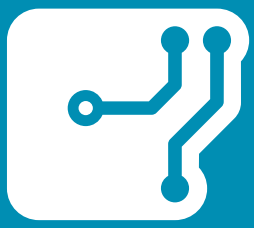

INESCTEC
TECHNOLOGY & SCIENCE
ASSOCIATE LABORATORY

COORDINATED BY
INESCPORTO
PORTUGAL

PLAN FOR SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES

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1 INTRODUCTION

The present document presents the plan for scientific and technology activities of INESC TEC, for the year 2012. INESC TEC is the Associate Laboratory recognized by the Ministry of Education and Science of Portugal.

Section 2 presents the overall plan, detailing the evolution to the present structure, the operation of the knowledge-value production chain, the long-term strategy and the planned evolution for 2012. The visit of the Scientific and Advisory Board will provide a key contribution for the development of INESC TEC in 2012.

Section 3 to 14 refer to the plan of each Unit, which start with a brief presentation of the areas of activity, and their relationship, expressed in two dimensions: (a) scientific and technology and (b) technology transfer. The Unit strategy is established following the sequence strategic analysis (SWOT) – strategic formulation (objectives) – strategic implementation (initiatives and actions for the year). Finally, a summary of activities is provided along with specific indicators.

The final section is the plan for the Scientific Council.

2 INESC TEC ASSOCIATE LABORATORY OVERALL PLAN

2.1 EVOLVING MODEL

In 2002 INESC Porto was recognised by the FCT – the Foundation for Science and Technology, as an Associate Laboratory. Although the model of an association or partnership between various independent units or institutions was far more common, the large size and unit based structure of INESC Porto led to a full correspondence between the Associate Laboratory recognised by FCT and the legal entity INESC Porto, as a private non-profit association.

In more recent years, the Portuguese Government successfully implemented a policy to encourage the cooperation, concentration and formation of critical bodies. The general terms of this policy were effectively put into practice by INESC Porto, whose experience in gains in scale and in organisational efficiency in scientific management has been recognised and proven over the years.

In 2011, INESC Porto took a bold step and built around its organization a new architecture for the Associate Laboratory. New Units become partners and a new organization was set up. Thus, new and ambitious objectives were defined – and a new brand was forged: INESC TEC.

INESC TEC stands in Portuguese for INESC Technology and Science (INESC Tecnologia e Ciência). This designation refers to all groups, units or institutions forming the Associate Laboratory recognized by the Ministry of Education and Science of Portugal.

INESC TEC has at its core the values and organizational strength of INESC Porto. The branding evolution (it is not a rupture) is justified by a number of strategic considerations, among which:

- The internationalization effort, namely in South America, for which it was estimated that, in balancing the pros and cons of name change, a net advantage would be gained in abandoning a geographical anchor for an explicit reference to the activity and mission [TEC, as in technology for the abridged name, and technology and science as full name].
- The need to have a strong identity as a unifying factor, when new Associate Units have been admitted that are hosted by institutions other than the University of Porto. In particular, the extension of the Associate Laboratory to the University of Minho, in Braga, was in a large extent incompatible with maintaining Porto as a symbolic identification.

In 2012, an organized succession of initiatives will contribute to put the name INESC TEC in the limelight and smoothly erase in the daily use the designation INESC Porto, which will be kept in all cases when the juridical nature of the association must be recalled.

Hopefully, this will also help in diluting differences between researchers integrated in the nuclear INESC Porto and in the Associate Unites (all will just belong to INESC TEC), bring about a desired sense of integration and of common belonging. This is seen as a useful tool for the task of building a common culture yet maintaining the genetic trait of INESC Porto.

2.2 STRUCTURE OF THE ASSOCIATE LABORATORY

The configuration of INESC TEC is made up of nuclear Units (U), Associate Units (UA) and a Privileged Partner (PP).

Their definition is the following:

- Nuclear Unit – a Research Group fully integrated in the institution INESC Porto
- Associate Unit – a Research Group recognized as a national Scientific and Technologic System Unit by FCT
- Privileged Partner – a Research Group not fully integrated in INESC TEC but with a special cooperation agreement

The following are the Nuclear Units (U) integrated into INESC Porto:

- USE – Power Systems (U)
- UTM – Telecommunications and Multimedia (U)
- UESP – Manufacturing Systems Engineering (U)
- USIG – Information and Computer Graphics Systems (U)
- UOSE – Optoelectronics and Electronic Systems (U)
- UITT – Innovation and Technology Transfer (U)
- ROBIS – Robotics and Intelligent Systems (U)

The following are the Associate Units (UA) and Privileged Partners (PP):

- LIAAD – Laboratory of Artificial Intelligence and Decision Support (UA)
- CRACS – Center for Research in Advanced Computing Systems (UA)
- UGEI – Unit of Management and Industrial Engineering (UA)
- CISTER –Research Centre in Real-Time Computing Systems (UA)
- HASLab – High Assurance Software Laboratory (PP, to become a UA following recognition by the FCT)

These UA and PP do not have a juridical autonomous statute and are sheltered under the following organizations:

- LIAAD – at INESC Porto.
- CRACS – at the Faculty of Sciences of the University of Porto, through its Association ADFCUP.
- UGEI – at IDMEC.
- CISTER – at ISEP, the school of Engineering of the IPP – Polytechnic Institute of Porto.
- HASLab – at the University of Minho.

The Associate Units maintain their own identity and will enjoy autonomy in decision making with regards to their activities and management, their funds and their revenue to support them.

The INESC TEC Units compose a dense puzzle of scientific and human resources. They constitute a true network of excellence, strongly meshed. Interactions among Units are encouraged at scientific level and coordinated at development and technology transfer level. Targeting large and multidisciplinary projects pertains to the strategic vision of the Associate Laboratory, and INESC TEC has the advantages of critical mass and sense of corporative organization. It empowers Units and researchers with the capacity to achieve ambitious goals that, independently and isolated, they would never be able to aspire to.

Figure 1.1 represents the dimension of the Associate Laboratory expressed by existing human resources at the time of the elaboration of this plan.

The coherence of the distribution of resources at INESC TEC is suggested in Figure 1.2, where the Units are represented – in light blue: INESC Porto nuclear Units; in dark blue: Associate Units and Privileged Partner. There is a suggestion of clustering of the Units, roughly in these four areas:

- Computer science, informatics, machine learning (A)
- Industrial systems and management (B)
- Power and energy (C)
- Communications and devices (D)

This clustering denotes affinities among Units and is in a way a graphic translation of the history of cooperation or stronger potential for cooperation. It does not represent an actual organizational scheme.

There is also the symbolic representation of the flow towards a Unit (Innovation and technology Transfer) that has the specific mission of organizing knowledge valorisation, especially in the launching of spin-off companies.

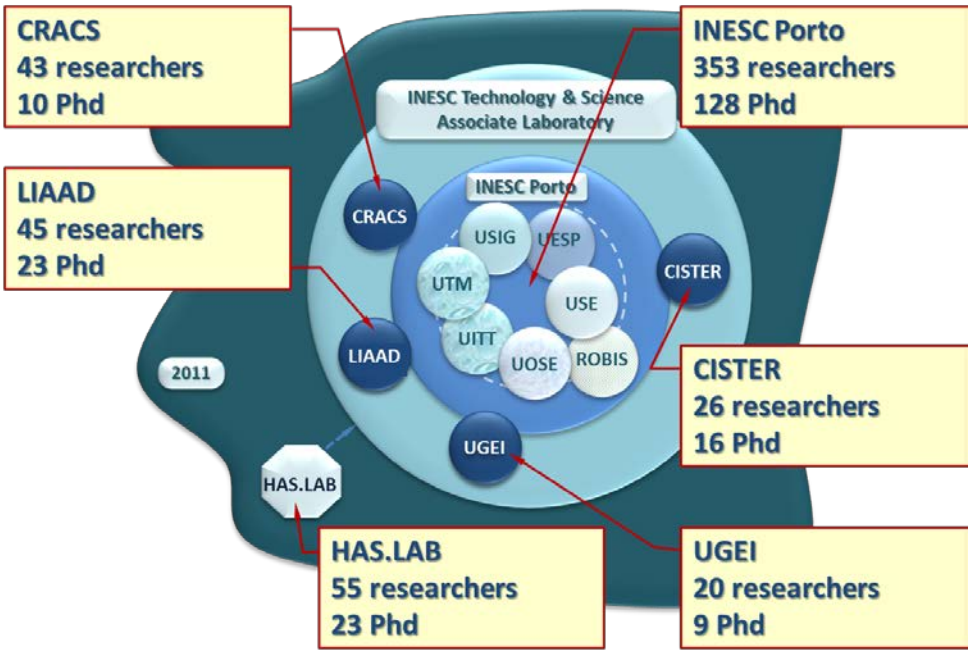

Figure 1.1 - INESC TEC cluster: INESC Porto at the core, Associate Units in close orbit and the Privileged Partner evolving to become a fully recognised Associate Unit.

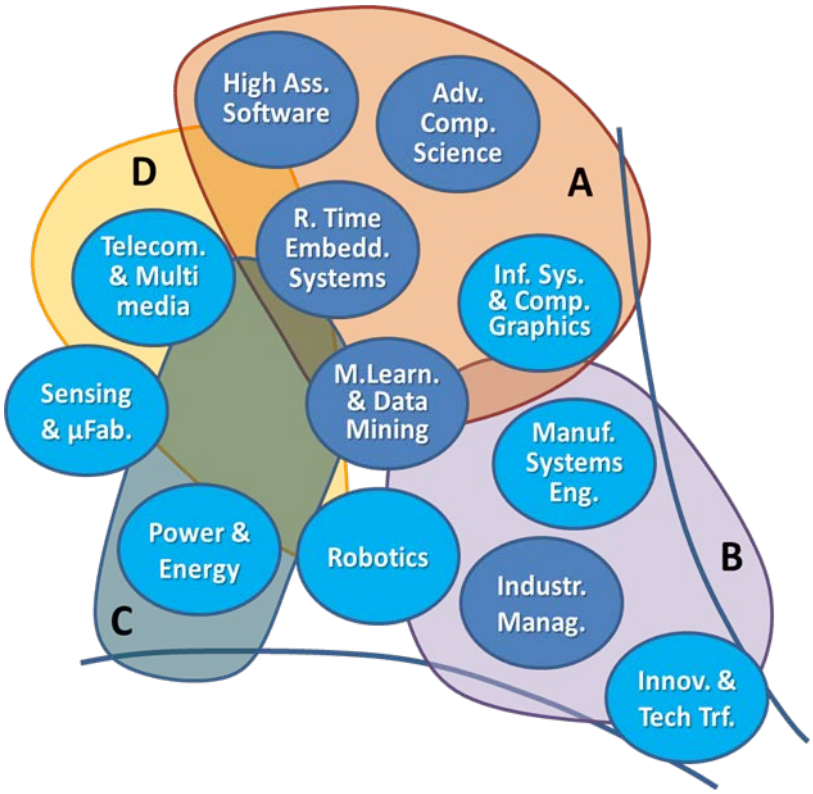

Figure 1.2 - Research Units and a possible clustering: a densely covered knowledge domain

2.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

INESC TEC aims to extend and reinforce the concept successfully implemented by INESC Porto, which is to aim simultaneously at excellent science and intensive technology transfer. In this respect, it departs from a more classical profile of a science-only devoted institution.

The activity of INESC TEC will continue to be based on the concept of knowledge and value production chain, with progressive stages that follow through until the possible creation of spin-offs. This concept is illustrated in Figure 1.3, which depicts the division into 4 stages:

- Basic knowledge production
- Applied Research Projects
- Development
- Technology transfer and valorisation.

The figure also shows some relevant outputs produced at each stage. The output at each stage also serves as performance indices for the corresponding activity. As with any model, the divisions between the stages are fluid and not rigid.

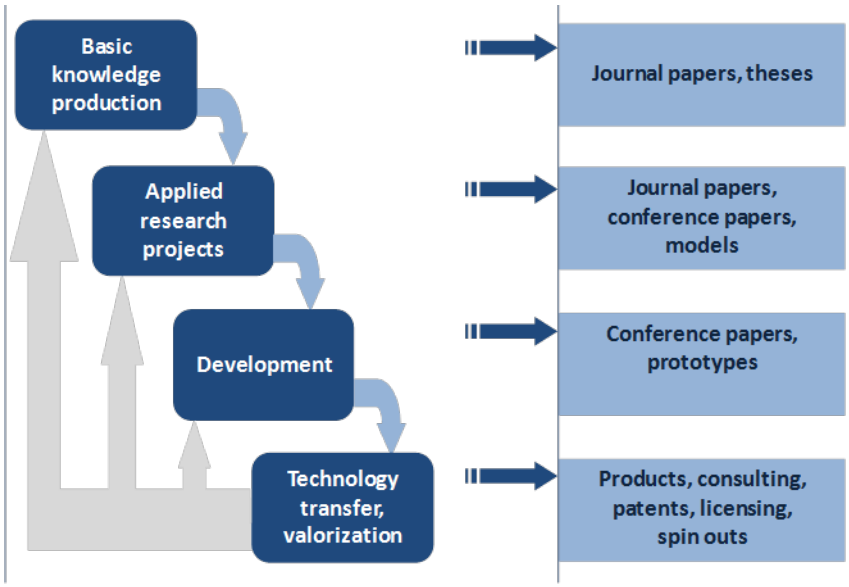

Figure 1.3 - Knowledge production and valorisation chain concept and productivity indices for each stage

INESC Porto Units and Associate Units present distinct coverage of this chain, some are more research orientated and are therefore positioned in the early stages. Others are more market orientated and are therefore positioned in the later stages.

The idea is not that all of the Units will cover the whole chain; but their organisation must allow for knowledge flow, not only within each unit but between units so that the Associate Laboratory as a whole can research and produce what is socially relevant.

This will mean that the Associate Laboratory can focus on both science and technology transfer. Furthermore, it will be strategically orientated towards being on par with scientific excellence, so as to have a direct impact on companies and the advanced training of human resources.

The success of this model relies on the capacity or ability to allow or guarantee an easy flow from top to bottom and a feedback in the reverse direction. In order to achieve this, one does not require that each researcher should act on every stage of the chain – however, there is a definite

incentive for the research Units to have a large enough dimension so that they can accommodate a broad spectrum of activities.

Also, there are measures put in place to generate and support dynamics among the several Units:

- Research projects joining together more than one Unit are encouraged;
- Cooperation in co-authorship of papers with authors from different Units is encouraged;
- Special Actions called LAI (Inter-unit Action Lines) have been put in place to allow cross-Unit fertilization;
- Direct contracts with industry are often conducted by a team constituted by members from a mix of Units;
- An adequate management and accounting procedure has been put in place to allow a Unit to use resources (including labour) from another Unit.

Each Unit has distinct characteristics in terms of positioning within the knowledge and value production chain. Figure 1.4 sketches the amplitude of activity in each Unit and it becomes clear that INESC TEC does not have a unique model for the Unit profile.

Also, the figure illustrates that no Unit is exclusively devoted to development and technology transfer – and that all Units, even the most upstream and therefore closer to basic research, do maintain activities related with applied research and development, ultimately leading to knowledge valorisation.

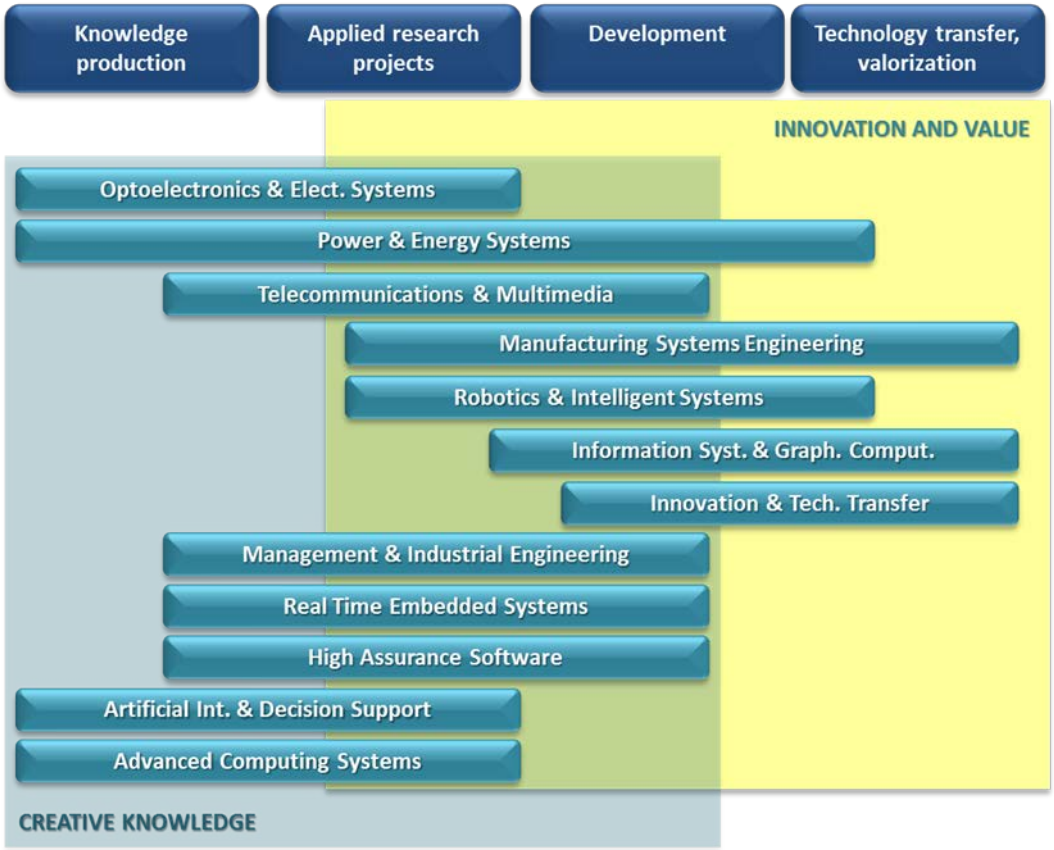

Fig 1.4 - Span of each Unit over the knowledge-value production chain. The creative knowledge area (more basic research) and the innovation and value area overlap in all Units.

2.4 LONG TERM STRATEGY

The strategic plan for INESC TEC defines as a long range target to constitute in the north of Portugal a high level Science and Technology cluster in electrical and computer engineering that may be perceived internationally as an important world player.

The discussion of the importance for Portugal of this achievement is beyond the scope of this document.

To meet this target, several steps must be taken and conditions assured. They are referred to in the following sections.

2.4.1 SCALE, DENSITY, CRITICAL MASS

The recent years have been devoted to growth and densification of the coverage of important areas of knowledge and capacity. A few examples: 1. The area of computer science, for years identified as a weakness of INESC Porto, witnessed the aggregation of several groups (LIAAD, CRACS, CISTER, HASLab), none connected with the Faculty of Engineering and two of them not related to the University of Porto. 2. The area of control and robotics has been reinforced with the constitution of a new Unit (ROBIS) with the integration of an external group from the Faculty of engineering. 3. The area of Industrial Management has been reinforced with the association of a new Unit (UGEI) formerly external to INESC Porto. 4. The programs run by FCT (Foundation for Science and technology, Government of Portugal) supporting the contracting of scientists have been used to reinforce fragile areas where excellence should be maintained – such is the case of optoelectronics (UOSE), very much depending of the resources of the Faculty of Sciences in scarce number.

So far, the basic requirement to take this step has been met, i.e., the capacity to remain an attractor and to inspire confidence – so that external groups may perceive a net positive trade-off when renouncing in some degree to full autonomy and accepting to live under a regulated governance.

2.4.2 EXCELLENCE IN SCIENCE

Without excellence, all aspiration to world recognition is void of hope. Therefore, the resolve in making robust a culture of demanding responsibility, quality, accountability, productivity of advanced science must be sustained at all cost. Most of all, incentives and recognition to high level science and researchers must be put in place. So far, the classical indicator of quality (papers in international journals) has witnessed a steady growth that has moved the ration papers/people to a value at international level for the areas of activity covered. A continued effort in pursuing excellence and valuing excellence as the trade mark of INESC TEC is the basic requirement for this step to be taken.

2.4.3 GENERATION OF NEW HUMAN RESOURCES

The deep involvement in Doctoral Programmes is a necessary condition to have available human resources to conduct research and then to publish results. INESC TEC must be able to add value to Doctoral Programmes in the several institutions that are in one way or another associates. In particular, the MAP (Minho-Aveiro-Porto) programmes in computer science and in telecommunications, as they join the strongest schools in the north of Portugal, should be examined as possible models to extend to other areas. The requirement to take this step is the strengthening of the alliance between INESC TEC and the Faculties/Universities to reinforce these programmes.

2.4.4 INTERNATIONAL VISIBILITY

One only exists when one is seen. Moreover, one is only valued when one is measured. The importance of international projects and activities is crucial to gain the status of world player. The long term objective is to guarantee that the international activity of INESC TEC may be accounted

for more than 50% of the total activity, measured either in indices of production or in financial results.

To achieve this, a first requirement must be taken in account: the massive presence in the European research effort consubstantiated in the so called European projects.

A second requirement is the constitution of a base of operations outside Portugal, to gain access to projects, funding, human resources and ultimately to conquer the status of multi-national organization. The operation in Brazil must be understood under this light.

2.4.5 EXCELLENCE IN TECHNOLOGY TRANSFER

The other face of the coin representing INESC TEC, as an interface organization in Engineering, must be the capacity to produce socially relevant results, translated through the several forms of achieving technology transfer. The relations with industry are crucial, and INESC TEC must become perceived as a partner of excellence. The requirement here is that all Units in INESC TEC may contribute to this objective – either directly or by integrating a process of knowledge transfer to other Units.

The target for the relevance of technology transfer in the profile of INESC TEC is 60% of project activity.

2.4.6 INTEGRATION

INESC TEC cannot become a loose federation of almost independent units or its potential will be put in jeopardy. Some units at present have more than 100 researchers and therefore the risk of self-containment in each private universe is real. The requirement is that the coordination of INESC develops an active policy for producing cohesion in the Associate Laboratory by strengthening the ties among its Units through:

- defining precise targets that capitalize on the excellence of the science developed at INESC TEC but that may focus on technology transfer as well;
- generating a deepening of cross-border fertilization;
- originating new science by fusion of knowledge and skills, giving support to groups that have in the past demonstrated excellence;
- conducting research through multidisciplinary fields by involving multi-disciplinary teams.

A plan of actions to promote these objectives must be available across the Associate Laboratory.

2.4.7 SPIN-OFF GENERATION

The launching of new spin-off companies is a strong indicator of the capacity of INESC TEC to induce transformational phenomena in the society within a short life-cycle. The requirement is that he model developed in INESC Porto must be redesigned to suit all INESC TEC.

2.4.8 SUSTAINABILITY THROUGH HEALTHY MANAGEMENT

The survival of the INESC TEC model depends strongly on the financial health of the organization. This sustainability depends on the following pillars: activity diversification (research + technology transfer with valorisation), geographical diversification (internationalization) and structural cost control.

The requirement is that all Units, especial the new Associate Units, absorb this concept of management and replace their old thinking paradigm for a new way, closer to private enterprise attitude and certainly akin of the cultural organisational model built by INESC Porto along many years.

2.5 PLANNED EVOLUTION FOR 2012

2.5.1 STRENGTHNING AND CONSOLIDATING THE ASSOCIATE LABORATORY

The year of 2012 (and partially 2013) will be conditioned by two important financing tools: PEST, a financing tool coordinated by FCT, and BEST CASE, a plan submitted to the ON2 regional programme.

The rationale behind PEST is the funding of each Unit in INESC TEC. The rationale behind BEST CASE is the funding of cross-Unit projects and activities. These two tools have been conceived in a way that allows the reinforcement of Unit and cross-Unit activities. Unfortunately, due to the delayed decisions regarding the approval of BEST CASE, the present plan can only rely on PEST funding.

The PEST programme, and hopefully BEST CASE, will be used as the necessary tools to reinforce the more fundamental activities and capacities of INESC TEC. This reinforcement will be achieved both by a policy of recruiting high-value human resources at PhD level and by launching and developing cross-area multidisciplinary projects that may allow important structural progress. However, one is aware that true reinforcement, in a way to satisfy the strategic vision, can only derive from actual joint project activity.

The activity of the Associate Laboratory may be seen from different angles. One perspective is depicted in the PEST program approved by FCT: the activity is organized in Research Lines; each RL will be anchored to a leading Unit, but a relevant interaction will be sought with other Units.

PEST and BEST CASE were designed to support fundamental science and basic knowledge development. The activity of INESC TEC cannot remain confined to this design or the strategic vision will not be fulfilled. Therefore, the policy to be implemented will include strong motivation and incentives for Units to establish stronger links with national and international industry and to develop systematic valorisation of the knowledge created.

Table 1.1 summarizes the synergy links identified in the PEST program and that will receive priority in being pursued.

The links among Units historically integrated in INESC Porto are robust; however, the connections of Associated Units with the INESC Porto Units and among themselves are still very weak. As a consequence, all efforts shall be devoted to reinforcing links and reducing or dissolving tensions resulting from cultural clashes.

In the most recent years, the Associate Laboratory grew substantially from the aggregation of new external Units. The continuation of the growth of INESC TEC in 2012 is a scenario not envisaged at this point.

In summary: in 2012, the main effort will be concentrated in strengthening and consolidating the Associate Laboratory.

2.5.2 CONSOLIDATION OF INESC TEC CAMPI AT ISEP AND UNIVERSITY OF MINHO

In 2012, INESC TEC will consolidate its Campi at ISEP and at the University of Minho.

The Campus of INESC TEC at ISEP has been defined in the beginning of 2011, with the signature of an agreement between ISEP and INESC Porto. This Campus gives shelter to the integrated unit ROBIS (in Robotics) and to the Associate Unit CISTER. It will receive a major boost in 2012 from the inclusion of a new building that will be occupied by CISTER. This is seen as a major step into providing this Unit with structural conditions to consolidate its activity and its international visibility.

The Campus of INESC TEC at the University of Minho will be organized in 2012, sheltering the Privileged Partner Unit HASLab. This Unit is already recognized as a Organic Unit of the School of Engineering of the University of Minho. The establishment of the INESC TEC Campus will follow the signature of a suitable agreement with the University of Minho.

Table 1.1 – PEST architecture: research Lines and research groups, highlighting synergy links between groups

		RESEARCH GROUPS											
		UTM	UOSE	USE	UESP	USIG	UITT	ROBIS	LIAAD	CRACS	UGEI	CISTER	HASLab
RESEARCH LINES	Networked Multimedia Systems and Services in Scenarios of Convergence	X				X		X		X		X	
	Photonics for Life Sciences: Optical Biochemical Sensing and Imaging	X	X									X	
	Sustainable Energy Systems and the Smart Grid	X	X	X		X			X			X	X
	Enterprise Collaborative Networks, Operations Management and Decision Support Systems				X	X		X	X		X		
	Digital Society – Software, Information and Interaction Technology, Services and Policies	X				X			X	X			X
	Technology and Innovation Management	X	X	X	X	X	X	X	X	X	X	X	X
	Robotics, Intelligent and Autonomous Systems for Complex Environments	X	X		X			X				X	
	Intelligent and Adaptive Systems and Mathematical Modeling in Decision Support			X	X				X	X			
	Architectures, Languages and Systems for Advanced Computing					X			X	X		X	X
	Industrial Engineering and Service Management				X				X		X		
	Real-Time Embedded Systems for Smart Environments							X		X		X	X
	Critical Information Systems – Dependable Software, Development Methods and Tools					X				X		X	X

The Unit HASLab does not benefit from the full recognition of FCT as a Research Unit, for lack of performance evaluation, and must wait until this process is completed. In order to be recognized as fully associated to INESC TEC, it must obtain a classification of Very Good or Excellent. This justifies the association of HASLab with INESC TEC as a Privileged Partner. Meanwhile, and following FCT advice, the researchers from HASLab will register as INESC Porto researchers and HASLab will function as Associate Unit temporarily integrated in INESC Porto.

2.6 SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board (SAB) of INESC TEC is constituted as an extension of the SAB of INESC Porto. However, a few more scientists have been invited to join in, in order to assure an adequate coverage of all main areas of activity, taking in account that new Units have been aggregated to the Associate Laboratory.

In 2012, the plan is to organize a visit and audit action by the SAB to INESC TEC, followed by a diagnosis and the proposal of measures to guarantee that coherency and quality across the Associate Laboratory is achieved. The challenge to the SAB is to identify the lines of deployment of the Units of INESC TEC so that actual convergence and consolidation is achieved.

Given the dimension of INESC TEC, the SAB must also define for itself an innovative organization scheme to make feasible the continued evaluation of activities and of cross-fertilization opportunities.

Furthermore, the political signs emanating from FCT in recent times lead to the expectation that the SAB may be called to perform a role of higher responsibility in the evaluation process conducted by the Ministry of Science. This further justifies the decision to reinforce the SAB and provide it with enhanced action capacity.

3 UESP - MANUFACTURING SYSTEMS ENGINEERING

Coordinator: Luís Maia Carneiro, Jorge Pinho de Sousa

3.1 PRESENTATION OF THE UNIT

The Unit areas of activity are related to Operations Management and Enterprise Information Systems applied to industrial companies and enterprise collaborative networks. Along with a strong application focus, the Unit is committed to conduct high quality research.

The Unit conducts R&D in the following domains: Manufacturing (operations management; advanced information systems for industrial management; planning and control systems; rationalization and optimization of manufacturing processes; intelligent automation systems; decision support systems for production management), Logistics (supply-chain management systems; logistic systems; transportation, distribution and warehouse systems) and Operations Research (optimization methods; Decision Support Systems).

Strategic Objectives

- Strongly contribute for the performance improvement of industrial companies, through R&D projects, consultancy, technology transfer and training.
- Foster high quality research initiatives in the specific areas where the elements of the group have international recognition, and start innovative research programmes in new emergent topics.
- Transfer the resulting knowledge and technologies to software houses, equipments producers and industrial companies, through applied research, technology transfer and consulting projects.

3.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Collaborative Network Management

New collaboration models, supply-chain management, flexibility and decision support systems.

Collaborative business networks form a strong interdisciplinary research area that covers topics such as: supply-chain management; strategies for the manufacturing of complex products; virtual organisations; dynamic capacity management; operations planning and co-ordination; early warning and event management; semantic and technical interoperability; collaborative performance management; life-cycle support of self-forming business networks.

For 15 years, UESP has been developing its competencies and know-how in these areas.

Information and Knowledge Management in Collaborative Networks

New methods, strategies and tools for information management and knowledge management in collaborative networks.

The Unit develops research in information and knowledge management in collaborative networks, including topics such as: models for socio-technical analysis, ontologies, collaborative processes, information management and knowledge management in collaborative networks.

Operations Management and Logistics

Design and development of strategies, models and innovative techniques for operations management and logistics.

These research and development activities address topics such as: operations strategy; operations management and production planning: capacity planning; operations scheduling; lean management; layouts design; supply-chain management systems; logistic systems; integration and optimisation of logistic structures; transportation and distribution systems

Operations Research and Decision Support

Mathematical programming and optimization methods, heuristic techniques, Decision Support Systems.

The Unit has a very strong and well-known group in Operations Research, with people developing consistent research activities for many years, and with a regular participation in several national and international associations and initiatives.

Some of these research activities have been framed by national and European funded projects and were developed around several doctoral dissertations. They cover areas such as: Mathematical Programming; Multi-Criteria Decision Analysis; Combinatorial Optimization and Meta-heuristics; Simulation; Decision Support Systems.

Applications cover a broad range of problems, including: planning and scheduling problems; vehicle routing and distribution; layout design. A particular, very strong area of application is on the so-called "cutting and packaging problems". In this area, the Unit has a team that is internationally recognised for research in the integration of these problems with tactical and operational problems, the use of multi-objective metaheuristics, and the hybridisation of metaheuristics and exact optimisation methods.

3.1.2 TECHNOLOGY TRANSFER

Consultancy services for operations management and information systems

Consultancy services in Industrial Organisation and Business Information Systems, project design and management, technological auditing, benchmarking, technology transfer and advanced training.

The Unit provides industrial companies and other organisations with a wide range of consultancy services, in areas such as Industrial Organisation and Business Information Systems. These services support companies in the management and improvement of operations, the analysis, engineering and optimisation of processes. Complementary, the Unit has a large experience in the analysis, specification, auditing and assessment of information systems in different business environments. These systems include data acquisition and production control systems, Enterprise Resource Planning (ERP), production scheduling, internal logistics, quality management, maintenance management, CAD/CAM and e-business.

Furthermore, UESP supports companies in the design and management of Research and Technological Development (RDT) projects and technological investment projects. Companies can also benefit from technological auditing services that evaluate their organisational status and their use of information systems.

UESP performs also benchmarking in accordance with the Benchmarking Index methodology and is part of the Portuguese network of Benchmarking Consultants. The Unit also supports technology transfer promoting technologic results in the international market.

Since INESC Porto INESC Porto does not implement commercial solutions it can assure independent advice and support to its clients.

Support for the creation and organisation of collaborative business networks

Organisation and management of collaborative processes, new business models, knowledge management, information systems and interoperability.

Based on a vast business experience, the Unit makes an important contribution to Collaborative Business Networks, by organising and managing collaborative processes and by developing models to represent inter-organisational processes.

At the same time, the Unit develops solutions for an efficient management of knowledge in business networks as well as for the analysis, optimisation and production process management.

The Unit has already developed decision support systems, business management systems and systems to support the coordination of business processes in rather heterogeneous collaborative networks. These systems can actively contribute to improve the global performance of industrial companies, with a particular focus on small and medium-sized enterprises.

Internal logistics and intelligent automation

Operations management, production scheduling, design and balancing of production lines, simulation and tele-maintenance.

In partnership with manufacturers of internal logistic systems and software houses, the Unit develops innovative solutions for product transportation, distribution and storage during the manufacturing process, in sectors such as footwear, furniture, or metalworking.

The Unit has already participated in the design of the layout for these types of systems and in the development of software applications for the management of industrial operations, production scheduling, balancing of production lines, simulation and tele-maintenance. With these production methods and innovative systems, UESP has actively contributed to improving productivity in industrial companies.

Advanced Information systems

Analysis, specification, development, technology transfer and assessment of information systems for industrial companies.

The Unit offers R&D services in the design and development of innovative information systems in topics such as operations management, distributed systems, integration of architectures and innovative integration applications and platforms. This experience includes a considerable number of projects in requirements engineering.

Planning and scheduling

Design and development of optimisation solutions for planning and operations scheduling systems.

The Unit has vast experience in the creation and development of innovative solutions to address problems in industrial systems planning and in operations scheduling. Projects developed in these areas have been successful both for individual companies and for collaborative networks or supply chains.

State-of-the-art multi-objective metaheuristics have been used in the design of powerful, general and flexible scheduling tools. Research is being done to support the extension of these approaches to make them able to handle many industrial problems, by for example considering different types of resources, complex operation sequences, parallel processing machines, or other types of practical constraints.

Optimisation and Decision Support

Structuring decision processes, Combinatorial Optimization problems, applications of multi-objective meta-heuristics to operations management and logistics, multi-criteria decision-making.

Activities in this domain may cover a broad spectrum of problems, widening the opportunities for transfer of know-how and scientific results.

Given the specific background, education and experience of people in the Unit working in Operations Research related topics, the main field of practical intervention arises in the area of Combinatorial Optimization. Most of the practical, interesting problems in Operations Management and Logistics are of this type, including layout design, operations scheduling, production planning, distribution and vehicle routing, etc. These problems have a considerable importance in the economical performance of many companies. In general they are "NP-hard" problems impossible to solve to optimality in an efficient way, and thus requiring the recourse to heuristic techniques.

The Unit has a very strong research group in state-of-the-art heuristic techniques, in their variants known as "meta-heuristics". Meta-heuristics have been extremely successful in dealing with a variety of problems in quite different areas. In general they are quite flexible to cope with the specific features of real problems. Moreover, some extensions of these procedures have been developed to consider multiple objectives.

By adopting this type of approaches, powerful Decision Support Systems can be designed and deployed, to support complex, multiple-criteria decision-making in both strategic and operational problems, thus covering a clear gap in current commercially available systems.

Cutting and Packing Problems

Methods, techniques and multi-objective optimisation tools to solve cutting and packing problems.

In this area, the Unit has a team that is internationally recognised for their expertise in modelling complex cutting and packing problems, and in designing algorithmic approaches to solve these problems.

Based on its expertise in the design and development of innovative solutions to optimise shape cutting in 1D, 2D and 3D, the Manufacturing Systems Engineering Unit (UESP) can actively contribute to optimising the use of raw materials for 3D packaging and for loading containers, respecting aspects such as load balance and unloading orders. UESP has developed important industrial solutions for the textile industry, the paper industry and the wood and metal working industries and these projects demonstrate our experience and internationally recognised competencies in this area.

This group has been extending the range of considered problems, by developing models that consider broader sets of constraints and optimization criteria, by integrating these problems with larger tactical and operational problems, by using advanced multi-objective metaheuristics, or by hybridising metaheuristics with exact optimisation methods.

The practical impact of these results in the performance of certain industrial sectors may be very significant, by optimizing the use of raw materials, by decreasing waste, and also by optimising the packing of products.

3.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)							
			Consultancy services for operations management and information systems	Support for the creation and organisation of collaborative business networks	Automation and Internal Logistics	Advanced Information systems	Planning and scheduling	Optimisation and Decision Support	Cutting and Packing Problems	Other areas (4)
Collaborative Network Management		I	M	H		M		L		
Information and Knowledge Management in Collaborative Networks		I	L	H	M	H		M		
Operations Management and Logistics		I	M	M	M		H	M	M	
Operations Research and Decision Support		I	L		H	M	H	H	H	
Other areas (3)	Data mining (LIAAD)	O	M			M	L			
	Forecasting (UGEI)	I/O	M				M	M		

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

3.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Manufacturing Systems Engineering Unit is jointly coordinated by Luís Maia Carneiro and Jorge Pinho de Sousa.

Currently the areas with more significant activity are Decision Support Systems, Enterprise Cooperation Networks, Internal Logistics, Operations Management, Cutting and Packing problems, Combinatorial Optimization and Meta-heuristics.

Consultancy services are structured and provided by a specific group in the Unit, coordinated by António Correia Alves.

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	13	13	14
		University and Polytechnic	14	14	14
		Grant Holders and Trainees (PG)	25	25	27
		Total R&D	***52***	***52***	***55***
	Shared Structure (Central and Local)		**2**	**2**	**2**
Total Internal			***54***	***54***	***57***

Source	2010	2011 (1)	2012 (Plan)
External Collaborators and Invited Researchers	5	10	10
Global Total	**59**	**64**	**67**

(1) Information at the time of the elaboration of the present Plan

3.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

3.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Good technical and scientific background.
S2	Considerable experience in structuring complex, real problems in a wide set of sectors.
S3	Internationally recognized competences in Combinatorial Optimization and Meta-heuristics.
S4	Good relationships with enterprise associations and technological centres from several industrial sectors.
S5	Trust relations with a significant number of companies.
S6	Active participation in the Manufuture and Footwear European Technology Platforms.
S7	Good network of contacts at the European level, mainly based on the participation on multiple international projects and European Technological Platforms.
S8	Multidisciplinary, complementary competences.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Wide activity scope leads to reduced critical mass in some areas.
W2	Insufficient commercial effort.
W3	The alignment between research and application areas should be improved even more.

3.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Companies are aware of the need to innovate and improve productivity.
O2	The 7th European RTD framework is fully operational.
O3	Increased funding from the European Commission associated with the Public Private Partnership – Factories of the Future.
O4	Due to the economical crisis funding programs to support RTD and innovation activities in companies have been widened also at a National level.
O5	The Unit has strong participation in several Competitiveness Poles where ambitious RTD projects are being developed and unique collaboration perspectives are being created.
O6	Good relationships with many foreign entities and researchers.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Reduced number of technological Portuguese companies, with own products, especially in the software domain.
T2	Foreseen reduction of structural funds for Portugal in the medium term.
T3	Dependency of Portuguese companies from structural funds to perform RTD projects.
T4	National and international crisis may lead to reduction of activity.

3.4 STRATEGIC FORMULATION

3.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Increase scientific excellence by focusing activities in specific areas, by participating in research projects with leading research organisations, at a national and an international level, by empowering younger researchers, and by promoting PhD and MSc projects.	S1	W1		T1
OBJ2	Increase critical mass in the Unit's main activity areas.		W1		
OBJ3	Improve the alignment between basic research, applied research and consultancy activities.		W3		
OBJ4	Maximise the impact of the Unit's activity in companies, and promote the valorisation of results.	S4 S4			T1 T3
OBJ5	Establish strategic partnerships with more software houses and producers of manufacturing equipments, allowing the alignment of the research activities with future industrial projects, for a better valorisation of the developed intellectual property. Enlarge the partners portfolio at international level.		W2	O2 O5	T1 T2 T3 T4
OBJ6	Reinforce cooperation with other RTD organisations at an international level.	S1 S3 S6 S7		O2 O6	T1 T3
OBJ7	Improve the balance of revenues resulting from national projects, European projects and company projects, through an increased participation in European RTD projects, and an increase in RTD activities and consultancy services for companies- these services should represent a minimum of 40% of the total activity volume in three years.	S1 S3		O2	T1 T3
OBJ8	Improve internal competences by developing the skills and motivation of human resources and creating conditions for attracting high level national and international researchers.		W1 W3		
OBJ9	Improve the Unit's external visibility, through the organisation and participation in key national and international scientific and industrial events.	S6	W2		
OBJ10	Develop innovative training initiatives, with an impact in the total income of the Unit, and providing a powerful marketing instrument.		W2	O1 O3	

3.5 SRATEGIC IMPLEMENTATION

3.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)									
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9	OBJ10
A1	Consolidate the scientific activity in a few focused areas where the Unit's research is considered to be of high quality – this is the case of enterprise cooperation networks, multi-objective meta-heuristics, cutting and packing optimization; flexibility and engineering systems.	H	H								
A2	Support the growth of the last two years, by promoting new initiatives in the above key areas, especially through European projects and contracts with companies. Maintain strong participation in industrial and academic networks such as the European Technology Platforms (especially in the Manufuture and the Footwear ETPs), in the IMS programme and in National Competitiveness Poles like Produtech and Fashion Pole.		H				H	M		M	
A3	Improve coordination and alignment between research and technology transfer and consulting activities. Reinforce internal management structures to cope with recent significant growth. This includes the setup of a Unit Coordination Council.			H	M	M					
A4	Reinforce the internal communication mechanisms and promote the definition of multidisciplinary research projects; promote an internal discussion on research opportunities and on the set-up and organization of new research projects.	M	M	H					M		
A5	Improve the IT platform to support project management and internal dissemination of the status and developments of each project.			M					H		
A6	Pursue the continuous improvement efforts in the professionalism and quality of services and projects. Pursue the work done in standardization and in the improvement of software development methodologies and practices, with impact on productivity, quality and maintenance services.				H					M	M
A7	Organize a set of innovative short and medium-size training initiatives for companies these initiatives should be strongly linked to the Unit's main research areas and show a clear differentiation from those currently available on the market (this offer should include areas such as enterprise integration and collaboration, advanced planning and scheduling systems, decision support systems, methodologies for IT adoption by SME).							M		H	H
A8	Increase the direct funding by companies, by increasing the volume of consultancy and technical assistance to companies, to a minimum of 30%.							H			

ID	Description	Relationship to medium and short term objectives (1)									
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9	OBJ10
A9	Consolidate partnerships with software houses and producers of equipments.					H		H			M
A10	Continue the development of new partnerships with national and international research organizations, leaders in fields near or complementary to the Unit's activity	H					H	H			

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

3.5.2 OTHER INITIATIVES / ACTIONS FOR THE YEAR

- Reinforce the participation of the Unit in European projects, thus increasing its visibility.
- Strengthen the institution's image in its main target markets, through some specific actions - special focus will be put on the organization of workshops and discussion panels with local companies and research centres.

3.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

3.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	77	221	444	523	18%
European Union Programmes	425	557	585	420	-28%
Consultancy and R&D Services	472	651	426	515	21%
Other R&D Services					
Other External Services	2				
Total (k€)	**976**	**1.429**	**1.455**	**1.458**	**0%**

3.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	6	15
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	30	20
Books (author)		1
Chapter/paper in books		2
Publications (editor)		2
Other publications (National meetings, local journals, etc.)	5	6
Theses concluded by members of the Unit	6	6
Total	**47**	**52**

Journal	2011 (Predicted)	2012
Data and Knowledge Engineering		1
Data Mining and Knowledge Discovery		1
Electric Power Systems Research		1
European Journal of Operational Research	1	
European Journal of Operations Research		1
Higher Education Policy	1	

Journal	2011 (Predicted)	2012
IEEE Transactions in Power Systems		1
International Journal of Computer Integrated Manufacturing		1
International Journal of Operations & Production Management		1
International Journal of Production Research		1
International Journal of Universal Computer Science	1	
International Journal on Production Economics		1
International Transactions in Operational Research	1	3
Journal of Heuristics		1
Journal of Manufacturing Technology Management		1
Lecture Notes in Computer Science	1	
Production Planning & Control		1
Robotics and Computer-Integrated Manufacturing	1	
Total	**6**	**15**

3.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	4	4	20	**28**
Doctoral	6	25	5	**36**
Total	**10**	**29**	**25**	**64**

3.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	4
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	3
Advanced training courses	1

(1) Actions involving single institutions are not included

3.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	Cogninet	António Lucas Soares	01-03-2010	29-02-2012
PN-FCT	Coordinator	Ana Viana	14-06-2010	13-10-2012
PN-FCT	CPackBenchFrame	José Fernando Oliveira	01-04-2011	31-03-2013
PN-FCT	EaGLeNest	António Miguel Gomes	15-04-2010	14-04-2013

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	KEP	Ana Viana	05-04-2011	04-04-2014
PN-QREN	HighSpeedShoefactory	Rui Diogo Rebelo	01-01-2012	31-12-2013
PN-QREN	Minerva	Paula Silva	01-02-2009	31-01-2012
PN-QREN	NEWALK	Rui Diogo Rebelo	01-01-2011	31-12-2013
PN-QREN	PowerTextilesXXI	Rui Diogo Rebelo	01-01-2011	31-12-2013
PN-QREN	Produtech-PSI	Luís Carneiro	02-05-2011	01-05-2014
PN-QREN	Shoe-ID	Rui Diogo Rebelo	31-10-2009	31-12-2011
PN-QREN	SysMAP	Luís Carneiro	02-02-2010	01-02-2012
PUE-I&D	ADVENTURE	Luís Carneiro	01-09-2011	31-08-2014
PUE-I&D	CORENET	Américo Azevedo	01-06-2010	31-05-2013
PUE-I&D	Fit4U	Rui Diogo Rebelo	01-07-2009	30-06-2012
PUE-I&D	FOODMANUFUTURE	Luis Carneiro	01-01-2012	31-12-2014
PUE-I&D	Net-Challenge	Luís Carneiro	01-06-2009	29-02-2012
PUE-I&D	PROsumer.NET	Luís Carneiro	01-06-2011	31-05-2013
PUE-I&D	VFF	Américo Azevedo	01-09-2009	28-02-2013
SERV-NAC	Auto-Ebiz	César Toscano	01-01-2010	31-12-2012
SERV-NAC	Consultoria	Luís Carneiro	01-01-2009	
SERV-NAC	EVOLEOTECH	António Correia Alves	28-09-2011	27-09-2012
SERV-NAC	PadinhoXXI	António Correia Alves	01-11-2010	31-12-2011
SERV-NAC	ParqueEscolar	Luís Guardão	01-11-2009	31-10-2012
SERV-NAC	PENTALINE	António Correia Alves	07-10-2011	06-10-2012
SERV-NAC	SIAC-Produtech	Luís Carneiro	01-01-2011	31-12-2013
SERV-NAC	SIIARI-1	Luís Carneiro	01-09-2010	31-08-2012
SERV-UE	FoodSupplyChain	César Toscano	01-04-2012	31-03-2014
SERV-UE	IzaroGrey	António Correia Alves	01-01-2007	

Source:

PN-FCT: National Programme - FCT

PN-QREN: National Programme - QREN

PUE-I&D: European Union Programmes - R&D

PUE-DIV: European Union Programmes - Others

SERV-NAC: Consultancy and R&D Services - National

SERV-UE: Consultancy and R&D Services - European Union

SERV-INT: Consultancy and R&D Services - International

OID: Other R&D Services

O - Other External Services

INT - Internal

4 UOSE - OPTOELECTRONICS AND ELECTRONIC SYSTEMS UNIT

Coordinator: Paulo Marques

4.1 PRESENTATION OF THE UNIT

The Optoelectronics and Electronic Systems Unit (UOSE) performs R&D mainly in optics and optoelectronics. It is oriented towards applied research and development in optical fibre sensors, imaging and microfabrication (integrated optics, novel materials, thin films, and photovoltaics). The Unit looks for opportunities for technology transfer to industrial companies using its specific competencies in optoelectronics and systems integration.

Strategic Objectives

- Strengthen competencies in the Unit's R&D fields of expertise.
- Begin a process of reinvestment in order to maintain a state of the art technological infrastructure.
- Enhance the multidisciplinarity within research activities expanding the applications of the existing technologies (e.g. Biosensors).
- Optimize the technology transfer process by improving active partnerships with industry and performing costumer oriented research.
- Strengthen existing links with partners in key areas of optical sensor field
- Strengthen existing links with the Department of Physics and Astronomy (FCUP) and with the Department of Computer and Electronic Engineering (FEUP) of the University of Porto.

4.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Optical Fibre Sensors

The use of optical fibre sensors is an expanding R&D topic and its significance is unquestionable. These sensors can be applied in several different areas, from the integrity of structural health, to environmental monitoring and aeronautics just to mention a few examples. Along the years the Optoelectronics and Electronic Systems Unit (UOSE) of INESC Porto has been active on the R&D in the area, ranging from intensity to interferometric based sensors and their multiplexing, with a focus at a certain stage on Fibre Bragg Gratings (FBG) as sensing elements. This activity supported a substantial scientific output and also actions directed to technology transfer.

With the emergence of microstructured fibres, the Unit started studying several solutions to measure physical parameters simultaneously or eliminating the cross temperature sensitivity. Currently, research in this area is more focused on applications for extreme environments and the energy sector. In addition, a strategic goal was set on expanding the use of the technological know-how to enable the measurement of chemical and biological analyses. Combining the optical fibre sensor technology developed with new chemical and bio sensitive materials enables a new generation of monitoring tools for which there is very high demand on industrial, environmental and health markets.

UOSE is also involved in new projects in which researchers are developing ultra-remote measurement systems with optical amplification and nonlinear effects. The aim is to perform long distance monitoring using nonlinear effects which enable reflective measurements at distances above 300 km. Such technologies are expected to become the basis for long range wide area monitoring of physical, chemical and biological parameters. Recently, UOSE is also working on a new generation of optical fibre sensors which can measure electric currents and magnetic fields for energy and biomedical domains.

Fibre-based optical sources are compact, flexible, exhibit output power and wavelength tuning possibilities, and therefore have also been in the focus of the Unit activity, within the development

of sensing systems, as is the case of the conception and implementation of broadband sources based on supercontinuum generation for remote sensing and interrogation of fibre sensors for gas detection.

The Unit is also engaged on the study, at a more fundamental level, of new optical concepts for optical sensing: the research of chaotic propagation in waveguides looking for the development of microlasers with highly favourable properties for ultra-sensitive acoustic detection, and the study of the phenomenon of surface plasmonic resonance associated with utilization of metamaterials in optical waveguides for biochemical sensing are examples of this approach.

In resume, the area of optical fibre sensors is composed of two main areas of research; one is more traditional and overlooks the aspects related to physical parameters detection and the second, which is more recent, looks into aspects related to bio-sensing. The development of these two areas is made in close cooperation and also with contributions of the other research fields within the group.

Imaging

Research, development and technology transfer in optical imaging and measurement techniques.

During the last decade UOSE researchers gathered specific knowledge on white light interferometry techniques applied to high spatial resolution optical imaging, assembled an optical coherence tomography system that is able to perform 3D scanning of micrometric structures in small samples, and seek to offer a versatile tool for quantitative imaging, with impact in many fields, such as microfabricated devices characterization, microfluidics, structural imaging, spatially resolved measurements, and, naturally, non invasive monitoring of biological tissues, in real time and in situ.

UOSE's R&D in this field was paramount in the establishment of an industry partnership (QREN: MEMIMETRIA) with a Portuguese company.

Integrated Optics and Microfabrication

Fabrication of microdevices using standard techniques for film deposition, lithography and etching processes, and microstructures characterization.

The optoelectronics and Electronic Systems Unit (UOSE) has been developing research activities in integrated optics, multiferroic and photovoltaic materials deposition. Photonic integration based on silica-on-silicon technology, hybrid sol-gel processing, lithium niobate and silicon nitride has been performed in the last years with the recourse of the unit cleanroom facilities and external collaborations. The research has been focused in the development of integrated devices with applications in optical communications, optical sensors and astronomical instrumentation.

During the last two years UOSE was particularly involved in the creation of the CEMUP-MNTEC, a micro/nanofabrication centre of Porto University associated with CEMUP - Materials Centre of the University of Porto. The process started by the initiative of researchers from UOSE and culminated in a successful proposal to QREN with an approved budget of just below 2 million Euros. The new cleanroom is expected to be fully operational in the third trimester of 2012. With the expansion of the cleanroom facilities, the group will see their activities consolidated and expanded to new research fields such as the development of lab-on-the-chip systems by converging to the integration of microfluidics with microphotonics. The interest of lab-on-the-chip systems has been increased in the last few years due to the enormous benefits for the health and environment sector with rapid diagnosis, real-time detection and monitoring of biospecies providing compact and low cost platform solutions.

The microfabrication activity is supported by accessing to several modern tools for films deposition, lithography, wet and dry etching, laser direct writing (UV laser and infrared femtosecond laser) and several microstructures characterization tools. For films deposition, UOSE has access to evaporators (thermal and electron beam systems), RF sputtering, Plasma Enhanced Chemical Vapour Deposition (PECVD), pulsed laser (excimer KrF) deposition (PLD) and spinners. The patterning of microdevices can be performed by a standard mask aligner for photolithography (i-line) and UV laser and a dry etching system (RIE or ICP). Characterization tools for profilometry, optical electronic and atomic

force microscopy are available as well as tools for chip processing such as a high precision cutting saw, polishing machines and furnaces. UOSE also supports an optical characterization lab for testing optical integrated devices

In the past, the Group has gain many experience in laser direct writing with UV sources which has been used in the production of integrated optics devices in photosensitive materials, and also in the production of different types of grating structures which supported the development of many types of sensors. During the last few years the group has been developing strategies to enhance its capabilities in terms of materials processing using ultrafast laser sources. This equipment is not available in the Group, so recently it was included in a Portuguese call for projects. This new equipment will be used in the fabrication of micro and nanodevices at submicron resolution using non-linear absorption effects. It will be mainly used to fabricate Bragg gratings for high temperature sensing using point-by-point writing either in planar silica substrates of optical fibres. Also, the group wants to explore micromachining using femto-etching in which wet-etching selectivity is achieved by laser exposure. Photonic crystal structures can also be obtained using two-photon photo polymerization.

Other aspects are related to the development of materials that can find application in the field of sensing. These include thin film/fiberoptic heterostructures to be used in the measurement of systematic and unsystematic deformations experimented by infrastructure and systems when they are submitted to external stress. Moreover, Hi-Bi/conductive oxide heterostructures will be developed to be used as high current sensors. In addition, high quality materials will be developed to be used as micro-electromechanical devices piezoelectric and temperature sensor

Standard and concentration solar cell have been a focus of research in the last three years in cooperation with an industry. We will continue with the preparation of standard and concentration solar cell using a physical deposition method. Standard CdS/CdTe thin film solar cell with efficiencies of higher than 8% will be prepared without any post-annealing process and the optimization of the deposition process of active layers of Ge/GaAs/GaP/InP concentrator solar cell will be carried out by RF magnetron sputtering.

Electronic and Optoelectronic Systems Integration

Research, development and technology transfer in the integration of systems, mechanisms and electronic and optoelectronic subsystems which include designing, prototyping, assembling and packing subsystems based on optics and electronics.

The Optoelectronics and Electronic Systems Unit (UOSE) not only conducts research, development and technology transfer tasks in the systems integration area, but also other activities concerning the integration of mechanisms and electronic and optoelectronic subsystems.

UOSE's work includes developing systems based on microcontrollers and microprocessors, designing and prototyping multi-layer printed circuit boards, as well as assembling and packing subsystems based on optic and electronic technology simultaneously.

Post-graduation support

The area of post-graduation support deals with all issues related to education. For example, UOSE is the driving force to the creation of an optoelectronics teaching laboratory in the Physics and Astronomy Department from the Faculty of Sciences; a number of high quality experiments are available for under and post-graduation students. As examples, experiments in optical fibre sensors, optical tweezers, optical fibre amplifiers and lasers, prism couplers, fabrication of optical fibre components (directional couplers, Bragg gratings, tapers, long period gratings, etc. With this action we expect to increase the number and quality of the students that choose optics and optoelectronics as their main subject.

4.1.2 TECHNOLOGY TRANSFER

Instrumentation

Research and development of new measurement systems as solutions for real problems, integrating the scientific knowledge fostered at the Unit.

UOSE performs Research and Development (R&D) on new measurement systems and concepts. Using the diversity of expertise of our researchers in the domain of Instrumentation, the Unit seeks innovative solutions for real problems.

UOSE's researchers are experienced in:

- optical fibre sources;
- optical fibre sensors and sensor networks (interrogation, multiplexing, ...);
- optical systems and integrated optics modelling;
- microfabrication (thin film deposition, lithography, etching, etc.);
- optical imaging;
- high resolution optical imaging and measurement;
- optical fibre technology;
- instrumentation based on image acquisition and processing.

Optical fibre technology and devices

New mechanisms for optical communications based on integrated optics and optical fibres for multiplexing using wavelength division, optical routing, integration/derivation multiplexers and wireless optical connections, in the fields of optical fibre sources and vision.

The Optoelectronics and Electronic Systems Unit (UOSE) conducts R&D projects aiming to develop new devices for applications when guided wave optics offers advantages. These involve optical communications, sensors, etc. The Unit's researchers have created innovative mechanisms based on integrated optics and optical fibres for multiplexing using wavelength division, optical routing, integration/derivation multiplexers and wireless optical connections, in the fields of optical fibre sources and vision.

UOSE is recognised for fabricating optical fibre or integrated optics filters, which are exposed to intense radiation patterns emitted by ultraviolet lasers. These submicrometric patterns cause periodic changes to the refractive index (Bragg gratings), which makes it possible to manufacture filters with a broad spectral selectivity.

The equipment developed at UOSE and installed in the laboratories are assets for producing not only uniform, apodised and chirped gratings with phase steps, but also long period gratings.

Environmental monitoring

New concepts of optical sensors to monitor biochemical parameters in the environment.

The Optoelectronics and Electronic Systems Unit (UOSE) is recognised for its expertise in optical sensors. At the Unit, the researchers develop new concepts of sensors which can be used to detect several physical, chemical and biological parameters with practical application in environmental monitoring and industrial process optimisation.

For that, UOSE has been promoting an important and strategic set of partnerships with key research groups specialised in preparing new materials and surface functionalization methods. The aim is to develop transducer elements capable of turning chemical and biological phenomena into signals that can be measured by the implemented optical platforms.

At UOSE, the researchers have been working in several projects in this area, mainly developing technology to measure, for instance, water temperature in estuarine environments, to monitor the

quality of water (dCo2, dO2, pH, Ammonia, etc.) in aquaculture facilities and to control and optimise bioreactors (CH4, H2, T) used in organic waste treatment and energy production.

Energy Use

New materials and designs for solar cells and thin films for energy purposes.

The Optoelectronics and Electronic Systems Unit (UOSE) pursues the development of new materials and designs for solar cells. At the Unit, researchers also employ their knowledge and expertise in the emerging area of thin films.

By investing in solar cells and thin films, we are taking a step forward in terms of rational and efficient energy use. The aim with this activity is to make it possible to obtain concentrating solar cells under different preparation conditions. The ultimate goal is to find the best absorption band spectrum, increase the amount of solar energy absorbed or decrease resistive and recombination losses, and consequently increase these cells' efficiency.

The RF magnetron sputtering deposition method has been used to obtain CdS/CdTe thin film solar cells. The cells obtained present a post-annealing efficiency potential of 8%. This fabrication process makes it possible to combine several active layers in a clean environment. This way, it is possible to use the solar spectrum more effectively and consequently the produced cell will perform more efficiently.

Health

Use of optical sensors and high resolution imaging in the health sector, namely for biological tissue, and new biochemical sensors.

UOSE has been expanding its R&D to other socially relevant monitoring issues, and in particular to the public health field.

UOSE has a solid collaboration with the Instituto Português de Oncologia Francisco Gentil (Portuguese Institute of Oncology Francisco Gentil), in Porto, in the field of ionizing radiation protection and dosimetry, for both monitoring and treatment environments. The current project involve the simulation of radiation transport (projects FIBDOSE, FLUOROCT and IORT) and the development of novel optical fibre dosimeters to be used in real time in radiation therapy (brachy and external) (FIBDOSE).

The R&D in high spatial resolution optical imaging techniques can also be applied in biological tissue monitoring, by performing three-dimensional non-invasive reconstructions of micrometric structures, in situ and in vivo.

As far as the new biochemical sensors are concerned, the work carried out with strategic partners includes designing microfluidic chips to characterise and diagnose cells using optical and electrical methods, methods for analytical imaging based on fluorescence, and studying the interaction of surfaces with proteins and DNA. Fibre optic probes as tools for analytical microscopy are also being explored taking advantage of the ability of the fibre to collect or deliver light with submicrometer resolution and perform trapping and manipulation of micro particles or single cells.

4.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology	Status (1)	Areas of Technology Transfer --> Relationships (2)					
		Instrumentation	Optical Fibre Technology and Devices	Environmental Monitoring	Energy Use	Health	Other areas (4)
Optical Fibre Sensors	I		H	H		M	
Imaging	I	H				H	
Integrated Optics and Microfabrication	I			F	F	F	
Electronic and Optoelectronic Systems Integration	I		H	H	F	F	
Other areas (3)							

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

4.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Optoelectronics and Electronic Systems Unit is coordinated by Paulo Marques with Ireneu Dias as assistant manager.

The Unit is structured into the following Areas:

- Area 1 – Optical Fibre Sensors, Leader: Orlando Frazão
  - Area 1.1 – Biosensors, Leader: Pedro Jorge
- Area 2 – Imaging, Leader: Carla Carmelo Rosa
- Area 3 – Microfabrication and integrated Optics, Leader: Paulo Moreira
  - Area 3.1 – Photovoltaics, Leader: Javier Cruz
- Area 4 – Electronic and Optoelectronic Systems Integration, Leader: Ireneu Dias
- Area 5 – Post-graduation support, Leader: Manuel Joaquim

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Unit Coordinators
  Paulo Marques, Coordinator
  Ireneu Dias, Unit assistant manager
- Area Leaders
  Orlando Frazão
  Pedro Jorge
  Carla Carmelo Rosa
  Paulo Moreira
  Javier Cruz
  Manuel Joaquim

Often, other members of the research unit participate on these meetings, depending on the agenda.

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	10	9	9
		University and Polytechnic	11	12	12
		Grant Holders and Trainees (PG)	28	32	22
		Total R&D	***49***	***53***	***43***
	Shared Structure (Central and Local)		**3**	**3**	**3**
		Total Internal	***52***	***56***	***46***
External Collaborators and Invited Researchers			6	6	4
		Global Total	**58**	**62**	**50**

(1) Information at the time of the elaboration of the present Plan

4.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

4.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Good technical and scientific background.
S2	Strong know-how in specific technologies.
S3	Strong background and know-how in sensitive fibre optic interferometric techniques/configurations suitable for label free biosensing.
S4	Connections and partnerships with renowned scientific groups and International networking potential.
S5	Good balance between PhD students and researchers.
S6	International recognition of quality and competence.
S7	The balance between basic science and applications development has allowed the development of new partnerships with local industry.
S8	The recent contracts made with researchers under the Science 2007 and 2008 programs and the Associated Laboratory contract allowed to cover partially the gap between academic staff and post-graduation students.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Critical mass not achieved concerning some areas and unbalanced distribution of human resources by research areas. For example, there is a lack of human resources in Imaging.
W2	Low number of approved European projects.
W3	Aging of the technological infrastructure.
W4	Dependence on expensive infrastructure and high cost of infrastructure operation and maintenance.
W5	Low number of pos-doc position.
W6	Low attraction of excellent young researchers/students from DFA/FCUP (theory/experiment).
W7	Strong dependence on external partnerships for chemo and bio functionalization.

ID	Description
W8	Low Internal collaboration between fibre and integrated optics.

4.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Know-how and technologies potential: the application areas for Unit's technologies are diversified and, consequentially, a larger use can be foreseen.
O2	Markets recognize the need for online chemical and bio-parameters monitoring.
O3	Brazil industry has high demand on sensors operating remotely and also in situations of extreme environments (high voltages, mining and oil drilling).
O4	High market potential for structural health monitoring in specific large infrastructures.
O5	Good prospects of future collaborations with companies/industry from the North of Portugal, in imaging and measurement.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Inadequate framework of reference concerning valorisation of post-graduate training activity: after concluding their degrees, post-graduate students, generally, don't compensate the Unit's financial and human resource effort on their behalf and, in consequence, they don't contribute to the system; a significant proportion follow college and polytechnic teaching careers or in corporations with few or no connections with Unit's activity.
T2	Predictable decrease of public funding regarding R&D activities: the supposed and desirable increase of funding of I&D activity by companies is not easy on the current context.
T3	The aging of the technological infrastructure drops the edge relative to other emerging groups.
T4	The low number of permanent academics based at the group facilities.

4.4 STRATEGIC FORMULATION

4.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Increase of integration and development of PhDs in the context of the Associated Laboratory framework.	S1 S2	W1 W6	O3	T1
OBJ2	Assessment of medium/long term R&D new opportunities: development of new optical sensors based on photonic crystal; sensor networks; photovoltaic materials and microfluidics.			O2 O3	
OBJ3	Re-equipment investment plan.		W3 W4	O2 O4	

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ4	Evaluation of new opportunities in technology transfer, especially in the Framework of FP7 and Portuguese QREN.	S4	W2	O2	
OBJ5	Implement an internal panel for internal proposal evaluation prior to final submission with the aim of increasing proposals quality and approval rate.		W2		T2
OBJ6	Strengthen interdisciplinary partnerships including companies/costumers and technological platforms.	S6	W2	O2	T2
OBJ7	Strengthen internal competencies in bio and chem functionalization, imaging and integrated optics.		W1 W5 W7	O2	T2
OBJ8	Strengthen Internal collaboration between the several research areas of the group (for example, between sensors and microfabrication).		W8	O1 O2 O3	T2
OBJ9	Enhance marketing quality and public awareness of the Unit activities.		W3	O1	
OBJ10	Increase revenue through services.			O3	T2

4.4.2 OTHER OBJECTIVES

The following objectives refer to specific aspects of the Unit:

- Strengthening of installed and established scientific and technological capacity;
- Search and assess re-equipment funding opportunities;
- Recently, and by UOSE initiative, the idea of creating a Micro and nanofabrication facility in Porto University was moulded. Discussions with other research group (IFIMUP), CEMUP and the rectory of Porto University reach the conclusion that this initiative would fit perfectly in the philosophy of CEMUP, and therefore this new facility will be born as a new structure of the existing centre. During 2010 an application to QREN funds was done and it was successful. UOSE had a strong role on this process at a technical and administrative level, and it will continue to participate actively to make this infrastructure a reality in the short term. It should be mentioned that UOSE maintain since its origin a small cleanroom completely operational; all the equipment that is resident on this cleanroom and was acquired during the last two decades will be transferred to the new infrastructure, contributing decisively to ensure that the new cleanroom is equipped with the technical equipments very quickly.
- Internal cross fertilization of technological and scientific competences;
- Integration of Unit's R&D interests with medium term objectives of current and potential corporate partners, for synergies and valorisation of Unit's activity;
- Increase of the economical and social impact of R&D results;
- Attraction of new university investigators;
- Internationalization;
- Integrated policy of intellectual property application and valorisation;
- Participation in scientific committees of conferences related to Unit interests;
- Seek for active participation in international photonics networks;
- Reinforce and optimize the Scientific potential of UOSE researchers;
- Continue the effort of increasing the visibility of UOSE at DFA (talks, projects, visits… curricula…);
- Work with academic institutions to create more competencies in optoelectronics and micro/nanofabrication at both under and post-graduation levels, contributing for excellence achievement on these areas.

4.5 SRATEGIC IMPLEMENTATION

4.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)									
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9	OBJ10
A1	Organize International summer course in optical fibre technology and integrated optics (promoted by COST Action).	M							M	M	L
A2	Advanced professional training course in the field of optical fibre technologies for technicians.			M							H
A3	Establishment of new and strengthening of already in place industrial partnerships, both national and international.				H		H	H			
A4	Explore synergies between the several areas of knowledge within the research Unit.								H	M	
A5	Proposals submission for European projects (7FP).	H		H	H	H					
A6	Proposals submission for national R&D projects.	H				H			H		
A7	Gradual and progressive internal re-organization and optimization of resources.					H				M	
A8	Meeting in DK and SW to establish collaboration with RISO Institute (energy area), Bioprocess Control Company (bioreactors) and Powersense company (HV current sensors).				H		H				
A9	FP7 call STREP in ICT-2011.3.5 Biophotonics e ERC call Synergy Grants.				H						
A10	Strong representation in Europtrode XI (6 papers) to seek new collaborations.				H		H				

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

4.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

4.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	171	209	187	136	-27%
European Union Programmes	25	7	1	52	5100%
Consultancy and R&D Services	194	253	284	248	-13%
Other R&D Services		14		22	
Other External Services		129			
Total (k€)	**390**	**612**	**472**	**458**	**-3%**

4.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	51	32
Papers in National Journals with scientific referees	2	1
Conference Proceedings in events with scientific referee and selection	51	10
Books (author)		
Chapter/paper in books		
Publications (editor)		
Other publications (National meetings, local journals, etc.)	8	
Theses concluded by members of the Unit	3	2
Total	**115**	**45**

Journal	2011 (Predicted)	2012
Applied Microbiology and Biotechnology	1	1
Applied Optics	4	1
Applied Physics B-Lasers and Optics	1	1
Applied Physics D	1	1
Applied Physics Letters	1	1
Biosensors and Bioelectronics	2	1
Chemical Physical Letters	1	1
Fibre and Integrated Optics	1	1
Gazeta de Física	1	1
IEEE Photonics Technology Letters	3	1
IEEE Sensors Journal	2	1
IEEE Transactions on Industrial Electronics	1	1
Journal of Electroceramics	1	1

Journal	2011 (Predicted)	2012
Journal of Lightwave Technology	1	1
Journal of Materials Science	1	1
Laser Physics	1	1
Materials Research Bulletin	1	1
Measurement	3	1
Measurement Science & Technology	1	1
Microwave and Optical Technology Letters	1	1
Optica Applicata	1	1
Optical Engineering	1	1
Optical Materials	3	1
Optics Communications	1	1
Optics Express - The International Electronic Journal of Optics	2	1
Optics Letters	7	1
Photonic Sensors	1	1
Photonics Technology Letters	2	1
Physical Review A	1	1
Semiconductor Science and Technology	1	1
Sensors and Actuators B-Chemical	1	1
Thin Solid Films	1	1
Total	**51**	**32**

4.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	2	2	2	**6**
Doctoral	5	9	2	**16**
Total	**7**	**11**	**4**	**22**

4.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	1
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	
Advanced training courses	

(1) Actions involving single institutions are not included

4.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	AQUAMONITOR	Pedro Jorge	03-01-2011	02-01-2013
PN-FCT	FIBDOSE	Carla Carmelo Rosa	01-06-2010	31-05-2013
PN-FCT	FLUOROCT	Carla Carmelo Rosa	01-03-2011	28-02-2014
PN-FCT	Hybrid	Pedro Jorge	01-03-2010	28-02-2013
PN-FCT	MCP	Nandyala Hussain	01-04-2010	31-03-2013
PN-FCT	Microphyte	José Luís Santos	15-01-2010	14-01-2013
PN-FCT	Multiferroicos	Javier Cruz	01-06-2010	31-05-2013
PN-FCT	SensEFil	Orlando Frazão	01-04-2010	31-03-2012
PN-FCT	SmartCoat	Orlando Frazão	01-05-2010	30-04-2012
PN-FCT	Wood	José Ramiro Fernandes	01-02-2011	31-01-2014
PUE-DIV	CostActions	José Luís Santos	01-01-2008	
PUE-DIV	Nanovalor	Ireneu Dias	01-01-2011	31-12-2012
SERV-INT	TECCON	Pedro Jorge	01-05-2010	30-04-2013
SERV-NAC	SensKanoe	Orlando Frazão	01-09-2009	30-06-2012
OID	Coop-Transnacional	José Luís Santos	01-01-2010	
OID	MicroNanoCarolina	Pedro Jorge	01-09-2010	31-08-2013
OID	NANOWIRES			

Source:

PN-FCT: National Programme - FCT
PN-QREN: National Programme - QREN
PUE-I&D: European Union Programmes - R&D
PUE-DIV: European Union Programmes - Others
SERV-NAC: Consultancy and R&D Services - National
SERV-UE: Consultancy and R&D Services - European Union
SERV-INT: Consultancy and R&D Services - International
OID: Other R&D Services
O - Other External Services
INT - Internal

5 USE – POWER SYSTEMS UNIT

Coordinator: Manuel Matos

5.1 PRESENTATION OF THE UNIT

The Power Systems Unit (USE) works in emerging areas that are essential for the electric sector: regulation and electricity markets, integration of dispersed renewable energy generation (such as wind power), microgeneration and microgrids, integration of electric vehicles, smart metering and smart grids, technical and economical management of distribution systems, the use of GIS and other IT in regional energy planning and uncertainty and risk assessment.

Strategic Objectives

- Consolidate current areas of scientific research and current contracts. Continue to work in the areas of traditional power systems and emerging domains related to DMS/EMS (Distribution Management Systems/Energy Management Systems) and smart grids.
- Develop partnerships with Portuguese companies to intervene in niche markets where INESC Porto holds a reputation of excellence.
- Increase international activity by participating in European Union R&TD projects and obtaining contracts in collaboration with local partners.
- Enhance the training of human resources and increase scientific diversity through MSc and PhD courses, visits to foreign institutions and by attracting guest researchers and students with study grants from foreign institutions in countries such as China (Macao) and Brazil and other Latin American countries.
- Increase exposure of results through participation in international conferences and systematic publications in international journals.

5.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Decision Making, Optimisation and Computational Intelligence

Classic and emerging optimisation methods with applications in energy systems, methodologies for multi-criteria decision support, including risk models and methodologies based on metaheuristics and evolutionary computation for optimisation and decision making. Computational intelligence based models (e.g. fuzzy systems, neural networks) for applications in energy systems.

Based on the its experience in applying methodologies to optimise decision support and solid knowledge on classic and emerging methods of optimisation, the Power Systems Unit (USE) is able to address problems and develop methodologies and solutions in this scientific area. The following areas can be highlighted:

- Multi-criteria decision support
- Uncertainty and risk modelling
- Optimisation based on metaheuristics and evolutionary computation
- Fuzzy models for power systems
- Models based on neural networks
- Decision trees
- Support vector machines
- Data streams
- Fuzzy inference systems
- Paraconsistent logic models
- Kalman filters

- Time series
- Regression
- Kernel regression for forecasting and classification

Forecasting

Forecasting models for short-term and very short-term load and renewable energy production, forecasting error analysis with probabilistic descriptions of uncertainties, time series studies and knowledge discovery in databases, application and selection of regression technologies: classic models, neural networks, regression trees, evaluation and estimation on confidence levels.

The team at the Power Systems Unit (USE) has solid experience in the creation of methodologies and forecasting models that support the operation of energy systems, including short-term, medium-term and long-term forecasting with or without weather ensemble predictions:

- Load forecasting
- Spatial load forecasting
- Market price forecasting
- Wind power forecasting including weather ensemble predictions
- Solar power forecasting including weather ensemble predictions
- Synergies between wind power and solar energy and loads

These models employ tools based on neural networks, information theory, machine learning, data mining, entropy and correntropy and scenario building in order to characterise uncertainties.

Static and Dynamic Analysis of Energy Grids

Classic and fuzzy models for electricity grid in steady load analysis, analysis of dynamic behaviour in isolated and interconnected networks, dynamic models for energy conversion systems, dynamic simulation models for microgeneration systems and microgrids and the design of models for the integration of electric vehicles into the electricity grid.

Based on the development of simulation platforms for computational applications (PSS/E, EUROSTAG, EMTP-RV, MATLAB) and specific applications, the Power Systems Unit (USE) has scientific expertise in static and dynamic analysis of energy networks:

- Developing classic and fuzzy models for steady state analysis of electric grids;
- Models for the dynamic analysis of isolated and interconnected networks;
- Design and robust parameterisation of Power System Stabilizers;
- Dynamic security evaluation tools and the definition of preventative control measures;
- Scheduling and economic dispatch in isolated systems with security constraints;
- Models for energy conversion systems, in particular for wind turbines and their control systems;
- Dynamic models for microgeneration units and their control systems;
- Evaluation of the dynamic behaviour of microgrids under balanced and unbalanced operating conditions;
- Dynamic equivalents of microgrids and distribution networks with high levels of dispersed production;
- Modelling and control of off-shore wind power and multi-terminal HVDC grids;
- Modelling and control of FACTS (Flexible AC Transmission Systems);
- Control models for systems that connect electric vehicle batteries to the network.

Reliability

Using models to analyse reliability in energy systems, reliability in static, spinning and operational capacity power systems looking at renewable and variable energy production, reliability of

composite systems (Generation and Transmission), microgeneration and microgrids, models to represent maintenance and the transport network.

The researchers at the Power Systems Unit (USE) have experience in developing methods based on Monte Carlo simulation methods associated with Markov models to evaluate the reliability of power systems for static, spinning and operational capacities and including the integration of renewable energy, focusing on securing energy supply.

USE invests in designing models to analyse the reliability of composite systems, which makes it possible to evaluate the flexibility of the transport system with wind power components, as well as models that make it possible to optimise the use of renewable energy through a combination of water pumping cycles and maximum integration of wind power.

USE has developed models to represent electric vehicles in distribution and transport systems, as well as reliability models to assess the adequacy of the distribution systems, taking into account the transition of passive electric networks to smart electrical networks (active) with microgeneration.

5.1.2 TECHNOLOGY TRANSFER

Planning and Forecasting

Planning and Operation of Electrical Energy systems with sustainable solutions for energy generation and transport, wind power and solar energy forecasting, load forecasting; solutions based on prospective research in computational intelligence, evolutionary computation, distributed computing and multiagent systems.

The Power Systems Unit (USE) works in planning and forecasting, conducting studies and developing applications for electricity companies and forecasting systems manufacturers, incorporating the most recent analysis, optimisation and reliability techniques. The following areas can be highlighted:

- Technological Services
  - Studies on Electrical Energy System Planning
  - Wind Power Forecasting
  - Energy Demand Forecasting and Management
  - Strategic Planning for Maintenance
  - Studies on Security of Supply
  - Analysis of the Long-term Impact of Electric Vehicles on the Electrical Energy System
  - Risk Analysis and Economic Viability
  - Fuzzy Approach to Power Flow
  - Multi-Objective Analysis
  - Support for Multi-criteria Decisions
- Computational Solutions
  - Decision Support Systems
  - Geographic Information Systems
  - Wind Power Forecasting Systems
  - Tools to Assess Security of Supply
  - Tools to Define the Operating Reserve

Electricity Markets and Regulation

Helping Market and System Operators and Regulating Authorities define tariffs according to network usage and incentive systems, guaranteeing a high quality service. Evaluating expansion plans and plans to strengthen transport and distribution systems and expansion plans for production systems in a market environment.

The Power Systems Unit (USE) has a history of conducting consultancy services and research studies in Electricity Markets that enables its researchers to consistently support state authorities and companies in the energy sector. USE's researchers have solid competencies in the following areas:

- Modeling Market and System Operator activity;
- Conducting studies on cost allocation for electricity grid users including short and long-term marginal cost methods and estimating for marginal compensation;
- Defining service quality indexes and their respective standards;
- Defining methodologies for regulating authorities to evaluate network expansion plans;
- Evaluating the impact of uncertainties on the cost of energy generation and power loads for electrical energy producing strategies;
- Problem modeling for power system expansion in a market environment;
- Evaluating plans for investments in new equipment for grids;
- Supporting tariff regulation for loss adjustment in electricity grids.

Distribution Systems

Analysis, monitoring and optimising Energy Distribution Systems and meeting the new challenges presented by efficiency requirements, environmental concerns and the growth of the electricity markets.

The Power Systems Unit (USE) is experienced in Research and Development (R&D) from projects based on the analysis, monitoring and optimisation of energy distribution systems that allow its researchers to work in the following areas:

- Network analysis;
- Optimising finding capacitor batteries and reclosers;
- Optimising network use through reconfiguration and reactive management;
- Optimising the restoration of services following system failures;
- Long and medium-term load forecasting on a global level or for feeder lines;
- Characterising consumers and defining typical levels of consumption;
- Characterising networks;
- Estimating and reducing losses.

USE is also active in new areas that can respond to the challenges presented by emerging electricity markets, such as:

- Analysing the conformity of procedures associated with reconciliation processes;
- Determining profiles for consumption, losses and microgeneration;
- Establishing Loss Adjustment Factors.

Smart Grids

Identifying and developing models, methodologies and solutions to manage and operate electrical energy systems with high levels of renewable energy, microgeneration and electric vehicles within the smart grids paradigm. Consultancy services to support network operators, companies that manufacture system control solutions and producers.

The Power Systems Unit (USE) has more than a decade of experience working with Smart Grids. Therefore, the Unit can provide services in the following areas:

- Network analysis in stationary and dynamic regimes;
- Functional design of control centres for wind power;
- Identifying operating procedures for networks with high levels of wind power;
- Studies on the integration of new production plants using renewable energy;
- Analysing the potential of integrating renewable energy into isolated or interconnected systems;

- Technical and functional specifications for solutions for the active management of distribution networks based on smart metering solutions;
- Developing functional and operational models for microgeneration and microgrids;
- Sizing and sitting FACTS devices in transmission grids;
- Control procedures for the operation and control of multi-terminal HVDC grids;
- Identifying and developing advanced solutions for the integration of electric vehicles in electricity networks involving and developing smart charging strategies.

DMS/EMS

Advanced functions for energy transport or energy distribution network management systems using optimisation techniques, computational intelligence and consultancy services, offering support to companies working in the energy sector in the definition of these systems.

The expertise of the Power Systems Unit (USE) lies in the specification, development and integration of computational tools for electricity grid management systems. These are based on state-of-the-art scientific methodologies. Some of the tools developed include:

- Topology processors
- Load allocation
- Fuzzy state estimator
- Voltage and reactive power control
- Fault location with fuzzy inference
- Optimal network reconfiguration
- Optimal power flow
- Contingency analysis
- Neural network load forecasting
- Training system for operators

USE is recognised for its experience in this area and this experience has come from long-term projects with industry (EFACEC since 1997), from the participation in various Research and Development (R&D) projects on network management systems funded by national and European programmes, and also in R&D projects in Brazil.

USE also offers consultancy services for companies operating isolated systems with a large renewable energy component to help define the requirements needed for the network management system and offer support during the selection of proposals and final trials.

Advanced Training

Organising lectures and training activities on emerging issues as part of projects with international consortiums, European projects or on request from companies.

The Power Systems Unit (USE) is composed of Professors from the Faculty of Engineering (FEUP), and other faculties from the University of Porto and international researchers that have strong scientific and technical competencies which have been consolidated through the Unit's participation in varied projects and development contracts. These competencies allow USE to provide training activities on emerging issues relating to Electrical Power Systems. Recent examples of these activities include:

- Organising five courses within the scope of the EES-UETP European consortium (Electric Energy Systems – University Enterprise Training Partnership);
- Participating in various TEMPUS projects funded by the European Union;
- Participating in projects funded by the CYTED programme and directed at countries in Latin America;
- Organising advanced training activities in 2004 for the Bulgarian energy regulator, funded by USAID (the United States Agency for International Development);

Organising internal courses, for example the 2007 course on "Regulation and Electricity Markets" that took place at the Portuguese electricity company Electricidade dos Açores and also the course aimed at researchers working at an Electricity company in Macau in 1998.

5.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)						
			Planning and Forecasting	Electricity Markets and Regulation	Distribution Systems	Smart Grids	DMS/EMS	Advanced Training	Other areas (4)
Decision Making, Optimisation and Computational Intelligence		I	H	H	M	H	H	L	H
Forecasting		I	H		M	M	H	M	H
Static and Dynamic Analysis of Energy Grids		I	L		H	H	H	M	L
Reliability		I	H		H	M	L	L	M
Other areas (3)	Smart Grids	I				H			
	Markets and Reg.	I		H					
	Distribution Systems	I			H	M	M		

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

5.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Power Systems Unit is coordinated by Manuel Matos.

The Unit is structured into the following Areas:

- Planning and Forecasting – Leader: Mauro Rosa
- Electricity Markets and Regulation – Leader: João Tomé Saraiva
- Distribution Systems – Leader: José Nuno Fidalgo
- Smart Grids – Leader: Carlos Moreira
- DMS/EMS – Leader: Jorge Pereira

and the special task

- Advanced Training Activities – Coordinator: João Tomé Saraiva

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Unit Coordinator
- Unit Coordination Assistant
- Area Leaders
- FEUP activities coordinator: Maciel Barbosa

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	3	6	8
		University and Polytechnic	12	14	16
		Grant Holders and Trainees (PG)	35	41	36
		Total R&D	***50***	***61***	***60***
	Shared Structure (Central and Local)		**2**	**2**	**2**
Total Internal			***52***	***63***	***62***
External Collaborators and Invited Researchers			6	5	5
Global Total			**58**	**68**	**67**

(1) Information at the time of the elaboration of the present Plan

5.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

5.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Stable basis of university researchers, enhanced in the framework of Associated Laboratory contract, and a well defined scientific and technical program that eases the integration of grantees and trainees.
S2	National and international recognition in the areas of regulation, electricity markets, wind power and other renewable energy integration, wind power forecasting, operational reserve assessment, smart grids and electric vehicles deployment.
S3	Credibility as an independent and contractually responsible entity.
S4	Leading research activity in emergent technological areas, like microgeneration, microgrids, smart metering, wind energy integration and electric vehicles.
S5	European and international activity, with some ability to participate at a strategic level in the European Union.
S6	Possibility of cooperation with other units of INESC TEC in interdisciplinary topics.
S7	Vast opportunities for encouraging young researchers to pursue work in advanced fields.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Limited number of senior elements necessary to support research and consultancy activities.
W2	Lack of adequate laboratorial facilities in emergent topics.
W3	Some lack of diversity in the basic scientific activity.

ID	Description
W4	Weak attractiveness of senior researchers remunerations.
W5	Irregular number of publications on high quality journals.

5.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Present and futures changes in the organization of the electric sector, at the national, Iberian (Iberian Market) and European level.
O2	Emergence of new paradigms for the organization of electric networks.
O3	Development of wind power and other renewable energy generation in Portugal.
O4	New industrial developments related with microgeneration, smart metering and active demand side integration.
O5	Electric vehicles integration in electricity grids.
O6	Increasing internationalisation of Portuguese industry.
O7	Increased opportunities in Brazil, namely through INESC P&D Brazil.
O8	Possibility of ON2 financing for program “Best Case”. Research line Smart Grids.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Globalization of the consulting activity, increasing competition.
T2	Increasing competition in European projects.
T3	Current Portuguese and International economical and financial crises.
T4	Loss of qualified staff due to attractive external employment opportunities.
T5	Changes in legislation to decrease incentives to DER development and EV deployment.

5.4 STRATEGIC FORMULATION

5.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Continuation of a balanced activity regarding high level research and development, technology transference to industry and support to industry and public administration, while contributing to the financial viability of INESC Porto.	S1		O3	T1
OBJ2	Consolidation of the present scientific and technologic areas of intervention	S1	W5	O1	

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
	through national and international contracts, supported by the human resources contracted in the framework of the Associated Laboratory and Ciência 2008.			O3 O8	
OBJ3	Development of international scientific partnerships, namely regarding European projects in new areas and specifically in demonstration projects involving pilot systems.	S3 S4 S5		O3 O5	T1 T2 T3
OBJ4	Full exploitation of the laboratorial infrastructure under development, namely through the development of stronger links with researchers involved with power electronics and telecommunications.	S4	W2	O4 O5 O6	
OBJ5	Extension of the Smart Grid research activities up to the transmission and generation levels of the electric power system and by integrating knowledge from sensors, telecommunications and computer science.	S6	W3	O2 O5 O8	T5
OBJ6	Exploitation of the possibility of accessing new markets through the connections made available through INESC P&D Brazil.	S3 S5		O7	T1 T2 T3 T5
OBJ7	Cooperation with other INESC TEC groups as possible partners on projects or consultancy demands.	S6		O1 O2 O8	T1
OBJ8	Commercial exploitation of software modules developed in the framework of projects.	S2 S4		O1	T5
OBJ9	Expansion of the scope of intervention of the Unit to new areas, namely through research on new emergent topics.	S5	W3	O4	T5
OBJ10	Definition of a policy for human resources for the next years.	S7	W5 W4 W3 W1	O8	T4

5.4.2 OTHER OBJECTIVES

The following objectives refer to specific aspects of the Unit:

Planning and Forecasting

- Planning and Operating Tools: development of the coded repository on planning and operating tools to deal with new PhD proposals and consultancy demands.
- Forecasting Team: consolidation of the forecasting research area within the Power System Unit in order to increase the scientific production on forecasting processes, mainly offering Master Thesis and PhD Proposals in accordance with forecasting process demands.
- Wind Power Forecasting: exploring the wind power forecasting demands through the national and international industry.
- Planning Research Area: Development of new methodologies and tools based on risk analysis considering networks expansion linked with Smart Grids concepts;
- Operating Research Area: Development of efficient computational algorithms to deal with huge dimension of transmission network.
- Consolidation of the Planning and Forecasting scientific area of intervention through the international market, mainly exploring the opportunities that come from INESC P&D Brazil.

Electricity Markets and Regulation

- Consolidation of the present scientific area of intervention in Portugal, namely continuing and strengthening the collaboration with several players in the electricity sector (for instance, EDP and REN);

- Continuation of the efforts to develop applications to help network providers (both in distribution and in transmission) to plan the expansion/reinforcement of their networks;
- Develop a strong effort to resume the collaboration with the Portuguese Energy Services Regulatory Agency, either regarding the development of studies and consultancy actions or in terms of the analysis or preparation of proposals for regulatory texts;
- Continue the collaboration held in the past with electricity companies of Açores and Madeira, namely on regulatory issues relevant for their activities.

Distribution Systems

- Continue the collaboration with the DSO regarding load and microgeneration (wind and solar) profiling, derivation of loss factors and loss profiles.
- Conceptualize and develop a research line on the use of the considerable amount of additional operational information coming from smart metering infrastructures, in order to define research objectives for the next years.

Smart Grids

- Define an action plan in order to have a wider view about smart grids, specially having a more active participation at the transmission system level;
- Participation in the Smart Grid initiatives, by promoting the development and integration the microgrids, multi-microgrids, smart metering, active load management and EV integration concepts;
- Promote a more active participation regarding support actions for the development of industrial and pre-normative solutions for smart distributions grids;
- Define a more active participation within the smart metering activities, namely those occurring at the national level, aiming at the definition of new tools in order to help DSO having a better exploitation of the available information;
- Define an action plan for the definition of short term framework regarding the inclusion of power electronics research activities within smart grids activities.

DMS/EMS

- Maintain a sustained relation with industry, namely with EFACEC but possibly with other players.
- Develop international scientific partnerships, namely regarding Brazil projects in this area, specifically with P&D projects involving Brazilian utilities and INESC P&D Brazil;
- Develop new methods to deal efficiently with new problems in the networks management related with Smart Grids;
- Develop more efficient algorithms in terms of computing time to deal with significant network dimension increase;
- Evaluate the use of semantic concepts, artificial intelligence techniques, mobility and personalization in the future activities.

5.5 SRATEGIC IMPLEMENTATION

5.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)									
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9	OBJ10
A1	Consolidation of the implementation of the laboratorial facility for testing and proofing smart grid and EV related concepts.	M			H	M		L			
A2	Review of the Unit's Areas and evaluation of the Unit Coordination Commission activity, in order to confirm or change the present organization of the Unit.							L		M	M
A3	Evaluation of the software developed internally in the framework of projects and contracts in order to detect opportunities for the conception of innovative software products.						M		H		
A4	Formalization of partnerships with utilities and manufacturers to develop standards and innovative products for smart metering and active management of distribution grids with large scale integration of microgeneration and EV integration.				H	M					
A5	Detailed analysis of human resource needs, namely at senior level.		M								H
A6	Definition of a portfolio for advanced training actions.	M									
A7	Participation in FP7/8 proposals.	M	M	H				M		L	
A8	Definition of a detailed action plan for interdisciplinary work on smart grids.	M			M	H		H		L	
A9	Identify ways to explore the market in South America, namely in Brazil and Chile.						H	L		L	
A10	Develop research on the topics of pan-European grid planning, operation and monitoring and distributed energy storage.	M		M		H				L	

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

5.5.2 OTHER INITIATIVES / ACTIONS FOR THE YEAR

Other initiatives / actions will be carried out during 2012, namely:

Planning and Forecasting

- Developing new concepts on security of supply involving electric mobility within planning and operating process that can be attractive to the industry.
- Integrating short-term and long-term operational reserve issues in order to explore some scientific opportunities and consolidating the operational reserve subject as the know-how area of Power System Unit.
- Developing a forecasting-based platform in for the integration of different applications based on forecasting process, essentially to deal with recent demands on wind power forecasting requests.
- Maintaining the existing link between INESC Porto and Portuguese and Spanish TSO through the improvements and new developments of tools.

Electricity Markets and Regulation

- Resume and increase the contact with the Portuguese Regulatory Agency;
- Develop tools to help generation and network agents to prepare long term expansion plans;
- Continue the research effort on the integration of uncertainties in several models related with power system operation under competition.

Distribution Systems

- Continue research on decision aid for loss reduction – optimization of investments in network reinforcement, aiming at reducing energy losses in the most effective way.
- Research on loss studies – characterization of losses in the HV networks, namely in the Portuguese distribution system grid. Determination of typical losses in a variety of scenarios. Analysis of the distributed generation impact in HV losses.

Smart Grids

- Commitment to research, development, demonstration and support to innovation in the Electric Vehicles deployment topic.
- Start research activities regarding the development of new protection systems for smart grids applications.
- Development of concepts, organizational schemes and general specifications for electric vehicles integration, with emphasis on pre-normative actions and on the industrial valorisation of results.
- Enhance the process of technology transfer to the utilities and industrial partners, taking into consideration the developments achieved in REIVE project.
- Define plans for establishing more stable links with researchers from the power electronics area in the framework of smart grid research activities.

DMS/EMS

- Maintain the relation with EFACEC with new contracts related with new functionalities namely the ones related with EMS.
- Increase scientific partnerships with institutions in Brazil, with ANEEL P&D projects involving INESC P&D Brazil.
- Improve the efficiency of already implemented algorithms in terms of computing time by changing some functions.

- Launch research activities related with low voltage networks, namely dealing with a large quantity of data and new state estimation challenges.

5.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

5.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	16	33	176	283	61%
European Union Programmes	155	332	282	370	31%
Consultancy and R&D Services	924	902	939	843	-10%
Other R&D Services		194	325	732	125%
Other External Services	17	16	15		-100%
Total (k€)	**1.112**	**1.477**	**1.737**	**2.228**	**28%**

5.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	16	18
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	81	45
Books (author)		
Chapter/paper in books		3
Publications (editor)		
Other publications (National meetings, local journals, etc.)	2	
Theses concluded by members of the Unit	1	6
Total	**100**	**72**

Journal	2011 (Predicted)	2012
Applied Energy	1	1
Electra	1	1
Electric Power Systems Research	1	2
Energy International Journal	1	1
European Transactions on Electrical Power	3	3
IEEE Transactions on Smart Grid	1	1
IEEE Transactions on Power Delivery	1	1
IEEE Transactions on Power Systems	3	3
International Journal of Power and Energy Systems 2011	1	1
International Journal on Advances in Software 2011	1	1

Journal	2011 (Predicted)	2012
The Proceedings of the IEEE	1	2
Wind Energy	1	1
Total	**16**	**18**

5.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master			53	**53**
Doctoral	3	13	5	**21**
Total	**3**	**13**	**58**	**74**

5.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	1
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	2
Advanced training courses	1

(1) Actions involving single institutions are not included

5.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	DYMONDS	Manuel Matos	01-10-2010	30-09-2013
PN-FCT	GEMS	Vladimiro Miranda	01-04-2010	30-09-2012
PN-FCT	GreenIsland	Manuel Matos	01-04-2009	31-03-2012
PN-FCT	LASCA	Vladimiro Miranda	01-01-2011	30-06-2013
PN-FCT	MicroGrids+EV	João Peças Lopes	01-01-2011	31-12-2013
PN-FCT	SMAGIS	João Peças Lopes	05-04-2011	04-04-2014
PUE-I&D	CitInES	Yannick Phulpin	01-10-2011	31-03-2014
PUE-I&D	iTesla	André Madureira	01-01-2012	31-12-2015
PUE-I&D	MERGE	João Peças Lopes	01-01-2010	31-12-2011
PUE-I&D	TWENTIES	Carlos Moreira	01-04-2010	31-03-2013
SERV-INT	AEAI_LOAD	José Nuno Fidalgo	01-01-2012	31-12-2012
SERV-INT	Argos	Vladimiro Miranda	01-12-2008	31-07-2011
SERV-INT	ONS-EOLICA	Mauro Rosa	16-05-2011	15-11-2012

Funding source	Short name	Leader	Starting date	Ending date (predicted)
SERV-INT	Parafuzzy	Jorge Correia Pereira	01-09-2008	31-12-2011
SERV-INT	SIMULESP	Jorge Correia Pereira	01-01-2011	31-12-2013
SERV-NAC	ACORES_VB	Carlos Moreira	30-09-2011	29-03-2012
SERV-NAC	ASIRP	José Nuno Fidalgo	15-06-2009	30-11-2011
SERV-NAC	Consultoria	Manuel Matos	01-01-2008	
SERV-NAC	DOPF-Efacec	Jorge Correia Pereira	01-09-2010	31-12-2011
SERV-NAC	EDA-RENOV	Carlos Moreira	15-03-2011	14-09-2011
SERV-NAC	EDP_FradesII	Carlos Moreira	20-07-2011	19-04-2012
SERV-NAC	EEM_RENOV	Carlos Moreira	01-09-2011	31-05-2012
SERV-NAC	EFACEC-DMS	João Peças Lopes	15-04-2001	
SERV-NAC	EFACEC-OPF	Jorge Correia Pereira	01-10-2006	
SERV-NAC	REN_FACTS	Carlos Moreira	06-03-2011	05-12-2011
SERV-NAC	REN-RECEP	João Peças Lopes	01-10-2007	31-12-2011
SERV-NAC	Vvar-Efacec	Jorge Correia Pereira	01-09-2010	31-12-2011
OID	REIVE	João Peças Lopes	02-03-2010	30-09-2012
OID	REIVE/ON2	João Peças Lopes	02-03-2010	30-09-2012
O	CoordEES-UETP	João Peças Lopes	01-04-2007	

Source:

PN-FCT: National Programme - FCT

PN-QREN: National Programme - QREN

PUE-I&D: European Union Programmes - R&D

PUE-DIV: European Union Programmes - Others

SERV-NAC: Consultancy and R&D Services - National

SERV-UE: Consultancy and R&D Services - European Union

SERV-INT: Consultancy and R&D Services - International

OID: Other R&D Services

O - Other External Services

INT - Internal

6 USIG – INFORMATION AND COMPUTER GRAPHIC SYSTEMS

Coordinator: António Gaspar, Fernando Silva

6.1 PRESENTATION OF THE UNIT

The Information and Computer Graphics Systems Unit (USIG) conducts R&D in the three main areas of Computer Science: Information Management and Systems, Software Engineering, and Computer Graphics and Virtual Environments. Research is closely matched with application areas in which the Unit has large experience and established successful partnerships. These are: public administration (local, regional and central government), healthcare, telecommunications, transport and industry, commerce and services sectors. In these areas of research, the unit is also strongly committed to advanced training of young researchers and professionals.

This Unit has some 20 years in contributions to the e-governing revolution and a strong tradition in technology transfer processes and projects. INESC Porto technology developed within this Unit is present in an extremely large number of municipalities and public administration organizations in Portugal.

Our challenge is to link emerging market needs with research objectives, creating innovative solutions based on excellent research results, producing societal impact and contributing to the modernization of enterprises and institutions.

Strategic Objectives

- Develop fundamental and applied research with international impact.
- Train highly qualified young researchers.
- Further develop scientific competencies in software engineering methodologies, information retrieval, digital preservation, and virtual environments and serious games, areas where demand by industry is increasing.
- Strengthen Unit's cohesion by promoting internal communication based on regular seminars
- Increase involvement in international projects, most particularly European projects.
- Increase the Unit's scientific publication record in international journals.
- Maintain strategic consultancy and technology transfer in the key areas of our unit.
- Achieve a sustainable balanced economic performance.

6.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Computer Graphics and Virtual Environments

Computer Graphics and Virtual Environments, with special emphasis on Image Synthesis and Visual Perception, Geospatial Systems, Virtual Environments and Digital Games.

Participating in Research and Development (R&D) projects on Computer Graphics and Virtual Environments, the Information and Computer Graphics Systems Unit (USIG) specialises in Image Synthesis and Visual Perception, Geospatial Systems, Virtual Environments and Digital Games. In this context, special attention has been given to urban environment modelling and visualisation in mobile devices. For that, the Unit's researchers study innovative methods with different applications, including urban planning based on virtual environments.

Within Geospatial Systems, research topics include geospatial and sensor Web semantics, time-space rationalisation and visualisation, which can be applied in spatial data infrastructures and environment sensor networks, as well as Ambient Assisted Living.

Software Engineering

Software architectures for complex systems, agile process engineering, managing knowledge in software projects and their organization, software quality, testing, verification and certification.

The Information and Computer Graphics Systems Unit (USIG) defines and develops software architectures for complex systems, and promotes agile process engineering adapted to each project. Furthermore, the Unit specialises in managing specific knowledge in software projects and their organisation, promoting software quality, testing, verification and certification.

With these activities, USIG aims to improve and bring innovation to the current software methodologies, with special emphasis on formal methods, agile and collaborative development methodologies.

Information Management and Systems

Information Systems, information retrieval, digital repositories and preservation; managing, retrieving and processing information in contexts of web mining, social web, web semantics and text mining.

The Information and Computer Graphics Systems Unit (USIG) specialises in Information Systems and Management, developing Research and Development (R&D) projects in Information Systems, Information Retrieval, Digital Repositories and Preservation. The aim is to study frameworks to manage, retrieve and process information in contexts of web mining, social web, web semantics and text mining. As a result, USIG has managed to develop innovative systems, including digital cultural heritage portfolios, as well as e-learning environments and tools. Modelling and control of off-shore wind power and multi-terminal HVDC grids;

Modelling and control of FACTS (Flexible AC Transmission Systems);

Control models for systems that connect electric vehicle batteries to the network.

6.1.2 TECHNOLOGY TRANSFER

Modernising Public Administration

Strategic Consultancy and Software Engineering for e-Government and e-Democracy at the levels of Local Public Administration and Central Administration.

The Information and Computer Graphics Systems Unit (USIG) has a long history of cooperation with Public Administration, which started in the 1980s with the development of an ERP (Enterprise Resource Planning) for Local Authorities.

Currently, collaboration takes place at the levels of Local Public Administration and Central Administration.

USIG's research activities focus mostly on Strategic Consultancy and Software Development. The aim is to modernise, improve and simplify administrative processes and implement e-Government and e-Democracy solutions.

Examples of these activities include the technical support to calls (SAMA) and regional development activities (technical teams of the PROT – Regional Planning for Portuguese Regions – North, West and Tejo Valley and Metropolitan Area of Lisbon), as well as the development of innovative applications (GeoForum, Collaborative Platforms).

Business Competitiveness

Strategic Consultancy and Technology Transfer in Information and Communication Technologies (TIC), innovatively integrating technology in business processes and using it as a differentiating factor in order to promote business competitiveness.

The Information and Computer Graphics Systems Unit (USIG) has a strong tradition of providing services to companies. Collaborations focus on Strategic Consultancy and Technology Transfer, and we promote the modernisation and optimisation of the companies' technology, aligning it with businesses. The Unit's scientific and technological competencies include: Information Systems, Decision Support Systems, Geographic Information Systems, Software Quality and Methodologies to Develop Software.

Examples of collaborations include the Master Plans for Information Systems, Studies, Opinions, System Integration and Software Development, integrated with Advanced Training, from a Technology Transfer perspective.

6.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)		
			Modernising Public Administration	Business Competitiveness	Other areas (4)
Computer Graphics and Virtual Environments		I	H	M	
Software Engineering		I	M	H	
Information Management and Systems		I	H	H	
Other areas (3)	Security (CRACS)	O	H	H	

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

6.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Information and Computer Graphic Systems Unit is jointly coordinated by António Gaspar and Fernando Silva.

The Unit is structured into the following Areas:

- Scientific Areas
  - Computer Graphics and Virtual Environments – Leader: Augusto Sousa
  - Software Engineering – Leader: Pascoal Faria
  - Information Management and Systems – Leader: Cristina Ribeiro
- Application Areas
  - eGovernment – Leader: Rui Barros
  - Transports – Leader: José Correia

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Unit Coordinators
- Area Leaders
- 2 researchers (Angelo Martins, Gabriel David)

Occasionally the coordination council will be enlarged to accommodate the participation of project coordinators and other senior researchers.

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	8	8	8
		University and Polytechnic	12	12	12
		Grant Holders and Trainees (PG)	24	26	26
		Total R&D	***44***	***46***	***46***
	Shared Structure (Central and Local)		**1**	**1**	**1**
Total Internal			***45***	***47***	***47***
External Collaborators and Invited Researchers			6	5	6
Global Total			**51**	**52**	**53**

(1) Information at the time of the elaboration of the present Plan

6.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

6.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Large experience in ICT consulting, development and project management activities, ranging from Contracted Services to R&D&TT projects in European and National funding programs.
S2	Integrated and encompassing offer of consulting services, development, demonstration and technology transfer in the area of ICT.
S3	Scientific competences in Computer Graphics, Information Management, Information Systems and Software Engineering.
S4	eGovernment domain knowledge.
S5	Membership of LIAAD, CRACS, CISTER and HASLAB R&D groups in INESC Porto LA.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Limited partnerships
W2	Short projects
W3	Limited marketing activity
W4	Limited cooperation with national software industry
W5	Unbalanced economic situation
W6	Reduced number of journal publications
W7	Team geographical dispersion
W8	Dependence on funded projects

6.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Various funding opportunities, at national and international level, with QREN and FP7.
O2	Increased use of ICT due to modernization need of institutions and enterprises.
O3	Growing national software industry.
O4	Existing International Research Cooperation programs, e.g. CMU-Portugal, UT-Austin.
O5	Participation in several Clusters and Associations (DANOTEC, CEDT, ITS Portugal, TICE.PT, AIFF, OCEANOS).

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Dependence on grants mindset.
T2	Increased competition in funding programs, particularly European.
T3	Economic crisis.

6.4 STRATEGIC FORMULATION

6.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Develop fundamental and applied research with international impact.	S1 S3			
OBJ2	Train highly qualified young researchers.				
OBJ3	Further develop scientific competencies in software engineering methodologies, information retrieval, digital preservation, and virtual environments and serious games, areas where demand by industry is increasing.	S1 S3 S4			
OBJ4	Strengthen Unit's cohesion by promoting internal communication based on regular seminars.		W7		
OBJ5	Increase involvement in international projects, most particularly European projects.	S1 S5		O1 O4	T2
OBJ6	Increase the Unit's scientific publication record in international journals.	S3	W6		
OBJ7	Maintain strategic consultancy and technology transfer in the key areas of our unit.	S2 S4	W4	O2 O5	T3
OBJ8	Achieve a sustainable balanced economic performance.	S1 S2 S3 S4 S5	W1 W2 W3 W4 W5 W8	O1 O2 O3 O4 O5	T1 T2 T3

6.5 SRATEGIC IMPLEMENTATION

6.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)							
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8
A1	Take advantage of various funding opportunities, at national and international level, and of large experience in consulting, development and project management to submit diversified proposals to different programs and partners, in cooperation with other Units, LIAAD, CRACS, CISTER and HASLAB groups, and involving national software industry.	H		M		H	H	H	H
A2	New projects should be based on key competences, to guarantee differentiation regarding other Units, R&D groups and enterprises, as well as guaranteeing added value to partners.			H		M	M	M	M
A3	Use eGovernment domain knowledge and track record to promote USIG's activities and create new partnerships.	H		M		H	M	M	M
A4	Involve private companies in consortia, taking advantage of new funding opportunities.			H		H			M
A5	Proposal submission in diversified funding programs, selecting partners with successful track records.	H				H			H
A6	Use key competences in proposals to guarantee added value and ROI for partners.	H		H		H		H	H
A7	Leverage academic core team, in proposals submission, with internal and external scientific partnerships, like other Units, LIAAD, CRACS, CISTER, HASLAB and Hillside Group.	H		H		H	H		H
A8	Use funding opportunities to diversify partnerships, internally and externally, with institutions and enterprises, particularly software houses, focusing in medium and long term projects.			H		H		H	H
A9	Increase number of direct contracts, to diversify funding sources.			H				H	H
A10	Develop website, focusing on success stories, key competences and their added value, particularly for the software industry. Approach software houses using funding opportunities or through service contracts with added value proposals.			H				H	H

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

6.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

6.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	242	294	597	464	-22%
European Union Programmes	39	231	316	302	-4%
Consultancy and R&D Services	590	348	235	367	56%
Other R&D Services		21			
Other External Services					
Total (k€)	**871**	**894**	**1.148**	**1.133**	**-1%**

6.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	4	13
Papers in National Journals with scientific referees		1
Conference Proceedings in events with scientific referee and selection	35	33
Books (author)		
Chapter/paper in books	2	1
Publications (editor)		1
Other publications (National meetings, local journals, etc.)	3	2
Theses concluded by members of the Unit	3	
Total	**47**	**51**

Journal	2011 (Predicted)	2012
Computer Graphics Forum		2
European Journal of Operational Research		1
International Journal of Computer Games Technology	1	1
International Journal of Medical Informatics	1	
International Journal on Software Tools for Technology Transfer		1
IPM		1
Journal of Applied Research in Intellectual Disabilities		2
Journal of Systems and Software		2
Journal of the American Society for Information Science and Technology	1	2
Journal of Virtual Worlds Research	1	1
Total	**4**	**13**

6.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	31	9	32	**72**
Doctoral	11	10	2	**23**
Total	**42**	**19**	**34**	**95**

6.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	4
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	2
Advanced training courses	

(1) Actions involving single institutions are not included

6.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	3DWikiU	Augusto Sousa	01-04-2010	30-09-2012
PN-FCT	ERAS	Augusto Sousa	01-03-2011	31-08-2013
PN-QREN	AAL4ALL	Ângelo Martins	01-01-2011	31-12-2013
PN-QREN	CNG	António Gaspar	03-01-2011	31-12-2012
PN-QREN	CompanyDocs	Rui Barros	01-01-2011	31-12-2013
PN-QREN	Desktop4IPbrick	Rui Barros	01-09-2010	31-08-2012
PN-QREN	ECOPLANNER	José Correia	01-02-2011	31-01-2013
PN-QREN	Mobiles-1	José Correia	30-05-2009	29-02-2012
PN-QREN	PortalDouro	António Coelho	01-04-2009	31-12-2011
PN-QREN	RobVigil-2	António Coelho	01-01-2010	31-12-2011
PN-QREN	TICE.Mobilidade	José Correia	01-01-2011	31-12-2013
PUE-DIV	CAALYX-MV	Ângelo Martins	01-04-2011	31-03-2014
PUE-DIV	CEMSDI	Rui Barros	01-06-2010	31-05-2012
PUE-DIV	eCAALYX	Ângelo Martins	01-05-2009	30-04-2012
PUE-DIV	RAIA	Artur Rocha	01-01-2009	31-12-2011
PUE-I&D	ICARUS-1	António Gaspar	01-01-2012	
PUE-I&D	ICT4Depression	Ricardo Henriques	01-01-2010	31-12-2012
SERV-NAC	AVESAT	António Gaspar	01-01-2011	31-12-2011
SERV-NAC	CCDRN-EA	António Gaspar	21-10-2010	

Funding source	Short name	Leader	Starting date	Ending date (predicted)
SERV-NAC	CorredorAzul	António Gaspar	01-01-2011	31-12-2012
SERV-NAC	GIS2R	António Gaspar		
SERV-NAC	MIELE	António Gaspar	01-01-2012	
SERV-NAC	RAIA.co	Artur Rocha	01-01-2011	31-12-2013
SERV-NAC	SI.VIDA 3	José Correia	01-01-2012	
SERV-NAC	TICE.PT	José Correia	01-01-2012	

Source:

PN-FCT: National Programme - FCT
PN-QREN: National Programme - QREN
PUE-I&D: European Union Programmes - R&D
PUE-DIV: European Union Programmes - Others
SERV-NAC: Consultancy and R&D Services - National
SERV-UE: Consultancy and R&D Services - European Union
SERV-INT: Consultancy and R&D Services - International
OID: Other R&D Services
O - Other External Services
INT - Internal

7 UTM – TELECOMMUNICATIONS AND MULTIMEDIA

Coordinator: Manuel Ricardo, Augustin Olivier

7.1 PRESENTATION OF THE UNIT

The Telecommunications and Multimedia Unit (UTM) performs Research and Development (R&D) in areas that will lay the foundations for modern communications networks and services such as network architectures, communications services, signal and image processing, optical technologies, microelectronics, digital TV, and multimedia.

Strategic Objectives

- Carry out applied research capable of competing on a national and international level;
- Help to improve the competitiveness of partners through the incorporation of innovative scientific results;
- Contribute to the scientific and technical training of high-quality human resources;
- Help modernising the scientific and technological education system;
- Promote the creation of new business initiatives by encouraging young researchers to take risks and use their initiative;
- Promote R&D activities that require multidisciplinary competencies;
- Develop and maintain critical mass in the Unit's key areas of expertise.

7.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Information Processing and Pattern Recognition

Research in Information Processing and Pattern Recognition, namely computer vision, sound and music computing and network information processing.

At UTM we combine fundamental and applied research in machine learning, signal processing and human-computer interaction, with applications in computer vision, image processing, sound and music computing, and network information processing.

Our research on Image and video processing focuses on medical images, manuscript documents and video object tracking and can be applied in areas such as surveillance and sports. Our research in sound and music computing covers music information retrieval, interactive music systems and musical robotics. The research at UTM on machine learning mainly focuses on the adaptation of learning techniques to the challenges presented by audiovisual data. Finally, our research on network information processing focuses on the analysis of the relations between elements that are typically expressed in the form of graphs and this can be applied in domains such as communications or social networks.

Multimedia Communications Technologies

Research and development in metadata, semantic technologies and ontologies, distributed technologies, data analysis and decision algorithms applied in the management and distribution of multimedia content; context-aware multimedia applications, recommendation systems for multimedia content and adaptable mobile multimedia applications.

At UTM we have vast experience in the development of multimedia communications technology, namely multimedia content management and distribution, context-aware multimedia services, recommendation systems for multimedia content and adaptable mobile multimedia applications.

Our main research topics focus on the adaptation of multimedia content according to its contexts of use and interoperability between content description systems and access systems for content repositories. Our strategic lines of research in this area include the use of middleware, semantic metadata and ontologies and intelligent data analysis techniques that can be applied in the development of transparent and non-intrusive systems. These lines of research will enable any user to access any type of content, in any place, from any type of multimedia device.

Communications Networks

Research and Development in Communications Networks, with applications in wireless communications, network management, security and Quality of Service.

At UTM we conduct research in Communications Networks and have developed skills in modelling communications networks and their elements, the performance analysis of communication networks and systems and in the implementation of these elements.

Our main research topics include the development of solutions for network self-configuration, routing in vehicular networks, large scale networks, network congestion control, optimisation using cross-layer techniques and machine to machine communications. One of our emerging lines of research is aimed at developing network management solutions using machine learning methods.

Optical Technology and Electronics

Optical Technology and Optoelectronics for Optical Communications, microwave circuits and antennas, Microelectronics, programmable logic and dynamic reconfiguration.

At UTM we integrate advanced skills in optical communications, microwave circuits and antennas, microelectronics (design and testability), programmable logic and dynamic reconfiguration.

Our research activities in optical communications and microwaves include the analysis and design of radio systems based on optical fibres (radio over fibre), signal processing in optical systems and in next generation passive optical networks, monitoring failures in optical networks, resource optimisation in Optical Burst Switching networks, the development of optoelectronic transceivers and the design of compact antennas for next generation mobile networks.

Our research activities in microelectronics and programmable logic include the design and testability of circuits, the characterisation and adaptive correction of performance, analogue computing, A/D and D/A conversion, image processing and dedicated computing applications in reconfigurable logic, methodologies for dynamic reconfiguration, hardware/software co-design and Very Large Scale Integration design.

7.1.2 TECHNOLOGY TRANSFER

Communication Network Solutions and Consulting Services

Architectures, management models and services for access networks (wireless networks, security, mobility management, planning and management of network resources).

The work carried out by UTM in the Communication Network area combines the planning and the design of networks capable of supporting multimedia services including video broadcasting services, wireless mesh networks for extending wired networks, vehicular networks, communication networks between objects and sensor networks. At UTM we have also developed security solutions for communication networks and services.

At UTM we have vast experience in the design, development and testing of communication protocols and software. This experience has been applied in a large number of projects and contracts with industrial partners.

Multimedia Systems and Services / Digital Media

Multimedia applications in heterogeneous environments, metadata, content adaptation and recommendation and access to context-based multimedia content.

At UTM we have a long history of cooperation with companies that produce and distribute multimedia contents and contents for TV and digital cinema. Working as an intermediary between content sources and consumers, at UTM we have gained vast experience in the development of distributed systems that allow users to access and use multimedia content in heterogeneous environments.

Our main areas of intervention include designing and developing annotation systems for multimedia content, managing distributed multimedia content repositories, adapting multimedia content to the context of use and content recommendation for IPTV and the mobile Web.

Intelligent Recognition Products and Systems based on Sound and Vision

Solutions to automatically process manuscript documents, medical decision support systems, automatic surveillance systems, systems to analyse the performance of athletes and sports teams using video, solutions for audio signal processing and sound and music computing.

At UTM we develop innovative solutions with practical applications in fields such as surveillance, sports and medicine. In the area of surveillance, we have designed alarm systems using the automatic analysis of image and video content. In the area of sports we have assessed the performance of athletes and sports teams by automatically analysing images and by using video sequences. In the medical field we have used our know-how in the automatic analysis of medical images to support medical diagnosis and reports. Intelligent human-machine interaction systems and specialised Optical Character Recognition solutions to automatically process manuscript documents have also been developed and applied in multiple fields of application.

At UTM we have also developed music-related solutions, including recommendation systems for musical contents, systems to analyse and visualise musical content in several formats, systems for music information retrieval and systems for the automatic generation of music.

Optical and Microwave Communication Systems and Networks

Telecommunication solutions based on wireless technology with optical fibre supports, research and development in compact multi-band antennas for mobile networks, developing, testing and characterising RF/microwave devices, antennas and waveguides.

At UTM we have an advanced laboratory for optical and microwave communications where researchers can test and characterise optoelectronic devices, RF/microwave circuits and waveguides. This laboratory makes it possible to develop and test optical and wireless communication systems and develop optical fibre based solutions for broadband wireless applications (Wi-Fi, UWB ECMA-368 and 60 GHZ ECMA-387). Furthermore, these facilities are used for research on nonlinear electrical dispersion compensation and equalisation using signal processing techniques in coherent optical systems.

We also specialise in the use of fractal techniques and band gap electromagnetic structures to develop compact multi-band antennas for the future generation of mobile networks. More recently, UTM has started developing skills in monitoring failures in optical networks, particularly in passive networks, using Optical Time Domain Reflectometer based on digital photon counting techniques.

Designing and Consulting in (Micro)electronic Systems for Communications

Semi/full-custom designing and testing of analogical, digital and combined (A/D) circuits and digital systems based on microprocessors and reconfigurable logic.

At UTM we specialise in the design of analogue and digital electronic circuits in silicon-monolithic material, printed circuits or reconfigurable platforms and the development of analogue or mixed-signal circuits for low and radio frequency applications.

Testing and auto-testing solutions for integrated circuits and systems, designing monitoring and testing systems based on personal computers, reconfigurable logic processing and computing solutions and/or embedded systems and implementing adaptive systems based on dynamic reconfiguration are also some of the areas we focus on for technology transfer.

7.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)					
			Communications Network Solutions and Consulting Services	Multimedia Systems and Services/Digital Media	Intelligent Products and Systems for Recognition Based on Sound and vision	Optical and Microwave Communication Systems and Networks	Designing and Consulting in (Micro)electronic Systems for communications	Other areas (4)
Information Processing and Pattern Recognition		I	M	H	H			
Multimedia Communication Technologies		I	M	H	M			
Communication Networks		I	H	M	L	M		
Optical Technology and Electronics		I	M			H	H	
Other areas (3)								

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

7.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Telecommunications and Multimedia Unit is jointly coordinated by Manuel Ricardo and Augustin Olivier.

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Manuel Ricardo, Augustin Olivier, José Ruela, Carlos Pinho, Maria Teresa Andrade, Paula Viana, Luis Côrte-Real, Jaime Cardoso, Fabien Gouyon, Carlos Guedes, Ricardo Morla, Henrique Salgado, Vítor Tavares, José Machado da Silva.

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	4	5	5
		University and Polytechnic	27	26	25
		Grant Holders and Trainees (PG)	58	64	60
		Total R&D	***89***	***95***	***90***
	Shared Structure (Central and Local)		**1**	**1**	**1**
		Total Internal	***90***	***96***	***91***
External Collaborators and Invited Researchers			13	12	12
		Global Total	**103**	**108**	**103**

(1) Information at the time of the elaboration of the present Plan

7.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

7.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Good environment for work (administrative efficiency).
S2	Solid and diverse scientific expertise (flexibility and adaptability).
S3	Experience in international projects, with relevant companies.
S4	Ease to integrate and to participate in multi-disciplinary projects.
S5	Size of the Unit in terms of researchers.
S6	Proximity to other internal R&D groups.
S7	Scientific merit of many of the elements of the Unit.
S8	Enhancer of teaching careers.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Lack of international recognition for leadership in one or more scientific areas (low external visibility).
W2	Lack of active participation of senior members in decision-making fora, at national and European level.
W3	Lack of information on the work and activities carried out by other groups and Units (deficient communication mechanisms within the Unit).
W4	Lack of systematized knowledge of the Portuguese industry, required to identify research challenges and opportunities.
W5	Lack of partnerships with foreign companies.
W6	Lack of critical mass in some areas (Multimedia, Optical Technology and Electronics).
W7	Dispersion of area activities without a common strategy decided at Unit level.
W8	Existing results and prototypes are not visible from our environment.
W9	Lack of motivation for the valorisation of knowledge.

7.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Exploitation of results and consolidation of partnerships in projects funded by the QREN programme.
O2	Fast technological evolution in most of the domains covered by the Unit.
O3	Increasing importance of communications, applications and services in horizontal activities.
O4	Availability of critical mass in the associates of INESC TEC and capability to extend current activity.
O5	Work done by MSc and PhD students as a potential source of valorisation and transfer of technology.
O6	Transport market with growing needs to add services.
O7	Availability of national and international young researchers.
O8	Closeness to PCT (*Pólo de Competitivade e Tecnologia*) OCEANO XXI (research in underwater communications).
O9	Existence of a large contact list of international partners.
O10	Explore synergies with other INESC Porto units: SmartGrids and Machine2Machine communications.
O11	Development of applications for smartphones.
O12	Explore international opportunities where INESC Porto has some kind of penetration/influence.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	End at the short-term of funding programs and reduced funding opportunities due to economic crisis.
T2	Absence of strategic industry partners.
T3	Lack of external visibility of INESC Porto in the Telecommunications and Multimedia areas.
T4	European programs very competitive and loss of influence of the UTM in FP7.
T5	Lack of students interested in technological fields.
T6	Relocation of businesses to other markets.

7.4 STRATEGIC FORMULATION

7.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Improve the UTM external image and visibility, both in the scientific and technology transfer domains.	S2 S3 S4 S5 S6 S7	W1 W5 W8	O1 O2 O3 O4 O6 O8	T3 T4 T6

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
				O9 O10 O11 O12	
OBJ2	Clarify the background and scientific strategy of each area for joint exploration of current and future opportunities.	S1 S2 S4 S6	W3 W6 W7	O1 O2 O3 O4 O12	
OBJ3	Attract the best students and researchers.	S1 S2 S7 S8	W1 W5 W6	O7 O12	T3 T5
OBJ4	Promote a continued collaboration with strategic companies maximising the common benefits.		W4 W5 W8 W9	O1 O3 O5 O6 O8 O9 O10 O11 O12	T1 T2 T4 T6
OBJ5	Strengthen internal communication and collaboration (among the several areas and internal Units). Explore synergies, promote joint projects and theses.	S1 S4 S6	W1 W3 W7	O3 O6 O8 O9 O10 O11 O12	T3 T5
OBJ6	Improve UTM's participation in European projects and consultancy services for companies.	S2 S3 S4 S5 S6 S7	W1 W2 W3 W4 W5 W8	O1 O2 O3 O5 O6 O8 O9 O10 O11 O12	T1 T2 T3 T4

7.5 SRATEGIC IMPLEMENTATION

7.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)					
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6
A1	Increase UTM participation in European project proposals.	H			H	M	H
A2	Propose new projects exploring results from projects with existing consortia.	L			H		H
A3	Publish in high impact factor forums.	H		H			M
A4	Improve UTM's Web Site to promote our results and competencies.	H	H	M			L
A5	Develop an integrated strategy for the Internet of things, by proposing at least one project.	L				H	M
A6	Explore the Brazilian market, by proposing at least one project.	H		L	L		M
A7	Promote periodic scientific meetings involving UTM areas and other INESC TEC Units.		M			H	L

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

7.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

7.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	398	552	713	592	-17%
European Union Programmes	178	191	268	336	25%
Consultancy and R&D Services	105	113	73	71	-3%
Other R&D Services		68	80	90	13%
Other External Services	33				
Total (k€)	**714**	**924**	**1.134**	**1.089**	**-4%**

7.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	20	23
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	48	45
Books (author)		
Chapter/paper in books	3	3
Publications (editor)	1	2
Other publications (National meetings, local journals, etc.)	13	15
Theses concluded by members of the Unit	9	12
Total	**94**	**98**

Journal	2011 (Predicted)	2012
Academic Radiology	1	
Annals of Surgical Oncology	1	
Annals of Telecommunications		1
Breast Cancer Research and Treatment		1
Computer Communications	1	
Computer Music Journal		2
Computer Networks	1	
Elsevier Journal on Microprocessors and Microsystems		1
EURASIP Journal on Audio, Speech, and Music Processing		1
Experimental Techniques	1	
IEEE Antennas and Wireless Propagation Letters	1	
IEEE Microwave Theory and Techniques		1
IEEE Transactions on Audio, Speech and Language Processing		2

Journal	2011 (Predicted)	2012
IEEE Transactions on Circuits and Systems		1
IEEE Transactions on Geoscience and Remote Sensing	1	
IEEE Transactions on Image Processing	1	
IEEE Transactions on Mobile Computing	1	
IEEE Transactions on Multimedia		1
IET Communications		1
IET Microwave Antennas & Propagation		1
Image and Vision Computing		1
International Journal of Multimedia Information Retrieval		1
International Journal of Pattern Recognition and Artificial Intelligence	1	
International Journal of Remote Sensing		1
Journal of Experimental Psychology: Human Perception and Performance	1	
Journal of Network and Computer Applications	1	
Journal of New Music Research	2	1
Journal of Systems Architecture	1	
Journal of Web Semantics		1
Multimedia Tools and Applications	3	1
Music Perception		1
Optics Express		1
Pattern Analysis & Applications		1
Simulation Modelling Practice and Theory	1	
Telecommunication Systems		1
Wireless Communications and Mobile Computing	1	
Total	**20**	**23**

7.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	8		30	**38**
Doctoral	8	40	12	**60**
Total	**16**	**40**	**42**	**98**

7.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	5
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	10
Advanced training courses	2

(1) Actions involving single institutions are not included

7.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	3dBCT	Jaime Cardoso	01-06-2011	31-05-2014
PN-FCT	CASA	Fabien Gouyon	04-04-2011	03-04-2014
PN-FCT	ImTV	Paula Viana	01-09-2010	28-02-2013
PN-FCT	KINETIC	Carlos Guedes	01-04-2009	31-12-2011
PN-FCT	MC-WMN	Manuel Ricardo	01-04-2012	31-03-2015
PN-FCT	MuMoMgt	José Ruela	01-02-2009	31-01-2012
PN-FCT	NeTS	Ricardo Morla	01-09-2010	31-08-2013
PN-FCT	OSP	Maria Inês Carvalho	08-04-2010	07-04-2013
PN-FCT	ProLimb	José Machado da Silva	05-04-2010	04-04-2013
PN-FCT	SafeHomeHealthCare	Ricardo Morla	01-05-2010	31-10-2012
PN-FCT	SELF-PVP	Vítor Grade Tavares	01-09-2010	31-08-2013
PN-FCT	SHAKEIT	Fabien Gouyon	14-03-2011	13-03-2014
PN-FCT	Steering	Maria Inês Carvalho	01-02-2011	31-01-2014
PN-FCT	SUM	Ricardo Morla	01-01-2011	31-12-2012
PN-FCT	WOWI	Henrique Salgado	01-01-2010	29-02-2012
PN-QREN	CNG-1	Maria Teresa Andrade	03-01-2011	31-12-2012
PN-QREN	Escolinhas_Criativas	Paula Viana	01-09-2010	31-08-2012
PN-QREN	Hotel3.0	Maria Teresa Andrade	01-01-2010	30-06-2012
PN-QREN	LUL	Luís Corte Real	02-01-2010	01-01-2012
PN-QREN	Mobiles	José Ruela	30-05-2009	29-02-2012
PN-QREN	P3.net	Ricardo Morla	02-02-2010	31-12-2012
PN-QREN	ReCoop	José Ruela	01-01-2009	31-12-2011
PN-QREN	RobVigil-1	José Ruela	01-01-2010	31-12-2011
PN-QREN	SITMe	Manuel Ricardo	01-06-2009	24-01-2012
PUE-I&D	Alicante	Manuel Ricardo	01-03-2010	28-02-2013
PUE-I&D	Convergence	Maria Teresa Andrade	01-06-2010	28-02-2013
PUE-I&D	Daphne	Henrique Salgado	01-09-2009	31-08-2012
PUE-I&D	MIRES	Fabien Gouyon	01-10-2011	31-03-2013
SERV-NAC	MultiRadioAccess	Manuel Ricardo	04-03-2011	03-03-2012
OID	REIVE-1	José Ruela	02-03-2010	30-09-2012

Source:

PN-FCT: National Programme - FCT
PN-QREN: National Programme - QREN
PUE-I&D: European Union Programmes - R&D
PUE-DIV: European Union Programmes - Others
SERV-NAC: Consultancy and R&D Services - National
SERV-UE: Consultancy and R&D Services - European Union
SERV-INT: Consultancy and R&D Services - International
OID: Other R&D Services
O - Other External Services
INT - Internal

8 UITT - INNOVATION AND TECHNOLOGY TRANSFER

Coordinator: Alexandra Xavier, João Claro

8.1 PRESENTATION OF THE UNIT

The Innovation and Technology Transfer Unit aims to contribute to the sustained development of R&D through people and knowledge valorisation.

UITT's mission is to develop R&D, Advanced Consulting and Executive Education in:

- Technology Management
- Innovation Management
- Technology Entrepreneurship.

Strategic Objectives

In the areas of Technology and Innovation Management the main objectives are:

- Improve INESC Porto's Management Practices in collaboration the Board of Directors and with other R&D Units;
- Support private companies in Technological Innovation Management processes.

In the area of Entrepreneurship the main objectives are:

- Support researchers and project promoters working in technology transfer;
- Support researchers and project promoters working on the valorisation of technology in the development of ideas, in the implementation of projects at the "proof of concept" stage and in the development of a business strategy;
- Support the Board of Directors by creating an innovative and entrepreneurial environment and culture at INESC Porto;
- Support public and private organizations operating technology entrepreneurship support programmes.

Concerning R&D activities the main objectives are:

- Knowledge creation in technology management, Innovation Management , and Entrepreneurship;
- Accept and support Master's and PhD students in the areas outlined above;
- Promote the valorisation of knowledge by development of conceptual frameworks, methodologies, tools and executive programmes to be supplied to private and public organizations.

8.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Technological Entrepreneurship

Commercialising technology, academic entrepreneurship, new businesses with great potential and creating new business deals in Creative Industries.

The Innovation and Technology Transfer Unit (UITT) invests in high quality research in entrepreneurship, for technology based companies, with the aim of improving its knowledge of how new businesses begin, grow and survive.

The Unit specialises in entrepreneurship and studies the difficulties in securing capital to commercialise technology in the early stages, looking at how different organisational solutions (pre-incubation and prior to approval of the concept) can help resolve this issue.

By studying factors that lead to support, such as downturns or blocked intentions, and entrepreneurial activities for university researchers in the early stages of business projects, UITT offers support in various aspects of the entrepreneurial process and in particular through the development of applied tools.

UITT conducts research on how to develop management capacities in new technological companies with great potential to enable them to meet internal and external challenges right from the beginning and as the company grows.

UITT's objective is to promote entrepreneurship and the valorisation and transfer of knowledge in Creative Industries by studying the character and impact of collaboration with universities, industries and the public sector and researching business models for digital media.

Innovation Management

Studying innovation, how it is organised, developed and commercialised for technology based companies.

At the Innovation and Technology Transfer Unit (UITT), researchers study practices, innovation management tools and the patterns of innovation (particularly in traditional industries) and have a successful history of contributing to the Portuguese Standards for Innovation Management (Research, Development and Innovation) and providing consultancy services in this area.

Furthermore, UITT studies the impact of investments in Research & Development (R&D) on the design, development and commercialisation of new products and services, not only internally for companies, but also in terms of their collaboration with R&D institutions.

Following a multidisciplinary approach that is at the "Front End of Innovation", UITT looks to combine methods and tools based on advanced concepts and tendencies in various areas, such as IT business systems, business integration, information and communication technologies and business analysis and modelling.

UITT looks at the advantages of using a combination of qualitative and quantitative methods in the study of innovative opportunities, looking at the user's needs and expectations and the possibilities that result from the development of new concepts, products and services.

UITT's team studies leadership as an entrepreneurial effort and consequently, as a driving force for innovation. The Unit also studies culture as a way of hindering or promoting innovation.

Innovation Networks

Open innovation, Technology transfer and Collaborative R&D.

The Innovation and Technology Transfer Unit (UITT) is recognised for its experience in studies on inter-organisational innovation in order to comprehend how innovation is managed in networks and with the aim of identifying the fundamental elements for collaborative innovation between companies, universities and public organisations. By analysing and comparing open innovation practices in various countries, UITT aims to understand the evolution and the different levels of openness found in various initiatives in this area.

UITT is also specialised in Technology Transfer by studying the impact of framework conditions, particularly on policies and innovation programmes in Technology Transfer Offices – TTOs. The research conducted at UITT in technological entrepreneurship and in academic entrepreneurship, in particular, and the commercialisation of technology is also highly relevant for technology transfer.

Using scientometric tools to analyse Research and Development (R&D) collaboration networks, UITT aims to measure and understand the impact of different instruments and collaboration incentives, such as technological clusters and international collaboration.

Technology Strategy

Technological roadmapping and integrating technology and operational strategies.

The Innovation and Technology Transfer Unit (UITT) studies the way in which companies create, keep and deliver value with technology. The aim is to understand how technology can be used to create and maintain a competitive advantage.

By exploring how uncertainties and flexibility are used in technological roadmapping, the UITT team can develop solutions to improve how technological roadmaps dynamically adapt to various future developments.

As part of technology integration strategies and operations in technological start-ups, UITT evaluates how companies grow and how their operational competencies change and study the adoption dynamics of technology in various contexts with different levels of complexity.

Engineering System Design

Flexible design of engineering systems in networks, integrated design of technology, operational and political systems.

The Innovation and Technology Transfer Unit specialises in the development of methods to design reliable products and complex systems in a proactive approach that results in the best performance in uncertain future operational conditions. Through the exploration of how uncertainties and flexibility interact in networks, UITT hopes to address the inherent complexities in the creation and operation of networks in uncertain conditions. An example of a case study is the work that is being developed for the energy network in the Azores Islands.

UITT also aims to improve system design methods to guarantee a higher integration of aspects related to engineering, management and social sciences that are traditional seen separately. By exploring innovative combinations for dynamic systems with optimised and flexible designs, the aim is to give rise to new analysis possibilities such as optimising policies, evaluating flexibility and system dynamics in uncertain contexts. Managing forest fires is a practical application of this type of work and UITT is currently involved in Project FIRE-ENGINE in this area.

Technology Policy

Developing human capital, innovation capacities and advanced training in entrepreneurship and commercialisation of technology.

The Innovation and Technology Transfer Unit (UITT) conducts research to promote the formation of policies in important technological dimensions of society, focusing on improving awareness of how economies develop, identify, value, assimilate and explore scientific and technological knowledge.

Within the framework of developing human capital and innovation capacities, UITT's researchers study the relationship between foreign trade, the development of human capital, individual Research and Development (R&D) efforts and economic growth. Using Portugal as a case study, UITT has looked at the relative impact that trade, human capital and R&D can have on growth, as well as looking at how the dynamics of technology adoption characterise this interaction.

By studying the role of networks and the role of education in particular, as important elements in the development and collaborative commercialisation of technology, the aim is to study successful initiatives and formulate proposals for technology and educational policies.

8.1.2 TECHNOLOGY TRANSFER

Technology Entrepreneurship

Providing personalised business and technological consultancy services and business incubator services that support the development of technology based entrepreneurial projects.

The LET-In service at the Innovation and Technology Transfer Unit (UITT) offers personalised accompaniment, technology and business consultancy and incubator services to develop technology based entrepreneurial projects that are associated with INESC Porto's areas of scientific and technological expertise.

UITT is involved in the early stages, the creative stages and the proof of concept stages, offering personalised accompaniment services to support the development of new business ideas, to develop studies on technical and commercial viability, to develop business plans and pre-industrial prototypes, for technology transfer, to secure strategic partners and investment and for specialist mentoring.

UITT is recognised for the advanced training activities, organising and participating in entrepreneurship and knowledge valorisation.

Furthermore, UITT focuses on the development of tools to support the creation, specification and development of concepts, the evaluation and development of the seed phase in valorisation opportunities as well as the creation, specification, organisation and the provision of information on markets that are relevant to the knowledge valorisation generated at INESC Porto.

UITT strongly believes in Physical and Virtual Business Incubation, with a list of successful companies in diverse areas that range from health, energy efficiency, the development of electronic audio systems, network solutions and information systems.

Advanced Consulting Services and Executive Education in Technology and Innovation Management

Developing, implementing and evaluating contents, methodologies, procedures and tools for Technology and Innovation Management.

The Innovation and Technology Transfer Unit (UITT) is recognised for its experience and knowledge in the development, implementation and evaluation of contents, methodologies, procedures, processes and tools for Technology and Innovation Management in diverse organisations that range from micro and large companies to industrial companies and entities that work in the service sector. These services are in accordance with the Portuguese Standard on Research, Development and Innovation Management (NP 4457: 2007).

Furthermore, the Unit provides companies with high value service packages that include consultancy services and specialised and advanced training in Technology and Innovation Management.

As part of its consultancy services, where relevant, UITT promotes interaction between companies and other R&D Units at INESC Porto or other stakeholders in INESC Porto's wide network of associates.

Support Defining Technical and Scientific RDI Projects

Support services for companies defining technical and scientific RDI projects, particularly as part of the NSRF applications (the National Strategic Reference Framework).

Based on its key competencies, UITT offers consultancy services to support and guide companies in the technical and scientific definition of RTD (Research and Technological Development) projects in Innovation or Entrepreneurship that come within the scope of the funding programmes offered by the NSRF to encourage RTD, Innovation and Qualification of national Small and Medium-sized Enterprises (SME). These services are provided in accordance with the needs and objectives of each company, INESC Porto's areas of activity and the specifications of the NRSF funding programmes.

UITT actively participates in preparing various applications for the NSRF's System of Incentives for Companies (such as incentives for co-promotion RTD projects and for the creation of RTD centres in companies or the Vales offered for RTD and Innovation), with an acceptance rate of 100% for the projects submitted. This confirms the high quality of the services offered at UITT in supporting the development of project applications.

8.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology	Status (1)	Areas of Technology Transfer --> Relationships (2)			
		Technology Entrepreneurship	Advanced Consulting Services and Executive Education in Technology and Innovation Management	Support Defining Technical and Scientific RDI Projects	Other areas (4)
Technology Entrepreneurship	I	H		M	
Innovation Management	I	M	H	H	
Innovation Networks	I	M	F	F	
Technology Strategy	I	M	F	F	
Engineering System Design	I				F
Technology Policy	I				F
Other areas (3)					

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

Additional comments:

- During 2012 the Unit will make an effort in order to prepare the next generation of Consulting Services, by the development of new methodologies and tools.

8.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Innovation and Technology Transfer Unit is jointly coordinated by Alexandra Xavier and João Claro.

The Unit is structured into the following Areas:

- Advanced Consulting and Executive Training - Leader: Alexandra Xavier
- Technology Management – Leader: João Claro
- Innovation networks – Leader: Marko Torkkeli
- Fuzzy front end of Innovation – Leader: João José Ferreira
- Innovation Policy – Leader: Aurora Teixeira

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Unit Coordinators
- Area Leaders
- External Advisory Board (to be defined)

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	1	3	3
		University and Polytechnic	6	6	6
		Grant Holders and Trainees (PG)	2	5	5
		Total R&D	***9***	***14***	***14***
	Shared Structure (Central and Local)		**1**		
		Total Internal	***10***	***14***	***14***
External Collaborators and Invited Researchers			3	5	6
		Global Total	**13**	**19**	**20**

(1) Information at the time of the elaboration of the present Plan

8.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

8.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Consulting Experience and Competences of Innovation management systems.
S2	Experience and competence concerning business development process.
S3	Experience and competence in advanced training in the area of innovation and entrepreneurship.
S4	Good relationship between the Unit and researchers.
S5	Good relationships between the Unit and some entrepreneurship advanced training courses and Initiatives.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Incipient international networking for the development of R&D projects.
W2	Inefficient commercial approach and lack of adequate staff to meet the expected increase of consulting activities in the area of innovation management systems.
W3	Upstream in the innovation value chain.

8.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Collaboration with other International Research Unit in European Projects (Lappeenranta University of Technology, Texas Austin University, IC2, WIFO, MIT, CMU), which will foster the Unit scientific output.
O2	Increasing awareness by public (Portuguese Government – QREN) and private (COTEC and Portuguese largest firms) entities of the need of innovation and R&D+I management training and certification.

ID	Description
O3	Public funds to help companies to implement technology and Innovation management practices.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Relative scarcity of entrepreneurial culture and empowerment of Portuguese economic agents in general and researchers in particular.
T2	Increasing competition in the area of R&D+I related training and consulting.

8.4 STRATEGIC FORMULATION

8.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Develop a medium-long term strategic plan for the Unit.		W1 W2 W3	O1 O2	T2
OBJ2	Develop a new Generation of Consulting and Executive Training.	S1 S2 S3 S4 S5	W1 W2 W3	O1 O2 O3	T2
OBJ3	Attract high quality MSc and PhD researchers in order to increase our critical mass both at scientific and consulting levels.		W3 W2	O1	T1
OBJ4	Implement visible and high quality training actions in the area of Technology and Innovation Management.	S1 S2 S3		O1 O2 O3	T2
OBJ5	Organize high quality events that financially support and give visibility to the Unit's scientific and technology resources.	S1 S2 S3		O1 O2	T1 T2
OBJ6	Enlarge our international collaborations through the participation in EU (and other international) projects.		W3 W2	O1	
OBJ7	To diffuse the 'Open Innovation' paradigm within the Portuguese economy.	S3		O1	

8.5 SRATEGIC IMPLEMENTATION

8.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)						
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7
A1	Reinforcing the scientific activity of the Unit.	H	M	H				
A2	Implement the training action plan in the areas of Technology and Innovation Management and Technology Transfer.		H		H			H
A3	Implement training actions concerning the dissemination of an entrepreneurial culture among researchers.		H		M			
A4	Identification and development of strategic collaborations and formal partnerships that might seem important to the development of the main areas of activities.	H	H	H	H	H	H	H
A5	To become a privilege consulting partner of Portuguese companies in the implementation of Technology and Innovation management practices.	H	H			H	H	

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

8.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

8.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	28	50	150	124	-17%
European Union Programmes				12	
Consultancy and R&D Services	70	169	89	49	-45%
Other R&D Services					
Other External Services	8	12			
Total (k€)	**106**	**231**	**239**	**185**	**-23%**

8.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	13	15
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	3	4
Books (author)		
Chapter/paper in books		
Publications (editor)		
Other publications (National meetings, local journals, etc.)	2	2
Theses concluded by members of the Unit	1	1
Total	**19**	**22**

Journal	2011 (Predicted)	2012
Acta Oeconomica	1	1
African Journal of Business Management	1	**1**
African Journal of Marketing Management	1	**1**
Behaviour & Information Technology	1	**1**
Ecological Economics	1	**1**
European Journal of Scientific Research	1	1
Evolutionary and Institutional Economics Review	1	1
Industrial and Corporate Change	1	**1**
International Journal of Business and Emerging Markets	1	1
International Journal of Business Innovation and Research	1	1
Scientometrics		1
International Journal of Entrepreneurship and Innovation Management	1	1

Journal	2011 (Predicted)	2012
Social Indicators Research	1	**1**
The International Journal of Technological Innovation, Entrepreneurship and Technology Management	1	**1**
Technovation		**1**
Total	**13**	**15**

8.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	8		8	**16**
Doctoral		10	1	**11**
Total	**8**	**10**	**9**	**27**

8.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	1
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	1
Advanced training courses	1

(1) Actions involving single institutions are not included

8.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	FIRE-ENGINE	João Claro	01-09-2010	31-08-2013
PN-FCT	NODES	João Claro	01-01-2011	31-12-2013
PN-QREN	PINC	Alexandra Xavier	01-09-2010	31-08-2012
PN-QREN	TecEmpreende	Alexandra Xavier	01-09-2010	31-08-2012
PUE-I&D	SPIN-UP	João José Pinto Ferreira	01-10-2011	30-09-2013
SERV-NAC	K2C_SGIDI	Alexandra Xavier	01-06-2011	30-11-2011
SERV-NAC	SGIDI-FLUPOL	Alexandra Xavier	01-02-2011	31-07-2011
SERV-NAC	SGIDI-Shortcut	Alexandra Xavier	01-10-2009	31-12-2012
O	Let-in	Alexandra Xavier	01-01-2008	

Source:

PN-FCT: National Programme - FCT	SERV-UE: Consultancy and R&D Services - European Union
PN-QREN: National Programme - QREN	SERV-INT: Consultancy and R&D Services - International
PUE-I&D: European Union Programmes - R&D	OID: Other R&D Services
PUE-DIV: European Union Programmes - Others	O - Other External Services
SERV-NAC: Consultancy and R&D Services - National	INT - Internal

9 ROBIS - ROBOTIC AND INTELLIGENT SYSTEMS

Coordinator: António Paulo Moreira, Eduardo Silva

9.1 PRESENTATION OF THE UNIT

The Robotics and Intelligent Systems Unit designs and implements innovative solutions within the areas of land, water and industrial robotics and intelligent systems.

The Unit works in close cooperation with Companies, other INESC-TEC Units and other Institutes and Universities, following the lemma from Research and Development to Innovation, passing through Design, Prototyping and Implementation.

Strategic Objectives

- Improve the alignment between basic research, applied research and transfer technology
- Maximise the impact of the Unit's activity in the companies, and promote the valorisation of results
- Establish strategic partnerships with international research key players, industries and stakeholders, allowing the alignment of the research activities with future industrial projects, for a better valorisation of the developed intellectual property. Special attention will be given to emerging international markets, and to Ocean applications, in convergence with the Maritime Strategy for the Atlantic Ocean Area (see https://webgate.ec.europa.eu/maritimeforum/system/files/com_2011_782_en.pdf)
- Improve internal competences by developing the competences and motivation of human resources and creating conditions for attracting high level national and international researchers
- Improve the Unit's external visibility, through the organisation and participation in key national and international scientific and industrial events.

9.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Land, maritime and aerial robotics

Land, maritime and aerial robots, intelligent control and coordination of multiple robots, autonomous navigation, control and decision.

The Robotics and Intelligent Systems Unit (ROBIS) performs Research and Development (R&D) on high precision positioning and navigation methods to be used in land, aerial and maritime robotics. The Unit also invests in simultaneous localization and mapping for structured and non-structured environments.

At the Unit, research focuses on the development of aspects related to autonomous navigation and control applied in mobile robots operating aerial, land and water environments.

At ROBIS, researchers are also known nationally and internationally for their work in intelligent coordination and control of multiple distributed robots, which can be used, for instance, in robotic soccer championships. In fact, ROBIS has won 1st place in several robotic soccer competitions.

Industrial and indoor robotics

Industrial and indoor robotics, industrial robotic manipulators, Automated Guided Vehicles (AGVs), navigation solutions for indoor environments.

The Robotics and Intelligent Systems Unit (ROBIS) develops robotic systems that can be applied in industry and indoor environments.

Machine learning for intelligent robotic manipulators that can be applied in the industry and Automated Guided Vehicles (AVG), complemented by positioning and navigation solutions, are also some of the competences for which ROBIS is known.

Intelligent sensors and systems

Intelligent sensors and perception systems, artificial vision for autonomous systems, underwater sonar technology for imaging and characterising 3D environments, probabilistic methods for sensor fusion.

The Robotics and Intelligent Systems Unit (ROBIS) specialises in the development of intelligent sensors and perception for robotic systems, as well as in real-time artificial vision systems for autonomous systems.

The Unit specialises in designing and developing autonomous vehicles used for environmental and structural monitoring, investing in vision systems and underwater sonar technology for imaging processes and to characterise 3D environments. Combined with these competences, ROBIS also plays an important role in the development of real-time sensing systems, probabilistic methods for sensor fusion, or even adaptive sampling in data acquisition from several sensors. In particular, developing and implement on-board real-time data processing applied to visual navigation, on board target detection and on board environment perception.

9.1.2 TECHNOLOGY TRANSFER

Security and defence

Robotic and embedded systems that can be used for security and defence purposes, tracking technologies and solutions to detect intrusions and robotic systems for surveillance and for search and rescue operations.

The Robotics and Intelligent Systems Unit (ROBIS) has proven experience in the development of robotic and embedded systems that can be used for security and defence purposes, namely for national security and border control.

Furthermore, the Unit develops tracking technologies and solutions to detect intrusions. With this technology it is not only possible to reduce costs, but also to increase security levels. These solutions may function as complements or reinforcements to security operational structures, with advantages at the levels reliability and treatment of information. An example of the advantages of this technology is the RobVigil project, developed by ROBIS.

Based on their experience and competencies, researchers at ROBIS create robotic systems for search and rescue operations, both in water and land environments. The Unit also studies maritime and port protection systems, as well as indoor and outdoor surveillance solutions.

Environmental monitoring and mapping

Environmental and real-time environmental monitoring systems and consultancy, systems to collect data in multiple environments, 3D characterisation and mapping systems, monitoring and assessing risk in underwater environments and extreme conditions.

The Robotics and Intelligent Systems Unit (ROBIS) develops automatic and real-time environmental monitoring systems. Furthermore, the Unit provides consultancy services in this area, and its client list already includes world renowned organisations.

Combined with environmental monitoring, researchers ROBIS study data collection systems in multiple environments (land, air and sea).

Benefiting from their experience in developing systems for environmental characterisation and 3D precision mapping, researchers at ROBIS are known for their inspection and risk assessment solutions for underwater and extreme conditions environments.

Industrial and Service Robotics

Design and consultancy in industrial and service robotics, industrial robotic manipulators, quality control technologies.

The Robotics and Intelligent Systems Unit (ROBIS) designs and provides consultancy services in industrial and service robotics, having already established important partnerships with the industry. Using automatic learning and programming concepts, ROBIS is capable of developing industrial robotic manipulators and solutions that can be used in the manufacturing industry.

ROBIS also specialises in developing custom services and technology robots that can be used to monitor and control quality in products.

Robotic equipment

Mobile and advanced robotic platforms, autonomous underwater vehicles, unmanned aerial vehicles, indoor and outdoor robots, embedded intelligent sensors.

The Robotics and Intelligent Systems Unit (ROBIS) specialises in designing mobile and advanced robotic platforms, and also provides consultancy services in this area.

One of its great areas of expertise is designing autonomous underwater vehicles used in environmental and structure monitoring, with MARES and TriMARES being two examples of projects of excellence both nationally and internationally.

However, the Unit's skills are not confined to sea or land environments. ROBIS invests in the development of aerial vehicles controlled remotely by electronic and computational means. Designed, projected and built to be used in missions that are hazardous for human beings, these devices can not only perform patrolling activities which include military, urban, coastal and border patrols, but also environmental monitoring and search and rescue operations.

At ROBIS, researchers we also develop land robotics devices for indoor and outdoor environments which can be used for surveillance, advertising, and other applications (CleverRobot and RobVigil).

The robotics devices are equipped with intelligent sensors, also developed by ROBIS.

9.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)				
			Security and Defence	Environmental Monitoring and Mapping	Industrial and Service Robotics	Robotic Equipment	Other areas (4)
Land, Maritime and Aerial Robotics		I	H	H		H	
Industrial and Indoor Robotics		I	M	M	H	M	
Intelligent Sensors and Systems		I	H	H	H		
Other areas (3)	Communications (UTM)		M	H	M	M	
	Manufacturing Systems (UESP)				H	M	
	Software Engineering (USIG)		M	M	M	M	

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

Additional comments:

- SSIARI (Sistemas para o Incremento da Inteligência Artificial na Robótica Industrial) Project, a contact with FLUPOL company, leads to a strong cooperation with the Manufacturing Systems Engineering Unit (UESP). ROBVIGIL a surveillance and monitoring robot is now using communication systems from UTM Unit and software developed in USIG Unit.

9.2 UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Robotics and Intelligence Systems Unit is jointly coordinated by António Paulo Moreira and Eduardo Silva.

Operational and strategic issues regarding the Unit are addressed within the Unit Coordination Council, constituted by the following members:

- Unit Coordinators: António Paulo Moreira & Eduardo Silva
- Other researchers: Anibal Matos, Nuno Cruz, Paulo Costa, José Carlos Alves, José Miguel Almeida, Alfredo Martins

The Unit research team present composition and planned evolution is shown in the following table:

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees			2
		University and Polytechnic	10	14	15
		Grant Holders and Trainees (PG)	14	18	23
		Total R&D	***24***	***32***	***40***
	Shared Structure (Central and Local)			**1**	**1**
Total Internal			***24***	***33***	***41***
External Collaborators and Invited Researchers					1
Global Total			**24**	**33**	**42**

(1) Information at the time of the elaboration of the present Plan

9.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

9.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Training capacity, ability to attract students (MSC / PHD), access to various resources (ISEP and FEUP).
S2	High implementation capacity associated with a consolidated experience in robotics / high expertise and multidisciplinary.

ID	Description
S3	Existence of several functional robotic platforms.
S4	Trust relationship with a significant number of companies and use of industry common language.
S5	Modern and quality facilities.
S6	Broad areas of competencies (land, sea, ...) and mastery of various technologies from the perspective of the use and integration.
S7	Spirit of sharing and internal communication which increases the synergy and internal flexibility.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Scarcity of publications in international journals.
W2	Lack of technical support.
W3	Poor communication and sharing between areas and Units (FEUP, ISEP, ...) and an interpersonal technical cooperation very clustered (isolation of the Units).
W4	Need to clarify / identify the areas that are leaders (national / global).
W5	Previous attempt to merge the teams used to work independently.
W6	Presence of Units with "overlap" in the areas of development.
W7	Greater dispersal of researcher (does everything).
W8	Difficulty of transforming academic solutions in products.
W9	Model of unit management and work methods to define in the context of merger.

9.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Existence of INESC Brazil, a facilitator in setting up projects and seeks partners.
O2	Polo PRODUTECH, industrial equipment market.
O3	Several sources of funding available (FP7, FCT, QREN, etc.).
O4	Favourable external environment with focus on the economy of the sea. INESC Porto is a cluster membership of the Sea.
O5	Internationalisation, support of INESC Porto.
O6	Networks of international contacts to explore.
O7	Recognition of a unit capable of performing scientific and industrial projects successfully. Reputation in the industry.
O8	FP7 Call “capacities”.
O9	Access to various R & D units in INESC Porto.
O10	Possibility of creating spin-offs.
O11	Need for innovation / optimization for companies.
O12	Growth in demand for solutions based on robotics.
O13	Access to foreign students.
O14	Will expressed to merge laboratories.
O15	Creating a cluster of industries around the robotics.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	High cost of testing / development robotics solutions.
T2	Existence of solutions off the shelf ever cheaper and smarter.
T3	Conflict of interest of institutions and Units. Own requirements for national recognition.
T4	Legislation non-existent on autonomous systems or at the beginning.
T5	Competition of many Units of robotics for domestic funds.
T6	Finalization of the FP7. Unknown future.
T7	Low interactivity and little relationship with partners and international teams.
T8	Consequences of the crisis in the national industry.
T9	Competition from other Units with superior marketing capability.
T10	Industry Portuguese unsophisticated and lack of technology makers.
T11	Current high dependence on third parties to carry out doctoral (ISEP).
T12	Human Resources needed to expand the unit requested by the market.

9.4 STRATEGIC FORMULATION

9.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Improve the alignment between basic research, applied research and consultancy.	S2 S4	W4 W7 W8	O2 O7	T4
OBJ2	Maximise the impact of the Unit's activity in the companies, and promote the valorisation of results.	S2 S4 S6	W1 W4 W8	O1 O2 O7 O10 O11 O12 O15	T4 T7 T8 T10
OBJ3	Establish strategic partnerships with international research key players, industries and stakeholders, allowing the alignment of the research activities with future industrial projects, for a better valorisation of the developed intellectual property.	S2 S4 S6	W4 W8	O2 O10 O11 O12 O15	T1 T2 T4 T8
OBJ4	Improve internal competences by developing the competences and motivation of human resources and creating conditions for attracting high level national and international researchers.	S1 S2 S3 S5 S6 S7	W1 W2 W7	O1 O5 O13	T7
OBJ5	Improve the Unit's external visibility, through the organisation and participation in key national and international scientific and industrial events.			O1 O4 O5	T7 T12

9.4.2 OTHER OBJECTIVES

The following objectives refer to specific aspects of the Unit:

Future research

- To port the previously gathered knowledge in robotic systems and real time vision systems to civil society activities such as tracking of humans in indoor sports. An FCT project is planned to help achieve this goal. The scientific goal of the project will aim at sports teaching (advanced team play analysis) and referee education.
- Autonomous marine vehicles: natural landmark navigation for AUVs; unconventional acoustic navigation networks; coordinated control of heterogeneous teams; vision based AUV guidance; modelling and control of autonomous sailboats; low bandwidth control of AUV teams.
- Control of mobile platforms: methodologies for automatic generation of mission plans; supervision of autonomous platform operations; cooperative operation of multiple platforms.
- Concerning vision based real time sensors: perception systems as a sensor for on board sensing; real time stereo sensing for mapping and self-localization; low latency and robust feature extraction in semi controlled environments.
- In the land robotics field: modelling and control of mobile robots; fast team coordination and global path planning; navigation and localization in semi structured environments (using natural and artificial landmarks); Soccer robotics will continue to be a major test bed for the scientific results in this area.
- Industrial robotic manipulators: vision and manipulator coordination; advanced sensing: measurements and testing of features; rapid teaching and programming interfaces; hiper-flexible cells; development of a universal language with translators to different manipulators.
- Intelligent control and smart sensors: control algorithms for complex dynamic systems, adaptive sampling strategies for environment monitoring.

9.5 SRATEGIC IMPLEMENTATION

9.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)				
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5
A1	Continue the consolidation of the scientific activity in the areas of activity.	H	L	L	H	M
A2	Disseminate doctoral programmes.	M	M	M	H	
A3	Participation to the call "Capacities - Research Potential" - Consolidate activities and implementing the strategies defined in the SWOT.				H	M
A4	Develop new partnerships with national and international research organizations, leaders in fields near or complementary to the Unit's activity.	M		L	H	H
A5	Increase the UNIT participation and the visibility in European projects.	M	L	L	H	H
A6	Consolidate partnerships with international research key players, industries and stakeholders and continue direct contact with large number of companies, in Portugal and abroad.	M		H		M
A7	Diversify funding sources - Submit applications to the European – FP7; Prepare projects for Brazil; Leverage other opportunities. Consulting of scientific high level.	H	M	M	H	M
A8	Define plans for the valorisation of the intellectual property of the Unit.	M	H	H	L	M
A9	Preparation of QREN proposals related to the following applications of marine robots: bathymetric surveys and search and rescue operations.		M	H	L	L
A10	Promote an internal regular discussion on research opportunities and project organization.	H			M	

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

9.5.2 OTHER INITIATIVES / ACTIONS FOR THE YEAR

Other initiatives / actions will be carried out during 2012, namely:

- Promote an internal regular discussion on research opportunities and project organization.
- Continue improvement of the professionalism and quality of services and projects.
- Development and implementation of strategies for the coordinated operation of multiple vehicles.

9.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

9.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes		122	147	119	-19%
European Union Programmes				128	
Consultancy and R&D Services		80	326	343	5%
Other R&D Services					
Other External Services					
Total (k€)		**202**	**473**	**590**	**25%**

9.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	6	8
Papers in National Journals with scientific referees	3	4
Conference Proceedings in events with scientific referee and selection	26	26
Books (author)	1	1
Chapter/paper in books	3	2
Publications (editor)		
Other publications (National meetings, local journals, etc.)		
Theses concluded by members of the Unit	3	14
Total	**42**	**55**

Journal	2011 (Predicted)	2012
Águas & Resíduos 2011	1	
IEEE Transactions on Education		2
Industrial Robot: An International Journal 2011	1	2
International Journal of Engineering Pedagogy 2011	1	
Journal of Rehabilitation Research & Development 2011	1	1

Journal	2011 (Predicted)	2012
Marine Technology Society Journal	1	2
Revista Portuguesa de Contabilidade	1	
The International Journal of Advanced Manufacturing Technology		1
Total	**6**	**8**

9.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	24		22	**46**
Doctoral		27	3	**30**
Total	**24**	**27**	**25**	**76**

9.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	
Advanced training courses	

(1) Actions involving single institutions are not included

9.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	COGNAT	Aníbal Matos	01-06-2011	31-05-2013
PN-FCT	CRO	António Paulo Moreira	01-01-2010	31-12-2012
PN-FCT	INSTEAD	José Carlos Alves	01-04-2010	31-03-2013
PN-QREN	PRODUTECH_PTI_PPS4	António Paulo Moreira	02-05-2011	01-05-2014
PN-QREN	RobVigil	António Paulo Moreira	01-01-2010	31-12-2011
PN-QREN	SIIARI-QREN	António Paulo Moreira	01-09-2010	31-08-2012
PUE-I&D	ICARUS	Aníbal Matos	01-01-2012	
SERV-INT	Lajeado	Aníbal Matos	02-10-2010	01-10-2013
SERV-INT	SUB-2	Aníbal Matos	01-01-2012	31-12-2012
SERV-NAC	AUTOCLASS	António Paulo Moreira	01-09-2012	31-08-2014
SERV-NAC	EDA-SAVEWATE	Aníbal Matos	01-01-2011	31-12-2012
SERV-NAC	SIIARI	António Paulo Moreira	01-09-2010	31-08-2012

Source:

PN-FCT: National Programme - FCT	SERV-UE: Consultancy and R&D Services - European Union
PN-QREN: National Programme - QREN	SERV-INT: Consultancy and R&D Services - International
PUE-I&D: European Union Programmes - R&D	OID: Other R&D Services
PUE-DIV: European Union Programmes - Others	O - Other External Services
SERV-NAC: Consultancy and R&D Services - National	INT - Internal

10 LIAAD - LABORATORY OF ARTIFICIAL INTELLIGENCE AND DECISION SUPPORT

Coordinator: Pavel Brazdil

10.1 PRESENTATION OF THE ASSOCIATE UNIT

LIAAD was created in 2007 from one of the groups (NIAAD) of another R&D unit and so some researchers of LIAAD have more than 20 years of experience in R&D. In 2007 LIAAD has initiated the process formalization of its relationship to INESC TEC as an "Associated Unit" which required the approval of FCT. The approval was finally given in 2011.

The association of LIAAD to INESC TEC is seen as an excellent opportunity for both sides to exploit common synergies and has already resulted in collaboration in several R&D projects and joint actions.

Strategic Objectives

LIAAD continues the tradition of conducting high quality research, both fundamental and applied, in the 3 major areas shown below:

- Data Mining (DM) for Decision Support
- Data Analysis and Statistical Methods for Decision Support
- Modeling and Optimization for Decision Support

10.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Data Mining (DM) for Decision Support includes the following lines of research:

Machine Learning and Data Mining (for Decision Support):

- Data Mining and Decision Support: Aid the User in Selecting an Appropriate ML / Data Mining Method: Exploit past information to determine which ML/DM algorithm is likely to produce better results on a new task. Integrate Data Mining in Decision Support, while trying to resolve real problems.
- Learning from Data Streams: The goal of this research area is to study, develop and analyse all aspects of Machine Learning (e.g. algorithms for summarization, change detection, classification, regression or clustering), in problems involving continuously flow data in dynamic environments. The models need to "adapt" to changing information.
- Modeling Dynamic Systems: Develop / enhance methods for modeling complex dynamic systems. Data mining tasks include numeric prediction (regression) models, monitoring for unusual events (e.g. extreme values), visualization, modeling using networked data with spatio-temporal features, etc. Development of models for ecological modeling - analysis of ecological data, namely water quality parameter data, with the aim of developing models for forecasting and monitoring the quality of water used in public distribution networks.
- Metalearning and Planning to Learn: Aid the User in Selecting an Appropriate ML / Data Mining Method: Exploit past information to determine which ML/DM algorithm is likely to produce better results on a new task.

Data Mining from Structured Data (for Decision Support)

- Distributed ILP for Data Mining: Use ILP methods to predict protein folding rules; detect complex patterns in protein unfolding; Simulations and discovery of structure-activity relationships in problems of drug design; DNA sequence analysis; Take advantage of parallel, distributed and Grid Computing to run ILP systems on large data bases.

- Web mining and Web intelligence: Use of recommended systems for Web portals. Automation of web site reconfiguration / maintenance of contents.
- Text Mining: Document Classification - classifying documents into categories, using e.g. words as features; Information Extraction - extraction of specific information about a domain (e.g. economic data, etc.) or tables from business reports; Opinion mining: The aim is to design automatic methods that enable to attribute positive / negative sentiment to a give text.

Data Analysis and Statistical Methods (for Decision Support):

- Data Analysis and Statistical Methods for Decision Support: Methods for processing symbolic data (variables can take multiple, possibly weighted, values); time series; STATIS methodology and other exploratory multivariate data analysis techniques etc.

Modeling and Optimization (for Decision Support):

- Simulation, Modeling and Optimization - Investigate problems in job-shop manufacturing environments, where a large number of different products are produced according to customer specification.
- Modeling using Multi-agent (MA) framework to modeling organizational dynamics: Simulate firms for a specific industries and geographical locations and observe the interaction among them, with attention to their cooperation (creation of networks), survival and evolution of networks.
- Dynamical Systems, game theory and mathematical finances:
  - Dynamical systems: Pseudo-Anosov diffeomorphisms, Explosion of smoothness, Tilings, Geometric measures, Hénon maps.
  - Mathematical Physics: Galileus pendulum.
  - Industrial organization: Oligopoly theory (Country protecting policies, Leadership and uncertainty), R&D strategies (use of patents, joint ventures), Mergers in hotelling networks, Behavioral Dynamics, Consumer behaviour and dynamics.
  - Game theory: Signalling games.

10.1.2 TECHNOLOGY TRANSFER

Use of Data Mining in Decision Support: Although the principal aims of LIAAD is basic and applied research, the R&D activity of LIAAD is motivated by real business problems and counts with collaboration of institutes and companies and help thus to transfer innovative solutions:

Forecasting bus travel time for controlling personnel costs (company STCP); Customer segmentation (large bank); On-line recommendation for marketing and web; Autonomous Trading Systems; Analysis of investment decisions under uncertainty; Detection of fiscal fraud; Development of models for ecological modeling - analysis of ecological data, namely water quality parameter data, with the aim of developing models for forecasting and monitoring the quality of water used in public distribution networks. Collaboration with a company (Águas do Douro e Paiva, SA). Applications of ILP to Intrusion Detection Systems; Business Intelligence for the Fashion Industry; Business Intelligence for Predictive Maintenance.

10.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology and areas of Technology Transfer

Areas of Science and Technology		Status (1)	Areas of Technology Transfer --> Relationships (2)					
			Manufacturing	Power Systems	E-governance	Transports	Content Management	Other areas (4)
Data Mining			L	M	M	M	L	
Statistical Methods								
Modelling and Optimization								
Other areas (3)								

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

10.2 ASSOCIATE UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

LIAAD is coordinated by its Coordinating / Directing Committee, which includes the coordinator of the Unit, Pavel Brazdil, and the following members of LIAAD: Alípio Jorge, João Gama, Dalila Fontes and Alberto Pinto.

In 2011 LIAAD included 45 researchers. This number includes 23 members with Ph.D. A great majority of the others are Ph.D. students. Many of the members have a lecturing post at the Faculty of Economics of UP. However, the Unit includes also members of other academic or professional institutions, including the Faculty of Science (FCUP), Faculty of Engineering (FEUP), Univ. of Beira Interior, National Institute of Statistics (INE) etc.

The Associate Unit research team present composition and planned evolution is shown in the following table – note that the process of formal registration of the research team is not complete, therefore the figures included in the main part of the Plan are applicable for registered members, so they are less than these figures.

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees			
		University and Polytechnic	20	23	26
		Grant Holders and Trainees (PG)	30	21	25
		Total R&D	***50***	***44***	***51***
	Shared Structure (Central and Local)		**1**	**1**	**1**
Total Internal			***51***	***45***	***52***
External Collaborators and Invited Researchers					
Global Total			**51**	**45**	**52**

(1) Information at the time of the elaboration of the present Plan

10.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

10.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	LIAAD has achieved an international recognition in several areas of activity in the areas/sub-areas of Machine Learning and Data Mining, Data Analysis, Optimization, Mathematical modeling. Members of LIAAD have a working contact with about 30 Universities worldwide.
S2	Members of LIAAD are good at exploiting interdisciplinary areas, by bringing in the know-how where they are strong and applying it to new problem areas.
S3	As the members of LIAAD work at several different Faculties and often share the information available to them, they are abreast of others, who do not have such connections.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Spatial dispersion: Some researchers tend to work at LIAAD central location at Rua de Ceuta. This includes some Ph.D. members, the post-graduate students supervised by them and many visitors. Other researchers, mainly those that have teaching duties at FEP, FCUP-DCC, FCUP-DM and FEUP tend to use the offices at their faculties to conduct research and also to supervise their post-graduate students there.
W2	Thematic dispersion: This is caused partly by spatial dispersion and partly by accepting new members that have different research interests from those of the founders of the Unit. The problem associated with "growth".
W3	LIAAD's domains are instrumental and are better exploited in multi-disciplinary projects.
W4	Many projects and relatively small teams.

10.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Increase collaboration with INESC TEC.
O2	Better exploit INESC TEC technical and administrative support.
O3	Find a new location for the lab's common facilities.
O4	Better align LIAAD's research with INESC TEC strategic aims in accordance with national and european policies.
O5	Promote collaboration between senior researchers in LIAAD and form larger/better teams.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Members of LIAAD could get involved in too many activities, which only promotes dispersion and hinders resolution of fundamental and technically difficult issues.
T2	Loss of important collaborators.
T3	Decreased evaluation due to thematic and spatial dispersion.

ID	Description
T4	More rigid rules from INESC TEC make project management more time consuming.
T5	Difficulty in getting funding for basic research in methods/algorithms.

10.4 STRATEGIC FORMULATION

10.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Increase the ratio number of journal publications/PhD researchers.	X			
OBJ2	Attract new PhD students to the unit.	X			
OBJ3	Find a new location for the lab.		X		X
OBJ4	Increase the degree of collaboration between PhD members of the unit (articles, projects, services, event organization).		X		X
OBJ5	Increase the degree of collaboration with other INESC TEC units.			X	
OBJ6	Attract new MSc students to the unit.	X			
OBJ7	Increase the volume of technology transfer.	X		X	
OBJ8	Stimulate younger PhD members to increase action.				X
OBJ9	Increase the degree of collaboration with other (e.g. foreign) institutions.			X	

10.5 SRATEGIC IMPLEMENTATION

10.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)								
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8	OBJ9
A1	Rewarding high impact publications with research budget.	H							H	
A2	Providing better administrative support for project leaders (FCT, EU, QREN, Services).	L	H				H	H	H	
A3	Promoting collaboration with other Units of INESC TEC through meetings and seminars.		M			H		H		L
A4	Improving visibility within INESC TEC by participating in meetings and events (e.g. LAIs).					H		H		
A5	Inviting/visiting prestigious researchers from foreign institutions.	L								H
A6	Revising rules for funding assignment.				L				H	
A7	Defining a new location for the common facilities of the lab.		H	H	H				M	
A8	Improving the lab's social atmosphere by promoting relaxed meetings.		M		H					
A9	Continue the practice of internal seminars/workshops with vivid discussions.	L	M		H				M	
A10	Continue the articulation with MSc courses at FEP, FCUP and FEUP.						H			

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

10.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

10.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

The activity of Associated Units may be carried out under contract with INESC Porto and other institutions. The figures in the following table refer to all the activity, while the planned income referring to contracts signed by INESC Porto is included in the main part of the Plan.

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	81	129	103	99	-4%
European Union Programmes			27	98	263%
Consultancy and R&D Services	27	23		9	
Other R&D Services					
Other External Services					
Total (k€)	**108**	**152**	**130**	**206**	**58%**

10.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	27	17
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	62	17
Books (author)	1	1
Chapter/paper in books	7	1
Publications (editor)	3	
Other publications (National meetings, local journals, etc.)	2	
Theses concluded by members of the Unit	3	
Total	**105**	**36**

Journal	2011 (Predicted)	2012
Basic & Clinical Pharmacology & Toxicology	1	
Computers & Operations Research		1
Data Mining and Knowledge Discovery	1	1
Economics Bulletin	1	
Electric Power Systems Research	1	
European Journal of Sport Science	1	
Intelligent Data Analysis	2	2
International Journal of Computer Science & Applications		1
International Journal of Production Research	1	

Journal	2011 (Predicted)	2012
Journal of Applied Statistics	1	
Journal of Difference Equations and Applications	11	
Journal of Dynamics and Games		1
Knowledge and Information Systems	1	1
Machine Learning Journal		1
Mathematical and Computer Modelling	2	
Operational Research: An International Journal	1	
Optimization Letters	2	
Progress in Artificial Intelligence		1
Statistical Analysis and Data Mining	1	
Total	**27**	**9**

10.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	3		24	**27**
Doctoral	2	13	5	**20**
Total	**5**	**13**	**29**	**47**

10.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	4
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	2
Advanced training courses	2

(1) Actions involving single institutions are not included

10.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. Both cases include contracts already signed or to be signed by INESC Porto and also by other institutions. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	CRN	Pavel Brazdil	01-05-2010	31-10-2012
PN-FCT	KDUS	João Gama	01-04-2010	31-03-2013
PN-FCT	PTDC/EGE-GES/099741/2008	Dalila Fontes	08-02-2010	07-02-2013
PN-FCT	PTDC/EGE-GES/117692/2010	José F. Gonçalves	2012	

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	VipAccess	Pavel Brazdil		
PUE–I&D	e-Policy	Luís Torgo	01-10-2011	30-09-2014
SERV-INT	SIMULESP	João Gama	01-01-2011	31-12-2013

Source:

PN-FCT: National Programme - FCT
PN-QREN: National Programme - QREN
PUE-I&D: European Union Programmes - R&D
PUE-DIV: European Union Programmes - Others
SERV-NAC: Consultancy and R&D Services - National
SERV-UE: Consultancy and R&D Services - European Union
SERV-INT: Consultancy and R&D Services - International
OID: Other R&D Services
O - Other External Services
INT - Internal

11 CRACS – CENTER FOR RESEARCH IN ADVANCED COMPUTING SYSTEMS

Coordinator: Fernando Silva

11.1 PRESENTATION OF THE ASSOCIATE UNIT

The Center for Research in Advanced Computing Systems (CRACS) is an associated R&D unit of the INESC-TEC associate laboratory, focusing on two main areas of Computer Science: "Computational Models and Languages for Scalable Computing" and "Information Mining and Web-based Systems". Research in the former focuses on the development of programming languages, compilers, runtimes and middleware frameworks towards scalable computing in advanced system architectures such as multi-core microprocessors and wireless sensor networks. In the later area, research focuses on information mining applications for domains with massive amounts of data and high demands for processing. Examples include genomics, proteomics, medicine, biological and social networks, plus web-based systems for enhanced e-Learning and e-Science. Complementary research focuses on frameworks for service oriented architectures. CRACS has also competencies in security, especially in e-Health and e-Government applications.

Our research work resulted in well-known and widely used software such as YAP Prolog, Logtalk, and Mooshak. More recently, we developed and released software for genome assembly, mammography analysis, motif discovery, name identification, runtime programming, sensor networks programming and real-time fault-tolerant p2p middleware.

CRACS is well networked internationally in its main areas of research. Among our main collaborators we count with are researchers from top Universities, such as CMU, Wisconsin-Madison, UT-Austin, and UT-Dallas in the US; Newcastle, York, Cambridge, Leuven, Amsterdam, UPM-Madrid, Bonn and Salzburgh in Europe; Tokyo Institute Tech. in Japan; and UFRJ in Brazil.

Strategic Objectives

- Develop fundamental and applied research with international impact.
- Attract more senior researchers in the core areas of CRACS to increase critical mass.
- Maintain or even increase the involvement of young researchers and their training.
- Engage in multidisciplinary research, particularly in areas where massive amounts of data and high computational demand are critical.
- Further develop scientific competencies in information mining and systems security, areas in high demand by industry, therefore strengthening our unit impact in the society.
- Increase involvement in international projects, namely European projects and projects within the partnerships with CMU and UT-Austin.
- Increase partnerships with industry.

11.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Next we detail the scientific and technological competencies existing in CRACS within its two main areas of research: (1) computational models and languages for scalable computing; (2) information mining and web-based systems.

Computational Models and Languages

Our group is at the leading edge on the implementation of Logic Programming (LP), YAP Prolog being its flagship system and Logtalk the "de facto" standard in object oriented logic programming languages. We aim to innovate on new logic programming frameworks that can integrate probabilistic reasoning and negation, relying on the use of parallelism and tabling to scale on larger

applications, and we aim to open new applications domains for LP. We plan to continue the development of type safe programming languages for distributed environments, such as robust programming languages for wireless sensor networks, and we have initiated investigation on using logic programming in this domain.

Parallel and Distributed Computing

Strengthen the work on distributed systems, namely on innovative peer-to-peer based middleware with support for both fault tolerance and soft real-time for demanding information systems, and on "run-time programming", that is, dynamic, incremental, reprogramming of applications through semantics preserving patches.

Machine Learning and Data Mining

Continue leading research in multi-relational data mining on supporting the development of large-scale mining systems using inductive logic programming and statistical multi-relational learning systems. Develop adaptive classification algorithms for online learning from continuous data streams, specialized data-structures and algorithms for mining large complex and dynamic networks, and scalable learning algorithms from structured and temporal multi-relational data. This work is motivated by applications such as author identification, sensor data streams, mammography analysis, genomics and proteomics.

Text Mining

Investigate frameworks for information mining and retrieval in contexts such as web mining, recommender systems, social web, semantic web, and text mining. Develop new advanced frameworks and service oriented architectures that lead us into the development of innovative systems such as federated libraries of semantically socially-assisted annotated documents, digital repositories of learning objects, and e-learning environments and tools.

Security and Digital Identity Mechanisms

Conceptualize and implement new ideas for federated identity management and federated authorization mechanisms for information systems. Resort to nonstandard computing, namely biologically inspired computing, to develop unsupervised learning tools for anomaly detection in particular for network intrusion detection.

11.1.2 TECHNOLOGY TRANSFER

Language Programming Systems

CRACS members provide support for both academic and commercial users of YAP and Logtalk on a regular basis. In particular, both systems are used in the implementation of PhD thesis and MSc thesis research results and in a diversified number of commercial applications (unfortunately, often under NDAs).

Security, Access Control and Auditability of Information Systems

Members from CRACS have worked has consultants for the Portuguese ministry of Health where they have delineated an extensive information security assessment program of the current government e-Health information systems, including network infrastructures and main centrally provided e-Health applications. From this massive evaluation effort, where more than seventy health institutions were evaluated, including the Portuguese main major Hospitals, resulted a comprehensive set of security document policies and recommendations that are now being put in place at the national level. Members from CRACS have also helped to delineate a secure identity management infrastructure for

the Portuguese Health professionals that, in the future, will serve as a core service for the entire e-Health services and constitutes the basis for the security plan being devised for the electronic prescription process, currently mandatory at the national level.

CRACS is also cooperating with the University of Porto (UP) in planning and deploying an innovative University Public Key Infrastructure (PKI), based on novel secure auto-enrolment processes devised by a member of CRACS. This PKI is supported by smart cards that currently constitute the main means of identification for the entire University, a universe of almost forty thousand individuals. These smart cards will also be used as a key component for the secure de-materialization of the main business administrative paper load, based on processes that are currently being conducted by UP. Members from CRACS are currently participating in a pilot implementation of the de-materialization of course grades reported by teachers, by employing the University Id smart cards as a secure signature-creation device (SSCD). This University card, besides electronic signature, is also being provided with key pairs and X509 certs for authentication and encryption. Advised by members of CRACS, UP has also acquired a large Hardware Secure Module with large keying capacity for the security and backup of critical key system components and for accelerating the massive crypto operations needed to support this security infrastructure.

Distributed Systems Middleware

Members from CRACS have acted as consultants in the development of real-time computing infrastructures to support demanding and critical information systems. An example is the consultancy provided to EFACEC in developing an innovative high performing p2p middleware with support for fault-tolerance and soft real-time to be used in the management of public transportation networks.

11.1.3 KNOWLEDGE-VALUE PRODUCTION CHAIN

The following table presents the contribution of Science of Technology areas to Technology Transfer areas, giving some insight into the operation of the knowledge-value production chain within the Unit.

Table of relationships between areas of Science and Technology

and areas of Technology Transfer

Areas of Science and Technology	Status (1)	Areas of Technology Transfer --> Relationships (2)			
		Programming Languages Systems	Security, Access Control and Auditability of Information Systems	Distributed Systems Middleware	Other areas (4)
Computational Models and Languages	I	H	M	M	
Parallel and Distributed Computing	I			H	
Machine Learning and Data Mining	I/O	M	M		
Text Mining and e-Learning Environments	I/O				
Security and Digital Identity Mechanisms	I		H		
Other areas (3)					

(1) I - Internal; O - Existing in another Unit of INESC TEC; E - External; C – To be created

(2) "Blank" – no direct relationship / contribution
L – Low or weak relationship / contribution; M – Medium relationship / contribution;
H – High or strong relationship / contribution; F – Future predicted relationship / contribution

(3) Existing areas in other Units of INESC TEC or specific domains addressed for the development of one or more areas of Technology Transfer

(4) Minor unspecified areas of Technology Transfer or future areas

11.2 ASSOCIATE UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Center for Research in Advanced Computing Systems Associate Unit is coordinated by Fernando Silva. Vítor Santos Costa is the vice-coordinator.

The Associate Unit is structured into the following Areas:

- Area 1 – Computational Models and Languages for Scalable Computing
  - Leaders: Luís Lopes and Ricardo Rocha
- Area 2 – Information Mining and Web-based Systems
  - Leaders: Álvaro Figueira and Inês Dutra

Operational and strategic issues regarding the Associate Unit are addressed within the Unit Coordination Council, constituted by all researchers holding a PhD degree. No substructure is imposed given the size of the unit.

CRACS is currently composed by a team of around 40 members of which 12 are senior researchers with PhD degree. CRACS is physically based at the Computer Science Department of the Faculty of Sciences of the University of Porto.

The Associate Unit research team present composition and planned evolution is shown in the following table – note that the process of formal registration of the research team is not complete, therefore the figures included in the main part of the Plan are applicable for registered members, so they are less than these figures.

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	1	1	1
		University and Polytechnic	10	10	12
		Grant Holders and Trainees (PG)	28	32	29
		Total R&D	***39***	***43***	***42***
	Shared Structure (Central and Local)		**1**	**1**	**1**
Total Internal			***40***	***44***	***43***
External Collaborators and Invited Researchers			1	2	3
Global Total			**41**	**46**	**46**

(1) Information at the time of the elaboration of the present Plan

11.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

11.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Extensive research experience with strong scientific indicators.
S2	Strong and diversified international research links.
S3	Internationally recognized competences in Logic Programming, Machine Learning and Parallel Computing.
S4	Software that is used worldwide: Yap Prolog (major Prolog system supporting tabling and parallelism), Logtalk, Mooshak.
S5	Large experience in training young researchers.

ID	Description
S6	Scientific and technical knowledge of systems security and identity management.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Limited experience in technology transfer.
W2	Limited success in European projects.
W3	Limited marketing activity.

11.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Companies awareness for innovation, specially in data mining and security issues.
O2	Funding at European level through FP7 framework.
O3	National funding programs involving academia and industry.
O4	INESC-TEC Inter-Unit Lines of Action (LAIs) to foster critical mass in more demanding areas.
O5	Cooperation with CMU and UT-Austin, among other top Universities.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Economic crisis may affect companies investment in innovation.
T2	Increased competition in funding programs.
T3	Dispersion of team members among many topical areas.

11.4 STRATEGIC FORMULATION

11.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Develop fundamental and applied research with international impact.	S1 S2 S3		O2 O5	

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ2	Attract more senior researchers in the core areas of CRACS to increase critical mass.	S1 S3			T3
OBJ3	Maintain or even increase the involvement of young researchers and their training.	S5			
OBJ4	Engage in multidisciplinary research, particularly in areas where massive amounts of data and high computational demand are critical.	S3 S4		O1 O2 O4	
OBJ5	Further develop scientific competencies in information mining and systems security, areas in high demand by industry, therefore strengthening our unit impact in the society.	S4 S6		O1 O4	
OBJ6	Increase involvement in international projects, namely European projects and projects within the partnerships with CMU and UT-Austin.	S1 S3 S4	W2	O2 O5	T2
OBJ7	Increase partnerships with industry.	S4 S6	W1 W3	O1	T1

11.5 SRATEGIC IMPLEMENTATION

11.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)						
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7
A1	Invite recent PhD graduates from our group, or our department, to pursue post-doctoral research or, in the cases where they are faculty at polytechnic schools, to continue with CRACS.		H			M		
A2	Visit CMU before Spring to prepare a joint project for the next CMU-Portugal call.	L			M		H	
A3	Propose research initiation grants to undergraduate and master students by involving them in smaller tasks in undergoing projects, and thus seduce them to engage in research for master's dissertation and possibly in doctoral research.			H				
A4	Invite recent faculty at U. Porto with relevant research related to our group to join CRACS.		H					
A5	Reinforce the internal communication mechanisms and promote the definition of multidisciplinary research projects; promote an internal discussion on research opportunities and on the set-up and organization of new research projects.	M				L	H	
A6	Organize a set of innovative short and medium-size training initiatives for companies, specially those related to advanced issues in systems security, access control, identity management, machine learning, and parallel and distributed.				M			H

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

11.5.2 OTHER INITIATIVES / ACTIONS FOR THE YEAR

Other initiatives / actions will be carried out during 2012, namely:

Internationalization:

Further develop existing international cooperation links and increment joint publications and involvement in research projects:

- Angelika Kimmig, Luc de Raedt, Bart Demoen, Hendrik Blockeel, Tom Schrijvers and Theofrastos Mantadelis from Khatholieke Universiteit Leven, Belgium, in areas of language implementation, probabilistic logic programming and inductive logic programming.
- Jan Wielemaker from University of Amsterdam on Logic Programming Systems.
- David Page and Jude Shavlik from the University of Wisconsin, Madison, US, on Machine Learning and Inductive Logic Programming.
- Markus Kaiser and Jennifer Simonotto at Newcastle University, UK, in pattern mining in brain networks.
- Chris Mitchell e Jason Crampton of Information Security Unit, Royal Holloway, University of London, UK.
- Priya Narasimhan, Frank Pfenning and Seth Goldstein from Carnegie Mellon University, US, on fault-tolerance and real-time middleware and language implementation.
- Keshav Pingali from UT-Austin, US, on graph algorithms in Galois.
- Taisuke Sato from Tokyo Institute of Technology, Japan, on Logic Programming and learning.
- Felipe França, Gerson Zaverucha, Bernard Marechal and Diego Carvalho from Universidade Federal do Rio de Janeiro, on machine learning and parallel and distributed computing.
- Gopal Gupta from U.T. Dallas, USA, in the area of Co-inductive Logic Programming.
- Gunter Kniesel from Bonn University, Germany, on Logic Programming Software Engineering research and tools.
- Christoph Kirsch from Salzburgh University, Austria, on Run-time patching.
- Miguel Revilla from Universidad de Valladolid, Spain, on Competitive e-Learning.
- P. Chico, M. Carro and M. Hermenegildo from Universidad Politécnica de Madrid, Spain, on Tabling in Logic Programming.

Outreach Activities:

- Participate in the organization of programming contests for high-school and university students, helping them to develop team work skills as well as professional competences.
- Propose short summer activities within the Junior University at UP, thus helping in encouraging talented high school students in pursuing science and technology studies.
- Collaborate with Latin America in reducing the technological gap, through common projects such as EELA on building a common grid infrastructure between Europe and Latin America.
- Propose doctoral-level courses and engage in the organization of doctoral programs such as the Joint Doctoral Program in Computer Science of the Universities of Minho, Aveiro and Porto.
- Propose courses and research proposals for dissertations for Master degrees in which members of CRACS are also involved as lecturers.

11.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

11.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

The activity of Associated Units may be carried out under contract with INESC Porto and other institutions. The figures in the following table refer to all the activity, while the planned income referring to contracts signed by INESC Porto is included in the main part of the Plan.

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes		143	150	233	55%
European Union Programmes			5	34	580%
Consultancy and R&D Services					
Other R&D Services		4	4	14	250%
Other External Services		12	12	12	0%
Total (k€)		**159**	**171**	**293**	**71%**

11.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	12	12
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	33	35
Books (author)		
Chapter/paper in books	3	3
Publications (editor)	1	2
Other publications (National meetings, local journals, etc.)	12	10
Theses concluded by members of the Unit	5	3
Total	**66**	**65**

Journal	2011 (Predicted)	2012
Computers & Education	1	
Genome Research	1	
Int. Journal on Parallel and Distributed Computing		1
International J. of Data Mining and Bioinformatics	1	
International Journal of Autonomous and Adaptive Communications Systems	1	
International Journal of Knowledge Society Research	1	
Journal of Integrative Bioinformatics	1	
Journal of Theory and Practice of Logic Programming	3	2
Journal Theoretical Biology	1	

Journal	2011 (Predicted)	2012
Learning Technology Newsletter of IEEE Computer Society's Technical Committee on Learning Technology	1	
The European Journal for the Informatics Professional	1	
Total	**12**	**3**

11.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	4	9	7	**20**
Doctoral	1	12	5	**18**
Total	**5**	**21**	**12**	**38**

11.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	3
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	1
Advanced training courses	2

(1) Actions involving single institutions are not included

11.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. Both cases include contracts already signed or to be signed by INESC Porto and also by other institutions. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	ADE	Vítor Santos Costa	01-02-2012	01-01-2015
PN-FCT	Breadcrumbs	Álvaro Figueira	01-10-2010	01-09-2012
PN-FCT	Digiscope	M Coimbra (IT), Inês Dutra	01-02-2010	01-01-2013
PN-FCT	HORUS	Vítor Santos Costa	01-01-2010	01-12-2012
PN-FCT	LEAP	Ricardo Rocha	01-03-2011	01-02-2014
PN-FCT	MACAW	F. Martins (LASIGE), Luís Lopes	01-01-2011	01-12-2013
PN-FCT	OFELIA	Manuel Eduardo Correia	01-01-2010	01-12-2012
PUE-DIV	GISELA	Inês Dutra (leading at UP)	01-09-2010	01-08-2012
PUE-I&D	e-Policy	L. Torgo (LIAAD), V. Santos Costa	01-10-2011	01-09-2014
SERV-NAC	Sigarra Log-on	Manuel Eduardo Correia	01-12-2011	01-07-2012

Source:

PN-FCT: National Programme - FCT	SERV-UE: Consultancy and R&D Services - European Union
PN-QREN: National Programme - QREN	SERV-INT: Consultancy and R&D Services - International
PUE-I&D: European Union Programmes - R&D	OID: Other R&D Services
PUE-DIV: European Union Programmes - Others	O - Other External Services
SERV-NAC: Consultancy and R&D Services - National	INT - Internal

12 UGEI - INDUSTRIAL MANAGEMENT AND ENGINEERING UNIT

The Associate Unit UGEI is in the process of finalising an internal reorganisation. For this reason it is only given a short description of the activities.

12.1 PRESENTATION OF THE ASSOCIATE UNIT

UGEI is an engineering and industrial management research unit that seeks to specify and develop novel systems that operate in an efficient and reliable manner. The typical problems, always motivated by real scenarios, are found in operations management, operational research and information systems. The UGEI ultimate goal is to achieve national and international recognition for the creation of knowledge in the intersection of industrial engineering, management and social sciences, and in its delivery for the target organizations.

Joining INESC Porto LA may represent an excellent opportunity to amplify and synergistically integrate the work being independently developed by the Unit and by INESC Porto. This judgment is supported by the following arguments:

- It addresses the scale problem. In fact, UGEI is a small unit, without critical mass to address even medium size problems. Since UGEI research foot print overlaps some of INESC Porto LA units, the scale problem will be addressed very effectively.
- On the other hand, UGEI researchers will effectively complement the expertise and man power deficiencies in some INESC Porto LA areas.
- UGEI will benefit from the organizational infrastructure of INESC Porto LA that has well recognized abilities to find and secure and manage medium and large scale research projects.
- There is an increased likelihood of participating and wining national and European projects.
- Joining INESC Porto LA will also bring high standards of productivity and scholarly publication, which are harder to comply in smaller research units.

The competence areas of UGEI, together with UESP, can be identified as:

- Operations Research; Decision Support Systems; Combinatorial Optimization; Heuristics and meta-heuristics (Simulated Annealing, Taboo Search, GRASP, Genetic Algorithms); Multi-objective Optimization and Mathematical Programming; Simulation; Forecasting Methods; Statistics; Data Mining; Data Envelopment Analysis.
- Information and knowledge management; Semantic web technologies; Socio-technical analysis;
- Web-based systems and interfaces; Human-Computer Interaction; Software Engineering; Service System Design.

The main application areas are:

- Operations Management; Advanced automation and internal logistic systems; Production Planning and Operations Scheduling, Cutting and Packing Problems.
- Logistics; Supply-Chain Management; Layout design; Distribution Problems; Vehicle Routing.
- Planning and management of Transportation Systems; mobility; vehicle routing and crew scheduling.
- Applied Statistics: Design of Experiments; Statistical Process Control; Applied Statistics.
- Enterprise Cooperation Networks; collaborative processes; Information Management and Knowledge in Collaborative Networks.

13 CISTER – RESEARCH CENTRE IN REAL-TIME COMPUTING SYSTEMS

Coordinator: Eduardo Tovar

13.1 PRESENTATION OF THE ASSOCIATE UNIT

CISTER (Research Centre in Real-Time Computing Systems), established in 1997, is a top-ranked Research Unit based at the School of Engineering (ISEP) of the Polytechnic Institute of Porto (IPP), Portugal. CISTER was, in the 2004 and 2007 national evaluation process, the only research unit in Portugal, in the area of Electrical and Computer Engineering, to be awarded the highest rating of "Excellent". This rating was awarded on account of an outstanding publication record of its researchers, and CISTER is also considered to be one of the leading European units in the area of Real-Time Computing and Embedded Systems.

The CISTER Research Unit focuses its activity in the analysis, design and implementation of real-time and embedded computing systems (RTS). In RTS, correctness depends not only on the logical result of computation, but also on the time at which the results are produced. Thus correctness and performance are very tightly interrelated. In recent years an increased pervasiveness of embedded systems in general and large-scale distributed systems in particular has emerged. This has introduced real-time concerns into mainstream enterprises, with clients in a wide variety of industries and academic disciplines.

Strategic Objectives

- Continued research focus and excellence in our research areas: Wireless Sensor Networks; Multicore Systems; Cyber-Physical Systems; Adaptive Real-Time Systems; and Real-Time Software;
- Selective and demanding publication efforts in highly reputed, peer-reviewed, international journals, as well as top conferences in the respective fields, many of which have higher impact than top journals;
- Selective, demanding and consistent participation of key Unit's researchers in scientific service;
- A strong participation in international reputed academic/industrial research partnerships with focus both on fundamental and applied research.

13.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Wireless Sensor Networks

Wireless Sensor Networks experience the transition from research to industrial deployment. During this transition new challenges appear in link quality management and general communication paradigms to scale small deployments to 1000s of nodes in a reliable and energy efficient manner.

In the Wireless Sensor Networks (WSN) area, the group has been leading R&D in IEEE 802.15.4 and ZigBee technologies (http://www.open-ZB.net) and provided methodologies to analyse, dimension and engineer WSNs with improved QoS. We, in collaboration with researchers at T.U. Berlin and U. Pisa, have finalized the implementation of the IEEE 802.15.4 protocol in TinyOS, within the TinyOS 15.4 Working Group and in the context of our leadership of the COTS4QoS research cluster (http://www.cooperating-objects.eu) under the CONET NoE. The area will continue the work of QoS in WSNs, focusing on real-time/timeliness, mobility support and energy-efficiency aspects. This will be based both on off-the-shelf technologies, as well as on novel solutions designed from scratch (e.g. hexagonal WSNs or BANMAC). The unit will also continue to contribute to the TinyOS 15.4 and ZigBee WGs, aiming developing platform-independent, standard-compliant, IEEE 802.15.4 Medium Access Control and ZigBee Network Layer protocols. Emerging technologies and standards such as the IETF 6loWPAN for pervasive Internet and IEEE 802.15.6 for body sensor network applications will also be explored.

Recently, we have consolidated our critical mass on radio link quality estimation in WSNs by designing an innovative estimator and an open-source benchmarking test-bed (http://www.open-LQE.net). Importantly, we have designed, implemented and demonstrated the largest WSN test-bed in Europe to date (303 nodes) under the EMMON project (http://www.artemis-emmon.eu). Work will continue to consolidate the EMMON WSN architecture for large-scale and dense real-time monitoring. The EMMON project will be complemented by the design of real-time and reliable mobility support in WSNs, through hand-off heuristics, radio diversity, interference modeling and link quality estimation.

Cyber-Physical Systems

In Cyber-Physical Systems, the computer systems do not only compute quantities, but are also tightly integrated and interacting with their physical environment, by taking sensor readings and acting on it. Such systems require a rethinking in the usual computing and networking concepts, while the importance of timeliness is increasing steadily. Another trend is towards massively networked embedded computing devices. Such extreme networking poses considerable technical challenges in terms of the distributed programming paradigms not reflected in current languages.

In the emerging Cyber-Physical Systems (CPS) area, we have been keeping a prominent role. Researchers of the group have further advanced the state-of-the-art in distributed algorithms that exploit dominance-based MAC protocols, which provide unprecedented advantages for WSNs, as aggregate computations (data aggregation, interpolation) can be performed with time complexity independent of the number of nodes, greatly leveraging scalability. One of the main continuing efforts is tackling the problem of scalable and efficient information processing in large-scale and dense systems. The unit will continue work on (PD)2 and advocate its use in industry. One initiative being driven together with Critical Materials and Brazilian Aircraft manufacturer Embraer aims at exploiting these results, to allow sustained air travel growth while minimizing carbon footprint. Local modulation of aircraft surfaces is a form of active flow control, which will be explored in term of its potential to offer significant reduction of fuel consumption and emissions. Implementing such a flow control system requires thousands of sensor/controller/actuator systems to be embedded across the aircraft wings and fuselage to create an active aircraft.

Also in the area of CPS, we are now leading a project with Portugal Telecom and CMU to use CPS technologies for energy-optimized data centers, typically voracious of energy and cooling.

Real-Time Software

Real-Time Software is concerned with languages, management of software concurrency, as well as decentralised middleware and operating system adaptation, which form fundamental building blocks of autonomic distributed systems.

The current use of software as the key component of any real-time embedded system is increasing the, often contradictory, demands for attributes such as flexibility, adaptation, isolation, reliability or availability. In the Real-Time Software area, group researchers work on middleware for cooperative and autonomic embedded systems, and analyse the support for developing multicore applications, both at the language level, and at the operating system level (software transactional memory and parallel tasks). In this area work will continue in the current efforts of the cooperative middleware, exploring its use in mobile systems, targeting commercial operating systems such as Android. The unit will also continue the work on the autonomic behaviour of interdependent nodes in dynamic distributed environments with QoS constraints.

Furthermore, area members have actively participated in a joint effort (project RESCUE with UBI, FCUP and UMinho) to integrate concurrency models with software verification approaches in embedded systems.

The unit will also continue to work on the specification of advanced programming models, to support the raised abstraction level required by the more complex modern systems. In particular work will be developed in software transactional memory and parallel support of real-time tasks at the operating system and virtual machines levels; in parallel, new programming models for WSN systems will be put forward.

Continuing the active participation in the standardization activities of the Ada language, work will continue in the introduction of native support in the Ada language for multicore and multiprocessor architectures.

Adaptive Real-Time Systems

Adaptive Real-Time Systems address the emergence of embedded devices exposed to different levels of criticality, reconfigurable and mobile systems. This is reflected in the work on server-based scheduling, adaptive service management, hierarchical systems, as well power management of energy constrained embedded systems.

The Adaptive Real-Time Systems area develops its work in the area of open real-time systems and with application in the widely used Android operating system. Group researchers have a successful cooperation with the University of Pennsylvania addressing temporal isolation in hierarchical real-time systems. Our researchers also investigate the issue of contention for implicitly shared resources, which are a major obstacle in ensuring temporal isolation in multicore systems. In a similar direction the group has developed an approach to the increased execution time due to the loss of working set in the caches and investigating the contention issues in a real-time environment using transactional memory. The achievements also included work in Quality of Service guarantees in distributed real-time systems.

The unit keeps developing novel techniques to allow temporal isolation in multicore platforms by developing metrics to estimate memory-bus and cache contention. Furthermore, power and thermal management in densely packed multicore systems are also being explored. The unit will continue in the future the work in hierarchical scheduling, tackling slack time management, as well as the development of component interfaces exploiting results obtained for flat uniprocessors. Further efforts will explore mode changes in multicore systems, to ensure system stability in the face of environmental changes. All of the above work aims to be implemented on commercial grade operating systems.

Multicore Systems

A trend addressed by the group is the increased deployment of Multicore Systems and the inherent challenges in providing solutions, which are able to support real-time guarantees, considering both identical and heterogeneous multicores.

Researchers in the multicore area of CISTER have achieved two important results: (i) created the first provably good resource sharing scheme for real-time tasks on multiprocessors and (ii) created a new algorithm for scheduling a set of tasks on a specific type of heterogeneous multiprocessor and this algorithm was shown produce schedules that were as good as the previous state of art (actually better) but with the additional advantage that the algorithm runs much faster (both in terms of time-complexity and in terms of running times in experiments). The former is relevant because the trend in multicore processors is towards a large core count and for system systems, sequential bottlenecks (such as sharing of non-cpu resources) becomes of greater importance. The latter is relevant because the trend among chipmakers is towards multicore chips with different types of processor cores (heterogeneous multicore). Intel Sandybridge and AMD Fusion exemplify this trend.

The multicore area will keep focusing the successful on-going research, tackling algorithms for assigning tasks on heterogeneous multiprocessors and handling resource sharing with provably good performance for heterogeneous multiprocessors. Practical aspects of implementing scheduling algorithms in real operating systems and the analysis of shared low-level hardware resources are also being explored. Particular focus will be given to GPU-based platforms.

13.1.2 TECHNOLOGY TRANSFER

CISTER strategy includes reinforcing collaboration with industry, in industry-driven projects that have an integrated perspective of research/innovation and pre-competitive development. This is achieved both through consortia in international and national R&D projects (e.g. projects within the ARTEMIS joint technological initiative: EMMON, RECOMP and ENCOURAGE, or with the CMU-Portugal

program: as SENODs), but also (more recently) through fostering patents and direct technology transfer contracts.

In 2011-2012, this activity will be pursued and cooperation links will be established with other research groups within the INESC-TEC Associated Laboratory to reinforce the technology transfer vector of the Unit.

Furthermore, specific technology transfer activities will be performed in two technologies which are deemed to be ready to be placed in the market: resource usage control of set-top-boxes and sensor network platforms for embedded monitoring. The unit will carry out outreach and interaction activities to leverage on opportunities that will naturally appear through the course of the interactions to occur resulting from the collaborative nature of the Associated Laboratory.

13.2 ASSOCIATE UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The Unit has a Director – Eduardo Tovar - and two Vice Directors – Luis Miguel Pinho and Stefan Petters. Together these form the Board of Directors (BoD).

The main responsibilities of the Director are: to represent externally the Unit; to manage and co-ordinate the activities of the Unit; to co-ordinate the definition of the plan of activities and budget; and to present the plan of activities, budget and yearly report (scientific and financial) to the Unit's Steering Committee and Executive Boards. The main responsibilities of the Vice Directors are to assist and replace the Director when necessary.

The BoD is assisted in governance by an Executive Board (ExecB), to manage day-to-day activities. The ExecB is structured by areas of responsibilities: (i) Finances, Quality & Procedures; (ii) Human Resources; (iii) Research Projects; (iv) Industry Contracts, IP-issues (v) Presentation & Image; (vi) Infrastructures & Facilities; (vii) IT Infrastructure and (viii) Administrative Support. These responsibilities are associated with individuals in the ExecB.

The Unit is structured into the following Areas:

- Wireless Sensor Networks – Lead by Mário Alves
- Multicore Systems – Lead by Konstantinos Bletsas and Vincent Nelis
- Cyber-Physical Systems – Lead by Eduardo Tovar
- Adaptive Real-Time Systems – Lead by Stephan Peters
- Real-Time Software – Lead by Luis Miguel Pinho

Operational and strategic issues regarding the Unit are addressed within the Unit Steering Committee, constituted by the following members:

- Director
- Vice-directors
- Research Line Leaders
- Three PhD researchers

The Steering Committee (SC) supports the BoD in contributing to the medium to long term strategic planning of the CISTER Research Unit. This includes providing direct input to the half yearly budget planning process, as well as reviewing the resulting overall budget. It is also involved in planning the opening or closure of research areas. Additionally the SC supports the BoD in the selection process and management of research staff and students. The SC includes the ExecB members and the research leaders.

The activities of the Unit are periodically reviewed by international top-ranked researchers. Annually, a number of on-site visits are performed by these researchers to discuss the Unit's activities and plans. Current members of the External Advisory Board are: Alan Burns (University of York, UK); Tarek Abdelzaher (UIUC, USA); Sanjoy Baruah (UNC, USA), Raj Rajkumar (CMU, USA) and Daniel Mossé (University of Pittsburgh, USA). The Unit has also been actively endorsing and driving bilateral research workshops with top research centres. These have been extremely useful as well in providing inputs for research plans and strategy.

The Associate Unit research team present composition and planned evolution is shown in the following table – note that the process of formal registration of the research team is not complete, therefore the figures included in the main part of the Plan are applicable for registered members, so they are less than these figures.

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees	1	1	1
		University and Polytechnic	11	11	11
		Grant Holders and Trainees (PG)	14	14	14
		Total R&D	***26***	***26***	***26***
	Shared Structure (Central and Local)				
Total Internal			***26***	***26***	***26***
External Collaborators and Invited Researchers			4	6	3
Global Total			**30**	**32**	**29**

(1) Information at the time of the elaboration of the present Plan

13.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

13.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Good technical and scientific background.
S2	Internationally recognized competences in real time and embedded computing systems.
S3	Good network of contacts at the European level, mainly based on the participation on multiple international projects.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Lack of matureness on technology transfer.
W2	No support for PhD students' tuitions from the hosting institution.
W3	Inability of the hosting institution (ISEP-IPP) to grant PhD degrees.
W4	Lack of experience on creating spin-offs.

13.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	Embedded systems is currently one of the only five Joint Technological Initiatives (and the only one imminently in ICT) being undertaken in Europe.
O2	Embedded computing systems are one of the areas witnessing higher growth in Information and Communication. Technologies (ICT), where over 98% of the current processors are embedded.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Reduced number of technological Portuguese companies in real-time embedded systems.
T2	Foreseen reduction of structural funds for Portugal in the medium term.
T3	Dependency of Portuguese companies from structural funds to perform RTD projects.
T4	Current FCT position of not funding Portuguese participation in Artemis JU.

13.4 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

13.4.1 SUMMARY OF PROJECTS TO BE DEVELOPED

The activity of Associated Units may be carried out under contract with INESC Porto and other institutions. The figures in the following table refer to all the activity, while there is no firm planned income referring to contracts signed by INESC Porto.

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	114	162	188	311	65%
European Union Programmes	132	80	120	412	243%
Consultancy and R&D Services	5	5	4	10	150%
Other R&D Services					
Other External Services					
Total (k€)	**251**	**247**	**312**	**733**	**135%**

13.4.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	4	
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	30	
Books (author)		
Chapter/paper in books		
Publications (editor)		
Other publications (National meetings, local journals, etc.)		
Theses concluded by members of the Unit	1	
Total	**35**	

13.4.3 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. Both cases include contracts already signed or to be signed only by other institutions. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
FCT	PT-CMU	Eduardo Tovar	2007-01	2012-08
R&D	CONET	Eduardo Tovar	2008-06	2012-05
R&D / FCT	EMMON	Eduardo Tovar	2009-03	2012-02
FCT	REHEAT	Björn Andersson	2010-02	2013-01
FCT	REWIN	Shashi Prabh	2010-02	2013-01
R&D / FCT	RECOMP	Stefan Petters	2010-14	2013-03
FCT	SENODS	Eduardo Tovar	2010-10	2013-09
FCT	MASQOTS	Mário Alves	2011-02	2014-01
FCT	VIPCORE	Arvind Easwaran	2011-02	2014-01
FCT	REPOMUC	Stefan Petters	2011-02	2014-01
R&D / FCT	ENCOURAGE	Luís Miguel Pinho	2011-05	2014-04
FCT	SMARTSKIN	Eduardo Tovar	2012	
FCT	SMARTS	Stefan Petters	2012	
FCT	AVIACC	Luís Miguel Pinho	2012	
FCT	REGAIN	Konstantinos Bletsas	2012	

14 HASLAB - HIGH-ASSURANCE SOFTWARE LABORATORY

Coordinator: Rui Oliveira, Jorge Sousa Pinto

14.1 PRESENTATION OF THE ASSOCIATE UNIT

The High-Assurance Software Laboratory conducts R&D in the following areas: formal methods (methods and techniques for rigorous software development, from specification and formal modelling to the analysis and verification of software, including also the formal study of software architectures and user-system interaction); dependable distributed data management and dependable distributed systems (replication protocols based on group communication, scaling data management in a cloud computing environment, and scalable information dissemination / aggregation protocols offering strong agreement properties); and cryptography and information security (provable security of new and existing cryptographic schemes and protocols, and developing formal verification tools to check security proofs at the highest levels of assurance).

The laboratory focuses in particular on proposing integrated trustworthy solutions to problems that can only be attacked using combined methods and techniques.

Strategic Objectives

- To consolidate the team's position as a national stakeholder in the area of trustworthy systems, by reinforcing the technology transfer effort to public and private enterprises managing critical infrastructure, and to the national software industry targeting the critical software market.
- To continue acquiring, developing, and integrating competencies in the area of trustworthy software, confirming and strengthening the position of the laboratory as a major international research unit in this area.

14.1.1 SCIENCE AND TECHNOLOGY DEVELOPMENT

Formal Methods

New formal methods and techniques for the rigorous development of trustworthy software systems, and their application to practical problems and contexts.

The general goal of Formal Methods (FM) is to certify properties of software systems (chiefly correctness and safety) through the use of mathematical techniques. Formal methods constitute an alternative approach to software reliability assurance, to which industry is progressively devoting more attention. In fact, not only is the need for formal methods increasingly more pressing, but the maturity of their underlying mechanisms is now more adequate for industrial use than it has been in the past, when it was extremely hard for non-specialists to be able to use FM tools. The perceived utility of formal methods is thus more and more indisputable.

HASLab researchers have been active in this area for 20 years now, with expertise at the following different levels: specification and formal modelling, software architectures, user-system interaction, and program analysis and verification.

Dependable systems

Advancing the state of the art in dependable distributed systems and large scale data management.

Traditionally, dependability for most business and government applications meant mostly the ability to eventually recover to a consistent state, in particular, taking advantage of scheduled down- time and the ability to catch-up while off-line. These requirements were thus matched perfectly by transactional mechanisms embodied in relational database management systems and asynchronous

transactional middleware. The emergence of e-Business and e-Government in the Web, with an emphasis on 24×7 availability and greater value being generated by online services, shifted the focus to improving availability while leveraging existing application technologies, with the current trend being that services in e-Business and e-Government become larger and more critical.

HASLab researchers have been contributing to the state of the art in large scale distributed data management for more than 10 years, both in national projects and by coordinating the GORDA european project on open replication of databases. This contribution has focused both on architecting DBMS interfaces for pluggable replication as well as in offering a spectrum of replication protocols for different circumstances. The topics currently being addressed include elastic high-performance transactional systems; resilience to a wider variety of faults; and scaling data storage to large scale in cloud computing environments.

The HASLab dependability team has also been contributing to the state of the art in dependable distributed systems by developing agreement protocols and information dissemination protocols offering strong consistency properties.

Cryptographic Security

Developments on the foundations and applications of cryptography and information security.

The foundations of cryptography have roots in both mathematics and computer science, drawing contributions from various scientific areas in the intersection between these two domains, including number theory, complexity theory, and information theory, where mathematical rigor is the norm. This stands in contrast to the practical applications of cryptography, where such formal guarantees often do not exist: in some cases, proprietary solutions are simply not subject to the desirable scrutiny; in other cases, the slow rate at which international norms and standards evolve implies that schemes for which no known vulnerability exists remain in use, despite the lack of theoretical validation.

The HASLab information security team is active in three dimensions of provable security, the area that focuses on constructing formal arguments of security for cryptographic schemes and protocols: (i) formalizing security models (goals and attack scenarios) suitable for practical applications, and studying the relations between such models; (ii) constructing security arguments to support new and, perhaps more importantly, existing protocols that are used in the real world without theoretical validation; (iii) developing formal verification tools that can be used to mechanically check theoretical security proofs at the highest levels of assurance.

On a more applied direction, the HASLab team is currently achieving the highest impact in the development of programming languages and compilation tools for the specific domain of cryptographic software. Also here there is an emphasis on high-assurance software development, by focusing on domain-specific methodologies and tools for the formal verification of cryptographic software implementations.

14.1.2 TECHNOLOGY TRANSFER

The technology transfer activity of the HASLab is not organized systematically in a set of areas of intervention: it has to this point been carried out by individual members of the lab or small consulting teams. The lab has in the last few years provided consultancy to public and private sector organizations, in the following areas: safety-critical software development; infrastructure management in cloud computing environments; digital certification and public-key infrastructure software solutions; information system security in the retail sector, and security-critical software in general. The lab has also provided important consultancy to a government agency regarding the development of the national citizen's card. A few start-up companies have been created or supported by members of the HASLab; the most recent case is Educed, a company that aims to apply formal methods in the critical software arena. Created by a group of young engineers that includes two HASLab doctoral students, Educed has recently won the GSI Accelerators Start Up Challenge, launched by Leadership Business Consulting.

14.2 ASSOCIATE UNIT ORGANIZATIONAL STRUCTURE AND RESEARCH TEAM

The High-Assurance Software Laboratory is coordinated jointly by Rui Oliveira and Jorge Sousa Pinto.

The Associate Unit is structured into the following Areas:

- Formal Methods
- Dependable Systems
- Information Security and Cryptography

Operational and strategic issues regarding the Associate Unit are addressed within the Unit Coordination Council.

The Associate Unit research team present composition and planned evolution is shown in the following table – note that the process of formal registration of the research team is not complete, therefore the figures included in the main part of the Plan are applicable for registered members, so they are less than these figures.

Research Team composition

Source			2010	2011 (1)	2012 (Plan)
Internal HR	R&D	Employees			
		University and Polytechnic	21	23	23
		Grant Holders and Trainees (PG)	28	32	33
		Total R&D	***49***	***55***	***56***
	Shared Structure (Central and Local)				
Total Internal			***49***	***55***	***56***
External Collaborators and Invited Researchers				3	3
Global Total			**49**	**58**	**59**

(1) Information at the time of the elaboration of the present Plan

14.3 STRATEGIC ANALYSIS - SWOT ANALYSIS

14.3.1 INTERNAL FACTORS

Strengths (characteristics of the Unit that give it an advantage over others)

ID	Description
S1	Well-positioned team, both at the national and at the international level, in the three pillar areas supporting the development of Trustworthy Systems.
S2	Good research indicators (more than 100 indexed papers, 10 successfully defended PhD theses, 3 best paper awards and one Innovation Research Award in the last five years).
S3	Experience in leading and participating in numerous research (national and international) and technology transfer projects.
S4	Outstanding network of research partners, including many excellent centres and institutions.
S5	Considerable experience in technology transfer and consultancy to the private sector and government agencies.

Weaknesses (Characteristics that place the Unit at a disadvantage relative to others)

ID	Description
W1	Funding track record perceived as standing below the potential of the team.
W2	Integration between the three research areas leaves room for improvement.
W3	International visibility needs consolidating: built out of individual initiatives and contributions that are not perceived internationally as coming from the same team/lab.
W4	Concerning technology-transfer, the impact in the areas related to trustworthy systems is often limited to individual initiatives, and needs leveraging.
W5	Inbreeding: the unit lacks the capability to attract, from external institutions, human resources of comparable (or higher) quality to the locally trained alumni.

14.3.2 EXTERNAL FACTORS

Opportunities (external chances to improve performance)

ID	Description
O1	In the national arena, there has lately been a strong drive by the Portuguese government to reinforce the ITC capabilities of the Portuguese state and industry.
O2	The Portuguese software industry is steadily increasing its net-worth and investing in export-oriented products, including large-scale critical software systems.
O3	Long tradition of "exporting" high-quality post-graduate students to renowned international institutions provides the lab with an opportunity to recruit valuable human resources and to promote the creation of spin-offs in close connection to research activities.

Threats (external elements in the environment that could cause trouble for the Unit)

ID	Description
T1	Budgetary cuts: present context adverse regarding funding.
T2	Historical distrust with which the Portuguese state and industry see national academia.
T3	Lack of flexibility to manage human resources.
T4	Senior members are all academic, often over-worked with teaching and management duties.

14.4 STRATEGIC FORMULATION

14.4.1 MAIN OBJECTIVES- MEDIUM AND SHORT TERM

The following main medium and short term strategic objectives are established as a consequence of the previous SWOT analysis, and establish the framework for the actions presented in the next section.

Strategic Objectives

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ1	Increasing participation in international (EC) R&D project proposals.	S1 S3 S4	W1		T1

ID	Description	Relationship to SWOT analysis			
		S	W	O	T
OBJ2	Increasing the number of projects with industry involving HASLab.	S3 S5	W1 W4	O1 O2	T1 T2
OBJ3	Developing integration degree between the three teams of HASLab, and thus the capacity to propose innovative, integrated solutions to problems, and to participate in joint initiatives.		W2 W3 W4		
OBJ4	Cooperating with other INESC TEC core and associated units, to broaden the scope of applications of the lab's R&D activity.	S1	W4 W5	O3	
OBJ5	Launching a yearly, integrated recruitment process, with high international visibility, and increasing direct recruitment.	S1	W3 W5	O3	T1
OBJ6	Restructuring the financial structure of the lab, to allow leveraging strategic objectives in an integrated way.				T1 T3
OBJ7	Keeping up the sustained growth observed in the productivity indicators.	S2			T1 T4
OBJ8	Improving internal organization and external visibility (PR).		W3		T2 T3

14.4.2 OTHER OBJECTIVES

The following objectives refer to specific aspects of the Unit:

- Learning good R&D management practices from other INESC TEC units, and from the institution as a whole.

14.5 SRATEGIC IMPLEMENTATION

14.5.1 MAIN INITIATIVES / ACTIONS FOR THE YEAR

For 2012, a number of main initiatives / actions are planned in line with the objectives defined in the previous section.

ID	Description	Relationship to medium and short term objectives (1)							
		OBJ1	OBJ2	OBJ3	OBJ4	OBJ5	OBJ6	OBJ7	OBJ8
A1	European project proposals involving at least two HASLab teams.	H		H	M			M	
A2	Deployment of the first integrated (i.e. involving the entire lab) international recruitment process.					H		M	
A3	Joint initiatives with INESC TEC units (e.g. on smart grids, already underway).	M	M	L	H			L	
A4	Consolidated partnerships with industry, through joint project proposals (i.e. QREN), increased consultancy and training.		H		M				
A5	Promoting an internal process leading to more adequate and effective administrative procedures.				L		H		H

(1) "Blank" – no direct relationship / contribution; L – Low or weak relationship / contribution; M – Medium relationship / contribution; H – High or strong relationship / contribution

14.6 SUMMARY OF ACTIVITIES EXPECTED FOR 2012

14.6.1 SUMMARY OF PROJECTS TO BE DEVELOPED

The activity of Associated Units may be carried out under contract with INESC Porto and other institutions. The figures in the following table refer to all the activity, while there is no firm planned income referring to contracts signed by INESC Porto.

Source	Total Income (k€)				
	2009	2010	2011 (Predicted)	2012 (Plan)	Variation 2011 - 2012
National Programmes	81	224	267	412	54%
European Union Programmes	117	232	116	116	0%
Consultancy and R&D Services	66	111	104	31	-70%
Other R&D Services					
Other External Services					
Total (k€)	**264**	**567**	**487**	**559**	**15%**

14.6.2 SUMMARY OF PUBLICATIONS BY MEMBERS OF THE UNIT

Type of publication	2011 (Predicted)	2012
Papers in International Journals with scientific referees	10	10
Papers in National Journals with scientific referees		
Conference Proceedings in events with scientific referee and selection	38	40
Books (author)	1	
Chapter/paper in books		
Publications (editor)	1	2
Other publications (National meetings, local journals, etc.)		
Theses concluded by members of the Unit	1	8
Total	**51**	**60**

Journal	2011 (Predicted)	2012
Computer Science Review	1	
Computers and Industrial Engineering	1	
EATCS Bulletin	1	
Formal Aspects of Computing	1	
Higher-Order and Symbolic Computation	1	
IEEE Transactions on Parallel and Distributed Systems	1	
Intelligent Data Analysis	1	
Journal of Statistical Mechanics: Theory and Experiment	1	
Science of Computer Programming	2	
Total	**10**	**10**

14.6.3 SUMMARY OF POST-GRADUATION THESES TO BE SUPERVISED BY MEMBERS OF THE UNIT

Type	Starting	On-going	Concluded	Total
Master	10		15	**25**
Doctoral	5	14	8	**27**
Total	**15**	**14**	**23**	**52**

14.6.4 SUMMARY OF ACTIVITIES OF DISSEMINATION AND TRAINING

Type	Number
Conferences with INESC TEC in the organization (in the organizing committee or chairing technical committees)	2
Specific actions for the promotion of the Unit's capabilities, oriented to technology transfer (e.g., technical presentations, participation in fairs, etc.) (1)	
Advanced training courses	

(1) Actions involving single institutions are not included

14.6.5 LIST OF PROJECTS

The following table presents the summary of projects corresponding to signed contracts. Both cases include contracts already signed or to be signed only by other institutions. The planned income presented in the previous section "SUMMARY OF PROJECTS TO BE DEVELOPED" includes new projects under contracts to be signed during the year.

Funding source	Short name	Leader	Starting date	Ending date (predicted)
PN-FCT	APEX	José Campos	2011	2013
PN-FCT	CASTOR	Carlos Baquero Moreno	2010	2012
PN-FCT	CROSS	Maria João Frade	2010	2012
PN-FCT	FAVAS	Jorge Sousa Pinto	2010	2012
PN-FCT	Mondrian	Luís Soares Barbosa	2010	2012
PN-FCT	PBGT	José Campos	2011	2014
PN-FCT	ReD	José Orlando Pereira	2010	2012
PN-FCT	SSaaPP	João Saraiva	2010	2012
PN-FCT	Stratus	Rui Oliveira	2011	2013
PUE-I&D	CumuloNimbo	Rui Oliveira	2010	2013
PUE-I&D	SMART	Manuel Barbosa	2010	2013
SERV-NAC	BDAT	Rui Oliveira	2011	2012
SERV-NAC	CSI	Manuel Barbosa	2011	2012
SERV-NAC	SMSP	José Orlando Pereira	2009	2012

Source:

PN-FCT: National Programme - FCT	SERV-UE: Consultancy and R&D Services - European Union
PN-QREN: National Programme - QREN	SERV-INT: Consultancy and R&D Services - International
PUE-I&D: European Union Programmes - R&D	OID: Other R&D Services
PUE-DIV: European Union Programmes - Others	O - Other External Services
SERV-NAC: Consultancy and R&D Services - National	INT - Internal

15 SCIENTIFIC COUNCIL

President: Manuel Matos

The Scientific Council will continue in 2012 to fulfil its statutory duties, regarding:

- analysis and opinion on annual reports and plans prepared by the Board of Directors;
- support to the process of issuing awards to the authors of papers published in scientific journals;
- analysis of other matters under request from the Board of Directors.

In the framework of the Associated Laboratory, the Council will also follow up the activity of the present inter-unit action lines (OIL and SPML) and support the launching of additional inter-unit action lines that may be proposed. The Council will be responsible for the validation, coordination, monitoring and evaluation of such entities, following the rules defined by the Board of Directors. A discussion of the experience of the present inter-unit lines will be promoted.

The Council will continue its effort to establish mechanisms to monitor the scientific production of the institution in terms of publications.

The Council will analyse the issue of strengthening the cohesion of the institution and favour synergies, namely in the framework of the Associated Laboratory, through a set of initiatives to be determined.