

**FORTH & STEP-C : CATALYSTS OF INNOVATION IN THE PERIPHERY OF
EUROPE**

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ABSTRACT

This paper aims to describe the role that the Foundation for Research & Technology Hellas (FORTH), the largest research organisation in Greece and the Science & Technology Park of Crete (STEP-C) play in the commercialisation and exploitation of the research results, in order to promote the development of the island and to stimulate the local economy.

Established in 1983, the Foundation for Research and Technology Hellas (FORTH) is the largest Research Organisation in the country. It employs about 1000 scientists, research technicians and graduate students and operates two Science and Technology Parks. It is recognised world-wide for its top quality research in the areas of Molecular Biology and Biotechnology, Laser Technology and applications, Materials Science, Informatics and Telematics applications, Applied Mathematics, Chemical Engineering and Biomedical Technology. FORTH promotes the development of new technologies, the diffusion of technological know-how, the creation of new products and services in a continuous effort to respond to the demand of the Greek society for modernisation and innovation, features, which allow the country to actively participate in the international economic competition.

One of the FORTH's strategic objectives is to develop its links with the society and also to serve as a catalyst for the improvement of competitiveness of local and national economy through development of new technologies and attraction of investments.

STEP-C was established in 1993 FORTH. The idea was to promote the creation of a third thrust of development on the island, in addition to the agriculture and tourism by encouraging new innovative companies to join the Park and become major vehicles of the technology transfer process.

STEP-C gears itself to become an ever increasing attraction as an Incubator, nurturing spin-offs and small innovative companies in the areas of Medical Equipment, Biotechnology, Telecommunications and Telematics, Microelectronics and Laser applications, Polymers and Applied Mathematics, which are key strength areas of FORTH and the University of Crete. The Park is currently accommodates 30 technological and service companies.

1. INTRODUCTION

The **Foundation for Research and Technology Hellas (FORTH)** (www.forth.gr), is one of the three main National Research Centres in Greece and the only one based in the periphery of the country. It consists of 7 Institutes located in the cities of Heraklion, Rethymnon (Crete), Patras (Peloponnese) and Ioannina (Epirus). FORTH was created and grown gradually during the 80's.

The Research Centre of Crete (RCC) was founded in Heraklion in 1983. At this time it comprised the **Institute of Molecular Biology Biotechnology (IMBB)**, the **Institute of Electronic Structure and Laser (IESL)** and the **Institute of Computer Science (ICS)**. The goals of the RCC were to create an important research infrastructure in crucial technology sectors, to support the development and the operation of the newly founded **University of Crete (UoC)** (www.uoc.gr), and to contribute toward Crete and Greece's economic and technological development. In 1984 two new Institutes were independently established: The **Institute of Chemical Engineering and High Temperature Processes (ICE-HT)** in Patras, and the **Chemical Process Engineering Research Institute (CPERI)** in Thessaloniki. In 1985, the RCC expanded to include two more Institutes, the **Institute of Applied and Computational Mathematics (IACM)** located in Heraklion and the **Institute for Mediterranean Studies (IMS)** located in Rethymnon. During the same year, RCC, with the support of Pancretan American Association set up in Heraklion the operation of **Crete University Press (CUP)**. In 1987, RCC, ICE-HT and CPERI were joined together to form FORTH, as a National Research Centre, supervised and partially funded by the General Secretariat for Research & Technology (GSRT) of the Greek Ministry for Development. However, it functions as a legal entity of the private sector. In 1988, the Marine Biology Department of IMBB was detached from FORTH to become an independent institute, the **Institute of Marine Biology of Crete (IMBC)**, (www.imbc.gr) which is one of the most successful research institutes in the country and leads the research in the area of Marine Biology and Biotechnology. During the 90's, FORTH established 3 Science & Technology Parks. The Science & Technology Park of Crete (STEP-C) (www.stepc.gr) in Heraklion, the Thessaloniki Technology Park (TTP), (www.techpath.gr) in Thessaloniki and the Patras Science Park (PSP), (www.psp.org.gr) in Patras. In the year 2000, CPERI and TTP were detached from FORTH to establish the National Centre for Research and Technological Development (EKETA) in Thessaloniki. In the next year, the **Biomedical Research Institute (IBR)** an independent Institute associated with the University of Ioannina (Epirus) joined FORTH, to become its 7th Institute.

2. FORTH AT A GLANCE

FORTH recognising the importance of science, technology and innovation in today's world, is actively pursuing:

- High quality basic research
- Development of innovative technology
- Collaboration with industrial partners within and outside Greece
- Creation of spin-off companies
- Development of Science & Technology Parks
- Educational activities in collaboration with Universities
- Publications of textbooks and monographs
- Specialised on the job training programmes.

Furthermore to those activities, FORTH acts as a consultant to the regional authorities, organises cultural exhibitions, produces music albums which document Greece's rich folk tradition and contributes to the local economy with more than 30 M €a year.

FORTH and STEP-C activities created more than 2000 high quality permanent jobs.

Achievement	Year
Gene transfer to med-fly for the first time	1995
Laser writing	1996
Photonic crystals	1997
The shortest laser pulses in the world	1999
Participation in the sequence of <i>Drosophila melanogaster</i>	2000

Table 1 : MAJOR SCIENTIFIC ACHIEVEMENTS OF FORTH

3. THE ROLE OF FORTH IN REGIONAL DEVELOPMENT

3.1.FORTH'S Research and Educational activities

FORTH is not just following scientific developments, but it is actively trying to stay at the forefront of current research and technology. Among FORTH's significant research achievements are the following:

Researchers at the IMBB were the first in the world to succeed in the transfer of genes to an insect that plays an important role in agriculture by opening a new practical prospect for the protection of agricultural production without harming the environment.

Researchers at the IMBB were the first to elucidate the insect chitin synthase and bacterial protein secretion molecular mechanisms, targets for the development of safe insecticides and potent antibiotics.

IMBB has participated in the completion of major international genomic projects such as that of *Yeast*, *Drosophila*, *Human* and recently that of *Anopheles* mosquito.

DNA/RNA restriction and modification enzymes are produced by IMBB and sold under the name MINOTECH to European and American companies. The largest share of the Greek market products of synthetic DNA products (oligonucleotides) is maintained by the Microchemistry Lab of IMBB.

In IESL, novel techniques have been developed for the micro structuring of materials by laser etching or deposition. Three-dimensional nanostructures with interesting application prospects in sensors, high-density information storage, photonic band gap materials etc have been obtained.

Laser based techniques have been developed at IESL for cleaning, analytical imaging and structural diagnostic applications in art conservation.

ICS activities in the area of telecommunications and networks led to the development of FORTHnet, which is historically the first and today the largest and most advanced multi-protocol computer network in Greece.

ICS is contributing to the widespread adoption of the principles of universal access and usability at national and international levels, and the development of applications and services that promote the equal participation of all citizens, including people with disabilities, in the Information Society. One of the many achievements in this field is the **AVANTI Web Browser** supporting universal access.

The technologies developed at ICS and the available know-how in the various fields of expertise have created a favourable environment for the island of Crete to play a major international role as an Information Technology and Telecommunications node in the wider Southeastern Mediterranean region.

ICS maintains Domain Name registrations in the [.GR] Top Level Domain.

The Department of Education and Training of ICS provides training in the use of computers and computing skills by offering courses targeted to various groups of professionals and students in the region of Crete. So far, more than 8,000 people have attended these courses. Additionally, more than 1,000 medical professionals from the region of Crete have been trained in the context of the HYGEIANet IT skills programme, (www.hygeianet.gr) while several hundred engineers have followed training courses in Computer-Aided Design.

Publications per researcher per year	2,5
Citations per researcher per year	30
Ongoing externally funded projects (2003)	260
Patents (2002)	30
Personnel (2002)	850
Budget (2002)	32 M€

Table 2: FORTH STATISTICS

3.2. FORTH'S Cultural activities

Although FORTH is a technological Research Centre, it contributes nevertheless to the regional and national cultural life. The Institute of Mediterranean Studies (IMS) is engaged in focused research aimed at selected areas in Humanities while Crete University Press (CUP) publishes books and produce music albums addressed to the general educated public. The "El Greco" Centre of IMS has organised several exhibitions and its movie lab has produced documentaries concerning cultural life and folk traditions.

In the field of cultural informatics, achievements include: the **POLEMON National Monuments Record System**, which is approved by the Central Archaeological Council for adoption by all units and supervised organizations of the Hellenic Ministry of Culture, and is already deployed at 10 locations; the **CLIO cultural thematic documentation system**, deployed at Benaki Museum; the **MAISTOR structural documentation system** for buildings, and the **ARXON document classification system and indexing system**, deployed at the Turkish Archive of Chanea.

One of the latest systems is the Laser System for the cleaning of the marbles of Parthenon (Acropolis of Athens) using modern Laser Technology, developed by the Institute of Electronic Structure & Laser.

3.3. FORTH as a Catalyst for Regional Development

The main mission of FORTH is the engagement in high quality basic and applied research. In carrying out this mission, FORTH does not neglect the development of new technologies, the diffusion of know-how and the creation of new products and services in an effort to respond to the demand of the Greek society for modernisation and innovation – features, which will allow the country to actively participate in the international economic competition.

In response to these challenges, FORTH, among other activities:

- Created 3 Science & Technology Parks (Crete, Patras, Thessaloniki) in the periphery of Greece.
- Set up in collaboration with the Greek Industrial Association in Athens and Northern Greece Association in Thessaloniki, HELP-FORWARD, (www.help-forward.gr). HELP-FORWARD mission is to make Greek enterprises and laboratories more competitive via

technology transfer, to facilitate the exploitation and utilization of RTD results, to strengthen the links between research and industry, to promote and facilitate innovation in enterprises and to contribute towards enhanced European cooperation. The highest distinction in the IRC network was awarded to IRC HELP-FORWARD on 21 November 2002 in Nuremberg, during the 7th annual meeting of the IRC Network. Following a vote between 250 technology transfer partner organizations from 31 countries, that comprise the 68 members of the IRCnet, HELP-FORWARD was selected by the majority of the European IRCs as the *“Best IRC for 2002”*.

- Created 8 spin-off companies among which FORTHnet S.A. is the largest Internet provider in Greece.
- Is engaged in sales of products and services of high technological content in an effort to test them in the domestic and international market and open the way for new spin-off companies.
- Developed the HYGEIANet network, (www.hygeianet.gr) which aims at strengthening health care in the Region of Crete guided by the principles of universality, accessibility, comprehensiveness, portability and public administration.

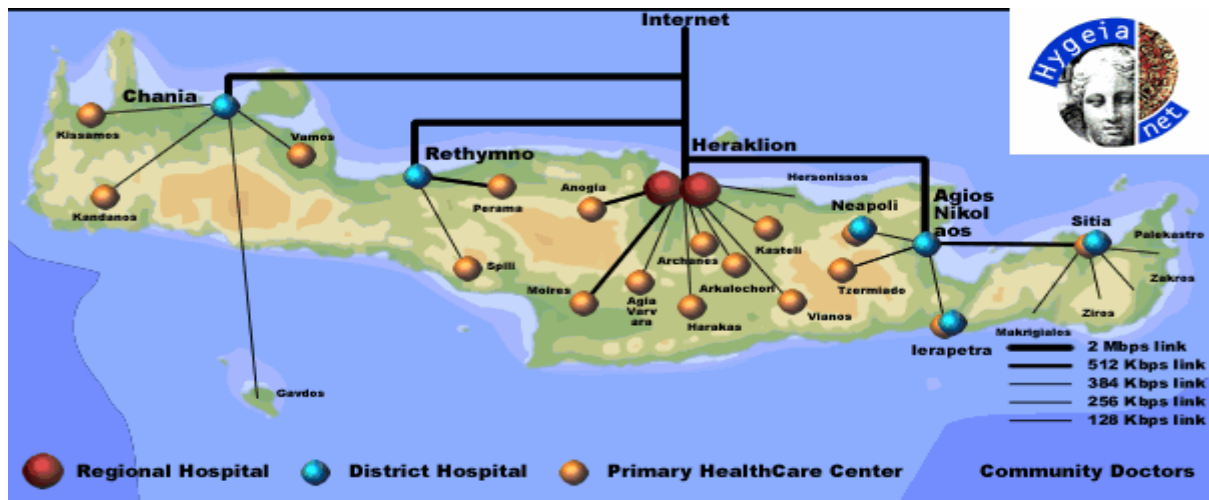


Fig. 1 “HYGEIANet“ Network

- Organise many conferences contributing thus to the development of conference tourism especially in Crete.

3.4. WHAT’S NEXT?

After almost 20 years of existence, FORTH established itself in the area of Science & Technology as one of the best performing research organisation in the periphery of Europe. It is now moving forcefully towards exploitation of its results through licensing, development of spin-off companies and partnerships in the areas of computer networks, technology in medical applications and art, biotechnology in medicine and environment and specialised industrial systems.

Future goals of FORTH include:

- Strengthening the scientific quality by promoting recruitments of scientists.
- Extending of training activities through an International Training Centre. The construction of a new building, which will host this activity is financed by the Regional Operation a Programme and is expected to finish at the end of the year 2004.
- Build long-lasting partnerships.
- Develop Crete as an Information Society model region.

4. THE SCIENCE & TECHNOLOGY PARK OF CRETE (STEP-C)

4.1. General Information

The Science and Technology Park of Crete, STEP-C, was established in 1993 by FORTH. The idea was to promote the creation of a third thrust of development on the island, in addition to the agriculture and the tourism industry⁽⁴⁾. It collaborates closely with the private sector as well as with the University of Crete (UoC) and the other HEIs of the island. STEP-C gears itself to become an ever increasing attraction as an Incubator, nurturing spin-offs and small innovative companies in the areas of Medical Equipment, Biotechnology, Telecommunication, Telematics and Telematics, Microelectronics and Laser applications, Environmental Technology, Polymers and Applied Mathematics, key strength areas of FORTH and the University of Crete. The Park operates in two buildings and has 4000 sq.m. of floor space with more than 100 offices and 12 labs, accommodating about 30 technological and service companies, at a privileged physical location, nearby Heraklion, which is the business centre of the island. It is situated at a short distance from the main town, 12-km away from the international airport of Heraklion and 4 Km away from the beach. The Park has developed one of the first “Resort Office” prototype in Europe, introducing an integrated concept for working and relaxing in an environment that promotes creativity, encourages commitment to new technologies and offers ample opportunities for all year-round enjoyment.

STEP-C Management Company (EDAP S.A.) is a private company with 26 shareholders mainly from the private sector. The Bank of Piraeus, one of the major Greek private banks became the main shareholder and it is expected to play a vital role to the development of the Park. A small team of experts with a wide scientific and business background operates the Park.

STEP-C provides space and support for development to small innovative companies, at their early stage of development, or hosts R&D departments of established companies, willing to collaborate with the Research Institutes to develop new products or services. The Park provides technological and administrative support, Internet and networking services, support for business planning and financial services as well as patent and library services. Some of the services are provided free of charge. The cost of office and lab space is half of the market price.



Fig. 2: The buildings of STEP-C (Heraklion, Crete)

4.2. STEP-C's strategic objectives

STEP-C has four key strategic objectives:

1. Technology Transfer

The transfer of research deliverables from the academic institutions to the industrial applications is the main objective of STEP-C. The newly established Centre of Technology Transfer (CTT) promotes this activity. The development of the CTT at the Park is a project financed by the Greek government (GSRT). The CTT is also developing mechanisms in order to provide technological support for the local businesses. The activities of the CTT include:

- Consulting services
- Technology auditing
- Partner searching
- Business Planning
- Market research
- Technological Information, etc

2. Attraction of companies to the Park

STEP-C encourages small innovative companies to come and operate within its premises and take advantage of the availability of skills techniques and products. The role of the Park is to create the “Innovative Environment” and to connect the scientific and technical development with the regional one. The Park works as an Incubator, nurturing small NTBFs, spin-offs from FORTH and the University of Crete, regional or international innovative companies.

3. Promotion of the Park products

This is a series of activities to promote research deliverables to the market. The Park provides technological and marketing support for the promotion of its members’ products, with special interest to the application of new technologies for marketing, e-commerce etc.

4. Development of an Education Centre

The objective is targeted to reinforce and re-train key company staff members through advanced offerings, especially in the management and quality assurance areas, in collaboration with other organisations.

4.3. Successful examples of Technology Exploitation

The following are examples of spin-off companies, which were established at STEP-C with the participation of FORTH and private investors.

1. **FORTHnet S.A.** (www.forthnet.gr). It is the successful outcome of the combination of scientific research and of entrepreneurial shrewdness. STEP-C is the place where FORTHnet, the largest Internet provider in the country was nurtured. It is a spin-off of FORTH, with a sound financial base and a very high growth rate. FORTHnet is specialised in the Telecommunications and Telematics applications Technology and employs about 550 people. A local shipping company and a private bank financed the establishment of the company during the early stages of its development. Since September 2000, the company has been listed in the Greek stock market with a market capitalisation of more than 170 Meuro. It is now a very dynamic group of 8 companies, in the area of Information and Communication Technology.

2. **MITOS S.A.** (www.mitos.gr). It is a small company specialised in the organisation of conferences and tourism services. It runs the Crete Resort Offices (CRO), which offer two different working environments. One consists of a comprehensive Business Centre inside STEP-C with high-speed data lines and a full secretarial support. The other, from inside a five star hotel, nearby STEP-C, just by the beach, designed for holidaymakers who wish to “tele-work” occasionally from a luxurious resort environment.

3. **FORTH Photonics S.A.** (www.forth-photonics.gr). This is an activity of FORTH, which aims at the development of Multi-Spectral Imaging Systems for non-destructive analysis in the fields of Biomedicine, Forensics, Plant Pathology and Visual Art as well as Medical equipment like colposcope, and imaging system for retina diagnosis. In collaboration with a Dutch company (Art Innovation B.V) FORTH Instruments Laboratory of IESL developed MuSIS 2007, a system for analysis and documentation of art works. On September 2002, FORTH Photonics S.A. was established as a private company, with funding from a Greek Venture Capital Company. The company has an initial capital of 5,5 Meuro and it will produce and market MUSIS 2007 and Imaging Systems for non-invasive diagnosis of epithelial dysphasia and malignancies. At this time the company employs 20 people.

4. **MINOS Biosystems Plc.** (www.minosbiosystems.com). This is a new activity for the exploitation of research results in the area of Insect Biotechnology. MINOS Biosystems Plc is a holding company, which was established in the UK, in collaboration with foreign investors and it aims to develop spin-off companies for the commercial exploitation of patents, which are related to the transfer of genes from one insect to other insects. This is a platform technology, which has the potential to use in other areas of Biotechnology. The Intellectual Property owned by IMBB was transferred to Minos BioSystems in exchange for an equity position. Minos BioSystems primary goals are (i) to improve and expand the existing IP portfolio and to identify potential partners with complementary technology and (ii) to raise additional funds to establish new companies, in some instances with partners for the development of specific products and services based on the technology platform. It is planned that the new companies will operate mainly at STEP-C focusing on (i) the development of novel environmentally friendly methods for the control of agricultural pests and disease vectors, (ii) the rapid production of low cost high value proteins for healthcare and research purposes and (iii) the identification of novel gene function in insect and mammalian genomes for the Agricultural and Pharmaceutical Industries.

5. **COMP-ITE S.A.** This is the latest spin-off company of FORTH. It was established last December with an initial capital of about 900000 € to exploit laser technology developed at IESL in collaboration with COMPUCON S.A. a leading Greek SME in the area of embroidering software. This company will start its operation during 2003.

6. **MINOTECH biotechnology.** (www.minotech.gr). Minotech produces and sells DNA restriction and modification enzymes, the most important tools of Molecular Biology, to the Greek and international markets. It employs 6 people and it is certified with ISO9001 certificate.

4.4. The role of STEP-C in the development of the “Regional Innovation Pole” of Crete

During the last year, the Greek Ministry for Development announced its interest to support the development of “**Regional Innovation Poles**”, in order to promote regional development through clustering and networking of research laboratories, innovative enterprises, technology transfer organisations and regional authorities. STEP-C is leading this initiative for the region of Crete, by promoting this idea among the regional stakeholders. A Business Plan will be submitted to the Ministry, which will be supported from the 3rd CSF Programme as well as from the Regional Operational Programme. This project is expected to materialise in the next 3 years. The Pole will be consisted of networked research laboratories and innovative group of companies (clusters). The “islands” will be established in the areas where competitive advantage exist e.g. Biotechnology and Biomedicine, Marine Biology, Agriculture, Tourism and promotion of the famous “Cretan Diet”, Information Technology with applications to Agriculture, Tourism and Health etc.

The elements of the Pole are shown in the following diagram:

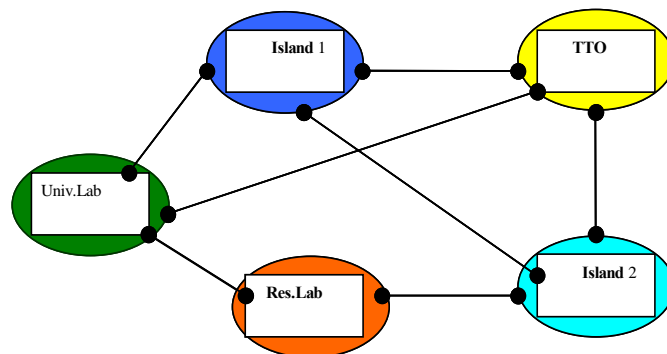


Fig. 3: Elements of the Regional Innovation Pole of Crete

5. DISCUSSION

Less developed regions like Crete, are characterised by weak and obsolescent production structures, which means less knowledge intensive businesses, weak and scarce human resources and non-existent or outdated financial mechanisms for innovation support. To achieve a long-term economic development, a growth policy that is designed to create strong incentives for innovation is required. This also requires focus on the following aspects, which are very critical:

- ◆ Developing a dynamic innovation system
- ◆ Promoting entrepreneurship
- ◆ Strengthening the education system in order to meet the market needs

1. Developing a dynamic innovation system

The rapid advances in the new technologies create particular problems for the small companies that dominate the productive system and the regional economy of Crete. There is thus a need for

boosting their own capacity to order research as well as to develop networks and clusters, which will provide easier access to the existing R&D resources.

A successful example of established network is the recent development of the “Cretan Food Cluster”, a network of 20 small innovative companies, which promote traditional Cretan products as well as the well-known Cretan Diet. Lessons from other regions suggest that regional economic success can evolve by design. The pattern of success suggests, among others, dynamic business clusters at the core of the regional economy. As a result, cluster-based economic development is a pathway to build competitive regional economies, as in the case of Crete. What is necessary is a supporting infrastructure, which will enable them to be competitive in their markets. This infrastructure includes:

- ◆ Development of the necessary human resources and systems to prepare, to advance and to renew skills to meet the changing needs of the productive system, as well as to deploy new technologies into the market place.
- ◆ Financing the extension and modernisation of the productive system.
- ◆ Disseminate the culture of venture capital and stimulate the society to acquire the culture for the entrepreneurial mentality.
- ◆ Development of physical infrastructure (transportation, telecommunications, energy, environment and natural resources) and improve the quality of life by providing health and social services and cultural and recreational attractions.
- ◆ Establishment of the regulatory structures, which will promote the reforming of the administrative and tax systems and specific measures to reduce the risks associated with innovation and establishment of new technology based start-ups and academic entrepreneurs.
- ◆ Secure the economic survival of the Science and Technology Park by taking the necessary measures to attract selective high quality foreign investment.

The mobility of production resources and financial capital due to globalisation has increased the tension between the centre and the periphery, since both want to attract these resources. These tensions force some regions towards greater specialisation in an attempt to hold their competitive strengths. The quality of these Centres of Excellence thus becomes of great importance for their ability to attract financial and production resources. Crete has the capability and the necessary supporting organisations to become a Centre of Excellence in some areas like Biomedicine, Laser Technology, Telemedicine and Teleworking, Biotechnology, Information and Telecommunication Technology. What is necessary is a regional policy towards the promotion and marketing of DFI in order to attract big international players and secure its position in the future. DFI marketing and promotion should be organised on a professional basis as well as IPR management. Crete can play the role of “test and demonstration” region for DFI, which could provide the basis for a pilot programme.

All these issues will be considered during the implementation of the Regional Innovation Pole Project, where FORTH and STEP-C are going to play a central role. FORTH’s Institutes are all “Centres of Excellence” after an evaluation procedure by the GSRT and this role is expected to strengthen in the coming years.

2. Promoting entrepreneurship

Despite its intrinsic strengths and international competitiveness, the Cretan RTD system has so far produced a few technical entrepreneurs. There have been a few spin-offs, few new technology-based start-ups, mainly developed by FORTH and very little academic entrepreneurship.

In order to mobilise the private sector in the region to increase investment in innovation, a Regional Innovation Fund should support regional incentives for innovation. The new Competitiveness Programme (www.antonistiki.gr) as well as the Regional Operational Programme will finance actions for the promotion of innovation and entrepreneurship, the exploitation of research results through the creation of spin-off companies and the development of new Science & Technology Parks and Incubators.

3. Strengthening the education system

It is evident that a changing demand for skills is a fact of technological progress. In a knowledge society, it is important that there is strong motivation for an education, which is compatible with the needs of the labour market. It is also important that the system should provide opportunities for people already employed to improve their knowledge capabilities. Despite the fact that Crete has the lowest unemployment rate among the 13 regions of the country, the labour market is poorly developed and its development requires high priority. The presence of strong Academic and Research Institutions provide an opportunity for the local human capital to improve its capabilities. What is necessary for the Universities is to establish postgraduate courses in the areas of Business Administration, Marketing and Technology Management, where a gap exists. Also, the regional authorities should promote the organisation of training courses and vocational training centres to meet the market demand and to support the local SMEs to organise courses addressed to their needs for the development of new skills for their staff.

6. CONCLUSION

Crete is a dynamic region with potential to develop high technology as a third pole, (after agriculture and tourism) and secure the sustainable development of the region.

Necessary measures toward this direction, include:

- Need to identify and promote specific initiatives to reduce the risks associated with innovation in the region
- Support to the establishment of business, scientific and cultural links with other regions
- Promote the development of mechanisms for financing innovation (seed funds, venture capital etc) and establish an entrepreneurial spirit in the region
- Involve a broad range of stakeholders
- Need to improve the education system and invest in training of people in new technologies
- Need to link and integrate new technology with the local demand (e.g. tourism with high quality health services)

The Science & Technology Park has to play a central role in the development and integration of the competencies of the local companies with the external ones.

FORTH's Institutes also have to continue its high quality research activities and remain Centres of Excellence.

The new Regional Operational Programme and the National Competitiveness Programme are expected to play a vital role for the development of the region. These integrated programmes include support to the local SMEs as well as to the Academic and Technological Institutions for:

- Exploitation of Research results and development of spin-offs and NTBFs
- Establishment of new technology incubators and Science Parks
- Promotion of academic entrepreneurship by establishing spin-off companies
- Support for the development of an effective intermediary system of technology transfer and innovation
- Support for clustering
- Establishment of a seed capital fund and a Venture Capital Fund
- Specific measures addressed to support particular needs of the local SMEs (e.g. Developing Quality Systems, Innovation Management etc) in order to enhance their competitiveness.

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