pollutants in the environment - identification of pollution sources and environmental processes
- Analysis and characterization of aromatic plant extracts (essential oils)

Identifying metals - quantitative multi-element analysis, Isotope analysis (Oil / Lubricants, Environment, Geochemistry, Metals / Alloys, Food, Clinical and Biological Samples)



Biomechanics

Biomechanics is the science where principles and methods of engineering, physics, chemistry, mathematics, and technology in biology and medicine are applicable. Hephaestus laboratory conducts research in the scientific field of biomechanics. Indicatively some fields to which the biomechanics laboratory can contribute are:

- design and analysis of the movement, absorption,
- change in bone nanostructure by applying mechanical loading,
- bone strength,
- studying tissue structure,
- three-dimensional representation of movement or body - bone,
- simulation of complex biological systems using the computer system GRID,
- manufacturing mechanical parts for applications to living organisms,
- development and implementation of specific technologies for diagnosis and monitoring of diseases,
- detection of toxins in animals and qualitative and quantitative composition analysis of plants.

Hephaestus Lab is cooperating with the Department of Medicine of DUTH and it may provide services in specific matters to companies operating in the field of drugs. The benefits that can arise in the local community, and in the general population include an increase in average age, lower cost of drugs, the efficacy of drugs, improving the quality of life of patients, new jobs, new forms of culture for the region.



Hybrid Technologies

Society and by extension the economy, faces a lack of natural resources and many environmental challenges caused by our dependence on oil. The goal is to encourage the use of renewable energy and environmentally friendly systems. The use of hybrid technologies, i.e. the replacement of conventional physicochemical processes of pressure and temperature by open containers in membrane systems, helps make the production process done in much milder conditions. Hybrid technologies are simple to operate and do not require major changes in the production line. Hybrid technologies can also help reduce costs and increase quality of life. In this sense, hybrid technology is extremely advanced technology and may benefit from further investments. EMaTTech has full equipment for the study of environmentally friendly energy. The region has a number of small and medium size enterprises that are engaged in the installation of photovoltaic systems and wind turbines and who are working with us to incorporate smart specialization in their applications.



Konstantinos Karakoulidis DATA COLLECT karakoul@teikav.edu.gr	More Facilities Lykourgos Magafas TGA / DSC magafas@teikav.edu.gr
Konstantinos Potellias RES-LAB potellias@teikav.edu.gr	Lykourgos Magafas EMAT ANALYSIS magafas@teikav.edu.gr
Lykourgos Magafas MAG-DEP magafas@teikav.edu.gr	
Dimitrios Bandekas REM-MEAS dbandek@teikav.edu.gr	Dimitrios Bandekas SENSORS dbandek@teikav.edu.gr
Lykourgos Magafas METAL-DEP magafas@teikav.edu.gr	Lykourgos Magafas ION - RAD magafas@teikav.edu.gr
Konstantinos Karakoulidis THERMO LOGG karakoul@teikav.edu.gr	Lykourgos Magafas OTDR magafas@teikav.edu.gr
John W. Nolan TEM john.w.nolan@me.com	Lykourgos Magafas LASER magafas@teikav.edu.gr

Electrical Engineering Division

Measurement Sector

The Laboratory of Electrical and Non-Electrical Measurements is well equipped with scientific instruments for e-laboratory electronic measurements with remote management modeling and programming procedures, including control, measurement, and output of data via specialized sensors connected through the Internet.

Laboratory of Power Electronics & Power Systems

In recent years the Power Electronics & Drives Systems Laboratory has been active both via major participation in projects and purchasing appropriate scientific & laboratory equipment as follows:

Wind Turbine systems

- Quality optimization (Power Quality Improvement) and performance (Power efficiency) of the generated power of wind turbine systems.
- Optimizing the supervision operation (condition monitoring) to ensure timely fault diagnosis and cost saving.

Photovoltaic Systems

- Optimize quality (Power Quality Improvement) and performance (Power efficiency) of the generated power from PV systems.
- Optimizing condition monitoring to ensure timely fault diagnosis (faults diagnosis) and cost saving.
- Optimization of the disconnection process from the main electrical network in case of emergencies (errors), damaging the equipment.

Industrial Plant Systems

- Energy saving
- Optimization of the various automations for improved control and quality of the final product.
- Optimization of the condition monitoring systems of various electrical systems to ensure timely faults diagnosis and cost saving



Theologos Panagiotidis
**CNC
AGIE**
tpanag@teikav.edu.gr

Ilias Sarafis
**ROBOTIC
ARM**
isarafis@teikav.edu.gr

Ilias Sarafis
**CNC
DMG**
isarafis@teikav.edu.gr

Georgios Tsakatas
FASTACAM
gtsaka@teikav.edu.gr

Georgios Tsakatas
INSTRON
gtsaka@teikav.edu.gr

**More
Facilities**

Theologos Panagiotidis
**R
SCAN**
tpanag@teikav.edu.gr

Theologos Panagiotidis
**CNC
IDA**
tpanag@teikav.edu.gr

Th. Panagiotidis
**TESA
MICRO-HITE
3D**
tpanag@teikav.edu.gr

Ilias Sarafis
POLYTEC
isarafis@teikav.edu.gr

Mechanical Engineering

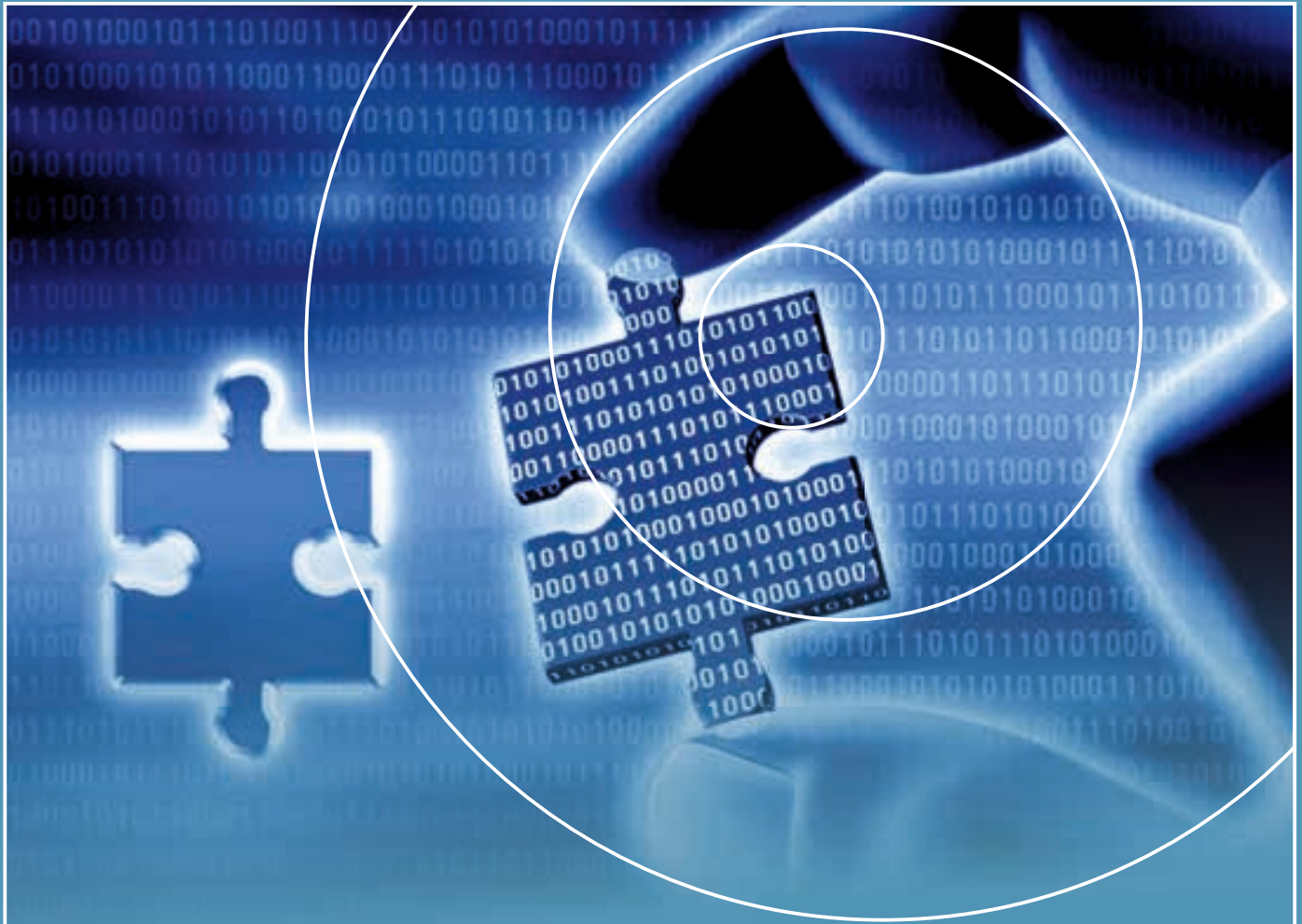
Mechanical Engineering Division

The socially productive and necessary range of scientific areas covered by the activities of a mechanical engineer to constantly evolving technology sectors (energy, environment, planning/construction products, systems development control, organization of production, etc.), are an essential purpose and motivation to carefully prepare graduates and researchers.

The Mechanical Engineering Division covers different research areas such as metrology, robotics and renewable energy systems. Its main research interests are the storage of energy (Energy Storage - Batteries), and rapid recovery of energy in a short time. The main applications of this method are in the fields of defence and industry with key advantage the cost and time in critical situations. One of the main research interests is the development of Nanostructured Photovoltaics in order to increase their efficiency. The commercial types of photovoltaics are basically made with silicon compounds, but the main drawback is their very low yield (10-13%). Research in this area is undertaken to increase efficiency through the use of nanocomposite materials during manufacturing. The increase in temperature of the environment and functions of PV has the effect of reducing their efficiency. According to studies, a temperature rise above 25°C/ 1°C causes a reduction in yield of about 0.1%. The use of cooling systems can therefore increase performance.

Other research interests of the engineering division are robotics for monitoring environmental Parameters, water desalination and development of fuel cells.





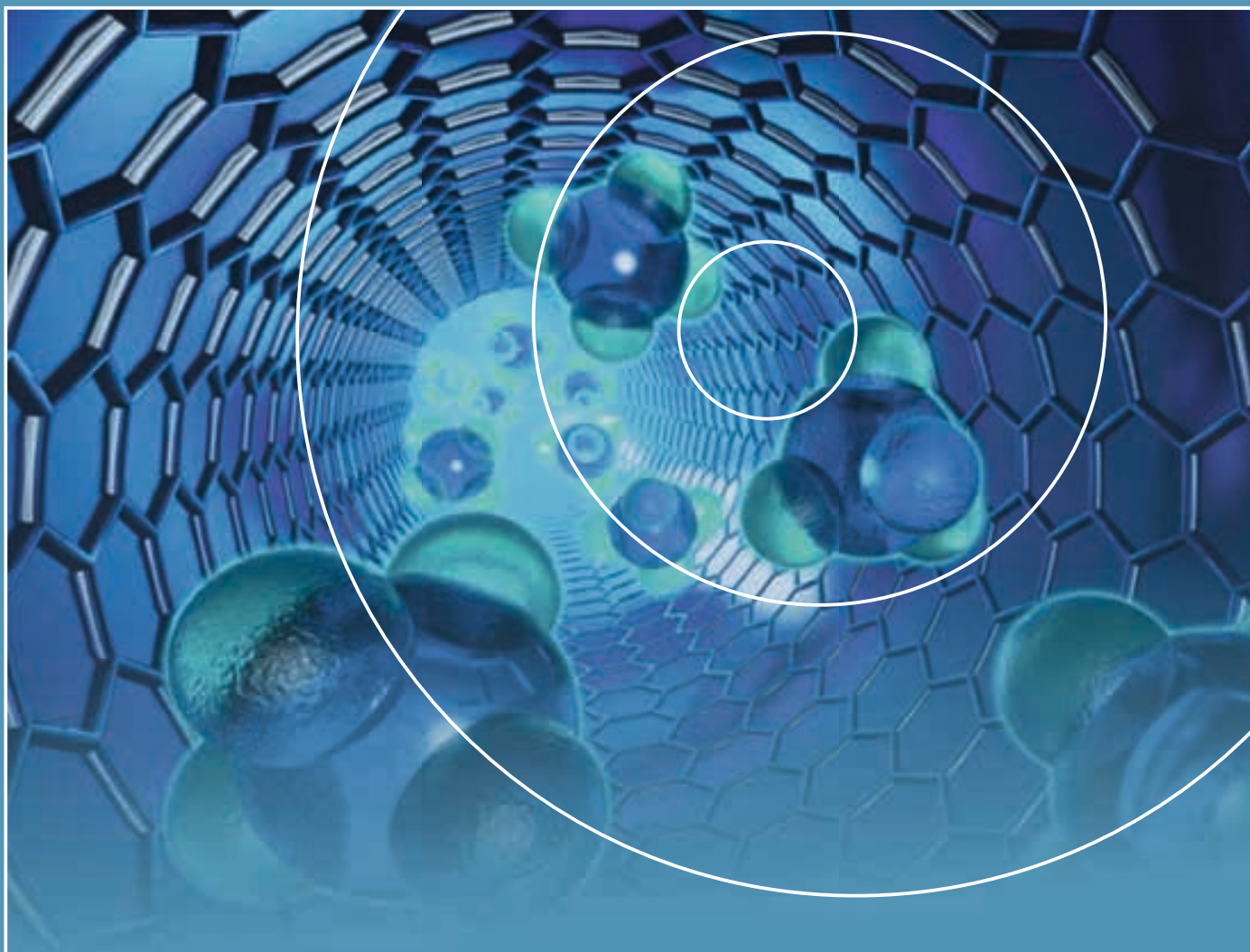
a future area of growth

Simulation
Division;

The Grid Ultra Computing Network is an architecture that promotes sharing applications/resources that gives the ability to related heterogeneous systems and applications to transparently share computing and storage resources. The aim of this architecture is to create a simple, virtual, unified system from a large number of different systems connected together over an advanced network. This virtual, unified system gives users and applications access to computing resources, devices and services. The resources shared by Grid architecture can be heterogeneous - to be implemented in different platforms, hardware architectures/software programming languages. It can be in geographically remote locations (within the limits of one or more regions) and belong to different management areas (administrative domains). Compared to the Web, that is a service for the distribution of information through the Internet, the Grid is a service for the distribution of computing power, storage space and other resources via the Internet. The institutes GRID system, to be developed over the coming year, will be linked with the European Grid Infrastructure through HellasGRID and will be applied as follows for the benefit of the region:

- Processing seismic data&Earthquake Planning and Protection
- Development and application of material models in nanotechnology
- Modelling of fluid flow in materials
- Computational chemistry
- Economic analysis and forecasting
- Weather forecasting and environmental studies
- Medical applications
 - Applications based on simulation
 - Image Analysis on demand
 - Tele-radiology and Epidemiology
 - Screening programs (Screening Programs)
 - The study of HIV AIDS (HIV).





Research Priorities

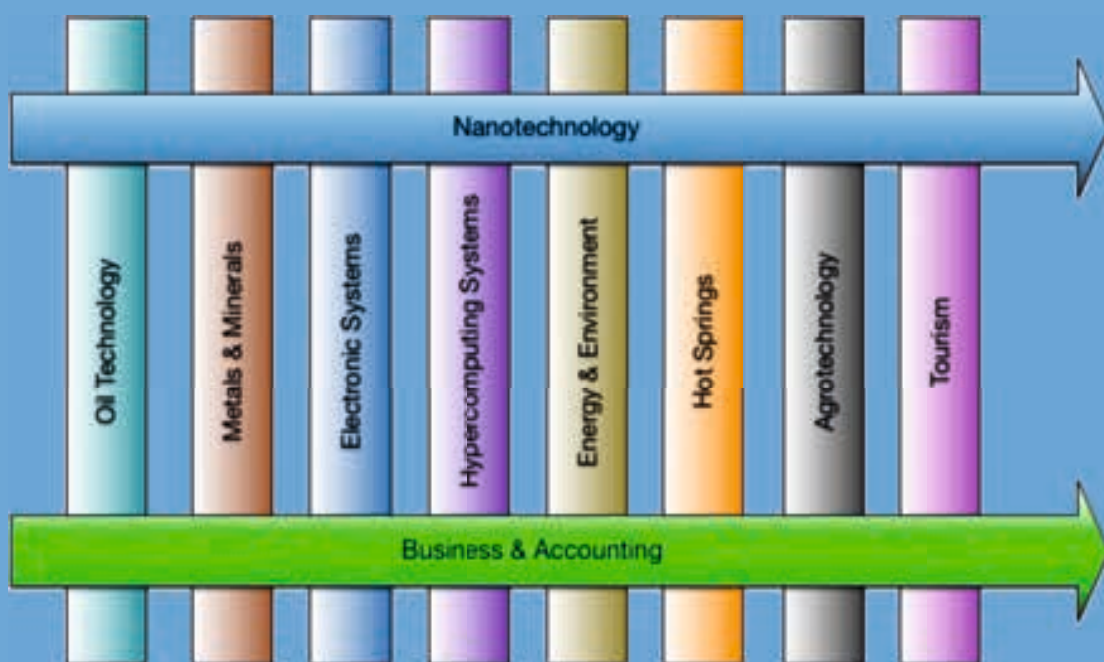
The faculty members established the following research themes based on the priorities of the Region of Eastern Macedonia & Thrace. There are 8 main themes, presented below vertically, with two important crosscutting themes, those of Nanotechnology and Business & Administration that can be applied to all vertical themes.

Nanotechnology is the understanding and control of matter at dimensions between 1 and 100 nanometers. Unusual physical, chemical, and biological properties can emerge in materials at the nanoscale. These properties may differ in important ways from the properties of bulk materials and single atoms or molecules. For example, a block of Gold is shiny and 'gold' in color, but a suspension of gold in solution can vary from pink to purple as the nanoscale gold particles get larger; this is due to quantum confinement inside the particles. Surface area, or the area of an object that is an exposed surface is also another important property, as greater surface area can allow chemical reactions to go faster. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter on this length scale. Because of its nature, Nanotechnology is widely acknowledged to be a multi-disciplinary area of research involving physics, chemistry and biology, to name just a few. The crosscutting nature of Nanotechnology in our research priorities will see that it is applied in each of the vertical themes.





The research priorities also place a strong emphasis on the development of applications-driven research and the transfer of technology from the laboratory to the work place or into society. Interaction with industry is therefore a key component of our strategy and one that can be exploited by further interaction of the institute with regional, national and international industries. The Business & Accounting department will play a key role in this activity, to determine and support the needs of industry, and also support the entrepreneurs in the institute.



“Themes



Theme I: Nanotechnology

During the different stages of the roadmap implementation, the development of nanoporous materials with tuned properties, continuous characterization and product evaluation efforts are essential. As previously mentioned, Nanotechnology is considered a crosscutting activity, which will be applied, where appropriate, to each vertical pillar, through development of materials, and utilization of ex-situ and in-situ characterization techniques to gain the necessary information about the synthesized materials and their properties. The ex-situ characterization techniques are important to obtain information about the chemical composition, structure, porosity, morphology, diffusion aspects, localization and nature of active sites, sorption selectivity/affinity, stability, catalytic activity etc. Techniques such as BET, SEM, TEM, XRD, SAXS, ICP-AES, HRTEM, TGA/DSC, TPD, NMR, UV/VIS, FTIR, FT-Raman, ESR etc., will be used. The targeted nanomaterials are:



- Microporous zeolite materials
(MFI, LTA, FAU, etc.)
- Mesoporous siliceous and non-siliceous materials (MCM, SBA, MSU, metal oxides, etc.)
- Combined micro/mesoporous siliceous and non-siliceous materials.
- Layered and pillared layered materials.
- Activated carbons, carbon molecular sieves and carbon nanotubes.
- Metal-Organic Frameworks
(MOF, ZIF, PMO)
- Silicagel, alumina and titania.

1. Adsorption applications

- a) Development of high-capacity CO₂ and CO selective adsorbents.
- b) Removal of VOC's, using adsorbents to concentrate the organics and then using a catalytic process to destroy them.
- c) New adsorbents for the storage of important gases such as natural gas and hydrogen with the aim of reducing the air pollution by combustion engines.
- d) New adsorbents for energy storage, ranging from batteries to super capacitors.
- e) Selective adsorbents designed for fast removal of some specific compounds.
- f) Removal of gaseous pollution compounds.
- g) Study of the domain theory on nanoporous materials.

2. Membrane applications

Intelligent membrane engineering can help to realize the process intensification strategy. Integrated membrane separations and new membrane operations, such as catalytic membrane reactors and membrane contactors, will play a crucial role in future technologies. However, so far no inorganic membrane is used in large-scale industrial gas separation. Membrane reactor technology has huge promise to deliver intensified processes that are more compact, less capital-intensive, giving higher conversions and selectivities in equilibrium and kinetically controlled reactions, respectively. Membrane reactors are expected to save energy and costs of feed/product separation. Innovative research areas for membranes:

- Carbon dioxide separation
- Hydrogen separation
- Dewatering of (bio)ethanol
- (Bio)ethanol removal from fermentation batches
- Catalytic membrane reactors
- Novel porous membranes (hybrid membranes)





3. Catalytic applications

Catalysis is an indispensable tool, when chemical substances are to be converted into valuable or environmentally more benign products. Catalysis enables one to make chemical processes more selective for the desired products, more energy-efficient and/or environmentally friendlier.

Innovative research items are:

- Stabilization of small metal clusters as guests inside nanoporous solids as hosts (gold nanoclusters for oxidation of carbon monoxide, production of propylene oxide by direct epoxidation of propene with in-situ generated hydrogen peroxide)
- Oxyfunctionalisation of alkanes with oxygen or air
- Catalytic combustion of VOC's in air
- Isomerization of heptane isomers
- Dehydrogenation of light alkanes
- Direct alkylation of aromatics with alkanes
- Process intensification
- Photocatalytic reaction



Theme 2: Oil Industry

The oil exploration carried out in the Gulf of Kavala is a complex process and requires the contribution of many specializations. With the institute's support, the Kavala Oil enterprise can benefit from R&D in the field of interest through specialized and extended services. EMaTTech has all the equipment required for routine and special core analysis and for geophysical data processing and data production via supercomputers. To this end, we will pursue an extension of the existing Memorandum of Understanding with the company. Note also that this support will strengthen the position of the company not only locally but also on a national and international level. In the same context, EMaTTech provides a Graduate Program in Technology of Petroleum and Natural Gas with the participation of international advisors and distinguished professors who are liable to add to the research strengths. The institute offers services in all three areas of the Oil & Gas value stream:

Contribution in Upstream area (Exploration and Production)

- Routine and special core analysis (standard / special core analysis)
- Design and simulation of reservoirs.
- Design and simulation of drill strings.
- Design and optimization of production.
- Checking oil fingerprinting (Petroleum Forensic Fingerprinting).
- Creating nanobubbles and enforce them in oil extraction in order to increase the usability of the reserves.





Contribution in Midstream area (transportation, storage and marketing)

- Study of phases during fluid flow in distribution networks.
- Calculation of pressure drop (PD) during the transportation of fluids.
- Design and optimization of energy management, taking into account the supply, demand and profit at local and national level.

Contribution in Downstream area (refining and processing)

- Implementation of Green Chemistry (Green Chemistry) in industrial catalytic processes.
- Upgrade the properties of finished fuels with environmentally friendly processes.
- Design, modeling, simulation and optimization of industrial chemical processes.

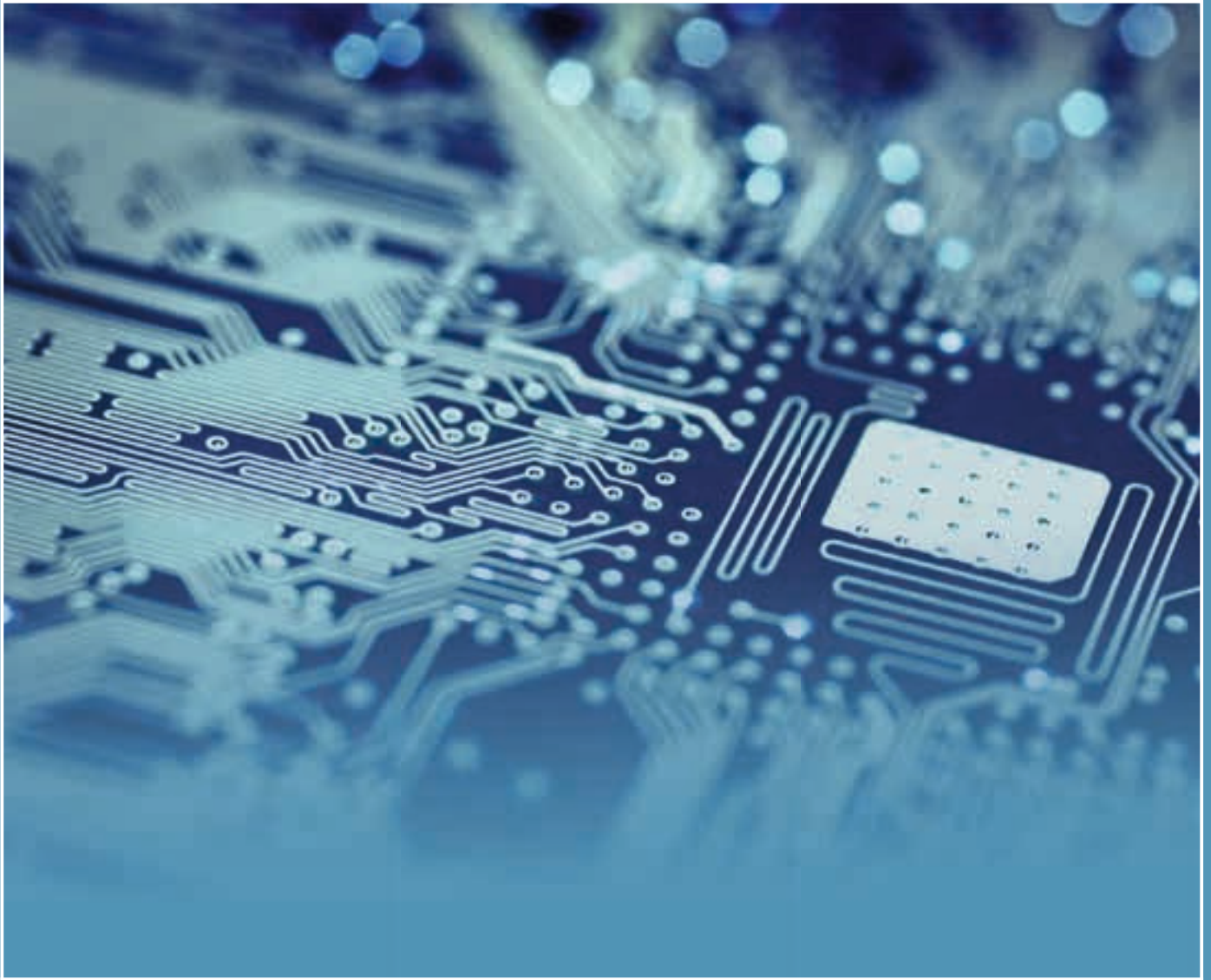




Theme 3: Metals & Rocks

The region has an abundance of mineral wealth in metals (e.g. manganese, Germanium, Antimony, Cobalt, Gallium, etc.) but also aggregates and ornamental stones such as marbles and granites. The marble industry is highly developed in Kavala and Drama and its capacity can be increased if supported by an R&D department as well as regular and special services in various fields of interest. The application of nanotechnology could improve product quality and lifetime, for example by changing surface properties, it can assist in the fight against surface corrosion and cracking, prevent the growth of algae, mold and microorganisms and seal the pores that absorb stains. The institute's highly advanced infrastructure can also be used for determination and certification of the region's marble, in terms of quality.





Theme 4: Electronic Systems

The institute has long-standing cooperation with PRISMA SA and other similar and/or smaller regional companies with possibilities to extend these partnerships. The laboratories in the Department of Electrical Engineering feature ultra high technology sensors for in-time monitoring; we believe the institute can offer important R&D services to industry. In the same context, the institute is liable to extend the service and biomechanical issues in collaboration with the Medical School of the University of Thrace. Furthermore, the continuous monitoring of surface and groundwater for heavy metals namely cadmium in river Nestos and chromium -6 in rivers Strymona, Evros and Axios is part of the proposed action. Additional control of water for irrigation and industrial purposes as well as monitoring of the marine area around the oil platform in the Gulf of Kavala, in collaboration with INALE is also proposed. Expected actions include:

- Smart sensor system for agriculture
- Fault detection and prognosis in industry
- Power system Modelling
- AI Control Systems
- Microelectronics
- Non-destructive control

Standard Measurement Center

The Department of Electrical Engineering has the infrastructure and experience to support the creation of a certified measurement center where individuals, companies and organizations can take measurements. There is significant demand in the region for such a center; currently interested organizations have to go to third parties, which makes it even more important to go forward with this initiative. In addition, such services can be provided to neighboring regions in Bulgaria and Turkey.





Theme 5: Hypercomputing Systems

EMaTTech is developing supercomputing technology (CERN-tier2), which will make it the largest computing center in Greece. The utilization level of R&D and extended services of this system is important for the development of the region. The institutes GRID system will be linked with the European Grid Infrastructure (EGI) through HellasGRID and is expected to be applied as follows:

- Processing seismic data
- Development and application of material models in nanotechnology
- Modelling of fluid flow in materials
- Earthquake Planning and Protection
- Computational chemistry
- Economic analysis and forecasting
- Weather forecasting and environmental studies
- Medical applications
 - Applications based on simulation
 - Image Analysis on demand
 - Tele-radiology and Epidemiology
 - Screening programs (Screening Programs)
 - The study of HIV AIDS (HIV).





Theme 6: Energy & Environment

Research in this theme provides particular emphasis on climate change and energy-demand reduction. EMaTTech has full equipment for the study of environmentally friendly energy, as well as a weather station. Business in the region involved in the installation of photovoltaic systems and wind turbines are also interested in R&D activities to incorporate smart specialization in their applications. Proposed activities include:

1. Development of intelligent user interfaces for designing and evaluating investments related to green infrastructure and assessment of interventions to optimize and protect natural areas and their biodiversity. The applications can be used by investors, young entrepreneurs and public Services & Organizations of monitoring & control. For their development, databases and design tools will be used and enriched to assess the qualification / impact of natural resources associated with the physical locations of the region. Some have already been developed by scientists of the laboratory as shown in the above table.
2. Intelligent decision support system for protection, restoration and sustainable use of NATURA 2000 protected areas. These applications can help regional Services to assess, monitor and evaluate proposed interventions in NATURA 2000 protected areas.
3. Intelligent decision support system for risk assessment of potential threats to NATURA 2000 protected areas.
4. Development of intelligent user interface for the evaluation of initiatives to showcase and promote the tourism potential of the natural areas of the region. These applications can be used by private investors, and public institutions both for optimizing the siting their suitability and to assess their impact (environmental, socio- economic and institutional consequences) in the context of sustainable development of tourism in natural areas of the region.
5. Network electronic information / education services for promotion of tourism especially in non - urban areas (including protected areas). These applications can be used by executives stakeholders, groups and individuals who are interested in tourism services.
6. Network electronic media stakeholders involved in shaping policy and actions in the protected areas.





Theme 7: Hot Springs

The region has some of the most popular spas in the country (e.g. Baths of Eleftheres, Lydia mud baths) and natural water sources in Drama. In Europe, companies utilize cosmetic spas for the secondary production of innovative products. However, the secondary use of Spa & Beauty products remedies requires R&D because there are some problems to overcome; for example, the mud slurry loses its natural healing properties when dislodged from its natural environment. The diffusion of therapeutic substances to and from its environment is continuous rather than discrete, so the therapeutic effect is lost quickly if the mud is bottled. The R&D and subsequent exploitation of these resources from the region will take part under the framework of a spin-off company being formulated by the institute with external partners.





Theme 8: Agrotechnology

Crop production is facing more and more difficulties in remaining competitive in the global market for reasons such as the loss of soil fertility and the consequent massive use of expensive nutrients, most notably Nitrogen and Phosphorous. More sustainable crop management strategies are needed to maintain or increase soil fertility. Additionally, inappropriate soil and water management and the overuse of external inputs in intensive crop production systems represent an economic loss for the farmer and a significant burden for the environment and have a subsequent impact on human health. Ensuring availability and access to sufficient safe and nutritious food is a key priority. The production and processing of food is a key economic activity, providing jobs, skills and training, attracting investments and supporting regional economies. Given the economic scale of the food sector, the potential gains from research and innovation, and restructuring the sector through a strong participation of SMEs, are significant.

Agrotechnology is a primary but low-tech activity in the region; agricultural production in recent

decades has been directed toward those crops that provide the highest EU subsidies and aid. Agriculture in the region is applied to an area of 572 thousand hectares. The forests in the region (77.86 % of its area) form the largest and richest forest ecosystem, with annual production of industrial timber estimated at 12-15 % of the national total. The contribution of forests to the national economy and society Drama is therefore important because of the employment of loggers and labourers on local crafts and industries. The region's priorities include the development of this industry through restructuring crops, improving the quality of produced agricultural products and promote the development of organic agriculture, in particular in the mountainous areas, along with plant growing through contract farming (e.g. herbs).

The institute can play an important role by assisting the region through its extensive service in these areas, and the institute's new infrastructure such as DNA analysis of seeds, proteomic analysis and organic chemistry laboratories, handled together with the department of Enology can contribute to agro technology services primarily in the field of food and beverages. The institute's Hephaestus Laboratory can also play an important role during the upcoming years by working with local industry to develop new products for application in the agrotechnology area, such as:



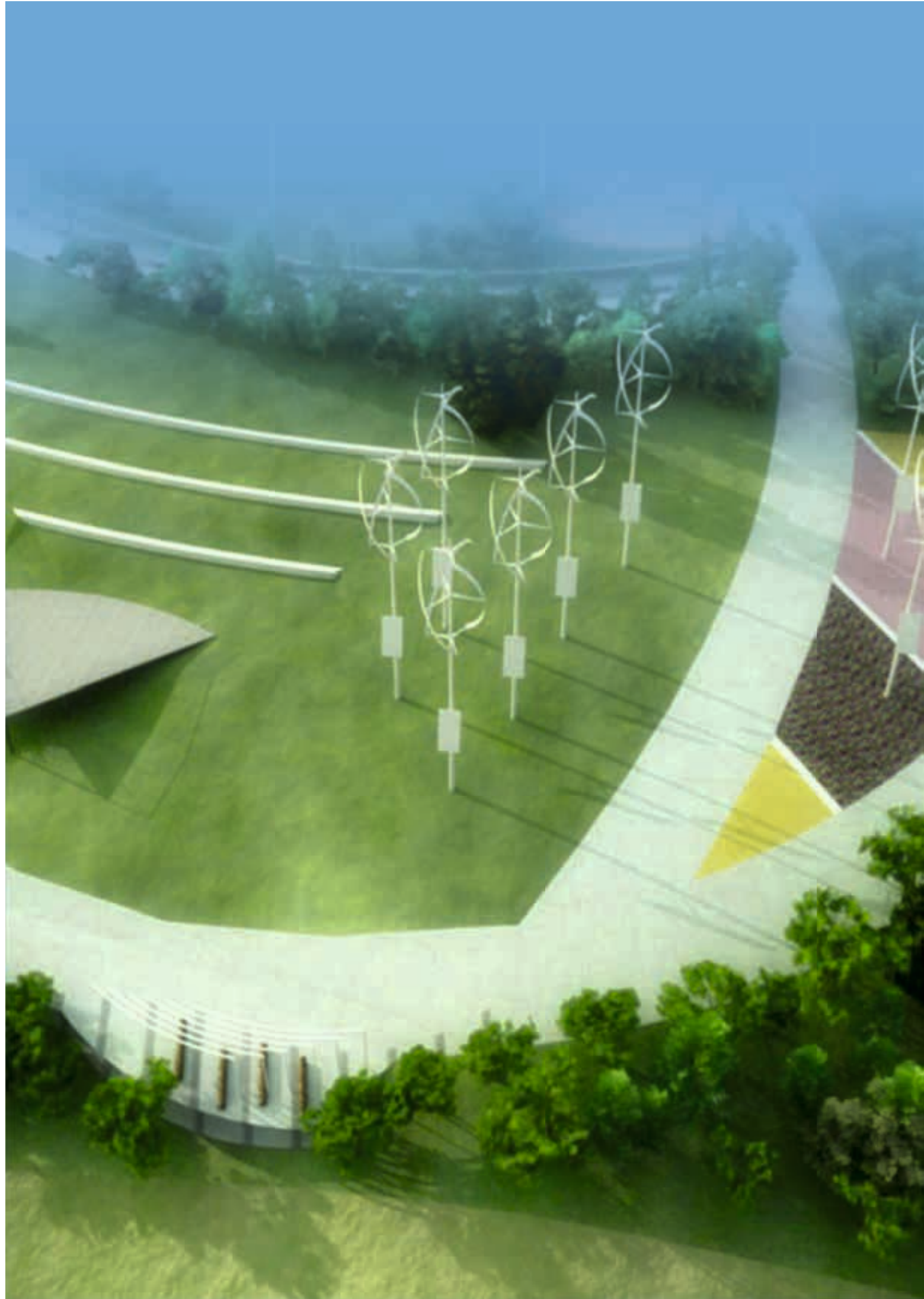


- Devices that could enable accurate tracking and recording of the environmental conditions and shipment history of a particular product.
- Smart systems capable of providing integrated sensing, localization, reporting and remote control of food products to increase the efficacy and security of food processing and transportation.
- Nano-sensors (inc. smart packaging) for the detection of pathogens and contaminants to secure manufacturing, processing, and shipment of food products. Potential sensors could indicate
 - o Temperature
 - o Freshness
 - o Ripeness

- Biosensor for winemakers: a device that is able to perform analysis of all the important components in wine.
- Nanofertilisers: Given the high surface area relative to the amount of nanomaterials, fertilizers based on nanotechnology could surpass conventional fertilizers. Unfortunately, lack of funding and progress on regulation and safety has held back advances in this area. Nutrients could be encapsulated in nanomaterials coated with thin protective films or delivered as emulsions or nanoparticles. Nanomaterials could be used to control the release of the fertilizer, ensuring that the plant only absorbs the nutrients; the nutrients are not lost to unplanned targets like soil, water, or microorganisms.

In addition, the Agricultural Technology department will be active in the following:

- Multi Criteria Decision Analysis in Forestry Management
- Water Management
- Risk Management in Natural Habitats
- Preventing, Monitoring and Confronting Debris Flow phenomena
- Landscape architecture
- Services for monitoring and protecting natural environments
- Use of IT for the promotion of Environmental Tourism





Theme 9: Tourism

Tourism is a very important business in Greece. Moreover, it is a first class application field of advanced information technologies and telecommunications. A number of key electronic services related to booking tickets, hotels, travel is already provided via the internet. These services (some of which are quite successful) are limited to seeking information and making reservations via one mainly tourism services company. In its most sophisticated form, provided electronic services are portals for tourism services. In some cases, search services are provided and the appropriate company provides the services (e.g. accommodation, car rental, etc.) through a number of search criteria. The potential of electronic services may be multiplied by fully utilizing the potential of smart devices, and using the institute's soon to be developed GRID infrastructure, given that the GRID provides increased data integration capabilities and services through:

- Integration Capabilities and search in heterogeneous databases, regardless of manufacturer, and data format (e.g. XML, RDBMS, OODBMS, files). These capabilities allow this fairly complex search processes in a broader data set, thus greatly facilitating the integration of data from different sources / providers.

- Utilization of available services (e.g., search, booking) following the standards of model Web Services. Such integration allows for multiple complex queries and bookings from a tourist application. Using these possibilities a Grid infrastructure can support innovative applications that provide highly personalized services. As a typical example we can consider applications that allow the automated synthesis of a tourist package consisting of a plurality of services (e.g. accommodation, travel, value added services, etc.) on the basis of a set of Grid/Web Services provided by different companies and completed within a grid infrastructure. The grid infrastructure can provide the cooperation of different organizations, companies, and service providers to cooperate in order to increase sales and profits. In such a case, the end user is facing a multitude of heterogeneous hand, no additional services, virtualized as a single provider of tourism services.





A person in a suit is writing the word "Accounting" in large white letters on a chalkboard. The word is the central focus. Surrounding it are various accounting terms written in a smaller, handwritten style: "Income", "Cash", "Expense", "Budget", "Revenue", "Credit", "Debit", "Assets", "Payable", "Ledger", and "Cost". The person's hand is visible, holding a piece of chalk and pointing at the word "Accounting".

Income Cash Expense
Budget Revenue Credit
Accounting
Debit Assets Payable
Ledger Cost

Theme 10: Business & Accounting Sector

Creating and economic research and business consulting center that will be engaged in support of exploiting research outcomes and the provision of consultancy services to business and agencies covering the following objectives:

- Technology transfer and cooperation with enterprises, especially SMEs.
- Advanced support services for enterprises; organization and administration (management), marketing, and design of new products, etc.
- Development of SME activities, support entrepreneurship and new business development (including support innovative new business spin offs and spin outs).
- Developing and promoting commercial services to tourism
- Promote product orientated research in the institute
- Development of a Technological Incubation system to support entrepreneurs; infrastructure support, entrepreneurial training and IPR facilitation





Key strategies

Key strategies

The strategies will take into account existing barriers and resources (people, money, power, materials, etc.).

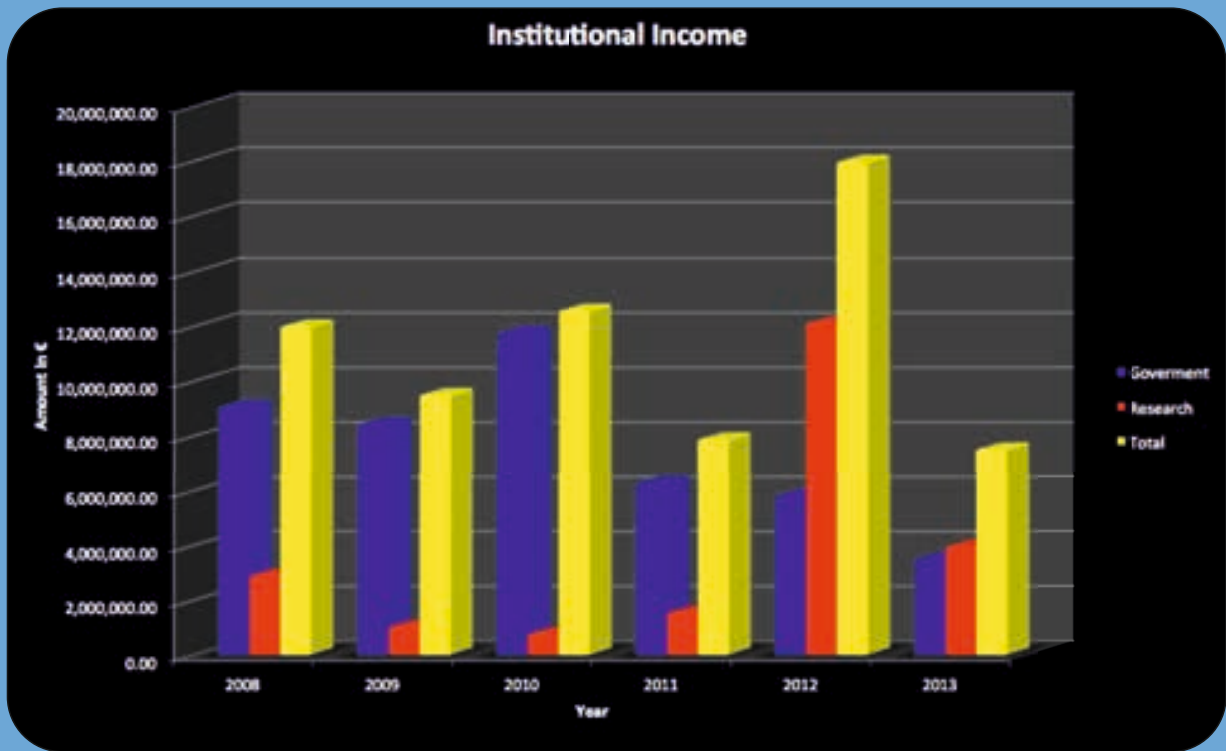
They will also stay with the overall vision, mission, and objectives of the initiative.

- Utilization of human resources
- Expand research
- Increase and maximize resources
- Attract talented people
- Gain the knowledge to reach excellence
- Student participation
- Offered opportunities
- Provide training, skills competence to make the difference
- Planned program
- Independency of the researchers
- Funding

Funding

The institute's financial strategy is based on a number of incomes, the most basic coming from the Greek state for day-to-day operation of the institute (electricity, heating, wages of Adjunct Professors and purchase of consumables). As shown below, this budget for running the institute has been cut due to government spending cutbacks. Such challenges can lead to new motivations to reforming operating principals, streamline and focusing research programming, and search for new sources of income. The institute has reacted sufficiently to overcome these cuts by bringing in funding to support research.





Financial income from the state, and research projects.

Making money is important as a means to support education and research activities. The main objectives of the institute's financial strategy is to close the gap between the funding needed to satisfy requirements and the available financial resources available to us. Improvements to the current strategy are necessary to create a cash-surplus, for maintaining, and enhancing infrastructure and hiring the personnel required to ensure our vision comes to fruition. An enhanced financial strategy will be realised by:

- Building on our strengths
- Recognising threats
- Expansion of non-core activities
- Gaining a greater income from core-activities, such as M.Sc. courses
- More efficient use of resources
- Improve cash flow through more diverse income streams

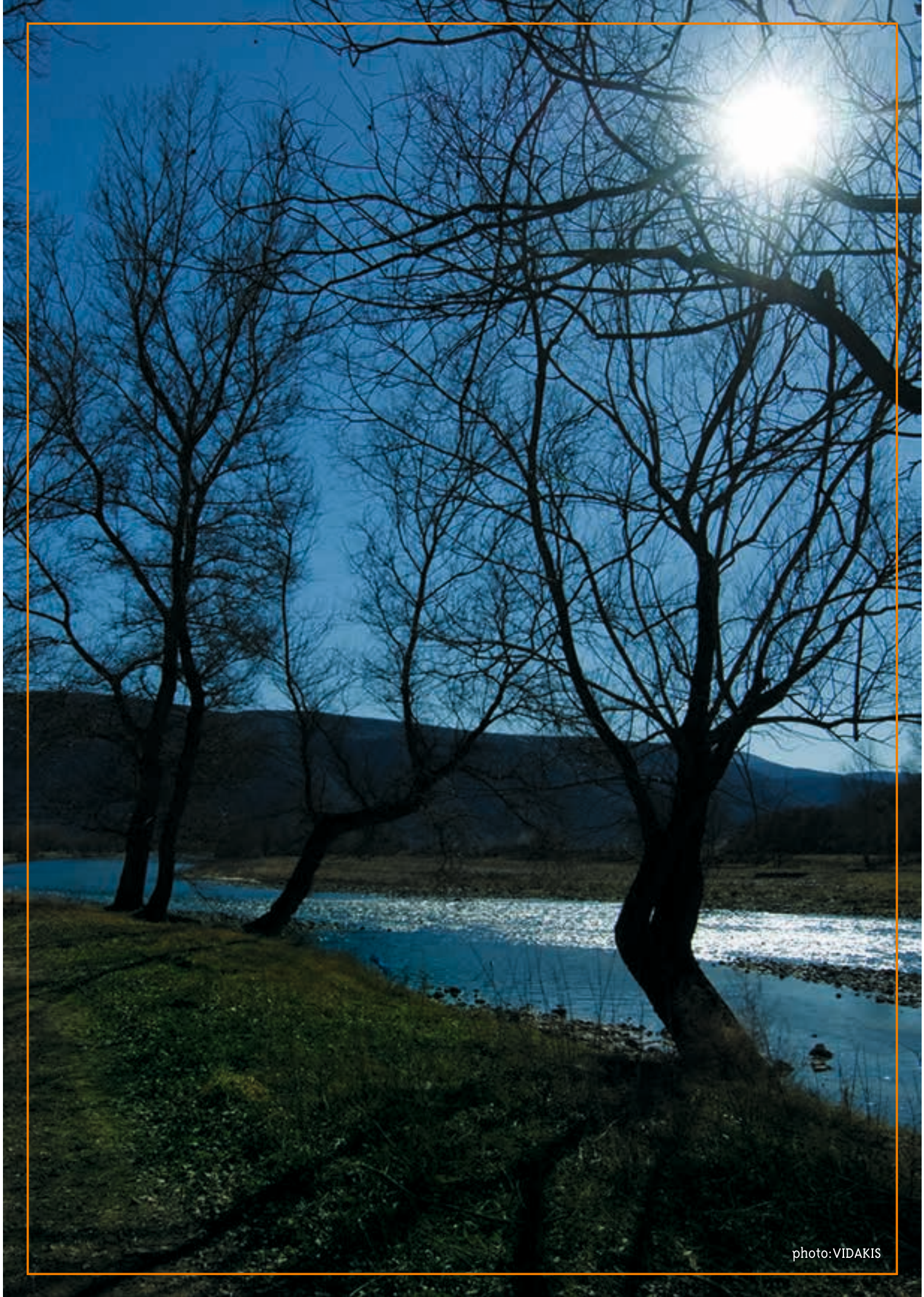


photo:VIDAKIS

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Texts Edited By:

Despina. A. Gkika
Nikos Ch. Vordos
John W. Nolan

Texts Corrected By:

John W. Nolan
Nikos Ch. Vordos
Despina. A. Gkika

Research Roadmap Designed By:

Thomi D. Aggelou
www.thomiaggelou.gr





Eastern Macedonia & Thrace Institute of Technology

