Information and Communication Technologies Institute

CarnegieMellon | PORTUGAL

AN INTERNATIONAL PARTNERSHIP

Terms of Reference

for the

Entrepreneurial Research Initiatives

Call for Proposals

July 2013

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

Table of Contents

1 Synopsis

The Phase II of the Carnegie Mellon Portugal Program emphasizes advanced education and research that can lead to significant entrepreneurial impact. The activities of the program are for the most part configured in Entrepreneurial Research Initiatives (ERIs). ERIs are projects in science, engineering, management and policy that link both fundamental and applied research to technological innovation and economic development. This bridging is pursued by explicitly focusing on important real world problems entailing significant scientific challenges. ERIs consist in integrated activities in research, innovation, advanced education and training of human resources, with industry collaboration and emphasis on the commercialization of technology for real world impact.

ERIs seek to stimulate and promote Portuguese innovation in Information and Communication Technologies (ICT) as such, and as enabling technologies in nearly all application sectors, in a global context where markets, industries, resources, and talent are internationally distributed. These projects seek to advance technology and engineering, develop talented innovators in Portugal and increase the competitiveness of the Portuguese ICT industry in today's globalized economy. Ultimately, they seek to foster a culture that integrates discovery, innovation and internationalization by acting as international engines of innovation and growth.

An international innovation engine is in fact a symbiotic relationship between researchers and industry partners, embedded in international knowledge and business networks, to create new ideas and to translate them into products, processes and services.

In essence, this solicitation calls upon efforts aimed at developing and linking capabilities and resources from fundamental research to technology commercialization, strongly supported in talent development. In order to achieve this, ERIs will:

1. Advance science-based discovery and link it to technological innovation.

2. Form cross-disciplinary international teams of researchers and industry professionals, capable of addressing complex real world problems, and operating effectively in a world of global research and innovation.

3. Provide opportunities for cross-national training of human resources, in the form of dual degrees, to develop capabilities to create and exploit knowledge for technological innovation in a global economy in ways that can address important real world problems while having the potential to impact positively the Portuguese economy.

4. Use instruments that facilitate experimentation (prototyping, proof-of-concept or proof-of-market) and collaboration, as required by the entrepreneurial and collaborative nature of ERIs. Testbeds and experiments with companies are examples of such instruments.

5. Interact with companies, markets, and end users during all stages of activity and provide effective ways to measure the impact of the activities on all these constituencies.

6. Involve industry, in a variety of modes, such as solving problems, developing capabilities, generating best practices, creating competitive solutions, creating complementary technologies, providing insights on performance improvement.

7. Develop a culture that combines research, education, and innovation, at an international scale, to create and sustain an international innovation engine to realize the ERI's vision.

2   Award information

2.1   Regulations and guidelines

Regulations governing access to funding are available at:

http://www.fct.pt/apoios/projectos/regulamento
http://www.fct.pt/apoios/projectos/normasexecucaofinanceira
http://www.fct.pt/apoios/bolsas/normasbolsasemprojectosunidades

The announcement of the opening of this call is available at:
http://www.fct.pt/apoios/concursos

The guidelines to writing and submitting proposals are available at:

http://www.fct.pt/apoios/projectos/concursos/2013/docs/20120607_Guiao_Candidatura_C20
13_versao_7_EN_para_publicar.pdf
http://www.fct.pt/apoios/cooptrans/parcerias/cmu/

The roadmap for Phase II of the Carnegie Mellon Portugal Program is available at:
http://www.cmuportugal.org/uploadedFiles/resources/CMU_Portugal_Phase2_v21MAY2012.p
df

2.2   Estimated number of awards and funding amount

Depending upon the quality of the proposals, four to seven new ERI awards are expected to be financed.

Approximately €6,000,000.00 are expected to be available to support the new ERIs starting in early 2014. From the total funding, € 3 million will be available to support resources and activities in Portuguese research institutions. The other half of the total funding will be available to support complementary activities at Carnegie Mellon University (CMU). The participating researchers from Carnegie Mellon University will be funded by the Information and Communication Technologies Institute (ICTI), at Carnegie Mellon University.

The maximum budget for Portuguese research institutions in each ERI will be of € 750,000.00.

The actual number of ERIs funded will depend on the scale and scope of the proposed Initiatives and the quality of the proposals submitted. Financial support through the Carnegie Mellon Portugal Program should be augmented by financial and/or in-kind support provided by participating companies, and possibly by other national and local government agencies.

The involved companies will not be funded by FCT.

2.3   Duration

A typical proposal should cover efforts for a period of up to four years. The progress achieved by the team will be assessed yearly by the Board of Directors of the Carnegie Mellon Portugal Program and FCT, with the necessity of approval for continued funding.

2.4   Application and deadline for receipt of full applications

Applications must be submitted online through the FCT website
https://concursos.fct.mctes.pt/projectos following the Announcement of the Call for Proposals.

The call is open from July 17, 2013 until October 16, 2013 at 17:00 Lisbon time.

2.5   Format requirements

Full applications must fulfill the following format requirements:

- Completion of the on-line FCT form, available through the FCT platform (https://concursos.fct.mctes.pt/projectos), according to the *Guidelines for Entrepreneurial Research Initiatives Proposals Writing* (http://www.fct.pt/apoios/cooptrans/parcerias/cmu/index.phtml.pt).
- As *Annex to Application*:
    - Include a summary (not exceeding three pages, Arial regular font, 11 point):
        - Clearly describe the ERI, stating its vision and goals, the proposed advances and the envisaged impact on innovation;
        - Briefly describe how the proposal meets the objectives of the Carnegie Mellon Portugal Program;
        - Present the nature and expected outcomes of the collaborative and cross-disciplinary work, and explain the advantages of conducting the proposed efforts as a collaborative and cross-disciplinary work;
        - State clearly the aims of the team as a whole and indicate the specific role played by each member in achieving the goals of the team;
        - Under the headings "Intellectual merit" and "Broader impacts" as relevant (see Appendix 2), provide highlights of the proposed research, education and innovation goals and strategies.
    - Include a detailed outline (not exceeding ten pages, Arial regular font, 11 point) of vision and rationale for the ERI, strategic plan, accomplishments in prior experience with the program (if applicable), research program, education program, innovation program, and infrastructure (see sections 4 and 5). The detailed presentation must delineate the specific contributions of each member of the team.
    - Include the CV and publication list of the principal applicant and each co-applicant (for each applicant, a maximum of 2 pages, Arial regular font, 11 point, including a list of up to 10 of the most relevant papers).
    - Include a detailed description of the financial and/or in-kind commitments from industry and possibly other government agencies (for each organization, a maximum of 1 page, Arial regular font, 11 point).

- Important note: All sections of the FCT form must be filled. Except where mentioned otherwise all the requested information needs to be in English. Please make sure that text entered in the on-line form is formatted and comprehensive.

2.6   Review of applications

The applications must follow the guidelines provided in these Terms of Reference and in the FCT on-line tools for general information on the application filling, namely instructions guidelines: http://www.fct.pt/apoios/projectos/concursos/instrucoes.phtml.pt.

Applications will be reviewed by an international panel of independent experts, as organized by FCT. The review panel will be responsible for evaluating the merit of each proposal.

The selection for funding is based on the criteria presented in section 5.

2.7   Notification, start of activity and reporting

The applicants will be notified in accordance with article 11 of the Regulations Governing Access to Funding for Scientific Research and Technological Development Projects. Funded applications are planned to commence by January 1, 2014.

A yearly report of the ERI will be delivered, for interim review by the Board of Directors of the Carnegie Mellon Portugal Program and by FCT. The Board of Directors has the right to recommend that further funding be discontinued or extended for one more year. At the end of the ERI a final report will be delivered, for review to the Board of Directors and FCT. The Board of Directors and FCT may request that a panel of experts reviews the progress of the ERI, yearly and at its end.

3   Eligibility information

3.1   Organization limit

Portuguese research institutions, mentioned in article 2, number 1 of the Regulations Governing Access to Funding for Scientific Research and Technological Development Projects, may submit proposals in partnership with a CMU faculty team, and with at least a company team. One of the Portuguese research institutions is the lead institution in Portugal. The CMU faculty team is the lead at CMU. Priority will be given to proposals including at least one Portuguese partner research institution with researchers who are faculty members in Portuguese universities offering doctoral programs with the breadth and depth appropriate to support the ERI's vision.

3.2   Other organizational requirements

The proposals must have at least two partner Portuguese research institutions and at least one company. CMU is a required partner in research and education. Financial and/or in-kind commitments from industry and possibly other government agencies must be included in the proposal, according to the *Guidelines for Entrepreneurial Research Initiatives Proposals Writing* (http://www.fct.pt/apoios/cooptrans/parcerias/cmu/index.phtml.en).

Whenever possible and appropriate, the research institutions may partner with national or local level organizations devoted to stimulating entrepreneurship, innovation, and job creation based on university technology.

3.3   Principal Investigator (PI) limit

The lead Portugal PI should be a faculty member, with a doctoral degree relevant to ICT, or with substantial career experience in ICT. The lead PI at CMU must hold a faculty appointment at CMU.

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

3.4 PI and researchers dedication

The lead Portugal PI shall be dedicated to the project, according to the duration of the proposed activities, at no less than 35%. The remaining members of the research team shall be dedicated to the project, according to their participation, at no less than 15%.

3.5 Limit on number of proposals per organization

There is no limit on the number of proposals to be submitted by a lead research institution and there is no limit on the number of ERI partnerships a partner research institution may join.

3.6 Limit on number of proposals per PI and researchers

A researcher may be identified as PI in at most one proposal. Researchers may be listed as co-PIs or senior researchers in multiple proposals.

4 Program description

4.1 Goal and key features of ERIs

The overarching goal of ERIs is to create a culture that links scientific discovery to technological innovation, through research and education, to advance technology and to produce graduates in science, engineering, management and policy who will be creative innovators in a global economy.

To achieve this goal, ERIs will have the following key features:

- A vision for bridging fundamental research to innovation and for developing an innovative and globally competitive workforce;
- A strategic plan for research, education and innovation, outlining a path to sustainability;
- A cross-disciplinary research program designed to support fundamental research motivated by solutions for real-world problems, in ways that can promote innovation and commercialization of technology;
- An emphasis on cross-cultural global research and education experiences through the partnership with CMU;
- An education program that strategically uses education programs, most importantly existing or new dual degree programs in the Carnegie Mellon Portugal Program, to produce creative and innovative talent, and that engages students in all phases of the research and innovation process, in particular, in partnership with Portuguese and other companies;
- An innovation program that includes partnerships with firms (startups and/or established companies), to support the ERI goals and to streamline the appropriate processes of technology transfer, and, whenever feasible and suitable, innovation and entrepreneurship support organizations to accelerate technological innovation and entrepreneurship.

An ERI will focus on real world problems that cannot be addressed without a significant level of fundamental knowledge in ICT, which feeds into devices, components and systems needed to realize the targeted solutions. Accordingly, the ERI's vision will identify and focus on opportunities to increase economic competitiveness and/or to contribute to solving important societal problems, through cutting-edge research in ICT, including innovation and commercialization goals. As appropriate to the topic area, the ERI will address the societal, policy and managerial implications of the ICT-enabled scientific and technological breakthroughs.

ERIs will be supported in emerging areas of ICT that are ready to feed into proof-of-concept solutions within the 4-year life span of support.

The following is a high level list of key strategic areas of the Carnegie Mellon Portugal Program, which, among other potential areas to be proposed, might be included and combined in ERIs:

- Future Internet Architectures and Business Models;
- Secure and Dependable Software-Intensive Systems;
- Large Data Analysis For Network Science, Engineering, and Consumer Analytics;
- Intelligent Electric Power and Smart Transportation for Sustainable Mobility;
- Human-Computer Interaction;
- Technology Policy and Entrepreneurship;
- Applied Mathematics.

For a more detailed and balanced discussion of the areas, please refer to the Roadmap for Phase II of the Carnegie Mellon Portugal Program.

The following items alone are not appropriate for a proposal:

- A vision and research program not requiring significant ICT-related research;
- A majority of effort put into fundamental research prior to development;
- Incremental advances to current practices;
- Individual components without integration into real world solutions.

4.2 Infrastructure required

ERIs require the following infrastructure:

- In Portugal, multi-institutional configuration, pulling complementary expertise and skills from several institutions: one eligible lead plus at least one additional Portuguese research institution, enabled by a cross-institutional commitment to support and sustain the ERI and to facilitate and foster the cross-disciplinary team, and its innovation and mentoring goals;
- A CMU faculty team as international partner in research and education, also providing complementary expertise and skills, as well as cross-cultural research and educational experiences for researchers and students;
- Capable leadership, faculty, researcher and student teams committed to a shared vision;
- Appropriate administrative and management systems to develop the ERI;
- Effective cross-institution collaboration among faculty, researchers and students through shared resources (e.g., shared data, experimentation, simulations, and testbeds), and shared programs of education, enabled by cyber-infrastructure;
- A partnership with industrial partners governed by membership agreements and appropriate intellectual property policies to support and sustain the ERI and to accelerate technology transfer and innovation;
- Effective academic policies that sustain and reward the ERI's cross-disciplinary, global culture, its goals for technological innovation, and the role of its faculty and researchers in mentoring;
- Financial and/or in-kind cost sharing support from industrial partners to enable the ERI to meet its goals.

4.3 ERI configuration

The minimum number of Portuguese research institutions is two. This does not imply that in order to be competitive, the proposal should necessarily include a large number of Portuguese partners; however, a configuration of just one Portuguese research institution is not acceptable.

The team must include at least a company that provides effective support and effectively participates in the work to be carried out.

The lead and each of the core partner institutions must be committed to an integrated configuration to fulfill the research, education and innovation goals of the ERI.

The ERI team may have researchers from several fields of research, including basic sciences, engineering, social sciences and/or humanities and arts.

ERIs provide an opportunity for students, researchers and faculty to collaborate in a globally connected university research and education environment to strengthen the ERI goals, and to enable graduates to work effectively in a globally connected economy. Thus, it is required that the Portuguese teams partners with a CMU team, carrying out activities under the ERI's strategic plan, that add value in both research and education.

ERIs can support both Portuguese as well as foreign students attending degree programs or in postdoctoral appointments offered by Portuguese universities, CMU, or in collaboration by Portuguese research institutions and CMU.

4.4 Strategic plan

The ERI strategic plan should include research, education and innovation components, and specify, overall, and for each of these three components:

- The desired goals;
- How the goals will be achieved;
- How progress and impact will be measured.

Each ERI should suggest its own set of indicators to assess progress and impact, according to its specific design. Suggestions of indicators in multiple areas that are relevant to ERIs are provided in Appendix 1. Whenever possible and appropriate, the proposal should include quantitative estimates of the outcomes that the ERI will seek to achieve.

This set of indicators must include the indicators required by FCT for project proposals and reports.

4.5 Prior experience with the Carnegie Mellon Portugal Program

Prior experience with the Carnegie Mellon Portugal Program is not required. If the PI or other members of the team participated in Phase I of the program, the proposal should briefly summarize this participation and provide details on what was accomplished.

4.6   Research plan

4.6.1   Strategic research plan

An ERI must have a strategic research plan motivated by its vision, in accordance with the key strategic areas of the Carnegie Mellon Portugal Program. The objective of the strategic plan is to define: (1) the relevant real world problems that are the focus of the ERI; (2) solutions envisaged for these problems; (3) the research challenges that these solutions might raise; and (4) the lines of fundamental and translational research to overcome these challenges.

A specific initial strategic plan must be created, with the understanding, however, that it may evolve over time, as the initiative develops and the uncertainty intrinsic to the early stages of technological development is progressively reduced.

ERIs should contain a balanced portfolio of fundamental research, and technology and product development. ERIs should include plans for both longer-term advances to knowledge and nearer-term results to meet more immediate industry needs. The research program should be cross-disciplinary in nature, encouraging mixed teams of faculty and students of different laboratories and disciplines. Whenever possible and appropriate, they can also include proof-of-concept activities, testbeds, experiments with companies, and translational research.

4.6.2   Detailed research plan

A detailed research plan should be provided that discusses and identifies the main goals of the research, open questions to be pursued, approaches to be taken, and how entrepreneurial activities will be pursued. The role and interactions among all partners should be identified. Collaboration and experimentation platforms (such as testbeds and experiments with companies) play a critical role in integrating the research and exploring the realities of envisaged solutions. These experimentation platforms are expected to go beyond laboratory conditions.

The detailed plan should describe the fundamental challenges the research will address and the methods to address them, in the context of known results and theory, to demonstrate that the desired results constitute potential breakthroughs and are attainable in four years. There should be sufficient depth in the proposal to allow reviewers to judge the quality of the effort proposed.

The research program may integrate basic sciences and engineering disciplines, and depending on the topic proposed, it may include humanities, arts and social sciences to achieve the vision of the ERI.

4.7   Graduate education program

The ERI may strategically use professional master or doctoral education programs already in place in Portuguese universities, most importantly the dual degree programs of the CMU Portugal Program. In this respect, ERIs can focus on strategies to graduate students who are adaptive and creative innovators, capable of advancing fundamental knowledge, and creating and exploiting that knowledge to accelerate innovation in a global economy.

Hence, the ERI will propose an education strategic plan that: a) states the educational hypothesis and the desired characteristics of the ERI's graduates; b) describes activities to impart these characteristics in the students; and c) assesses progress and impact.

4.8   ERI innovation program

ERIs will seek to develop a culture that integrates discovery, innovation and internationalization, by acting as international innovation engines.

An international innovation engine is a symbiotic relationship between researchers, small businesses, larger industry partners, and innovation and entrepreneurship support organizations, embedded in international knowledge and business networks, to create new ideas and their translation into products, processes and services.

The proposal will include a strategic plan to develop such an engine, describing the involvement of industry (startups and/or established companies) to promote and accelerate commercialization. Industry should be able to: provide strategic guidance on planning, research, education and innovation; contribute to the research and education programs with knowledge of product/service design and manufacturing/delivery; guide the translation of research into innovation; help in establishing the culture of innovation and the international experience required for students, researchers and faculty.

If the proposal includes innovations in services or professional practices, services firms or other organizations contributing to accelerating and facilitating their use in practice should be engaged in place of technology-focused firms.

Industry involvement will be governed by agreements defining scope and function, and by IP policies that facilitate joint developments among multiple research institutions and industry. The support from the Carnegie Mellon Portugal Program may be complemented by financial and/or in-kind support from industry. The level of support from firms committed to the ERI should demonstrate strong industry interest.

Whenever feasible and suitable, innovation and entrepreneurship organizations may be involved in the ERI, to support the innovation program and to bring awareness and knowledge of entrepreneurship and innovation to the ERI's students, researchers and faculty in the scope of the education program.

4.9   ERI leaders and team members

Each ERI must identify the Portugal research institutions, the companies, and CMU PIs. When other researchers are involved, these should be also identified and the role they play. For specific instructions, please refer to the *Guidelines for Entrepreneurial Research Initiatives Proposals Writing* (http://www.fct.pt/apoios/cooptrans/parcerias/cmu/index.phtml.pt).

The ERIs will be periodically reviewed and feedback will be provided to the PIs. As a consequence of this review, if an ERI's progress is not considered to be satisfactory, it may be terminated. Each ERI may also want to establish its own complementary review and/or advisory structures.

5   Evaluation and selection criteria

Applications will be reviewed by international panels of independent experts, as organized by FCT.

The selection and ranking of the applications will be based on the following criteria, detailed in the Regulations Governing Access to Funding for Scientific Research and Technological Development Projects:

A. Scientific merit and innovative nature of the project from an international standpoint;
B. Scientific merit of the research team;
C. Feasibility of the plan of work and reasonableness of the budget;
D. Contribution to the body of knowledge and competence of the National Science and Technology System;
E. Potential economic value of the technology.

Application of these evaluation criteria shall take into account, among other considerations, the following:

a. For criterion A:
   i. Relevance and originality of the project proposed (based on the state-of-the-art in a determined scientific area and previous work done by the proposing team);
   ii. Methodology adopted for carrying out the project;
   iii. Expected results and their contribution to scientific and technological knowledge;
   iv. Resulting publications and articles;
   v. Contribution towards promoting and disseminating science and technology;
   vi. Production of knowledge that can be incorporated into and applied to the business sector, if applicable;
   vii. Benefits to society and contribution to economic growth;
   viii. Relevance towards obtaining comparative advantages for Portugal, in accordance with the objectives of the Carnegie Mellon Portugal Program;
   ix. Importance of the targeted real world problems and of the identified technical, societal and economic challenges;
   x. Clear motivation for a high quality cross-disciplinary research to address the identified challenges through significant upstream research efforts, expanding the body of knowledge and looking at enabling novel real-world solutions for the long-term, and downstream research and development efforts, in close connection with industry, enabling new real-world solutions for the near-term;
   xi. Level of integration of research, education, and innovation, leading to a culture of discovery and innovation (an innovation engine);
   xii. A strategy to educate graduates who are adaptive, creative innovators, capable of advancing fundamental knowledge and exploiting it in ways that allow for creating innovations in a globally connected, innovation-driven world;
   xiii. Effective plans for mentoring graduate students and postdoctoral researchers.

b. For criterion B:
   i. Scientific productivity of the team (references to publications and citations in published works, other relevant indicators);
   ii. Abilities and skills to adequately execute the proposed project (team configuration, Principal Investigator's (PI) qualifications);
   iii. Ability to involve young researchers in training;
   iv. Availability of the team and non duplication of objectives in relation to other projects underway;
   v. The degree of internationalization of the team;
   vi. Degree of success in previous projects in relation to the Principal Investigator (PI) (in the case of young PIs, this requirement must be assessed based on the potential revealed by the PIs curriculum vitae in the absence of prior concrete accomplishments);
   vii. Qualifications of the lead Portugal PI as faculty member, and relevance of the PI's doctoral degree and/or career experience to ICT;

viii. Accomplishments in prior experience with the Carnegie Mellon Portugal Program (if applicable);

ix. Level of commitment of any companies participating in the project (if applicable);

x. Team qualifications regarding leadership, disciplines and collaboration potential;

xi. Alignment between the team's recent and proposed research advances and emerging opportunities for technological innovation;

xii. A strategy for cross-institution collaboration in research, education, and innovation, effectively organizing and integrating resources and activities;

xiii. Inclusion of Portuguese partner research institutions with researchers who are faculty members in Portuguese universities offering doctoral programs with the breadth and depth appropriate to support the ERI's vision;

xiv. Strong advisory committee, with industry and academia representation, working symbiotically to contribute to bridge science and industry.

c. For criterion C:

i. Organization of the project in terms of the proposed objectives and resources (duration, equipment, size of the team, institutional and management resources);

ii. Institutional resources of the proposing and participating entities (technical-scientific, organizational and managerial and, when appropriate, co-funding capacity on the part of companies);

iii. Quality of project design and rationale for the proposed budget;

iv. Level of access to knowledge from other initiatives;

v. Support from leaders at partner institutions towards cross-disciplinary research, industry membership and IP policy;

vi. Experimental, computational, and other required equipment, facilities, and laboratory space to support the research;

vii. Cyber-infrastructure effectively used for collaboration and sharing of information across all partners including both Portuguese research partners, CMU and industrial partners;

viii. Level of committed industry financial and/or in-kind support commensurate with typical levels of support for academic research in the fields involved in the ERI.

d. For criterion D:

i. Contribution to the body of knowledge and competence of the National Science and Technology System (expected effects and results);

ii. Enhancement of partnerships for research, education and innovation;

iii. Clear path for the sustainability of the ERI.

e. For criterion E:

i. Potential economic value of the technology (if appropriate), namely in terms of its impact on the competitiveness of the national socio-economic system;

ii. A strategy to develop an innovation engine, partnering with startups and/or established companies;

iii. A rationale for selecting industry partners, and means to engage these partners in planning, research, education, and innovation;

iv. Effective plans and instruments to promote interaction with potential markets and end users, including prototyping, proof-of-concept and proof-of-market;

v. Facilitation of collaboration with industry and technology transfer, through proposed draft partnership agreements and Intellectual Property (IP) policy;

vi. Clear strategy for researchers to affiliate with startups and/or established companies, to license IP, carry out translational research, accelerate commercialization, and provide students with innovation experiences;

vii.   Whenever possible and appropriate, effective partnering with innovation and entrepreneurship support organizations in education and innovation activities.

6   Illustrative examples of ERIs

This section presents two of multiple potential ERI configurations, for illustrative purposes only. They should not be regarded as guidelines for proposals to follow.

These examples are provided to help with the development of ERI proposals. They should not be considered as the only two formats that an ERI can adopt, but instead as an illustration of the possibilities of integrating research, innovation, education and industry collaboration, to bridge knowledge generation and real word impact.

6.1   Illustrative example of a Phase I research project with an ERI configuration

DRIVE-IN focuses on improving the experience of the users of automotive vehicles and the overall efficiency of vehicle and road utilization. Road crashes are today the ninth leading cause of death worldwide, with particular significance at younger ages. The cost of road traffic congestion represents 1% of the European Union GDP, and a similar number is estimated for the United States. American drivers also spend an average of three hours per day in their vehicle, creating an opportunity to explore the concept of "connected drive" for the distribution of advertising and entertainment content. The project aims at achieving these improvements through the use of inter-vehicle communication, bridging its foundations and applications.

The most fundamental research thrust in the project is the creation of geo-optimized VANET protocols. With the support of these protocols, more applied research is directed to the creation of distributed and collaborative vehicle routing algorithms, and the development of a variety of applications and services aimed at improving the user experience while in the car.

A simulation platform and a real testbed with a VANET of 500 taxis are used for large-scale experimentation of the routing algorithms and the applications and services. These platforms are also important instruments for collaboration between the partners of the project as they allow a preliminary evaluation and validation of protocols, systems and applications under realistic conditions. With respect to the vehicular environment, where the investment cost required to deploy a dedicated fleet comprising hundreds of automobiles is prohibitive, the existence of such a testbed involving the taxi fleet of one of the partners allows the creation of proof-of-concept experiments that are critical to make research evolve into entrepreneurial initiatives.

The projects team brings together research teams from: Universidade do Porto; Universidade de Aveiro; Instituto de Telecomunicações; CITTA - Research Centre for Territory, Transport and Environment; LIACC - Artificial Intelligence and Computer Science Laboratory; and Carnegie Mellon University (CMU). This cross-disciplinary team brings together expertise in wireless networks, spatial databases, data mining, and transportation planning. The international partnership with CMU enables complementary efforts in related areas and brings strong connections with key industrial partners, such as General Motors.

The project is a collaborative effort with NDrive, a global player in the Navigation Systems market, that explores strongly the concept of Connected Drive, namely through real-time route-choice based on traffic conditions. RadiTáxis, the largest association of taxis of Porto and the oldest in the country, allows the use of their fleet of 450 taxis to deploy the VANET testbed. IMTT, the central administration body responsible for the coordination of inland transport, provides financial support to the installation of in-

car computers and mobile communication devices in the testbed vehicles. The project is also collaborating with Geolink, a startup focused in the management of geospatial information, to develop and commercialize solutions in the areas of taxi dispatch systems and vehicular mobility optimization based on the research carried out in the project. The project also seeks to license other intellectual property to be developed in the areas of vehicular ad hoc networks and next-generation drivers information systems, in particular to one or more related spin-offs.

4 ECE dual degree and 3 regular PhD students are involved with the project. The ECE PhD Program provides a research-intensive study of the fundamentals of electrical or computer engineering. At CMU and the Portuguese Universities the students are exposed to advanced courses in wireless networks, machine learning and distributed systems, which provide them with focused advanced knowledge and skills in the areas that are particularly relevant for the project. The PhD curricula together with the project's research and innovation programs provide an environment where the students can develop creativity and adaptation skills through the involvement with real problems faced by the industrial partners of the project. For instance, the problems suggested by the PhD students involved in the program for their Practical Assignments in courses such as Machine Learning or Distributed Systems are leveraged in practical and significant problems, such as Automatic Destination Prediction, Passenger Finding Intelligence, Intersection Traffic Control Strategies, all based in rich datasets and measurements derived within the project. The international dual degree program in particular exposes the students to an international and multi-cultural environment, preparing them for future careers in international settings.

The project is thematically included in the strategic focus area of New Generation Dependable Trusted Networks and Telecommunications Policy (NGN), and contributes to the strategic vision of the Carnegie Mellon Portugal Program by advancing and exploiting technology capabilities and collaborations between CMU and Portuguese universities and industry, in a focused ICT area where Portugal can aim at being competitive at an international level.

6.2   Illustrative example of a hypothetical ERI with a center-like configuration

The goal of the ERI is to foster entrepreneurship and innovation through a virtual center dedicated to a key strategic area of the Carnegie Mellon Portugal Program in Phase II, with an agile affiliate structure and research ecosystem. The ERI will leverage research collaborations and will be centered on the development of human capital through the existing dual degree programs that are relevant to this key strategic area.

The virtual center will have a co-director at CMU and co-directors at Portuguese institutions, and two kinds of affiliates: (1) joint CMU-Portugal research projects and (2) industry partners.

The affiliate research projects are defined in the proposal and draw upon collaborations established during Phase I of the partnership, as well as new collaborations. The projects feature both intellectual merit and potential for technology transfer or industrial innovation.

Current and prospective affiliate industry partners serve as applied research or development partners, technology transfer vehicles, vectors for transformative practices, and internship hosts.

The assignment of funding to the affiliate research projects is established and reviewed internally according to a well-defined flexible mechanism that takes into account the evolution of the activities and outcomes in each research project and the availability of resources (such as highly qualified students and postdocs, as well as other complementary resources).

PhD students admitted to dual degree programs are matched with co-advisors who are engaged in an affiliated project. During their course of study, PhD candidates intern at a startup company in the US, and collaborate with or intern at an industrial affiliate in Portugal. MS students admitted to a dual degree Professional Masters program carry out a studio project and/or internship with an affiliated company, with impact on industry practices or innovation potential. Students also participate in entrepreneurship courses during their course of study.

Appendix 1 – Suggestions of ERI indicators

Area	Indicator
Education	Dual degree PhD students involved
	Single degree PhD students involved
	Dual degree Professional Masters students involved
R&D	Books[1]
	PhD theses[1]
	Master theses[1]
	Other outputs of advanced training[1]
	Papers in international journals[1]
	Papers in national journals[1]
	Publications accepted in international conferences with peer review
	Book chapters
	Communications in international meetings[1]
	Communications in national meetings[1]
	Reports[1]
	Disclosures
	Models[1]
	Software[1]
	Pilot plants[1]
	Prototypes[1]
	Studio or capstone projects concluded
Innovation	Patents[1]
	New products, processes and services
	Improved products, processes and services
	Licenses
	Business plans developed
	Spin-offs created
	Experimentation platforms created
	Concepts tested in experimentation platforms
Dissemination	Organization of seminars and conferences[1]
	Participation in seminars and conferences
	Science communication (news, features in the media)
	Public documents
	Visits to website
Collaboration	Co-authored publications
	International visits

[1] Available on FCT project proposals and reports.

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA

Appendix 2 – Research highlights

Highlights of the proposed research, education and innovation goals and strategies should illustrate the following:

1. Intellectual merit:
   a. Importance of goals/challenges to advance fundamental and applied knowledge;
   b. Team qualifications, including scientific merit and productivity, leadership, skills, disciplines and collaboration potential;
   c. Level of creativity, originality, inter-disciplinarity and transformation potential;
   d. Quality of project design, organization, research methodologies, and rationale for the proposed budget;
   e. Level of access to resources, including knowledge from other initiatives.

2. Broader impacts:
   a. Relevance towards obtaining comparative advantages for Portugal, in accordance with the objectives of the Carnegie Mellon Portugal Program;
   b. Level of integration of research, education and innovation;
   c. Enhancement of partnerships for research, education and innovation;
   d. Dissemination to enhance scientific and technological understanding;
   e. Benefits to society and contribution to economic growth.