Faculdade de Engenharia, Universidade do Porto

Tese de Mestrado em Inovação e Empreendedorismo Tecnológico

The strength of weak or strong ties?

Assessing the influence of Technology Research Organizations based on Human Resources mobility

Cristiana Pedrosa

2009

Supervisor: Aurora A.C. Teixeira

Acknowledgements

First of all I would like to acknowledge my supervisor, Aurora Teixeira, for the guidance, ideas, availability and for never giving up.

To all MIETE teachers thank you for all the transmitted knowledge and for opening my mind – “The sky is the limit”.

A special word of acknowledgment goes to my family and close friends for all the support.

I would also like to acknowledge the INESC Porto human resources collaborators and all respondents to the survey, ex INESC Porto collaborators.

Finally thank you to all who contributed in any way for this project, and was not mentioned before.

Abstract

The purpose of this study is to purpose a new approach to assess the range of influence of R&D and Technology Transfer organizations. Through an approach based on human resources mobility, and (re)visiting Mark Granovetter's Weak Ties Theory, our study intends to complement strict econometric and scientometric based methods to assess the influence of R&D and Technology Transfer organizations.

Several authors stated that human resources constitute an important vehicle of technology transfer but the economic and scientometric based methods to assess impacts of R&D organizations overlook that particular factor. Sociological aspects are often connected to economic and scientific results, but have not been referred by the existing impact studies.

In order to assess the range of influence of a R&D and Technology Transfer organization, we went through an in depth analysis of 715 former collaborators of INESC Porto. Based on this population we built a unique human resources database containing 152 former collaborators, supported by primary information gathered from a direct survey to all former collaborators of the R&D organization. The database was divided in two groups: collaborators who worked for the institution for more than one year (strong ties) and collaborators who worked less than one year (weak ties). Statistical analysis of the respondent database yield that most of the former collaborators connected to the organization by means of strong ties are the ones that maintained contacts with the organization thus bridging their present employer organizations with INESC Porto. Strong ties enable therefore the enlargement of the extent of the technology transfer process and knowledge diffusion by informal means. In this vein, contrasting with Granovetter's theory, only strong ties (and not weak ties) are local bridges for knowledge diffusion. Former collaborators which have strong ties are therefore key actors for improving the range of influence of INESC Porto beyond the strict sphere of science, guarantying a successful and sustainable link between science and industry, mostly based on informal linkages.

Keywords: Human Resource Mobility; Technology Transfer Organizations; Impact studies

Resumo

O objective deste estudo é propor um novo panorama na análise do impacto de organizações de I&D e Transferência de Tecnologia. Através de um método baseado na mobilidade de recursos humanos, e (re)visitando a teoria dos laços fracos (Weak Ties Theory) de Mark Granovetter, temos a intenção de complementar métodos econométricos e cientométricos no estudo do impacto de organizações de I&D e Transferência de Tecnologia.

Vários autores concordam com a premissa de que os recursos humanos constituem um importante veículo de transferência de tecnologia, mas os métodos econométricos e cientométricos tradicionais para inferir impactos de organizações de I&D geralmente não se focam neste particular factor .Aspectos sociológicos estão geralmente ligados a resultados económicos e científicos mas não têm sido referidos nos estudos de impacto existentes.

Para analisar a influência de uma organização de I&D e transferência de tecnologia, efectuamos uma análise extensiva de 715 ex colaboradores do INESC Porto. Com base nesta população construímos uma base de dados de recursos humanos única, contendo 152 antigos colaboradores, suportada por informação primária recolhida através de um inquérito directo a todos os antigos colaboradores desta instituição de I&D. A base de dados foi dividida em dois grandes grupos: colaboradores que trabalharam na instituição durante mais de um ano (laços fortes – strong ties) e colaboradores que trabalharam menos de um ano (laços fracos – weak ties). Uma análise estatística da base de dados de respondentes permitiu-nos verificar que a maioria dos antigos colaboradores ligados à organização através de laços fortes têm mantido contacto com a organização, ligando as actuais organizações empregadoras e o INESC Porto. Os laços fortes permitem assim o alargamento da extensão do processo de transferência de tecnologia e difusão de conhecimento através de meios informais. Deste modo, contrastando com a teoria de Granovetter, apenas os laços fortes (e não os laços fracos) são pontes locais para a difusão de conhecimento. Os antigos colaboradores que têm laços fortes com a organização são actores chave no alargamento do grau de influencia do INESC Porto para além da esfera restrita da ciência, garantindo uma ligação sustentável e conseguida entre a ciência e a industria, principalmente baseada em relações informais.

Palavras-chave: Mobilidade de Recursos Humanos, Organizações de Transferência de Tecnologia, Estudos de Impacto

Contents

Index of Tables

Index of Figures

Abbreviations

INESC Porto – Instituto de Engenharia de Sistemas e Computadores do Porto

TT – Technology Transfer

R&D – Research & Development

UI – University-Industry

TTO – Technology Transfer Office

SME – Small and Medium Enterprise

ROI – Return on Investment

GDP – Gross Domestic Product

UITT – Unidade de Inovação e Transferência de Tecnologia

UOSE – Unidade de Optoelectrónica e Sistemas Electrónicos

USIC – Unidade de Sistemas de Informação e Comunicação

UTM – Unidade de Telecomunicações e Multimédia

DIL – Departamento de Informação e Logística

IT – Information Technologies

SCI – Serviço de Comunicação e IT

SIG – Serviço de Informação e Gestão

POCI – Programa Operacional Ciência e Inovação

IEFP – Instituto de Emprego e Formação Profissional

UK – United Kingdom

USA – United States of America

FEUP – Faculdade de Engenharia da Universidade do Porto

FEP – Faculdade de Economia da Universidade do Porto

FCUP – Faculdade de Ciências da Universidade do Porto

FCTUC – Faculdade de Ciências e Tecnologia da Universidade de Coimbra

UTAD – Universidade de Trás-os Montes e Alto Douro

CERN – European Organization for Nuclear Research

MIT – Massachusetts Institute of Technology

ISMAI – Instituto Superior da Maia

ISEP – Instituto Superior de Engenharia do Porto

IPP – Instituto Politécnico do Porto

EGP – Escola de Gestão do Porto

Introduction

Technology transfer (TT) has been generally defined as the managed process of conveying a technology from one party to its adoption by another (Spann et al., 1995). The technology transfer process can be made by several ways: human capital exchange between R&D Organizations, industry (Lee, 1996; Martin, 1998; Bercovitz and Feldmann, 2007, Santoro and Gopalakrishnan., 2000), and other entities (e.g., government bodies); consultancy (Lee, 1996; Martin, 1998; Feller et al., 2002; Bercovitz and Feldmann, 2007; Martinelli et al., 2007); transfer of intellectual property rights from the public domain to industry (Lee, 1996); start-up assistance to new technology-based firms (Lee, 1996); university-Industry (UI) business partnership through equity investment (Lee, 1996); resource sharing (Santoro and Gopalakrishnan, 2000); collaborative research, including UI consortia (Lee, 1996; Feller et al., 2002, Santoro and Gopalakrishnan, 2000), and UI alliances (Lee, 1996); patents, licenses, and spin-offs (Feller et al., 2002; Bercovitz and Feldmann, 2007); publications in open literature (Feller et al., 2002); training of graduate students (Feller et al., 2002; Martinelli et al., 2007; Bercovitz and Feldmann, 2007); research grants (Martinelli et al., 2007 ; Bercovitz and Feldmann, 2007); and research contract (Martinelli et al., 2007; Bercovitz and Feldmann, 2007).

Recently attention is being given to the relationships existing between scientific research and regional economic growth, thus governments have fostered applied research and technology transfer. National Systems of Innovation are more discussed and Research Centres are created to work more closely with industry (Feller et al., 2002). The (human and physical) resources at these centres are more specialized and concentrated to better respond to organization's needs. For policy makers, in general and organizations' board of directors in particular, it is important to study and measure the effects of national and regional programs and the impacts of research centres, namely Technology Transference and R&D Organizations. This impact reflects, at least in part, the extent and importance of technology transfer processes.

Typical impact studies focus on econometrics and scientometric, based on clear quantitative measures. There are, however, many problems in measuring technology transfer due to subjectivity, and measures are not always representative of the real dimension of the process. For example, counting licenses and royalties does not distinguish successful breakthrough innovations from simple incremental improvements (Spann et al.,

1995). While measures of formal collaborations like sponsored research are routinely published, less is known about informal collaborations and R&D Organizations consulting. This yields an underestimation of the impact of the R&D Organizations in transferring technology (Bercovitz and Feldmann, 2007). In what concerns informal collaborations, knowledge spillovers constitute an important factor in shaping the regional conditions for innovation activities (Fritsch and Franke, 2004). In fact, Shartinger et al (2001) concluded that the main channel of knowledge transfer to the business sector is the **mobility of human capital**. Many authors agree on the statement of human capital as an input from universities to private companies but studies usually do not focus on this particular factor.

In the present dissertation we aim at exploring the influence and impact of an R&D Organization through a human resource mobility/network-based approach. More specifically, by identifying past collaborators' career trajectory and present professional position and geographical location of their activity we are able to assess **how far and wide has the technology transference process occurred**. We are implicitly assuming that former collaborators of the research organization embodied (some of the) organization's technology and knowledge, and thus such technology and knowledge is transferred for organizations where the former collaborator is employed during his/her career trajectory. Thus, based on this novel (albeit partial) perspective of the technology transference process, we reach a simple but encompassing vision of an **R&D Organization range of influence at the regional and even national and international scales**.

The present dissertation embraces a novel contribution to the literature in the area by assessing the impact of an R&D organization via geographical and occupational mobility of its former human resources. In order to frame in a theoretical perspective such contribution, we (re)visit Granovetter's weak ties theory (1973) and apply it to our context. We classify the organization's former collaborators into two groups: a first group comprising former collaborators who spent few months (less than one year) in the organization, and thus having established weaker ties within the organization – in Granovetter's jargon, 'the acquaintances'; a second group which were employed in the organization for over one year, and thus having established within the organization's members strong ties, or in Granovetter's words, friendship and kindship ties. Our aim is to assess to what extent weak and strong ties are a (present) source of collaborations, partnerships and business with the research organization, and thus infer about organization's scope and length of influence.

The dissertation is structured as follows. In the next chapter we review the literature on the influence and impact of Technology Transference and R&D Organizations, and bridge it to sociological network approaches. Then, in Chapter 2, we detail the methodological aspects of the present study. The mapping for assessing the impact of INESC Porto considering geographic, economic, and scientific levels, based on a new approach - the benefits to the organization from the former human resources - focused on human resources trajectory, is performed in Chapter 3. Finally, in Conclusions we summarize the main outcomes, limitations and implications of our research.

Chapter 1. The influence and impact of Technology Transference and R&D Organizations. Bridging technological and sociological fields of research

1.1. Initial considerations

In this chapter we define Technology Transference and R&D Organizations, and analyse the main functions of these organizations as mentioned in economics and technology-related literature. We then add the contributions of sociological studies, namely Ganovetter's theory of social networking by arguing that this stream of research is scientifically pertinent to account for the influence that R&D organizations have at a more macroeconomic level, thus complementing economic and technological impact studies.

1.2. The main functions of Technology Transfer and R&D Organizations and the quest for evaluating their impact

Several studies have been conducted on Technology Transfer and R&D organizations and their major functions (Howells, 2006). R&D organizations include universities, government organizations, and private specific organizations. The roles of R&D organizations are often defined as knowledge production, human capital development, technological innovation, capital investment, regional leadership and influence and technology transfer (Drucker and Goldstein, 2007).

Other organizations, like Technology transfer Offices (TTOs), often part of R&D organizations, focus mainly on the technology transfer process, concerning technology commercialisation. Through a literature survey, Howells (2006) described the main functions of technology transfer organizations, which he named 'intermediaries', focusing mainly on the literature of technology transfer. Additionally, he defined types of intermediaries in the process, and discussed the economic role of such organizations. Since there are pronounced barriers for the interaction between firms and research organizations (Shartinger et al, 2001) and the gap is even wider when considering SME's (Izushi, 2003), intermediaries assume an important role on bridging these sectors (Howells, 2006). Wolson (2007), on a study about the role of TTOs in the biotechnology sector in South Africa, stated that TTOs could have a crucial role in bridging research organizations and industry. In particular, TTOs could contribute for the establishment of new companies.

Howells (2006) identified several functions of Innovation Intermediation: 1. Foresight and diagnostics, 2. Scanning and information processing; 3. Knowledge processing and combination/recombination; 4. Gatekeeping and brokering; 5. Testing and Validation; 6. Accreditation; 7. Validation and regulation; 8. Protecting the results; 9. Commercialisation; and 10. Evaluation of outcomes.

The need of evaluating the performance of R&D and Technology Transfer organizations is clear either to R&D organizations, to justify and attract the funding (Kostoff, 1995; Martin, 1998) and to improve their work with cost reduction, but also for policy makers, and sponsors, including companies with collaboration with these organizations, to evaluate the outcomes of the organizations in which they are investing

The question of collaborations and research evaluation is complex, and organizations cannot precisely evaluate the economic incomes of working with research centres and universities (Feller et al., 2002). Public investments generate questions concerning the magnitude and distribution of their impacts as well as their effectiveness. Thus, governments question the possibility of an evaluation system for research.

There have been various attempts made to assess the impacts of the activities undertaken by research organizations. However, as Martin (2004) states, many of these studies are in part inadequate or incomplete, being static and thus more dynamic approaches should be used. Further, the studies find that knowledge transfer programmes are often subject to political, rather than economic, decisions because of their difficulties of measuring benefits and costs (Izushi, 2003). Most studies are more focused on universities, rather than R&D centres. The approaches and methodologies used have varied widely, and yielded a wide range of estimates concerning the impacts of universities on their regional economies.

Drucker and Goldstein (2007) performed a review of current approaches for the assessment of the regional economic development impact of research universities. Starting with modern university functions, most methods assess the impact of these organizations on regional economic development by measuring the outputs of these functions. Traditional approaches have focused on outputs arising from direct spending and regional investment, and have extended to consider the effects of human-capital creation and consequent migration patterns. More recently, approaches have started to consider knowledge creation and technology transfer activities. We here identify two main approaches for assessing

impacts of research universities (more than research organizations): econometric based and scientometric based approaches.

1.3. Assessing the influence of organizations using the traditional (economic and technology-based) approaches

1.3.1. Econometric based approaches

Econometric based approaches are considered to be more traditional approaches (Drucker and Goldstein, 2007; Sorensen and Chambers, 2007) because were the first to be used, with the intent to evaluate public investments and sponsoring to research universities. Strict economic impact studies usually account for economic metrics, such as patent or licenses granted and royal incomes (Golob, 2006; Spann et al.,1995), jobs creation (Martin, 1998; Spann et al, 1995), spin-offs (Golob, 2006), etc. (cf. Table 1). These metrics usually reflect a simple, narrow perspective of evaluating R&D economic benefits as a direct result of R&D investments. An example of this simple perspective is Bessette (2003), who suggests a possible method to quantify research outputs such that economic impacts are reported as a percent return on investment (ROI).

Table 1: Some econometric based impact studies

Authors (date)	Functions considered	General approach	Method/Metrics used	Main conclusions
Martin (1998)	National economic growth Influence on regional milieu Capital Investment Human capital creation	Econometric	Production Function	The universities activities translate, when its economic impact is measured through the dynamic approach, into an appreciable growth in GDP and employment.
Sable (2007)	Influence on regional milieu	Econometric	Region data	Although high-tech industries such as biotechnology are considered drivers of economic development, the local development impact of these clusters is not entirely positive. This is especially true with regard to the impact upon the low and semi skilled population. It has also contributed for gentrification and pollution.
Rosenfeld and Roth (2004)	Influence on regional milieu Transfer of existing know how Human capital creation Technological innovation	Econometric	knowledge transfer activities	Spatial proximity is generally important for the establishment of knowledge transfers.
Golob (2006)	Influence on regional milieu Transfer of existing know how	Econometric	Technology transfer activities (licences)	Universities that view the primary objective of technology transfer as a revenue generator for their organizations generate fewer spin-offs than those that incorporate a local economic development component. Academic entrepreneurs with a pre-existing affiliation with the licensing organization are more likely to locate in the area than outsiders utilizing the technology.
Bessette (2003)	Influence on regional milieu Capital Investment	Econometric	Calculation of ROI for research	This possible method is suggested to quantify research outputs and evaluate research organizations

Other studies, consider macroeconomic data, for example, Martin (1998) measures the economic impact of Canadian university through a dynamic approach, as the growth in

GDP. At a more local level there are also economic impact studies of universities, R&D organizations and high tech clusters on the local economy. These studies focus on the overall impact on local real estate, services, jobs creation, and related organizations. For example, Sable (2007) performed a study on biotechnology clusters in the San Diego and Boston metropolitan areas, exploring the influence of this high tech industry on the local labour and real estate markets.

Sorensen and Chambers (2007) defined economic based metrics as conventional metrics, including research expenditures, new invention disclosures, patents filed, licenses executed and gross income earned with licenses. These economic metrics, however, are narrow and may not reflect the real impact of R&D. R&D organizations have wider functions, like knowledge creation that can not be accounted with these methods, because it is not directly reflected on an economic metric. Spann et al. (1995) also criticizes narrow metrics like counting licenses, because it does not distinguishes the innovations involved, which may have different impacts. Royalties' revenues have the same problem, because some transfers can be more successful than others, thus this metric does not provide full understanding of the real effectiveness of all transfer processes.

In conclusion, econometric based approaches for assessing impacts of R&D and technology transfer organizations stand exclusively on economic metrics, which simply relate, in most cases, economic outputs with inputs. At a regional level, these studies usually reflect the organizations influence outlining only the aspects of regional economic growth, and neglecting other major functions of R&D and technology transfer organizations. Thus this branch of impact assessment literature can be viewed as incomplete in assessing the real total impact of such organizations with more than just economic functions for society. Knowledge diffusion and knowledge flows are more studied with the methods presented on the following section, scientometric and bibliometric based approaches.

1.3.2. Scientometric and bibliometric based approaches

Another branch of literature addresses scientific production and diffusion using methods which consider publications. This branch is the scientometric or bibliometric approach. These two usually overlap because both are associated with quantitative metrics related with literature production. Thus, such less economic approaches generally focus on the knowledge creation and diffusion functions of R&D organizations.

Meyer (2004) distinguishes, in a bibliometric way, three main approaches for exploring the link between science and technology, these are patent citation analysis, tracing firms' publication activity and universities patenting activity. Most common studies count citations to analyse the success of researchers, organizations or countries in a given period. Scientometrics have also been used to assess the evolution and geography of scientific production as an output of R&D activities. Sequeira and Teixeira (2009), based on the work of Wagner and Leydersdorff (2005), identified four different approaches used on scientometrics and bibliometrics studies: 1. the increase in the interconnectedness of scientists; 2. social sciences analysis of collaboration in general and international linkages in particular; 3. policy analysis of the implications of linkages for funding and outcomes; 4. studies that address the implications of scientometrics' tools usage. Although scientometrics provide a different perspective from econometric approaches, covering the linkages between researchers and science networks at the regional, and also at the national and international levels, it also has limitations, as summarized by Sequeira and Teixeira (2009).

Table 2: Limitations to scientometrics

Authors	Scientometrics limitations
Pinski and Narin (1976)	No normalization for reference practices in the different scientific disciplines bias favouring journals with large papers
Tomer (1986)	The nature and merits of the citing journals are not clearly differentiated
Asai (1981); Glänzel and Schoepflin (1995); Moed *et al.* (1998)	Citation frequency is a matter of age bias
Schubert and Glänzel (1986)	There is no suggestion in literature of the deviations from the citation impact statistic instrument
Glänzel and Schoepflin (1995); Moed *et al.* (1998)	It is not that frequently that the average time for a scientific paper to reach peak in citations is of two years
Moed *et al.* (1998)	The description of citation patterns should no anchor only on one single measure
Moed and van Leeuwen (1995, 1996)	Impact factors may be inaccurate in some cases
Braun and Glänzel (1995) ; van Leeuwen *et al.* (1997)	Eerrors in the calculation of impact factors may be due to incorrect identification in references
Schwarz *et al.* (1998)	The observation period may be too short, failing in depicting all the citations accumulated over the years; One have to consider the distorting Matthew effect in citations' behaviour (cf., Merton, 1968, 1988, 1995), which infers that cited authors will continue being cited; Low or none citation rates do not diminish a paper; Papers unfolding useful and new measurement techniques have higher citation scores compared to those presenting research results by using established and well-known methods; Self-citation (and/or friendship citation) practices vary between scientific fields of study; When scientific work gets to be considered as 'classic', then it may lose explicit citations; Utterly disregarding works not published in indexed journals has its consequence over analysis.

Source: Adapted from Sequeira and Teixeira (2009)

According to Sequeira and Teixeira (2009), scientometrics studies are not used to analyse the impact of R&D organizations. With his study on INESC Porto, he employs

scientometrics for mapping the organization's influence at international level, thus being innovative in the use of this approach.

Patent citation analysis and co-authorships have also been used as a tool for building network patterns and mappings. The functionality of networks is based on the statements of organizations complementarity and bilateral transfer of information (reciprocity) (Cantner and Graf, 2006). Actors in networks are researchers from universities and R&D institutions, companies, TTOs and policy makers, and usually represent the nodes of the networks. The links between these actors are formal (licences, grants, contracts, etc) and informal (friendships, former co-workers, conversations on conferences, fairs and informal meetings) bilateral relations which involve knowledge transfer (Cantner and Graf, 2006). Typical scientometric methods easily account for formal links but informal links are harder to assess.

Summing up, unlike econometric approaches, scientometrics focus on science production, being mainly based on publication count and citation analysis, capturing an intangible face of the process of technology transfer of organizations. This wider perspective emphasizes knowledge diffusion and can be used for example for mapping research activity, to study the linkages between researchers, science networks, national and international collaboration patterns and evolution. For these mappings and network analysis, tracking citations is one of the most used methods.

To our best knowledge the only study using scientometrics for assessing the influence of R&D organizations is that of Sequeira's (2009), who maps the international scientific network of INESC Porto. Scientometric methods have also been used to build scientific mappings of research networks, by analysing co-authorship and citation tracking. These studies consider researchers networks and can provide a more wide perspective on the extent of technology transfer and knowledge diffusion activities. Sequeira and Teixeira (2009) used a scientometric based method to build a scientific mapping of INESC Porto. By analysing the evolution of citation of INESC Porto researchers' publications by foreign authors, he evaluated the international influence of the organization, thus bridging scientometrics and econometrics methods. Maps of scientific networks can be an important tool to complement traditional methods for assessing impacts. Traditional methods emphasize formal technology transfer methods like licences and patents, but do not account for more informal methods, which constitute important vehicles for knowledge

diffusion. By considering cooperative relationships between actors, spillovers are also taken into account, because relationships ca be an important vehicle for such spillovers (Fritcsh and Franke, 2004). Furthermore, by considering the geography of these networks, knowledge flows can be traced, bringing new highlights to the question of geographic proximity and also international cooperation.

1.4. Proposing an alternative approach based on human resources mobility and ties for assessing the impact and influence of R&D organizations

On traditional econometric studies for assessing the impact of research organizations, the metric associated with this function is the number of jobs created (direct or indirectly). However, counting jobs does not measure the extent of technology transfer. Typical studies within this approach tend to be focused, as surveyed in previous sections, on universities or companies incomes and outcomes.

Several authors agree (e.g. Drucker and Goldstein, 2007, Lenzi, 2006, Crespi et al, 2007, Almeida and Kogut, 1999) that human capital exchange between R&D organizations and industry is an important vehicle for the technology transfer process. When defining the role of R&D and technology transfer organizations, creation of human capital is considered one of the main functions (Drucker and Goldstein, 2007). This is because when linking organizations the interactions occur between people, thus knowledge transfer is mediated by individuals, despite organizations. Also, especially on high technology, knowledge intensive fields, the nature of knowledge is tacit and complex (Almeida and Kogut, 1999, Lenzi, 2006; Crespi et al, 2007) and is often embedded in workers. These highly skilled and usually specialized workers accumulate knowledge through their learning process and career and disseminate their knowledge on their jobs. When workers move from an organization to another, their knowledge flows between the organizations, thus workers mobility is of extreme importance in technology transfer processes.

To study technology transfer processes and the location of knowledge, several authors used network analysis. This is the case of Cantner and Graf(2006), Almeida and Kogut (1999), Waters and Smith (2008), Hussler and Rondé (2007) and Hoisl (2007). The networks usually are focused on inventors and are built by tracking patents co authorship.

Social networks influence economic outcomes by affecting the flow of information, affecting the actors‘ actions and because trust and confidence is implicit on economic

relationships (Granovetter, 2005). Social network analysis was initially used mainly in sociology field, being later developed as a multidisciplinary method, combining statistics and mathematics, and being applied in other fields of study such as economics. Granovetter (1973, 1983) developed a sociological theory, baptized as the weak ties theory, to link micro level interactions to macro level patterns. In this theory, he highlights the importance of relationships as links between units. He defines two distinct types of linkages between actors: weak and strong ties. Weak ties are relations an individual maintains with acquaintances, whereas strong ties are the linkages he/she maintains with close friends and family (Granovetter 1973, 1983). The major breakthrough of his studies is that, unlike it would be expected, weak ties become more valuable than strong ties in information diffusion. Because close friends and family tend to move in the same circles and usually have similar interests; as such the shared information often overlaps. Thus acquaintances who probably move in more different circles can be a source of new information. Weak ties therefore can constitute bridges between different social networks, thus vehicles for information diffusion, information which affects individuals. Weak ties can therefore determine the extent of information diffusion in large scale social structures. One main outcome from his studies is that in scientific fields, new information and ideas are more efficiently diffused through weak ties (Granovetter, 1993).

This sociological theory has been transposed to studies in other fields, especially in economy. On considering knowledge diffusion and technology transfer this theory could be relevant on the assumption that weak or strong ties can be vehicles for knowledge diffusion. Considering this assumption, a few questions arise which are relevant for the present dissertation:

1. Are strong ties researchers more mobile than their weak ties counterparts, being a privileged vehicle for knowledge diffusion and technology transfer
2. Do strong ties researchers maintain stronger and more lasting relations with their former organization once they left than their weak ties counterparts?

Since we are studying technology transfer and knowledge diffusion, the issue of strong/weak ties might be of huge importance enabling to assess, in a new complementary perspective the impact and influence of technology transfer organizations.

To answer these questions we analyse data from INESC Porto former collaborators/researchers, and try to assess whether there are ties between these individuals

and INESC after they have left. In analogy with Granovetter's theory, the strength of ties is measured by the time spent together, so in the present study we separate weak ties from strong ties based on the time former collaborators spent working in INESC.

So here we try to show that knowledge diffusion is made through these former collaborators who might have strong (work in the organization for over 1 year) or weak (work in the organization for 3 months up to 1 year) ties with the organization. According to Granovetter one would expect that weak ties former collaborators would be, to a larger extent than strong ties, potential bridges between the two worlds, the academic world, where they once did research, and the industrial world, where they are now presently working.

Such bridges are likely to lead to formal links between the former and present organizations (Cantner and Graf, 2006). Informal links that former collaborators maintain with present collaborators of the organization might also be sufficient to activate these formal links between the respective organizations (Ponomariov and Boardman, 2007).

Within this novel approach we aim to assess the influence of a research and technology transfer organization, filling a gap and bringing sociological related methods into the evaluation of R&D organizations impact and influence.

Chapter 2. The influence and impact of Technology Transference and R&D Organizations: methodological underpins

2.1. Initial considerations

In this chapter we describe the methodological aspects of this work. In order to gather information about the career path of former INESC Porto collaborators we built a survey. On the following sections we describe the survey and the process of data gathering (Section 2.2.). Then, in Section 2.3., the target population is described and the representativeness and main characteristics of the sample are described.

2.2. Target population and data gathering issues

INESC Porto – Porto Institute of Systems and Computer Engineering – is an organization with activities on technology R&D, technology transfer, consulting and advanced training. It develops basic and applied research on areas such as Information Technology and Systems. INESC defines its main mission as linking industry and academics (INESC Porto, 2008). INESC Porto started as the Porto site part of INESC, since 1985. It was founded as a non profit private association of public interest in 1998. The main objectives of INESC Porto as stated on *Manual de Acolhimento* are: Science and Technology production, at national and international level; Training and education of high skilled scientific and technical human resources; Adjustment of the education system to real social and economical needs; To contribute for a modern Portugal, a stronger economy and a better society.

INESC Porto integrates six units, specialized in different areas: UITT – Innovation and Technology Transference Unit; UOSE – Unit of Optoelectronics and Electronic Systems; USE – Unit of Energy Systems; UESP – Production Systems Engineering Unit; USIC – Information and Communication Systems Unit; UTM – Telecommunications and Multimedia Unit.

There are also supporting services, included in a Department of Information and Logistics (DIL): Managing Control, Finances and Accountability, Human Resources, Legal Support, Logistic Support. Other support services are: Communications and IT Service (SCI),

Management Information Service (SIG), Communication Service, Infrastructure Management Service, Library and Documentation Service.

Table 3: INESC innovation intermediation functions

Innovation intermediation functions (Howells, 2006)	INESC functions
1. Foresight and diagnostics	+++
2. Scanning and information processing	++
3. Knowledge processing and combination/recombination	+++
4. Gatekeeping and brokering	0
5. Testing and Validation	++
6. Accreditation	0
7. Validation and regulation	0
8. Protecting the results	+
9. Commercialisation	+
10. Evaluation of outcomes	+++

Legend: +++ - core function; ++ reasonably important function; + function with small importance ; 0 – no function

Using Howells' (2006) taxonomy, the most prevalent role of INESC is the knowledge generation and combination of roles (Table 3). The role of innovation intermediation is one among others.

INESC Porto promotes a culture of scientific and technological excellence on all intervention areas, and through its collaborators plays an active role on the R&D political structure at regional, national and European levels. As an interface organization, bridging the university and companies, acquires a unique hybrid culture, where academic values and interests are added to the efficacy of an active entrepreneurial approach. The endorsement of an informal relational culture inside the institute promotes a more flexible work environment, perfect to conduct scientific research as well as develop capacities of INESC Porto collaborators.

Human resources can be linked to INESC Porto by the following types of connection: **Hired Worker** – Connection formalized by a work contract. These contracts usually last for 12 months, renewable up to 72 months; **Grant Worker** – Collaborator with a research grant or academic grant (master or PhD), conceded by INESC Porto or other organizations;

Higher Education Teacher – Worker who has as main function teaching at a University and develops R&D activities on areas related with INESC Porto intervention areas, usually with a human resources protocol with the university; **Remunerated Internship –** Collaborator with an internship to finish his degree, POCI program, or the National Internship Program promoted by IEFP; **Non Remunerated Internship** – For students, with no salary, with the purpose of promoting and challenging their training in R&D areas directly connected to INESC Porto activities; **Invited Researcher** – Researchers who sporadically develop research work in a Unit/Department/ Service of INESC Porto.

Currently there are 335 active collaborators and 715 former collaborators. Figure 1 depicts the INESC Porto's active and inactive population, by type of link.

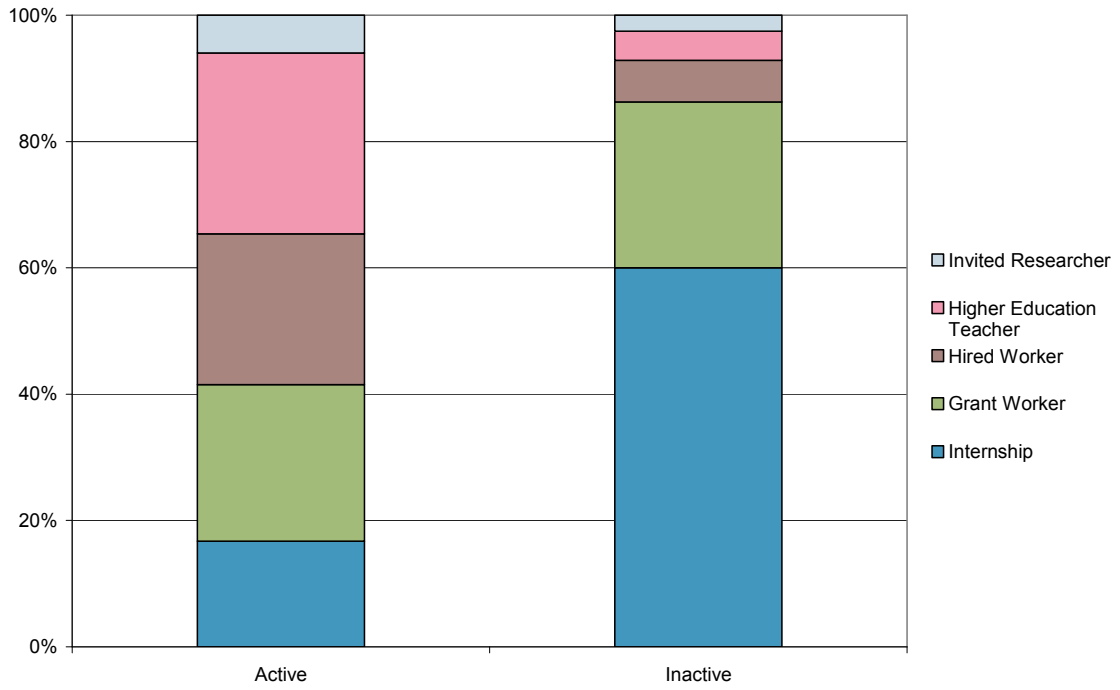

Figure 1: INESC Porto's active and inactive population, by type of link

The starting point of this study was a human resources database of INESC Porto with all collaborators since the beginning of the organization in 1998. In this database there was the following information about the workers was available: Personal data : full name, nationality, sex, address, phone number, date of birth, origin, academic degree, on going education; Connections to INESC Porto: start and end date, type of connection, cost centre, reason to end connection.

With the connections start and end dates, we selected only the inactive collaborators and calculated the connection time for each one (Table 4).

Table 4: Minimum, maximum and average time of collaboration for each link type

	Nr of former collaborators	Min. connection time (months)	Max. connection time (months)	Average time (months)
Interns	429	0,8	92,3	8,4
Grant Workers	188	1,1	99,8	24,2
Hired Workers	47	2,8	226,2	49,8
Higher Education Teachers	33	11,3	191,7	67,9
Invited Researchers	18	0,6	88,3	23,89
Total	**715**			

In this database we analysed the connection durations and decided to eliminate collaborators with links shorter than 3 months. In fact, when contacted, these former collaborators stated that their passage by INESC Porto was very brief and that they were not representative of the INESC Porto population, and also did not stay enough time in the organization to have any impact on their professional lives. A total of 97 former collaborators were thus initially excluded of the study.

2.3. Aims of the study and the description of the questionnaire

To assess information about the former collaborators' professional path, a short survey was developed. It was decided that the survey had to be short, comprehensive and straightforward. The survey has 4 questions with both multiple choice and open answers. Along with the survey a small introduction was given explaining the purpose of the study and the importance of the survey.

In the first question of the survey the main goal of this work was approached by asking the collaborators about their career since they left INESC Porto. We asked about the companies where they worked (nationality, number of workers and sector), in order to characterize the human resources market for former INESC collaborators and map the population in terms of sectors. We asked also about their position in the company to see how far (professionally) they reached and consequently how strong would be INESC Porto influence. The starting and ending dates are also important for the study to have the mapping across time. For the geographical mapping of former collaborators, the location (city, country) of the company is a crucial question. Because the survey could not be very

extensive, workers with a long professional path were asked to describe only the 3 jobs where they had been for longer time.

In the second question of the survey we asked if former collaborators still have/had contact with INESC after they left, and in the case the answer was positive the type of contact (Question 3). With this question we aim at assessing whether there was still a tie to the organization, and the type of tie: informal or formal (participation in projects, human resources hiring or supply, services supply or demand, and other). Finally there was an open question about how INESC Porto had influenced their professional path.

The complete survey is in Appendix.1.

2.4. Data gathering method

The data gathering process was carried out between April and May 2009, lasting for a 1,5 month period. The addresses and phone numbers of the population were not updated because the human resources database had information workers gave by the time they joined INESC. Some records were incomplete, lacking the phone number. For this cases the survey was sent by mail to the address they had by the time they were working at INESC.

For the other former collaborators we tried to get the answers to the survey by phone interviews. Because the data was not up to date, many phone numbers were no longer being used and it was not possible to contact the collaborators with this mean. The phone interviews were in a total of 130. Some individuals required to answer the survey by email and gave us the respective updated email. The survey was sent by email to 51 collaborators, having been answered 22.

To find the remaining collaborators, we used the web 2.0 based professional networking website LinkedIn. This website is widely popular in Portugal and is specially adopted by IT workers. Through LinkedIn some workers were found, and their path was there described. Finally we used Google to find additional workers and tried to build their path with the information found. Figure 2 summarises the data gathering process.

Figure 2: Data gathering process

2.5. Representativeness and brief description of the respondent sample

In the end of the process, 152 collaborators answered the survey, representing 24,6% of the total INESC Porto former collaborators population. As an international research organization, INESC Porto has collaborators from several countries all around the world as shown on the following table.

Table 5: Origin of former collaborators for sample and population

Origin	Population	Sample
Portugal	557	150
Europe	22	0
South America	24	1
North America	3	0
Asia	5	0
Africa	6	1
TOTAL	611	152

On the following figures we describe the sample and compare it to the total population.

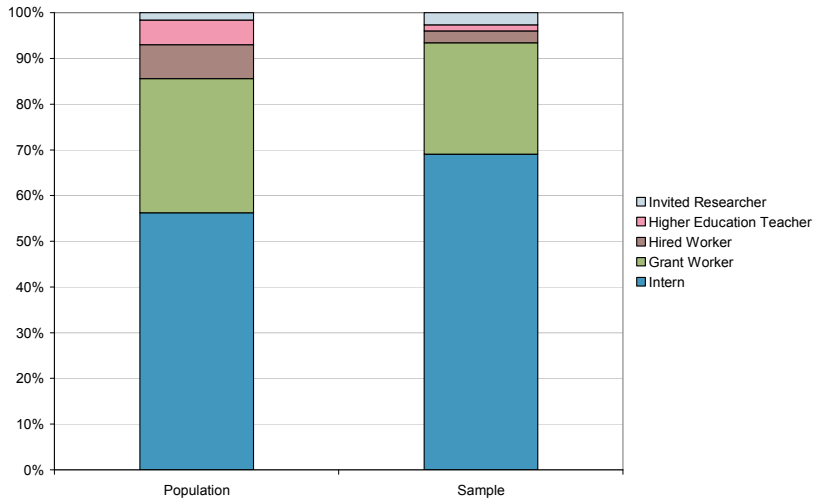

Figure 3: Link type for sample and population

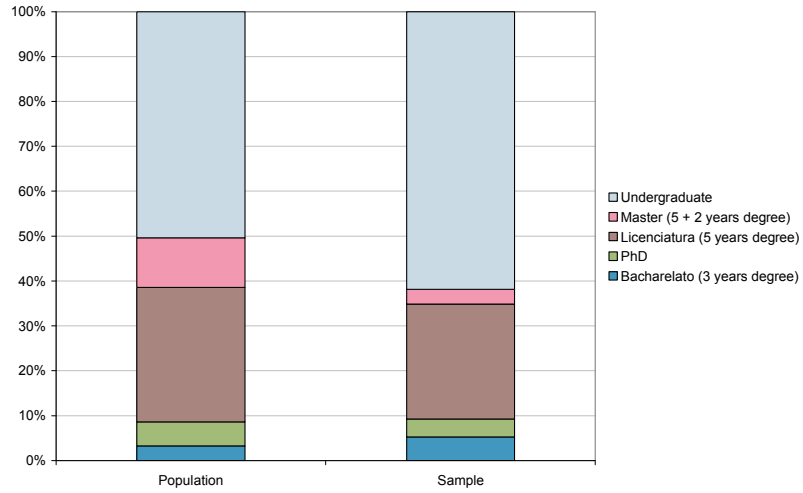

Figure 4: Academic degree for sample and population

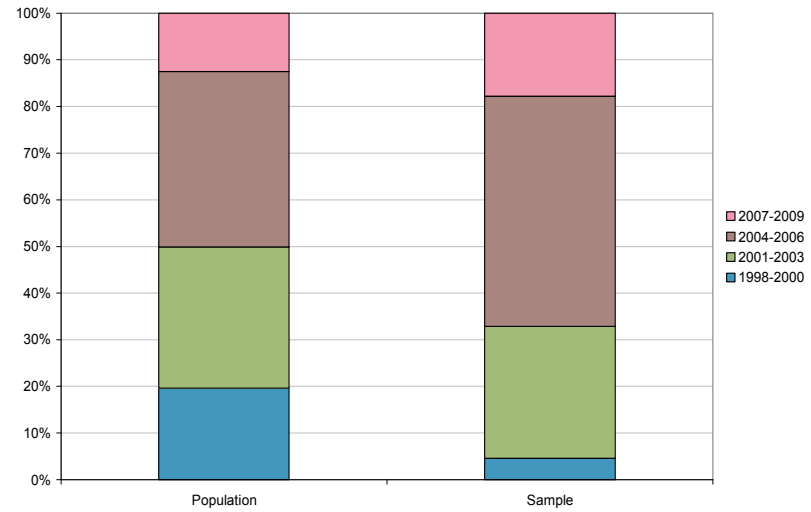

Figure 5: Link end date for sample and population

Because the more recent data from the database was the most updated, the sample is more significant for more recent periods (2004-2006 and 2007-2009). The last period (2007-2009) includes data only until February 2009 and that is why this fraction is smaller compared with the previous periods.

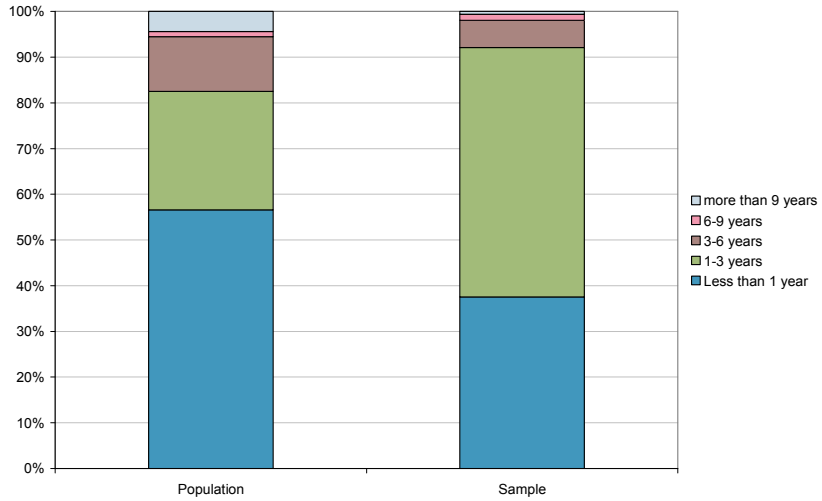

Figure 6: Link duration for sample and population

The most representative group is the group of collaborators who stayed in INESC for 1-3 years.

By analysing the figures it can be stated that most former collaborators were interns and grant workers, who stayed for 1-3 years or less than 1 year. These collaborators were mostly undergraduates, thus finishing their degree, and licentiates (5 years degree) on their first job experience.

Because the periods of 1998-2000 and 2007-2009 have less data than the remaining periods (the first record of a collaborator leaving INESC is from April 2008, and the records referring to 2009 are only until February 2009), the number of former collaborators leaving INESC on these periods is smaller. For our sample though, data is more representative for more recent groups (collaborators leaving on the periods of 2004-2006 and 2007-2009).

Chapter 3. An alternative approach for assessing the impact and influence of R&D organizations based on human resources mobility and ties: evidence of the INESC Porto

3.1. Initial considerations

In this chapter we build the mapping of ex INESC human resources, covering four time periods: from 1998 to 2000, from 2001 to 2003, from 2004 to 2006 and finally from 2007 to 2009. We then analyse the answers to the last 3 questions of the survey and discuss the results comparing to Granovetter's weak ties theory.

3.2. How far and wide has the technology transference process occurred: the geographical perspective

For the geographic mapping we used all the collected data. For each period the former INESC collaborators were distributed by country. We then separate each map in two: weak and strong ties mapping.

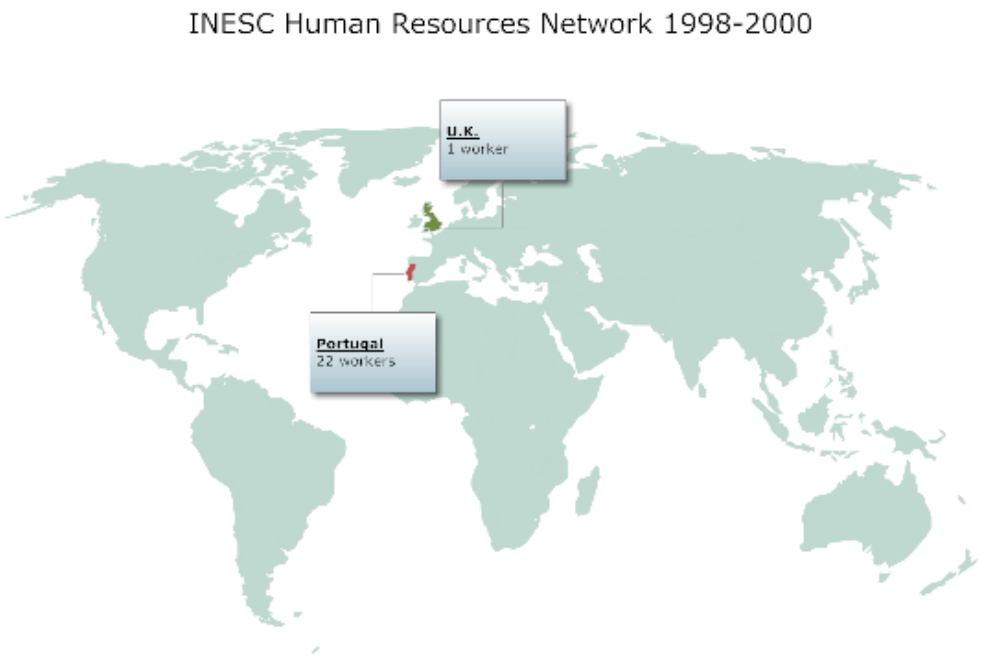

Figure 7: INESC Porto former collaborators mapping for the period of 1998-2000

For this period the data collected was scarce because contacts were not updated and many collaborators were not found. From the collected data it can be observed that most workers stayed in Portugal and that the international network is not significant, as it resumes to 1 collaborator in the UK.

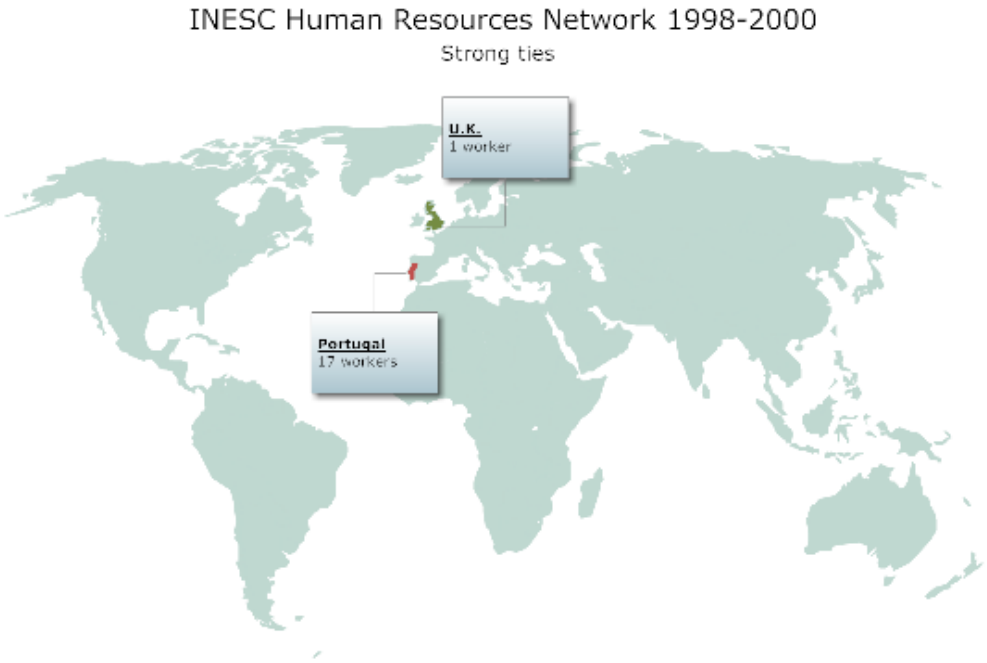

Figure 8: INESC Porto former collaborators mapping for the period of 1998-2000 – strong ties

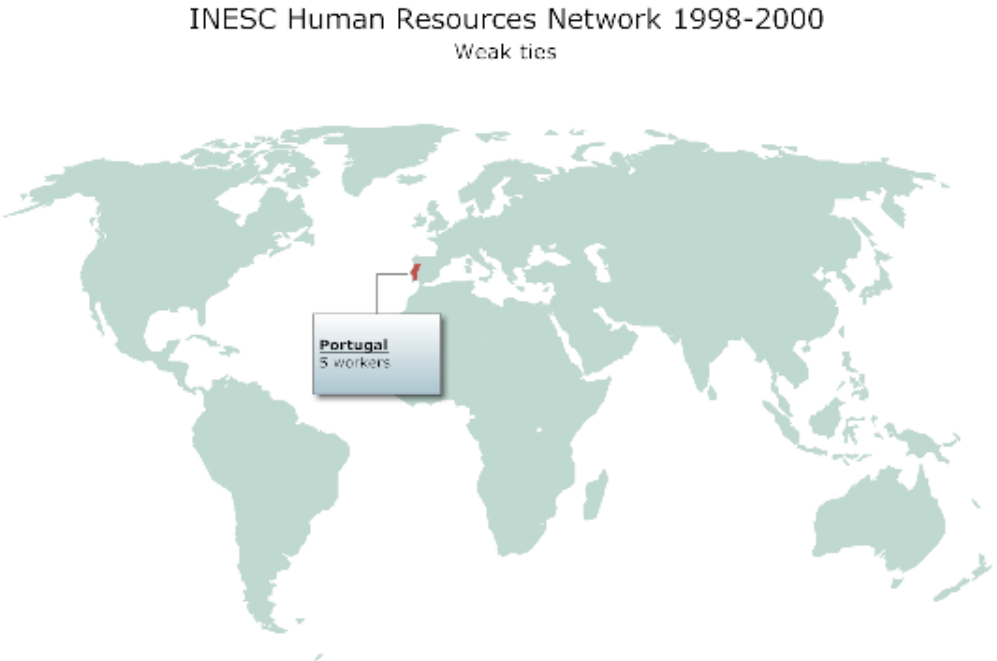

Figure 9: INESC Porto former collaborators mapping for the period of 1998-2000 – weak ties

For this period it can be observed that most collaborators were linked by strong ties. Even the only collaborator working abroad was a strong tie link.

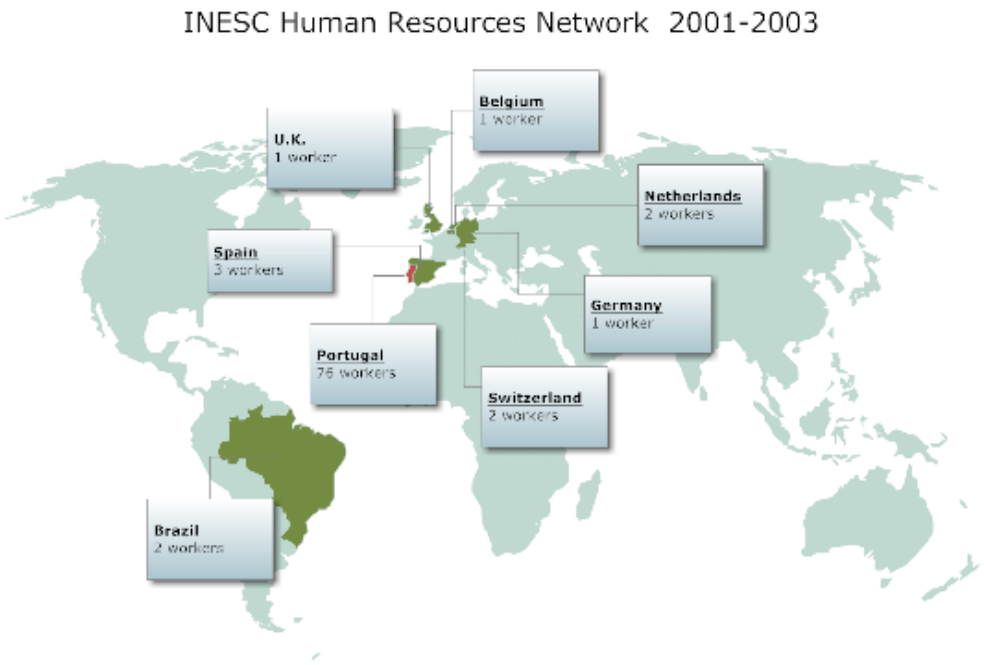

Figure 10: INESC Porto former collaborators mapping for the period of 2001-2003

For this period it can be observed that the INESC Porto international human resources network has increased greatly, with workers on several European countries and also in Brazil.

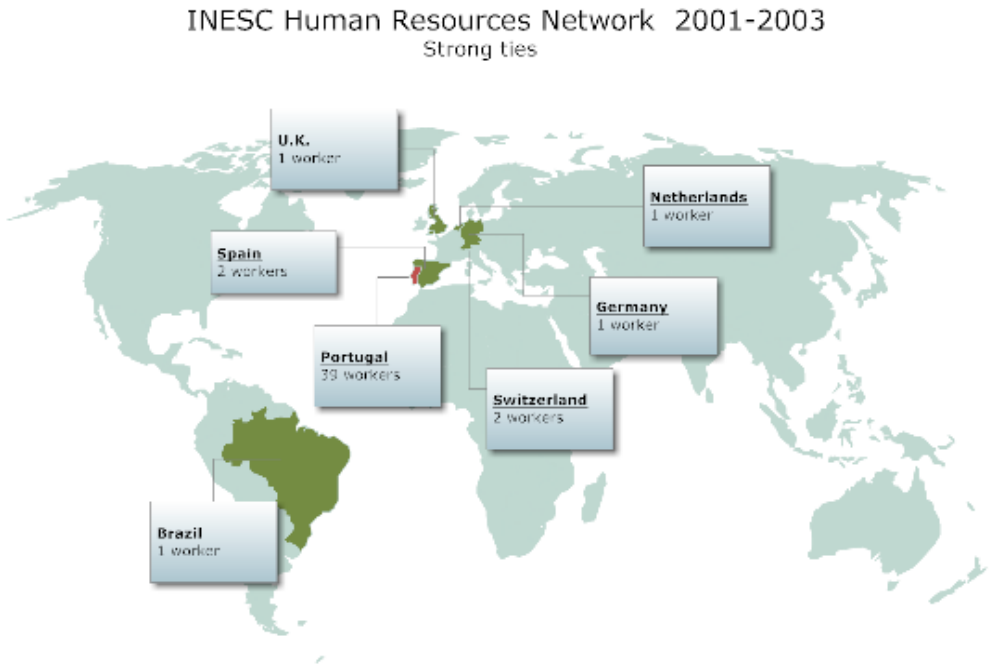

Figure 11: INESC Porto former collaborators mapping for the period of 2001-2003 – strong ties

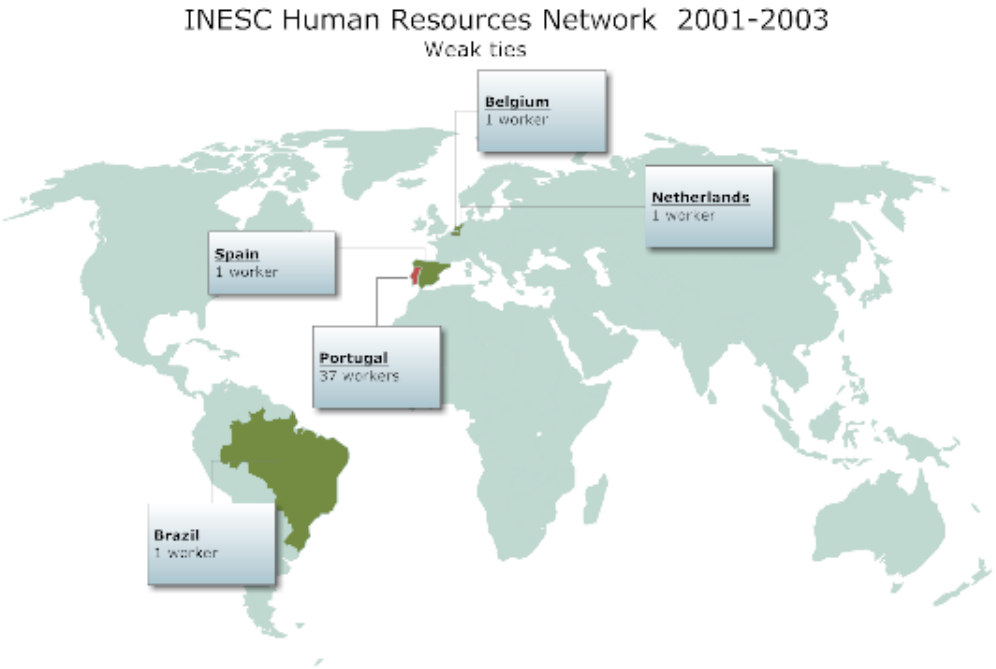

Figure 12: INESC Porto former collaborators mapping for the period of 2001-2003 – weak ties

Comparing this mapping with the previous it can be showed that strong ties are more frequent for foreigner countries. As for Portugal, weak and strong ties are similar.

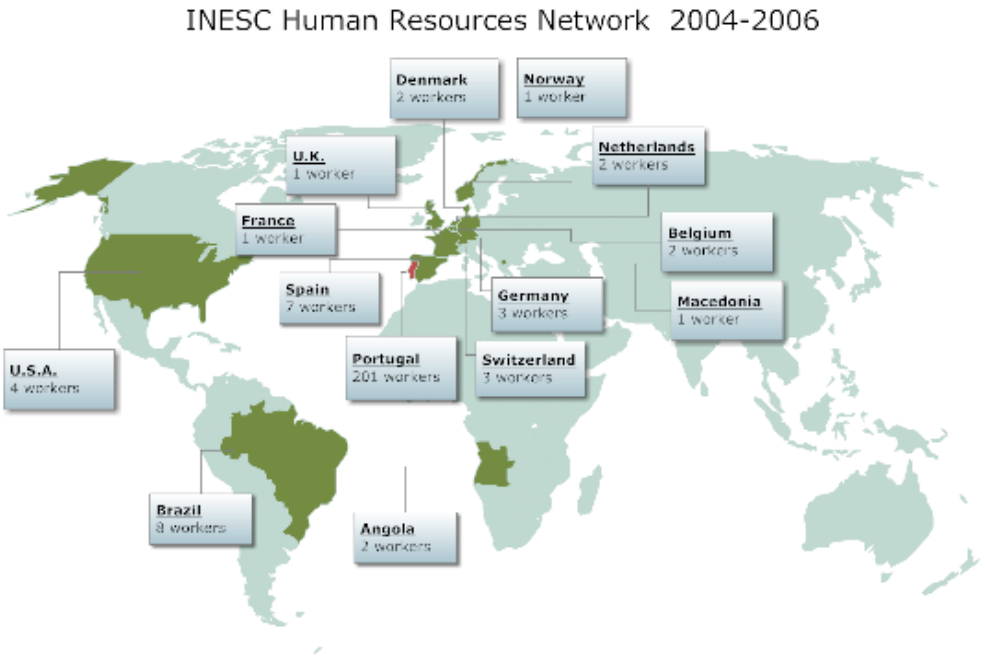

Figure 13: INESC Porto former collaborators mapping for the period of 2004-2006

For this period the INESC Porto network has increased to more European countries and also USA and Angola.

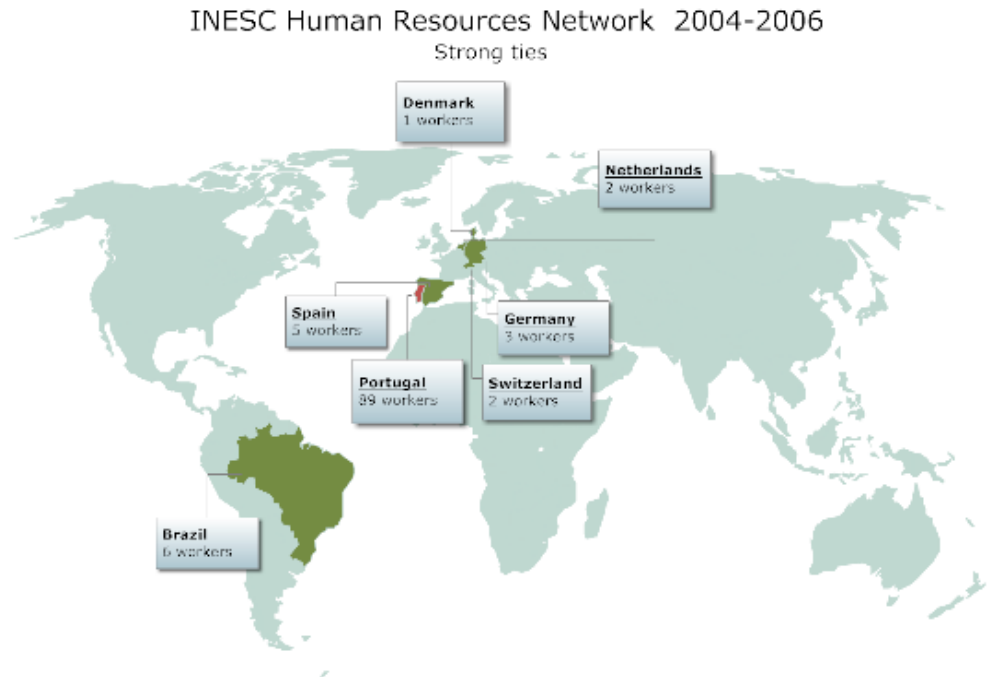

Figure 14: INESC Porto former collaborators mapping for the period of 2004-2006 – strong ties

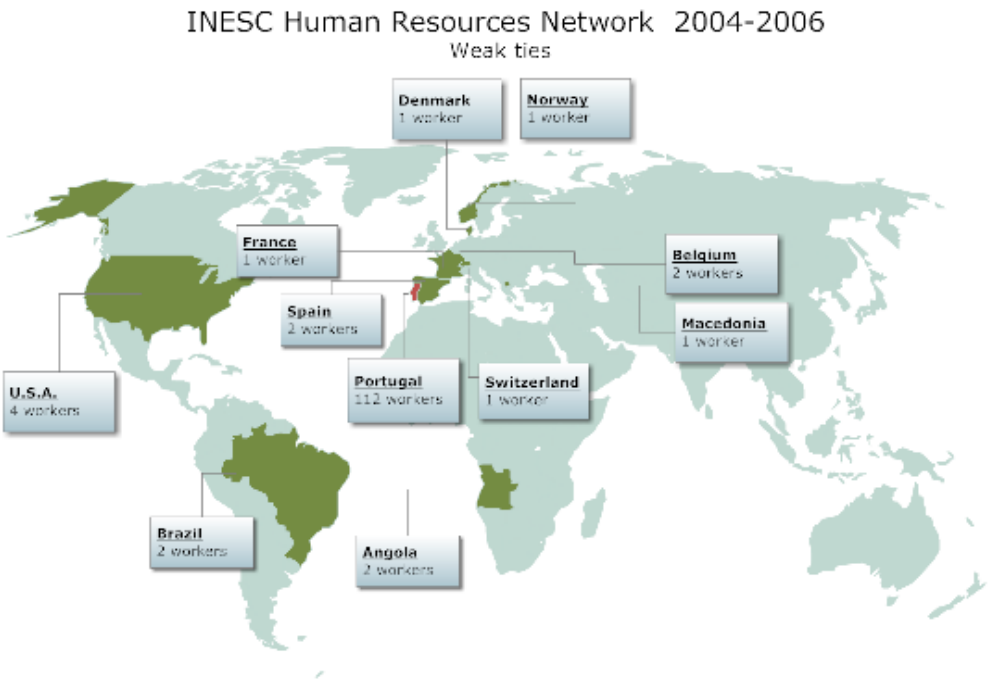

Figure 15: INESC Porto former collaborators mapping for the period of 2004-2006 – weak ties

Unlike the previous period, there are more weak ties for foreigner countries than strong ties. The same is observed to Portugal.

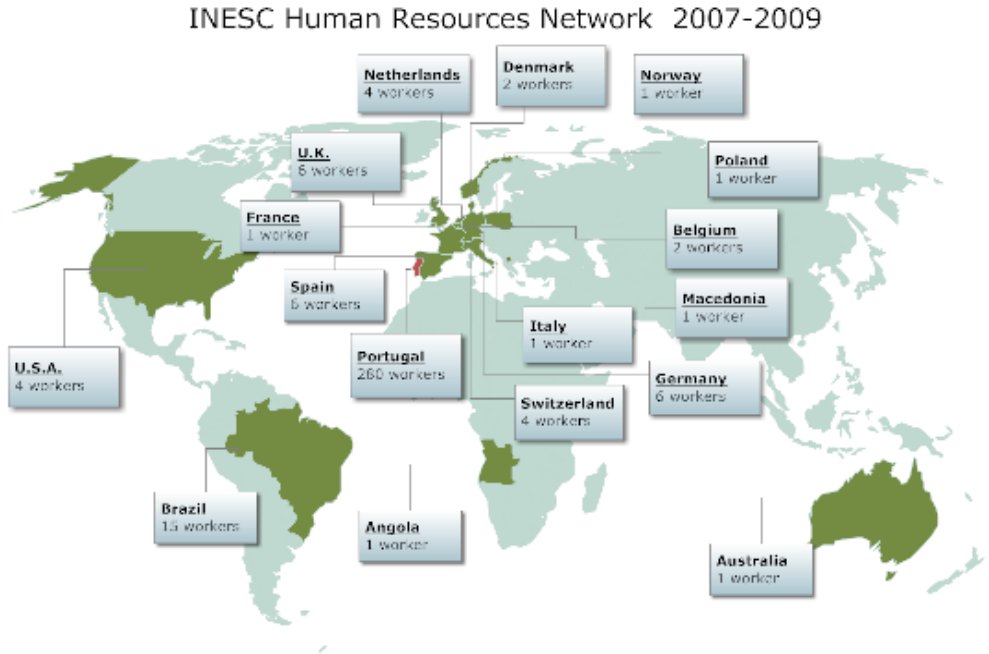

Figure 16: INESC Porto former collaborators mapping for the period of 2007-2009

Again the INESC Porto international network has increased. Comparing with the previous periods it can be observed that there is a tendency for the international network to grow.

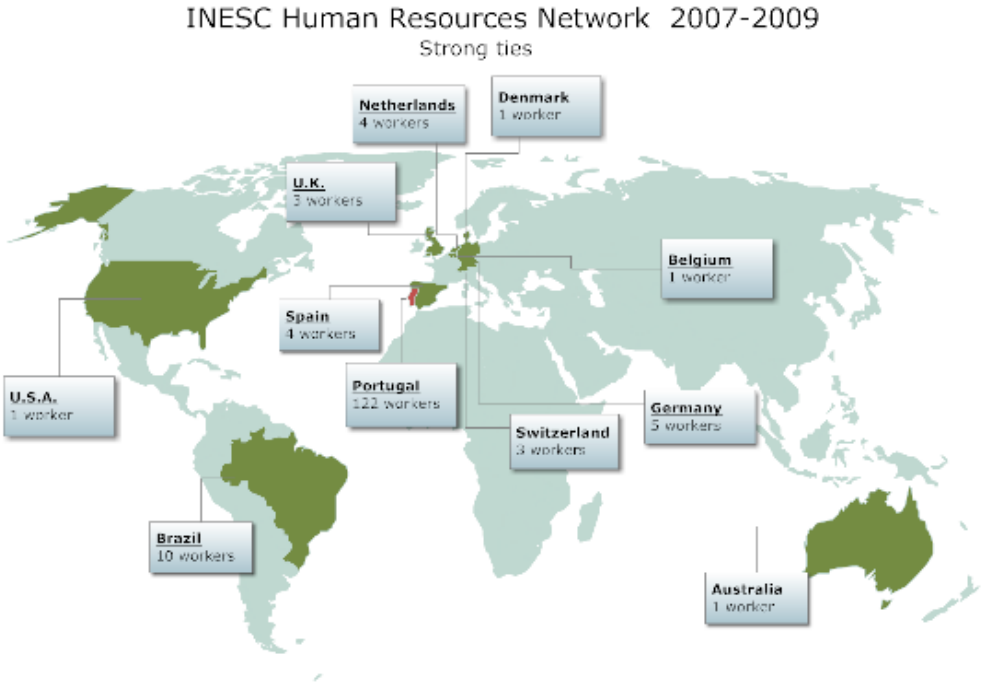

Figure 17: INESC Porto former collaborators mapping for the period of 2007-2009 – strong ties

Figure 18: INESC Porto former collaborators mapping for the period of 2007-2009 – weak ties

Again weak ties are more frequent than strong ties as on the previous periods.

In conclusion, on analysing all mappings, it was possible to observe that the INESC Porto international network based on human resources has increased extending to almost all continents, thus the INESC Porto influence is widening on what concerns international linkages. Analysing the networks on what concerns the strength of sties we find that the most part of workers has weak ties with the organization.

It should be noted that INESC Porto as a research organization recognized internationally receives collaborators from other countries, and once these collaborators finish their linkage with INESC they most probably return to their country. This is the case of the Brazilian workers, all former INESC collaborators working in Brazil are Brazilian researchers who spent some time doing research at INESC Porto and returned to their home country after finishing their research.

Because most former INESC collaborators stayed in Portugal, we analysed the geographical distribution with more detail in Portugal, separating in four main regions: North (including Porto area and Minho and Trás-dos-Montes), Centre (including Aveiro and Coimbra), Lisbon and Islands (Madeira and Açores). The South region of Portugal is not included because none of the former INESC collaborators worked/works there.

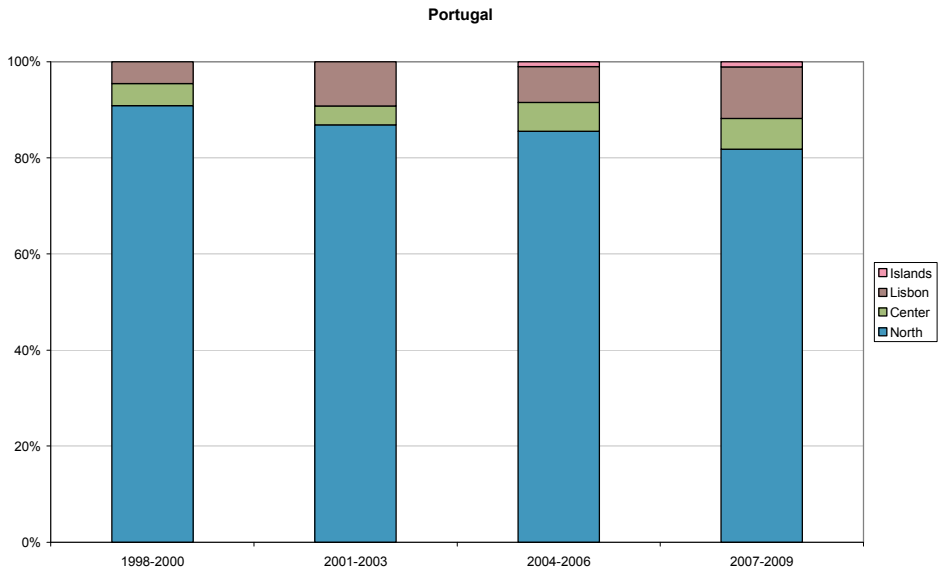

Figure 19: Former INESC Porto collaborators distribution in Portuguese regions for each period

As it would be expectable most former INESC collaborators stayed in the North region of Portugal, the INESC Porto region. Although the Centre region is closer to Porto than

Lisbon, this area has more collaborators probably because is where most IT and Consulting companies are located.

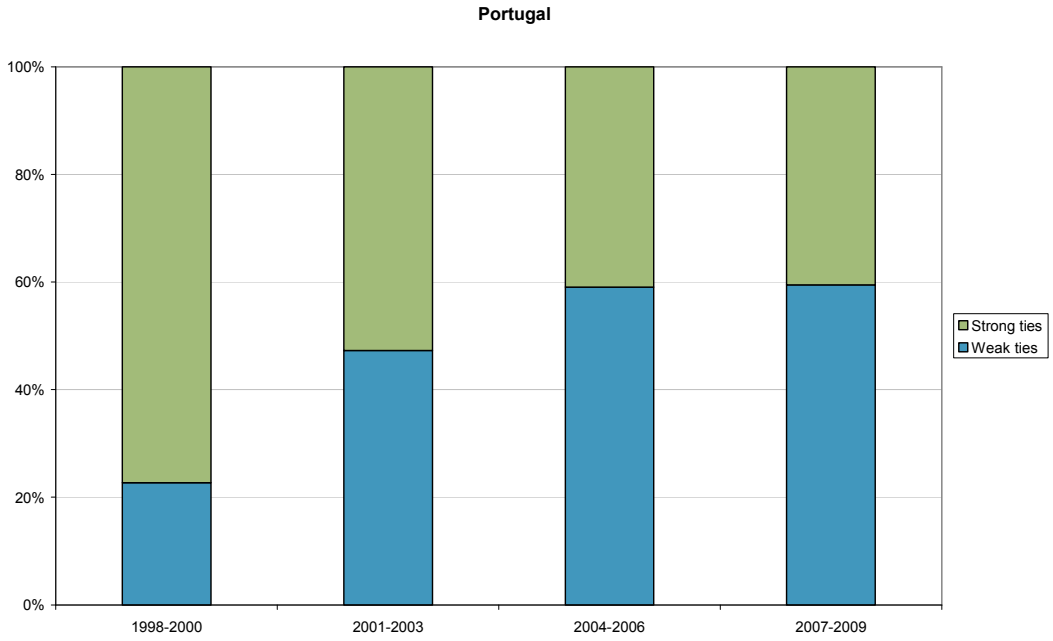

Figure 20 : Weak-Strong ties rate for each period in Portugal

For the earlier periods (1998-2000, 2001-2003) strong ties are more frequent than weak ties. The number of weak ties increased and on more recent periods (2006-2006, 2007-2009), weak ties are more frequent than strong ties. For these two latter periods the rate of weak-strong ties has remained constant. This is explained by the increase in the number of interns (who stay for shorter periods of time, thus being weak ties) working for INESC in the latter years.

3.3. How far and wide has the technology transference process occurred: the business-sectorial perspective

For the same periods of time mentioned previously we now distribute the former INESC collaborators by sector. For a better visualisation the sector categories are few but wide, including several smaller areas. Thus the seven sector categories are: 1. Consulting; 2. Education/ R&D, including universities, secondary schools and research organizations; 3. Engineering, including civil engineering companies, electronic, automation and control, etc, 4. IT/ Multimedia, 5. Manufacturing, for all kinds of industries such as food, electronics, automobile, cork, wood, etc, 6. Energy and 7. Services/ Other, including banking, sales, government, etc.

For each period we present the distribution (%) by sector and for each sector the Weak-Strong Ties rate. A complete list with all organizations part of INESC Porto human resources network for each period is on Appendix 2.

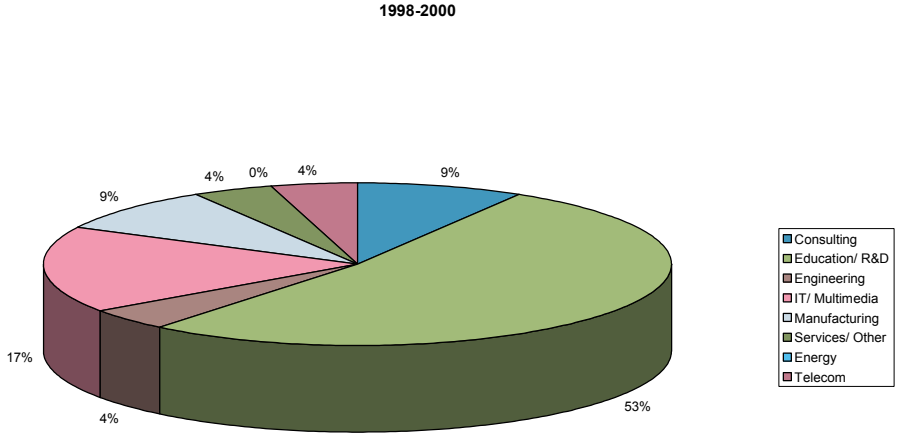

Figure 21: Former collaborators distribution by sector for the period 1998-2000

For this period the most significant sector is Education/ R&D with more than 50% of the former collaborators found. In fact most collaborators went to work at FEUP as teachers/ researchers. We also found workers at other faculties part of Porto University like FEP and FCUP. Institutes and a private university are also part of the network. IT/Multimedia is the second largest sector for this period since it is the most significant area of INESC Porto. Companies on this sector are Novabase and ParadigmaXis. This last company, a spin-off, is linked to INESC through the owner who has a strong tie with INESC and also by another worker with a strong tie. In Telecom sector we have PTInovação and in the engineering sector EFACEC, which are Portuguese major companies in these areas. As mentioned before the sample for this period is very small. Crossing these results with the geographical mapping, the only international link for this period is a University in London. For the sector of Consulting the linked company is Deloitte a large multinational consulting company.

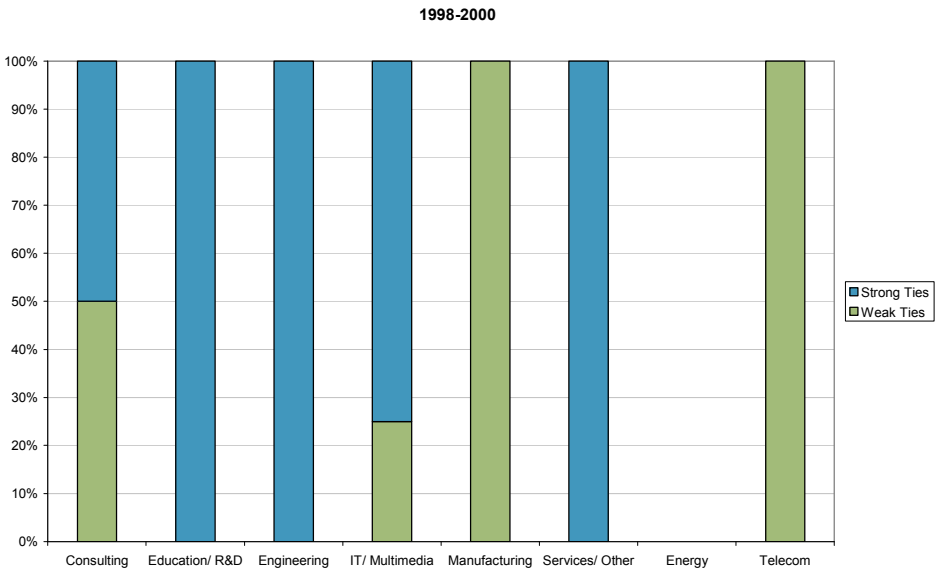

Figure 22: Rate Weak-Strong Ties for each sector in the period of 1998-2000

For this period it is important to highlight for the most representative sector – Education/ R&D the fact that all ties are strong ties. This is because for this period most INESC workers were higher education teachers.

In the sector of Energy there are no companies on INESC human resources network for this period.

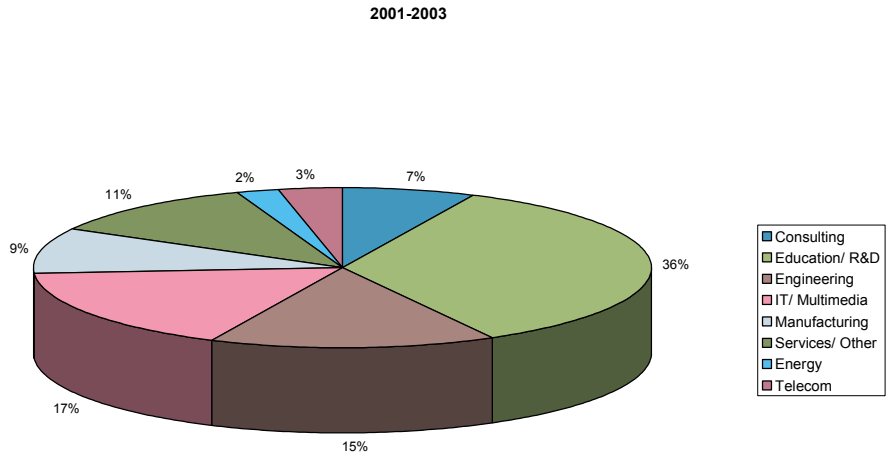

Figure 23: Former collaborators distribution by sector for the period 2001-2003

As in the previous period, the most representative sector is Education/ R&D with FEUP as the most frequent link. Again other faculties of Porto University (FEP, FCUP) are still linked to INESC. The number of Portuguese universities linked to INESC increased and spread geographically for public (e.g. FCTUC, UTAD) and private (e.g. Universidade

Católica Portuguesa) sectors. As for universities outside Portugal, we have Universidade Federal do Pará (Brazil) as the most represented. Now INESC Porto is also linked to major European R&D organizations like CERN (strong ties) and the European Space Agency (weak ties).

The second biggest sector is again IT/ Multimedia, and the most represented company in this sector is again ParadigmaXis, followed by MOG Solutions, being both INESC Porto spin-off companies. Also all ties to these two companies are strong ties. This fact reinforces the findings of Johansson et al (2005), who studied strong ties between spin offs and their respective university R&D department. He found that spin-offs are still dependent on the universities, thus maintaining formal and informal links with the respective university R&D department. The level of informality between the two institutions is very high and this is maintained by successive hiring of human resources (graduate and faculty) from the university (Johansson et al, 2005). The few resources of spin-offs, geographic proximity and especially trust are the main reasons for maintaining these ties for a long time.

The sector of Telecom, also a very strong area in INESC Porto, is the third biggest sector now and is still most represented by PTInovação. The sector of Energy is now represented for the first time, with the biggest energy company in Portugal, EDP, linked by a strong tie.

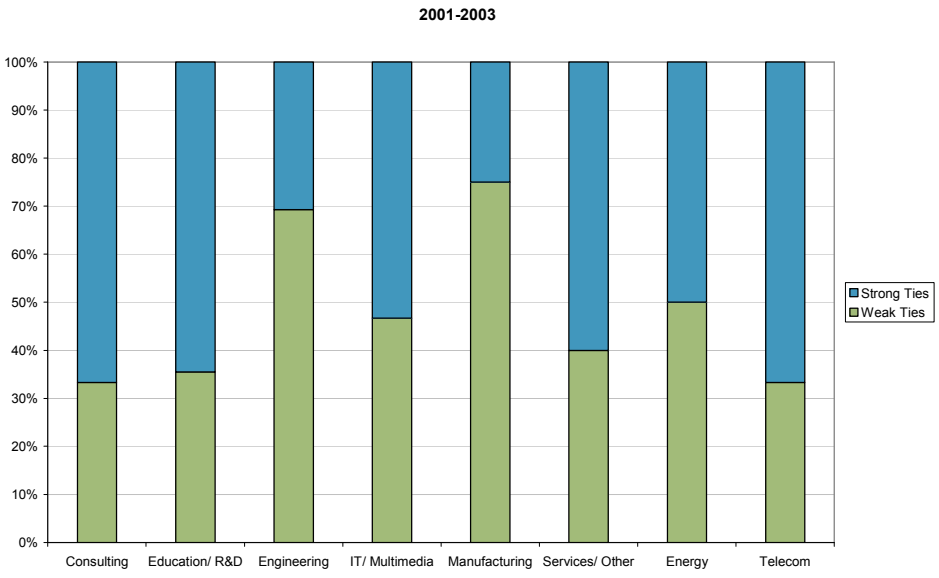

Figure 24: Rate Weak-Strong Ties for each sector in the period of 2001-2003

For this period the rates Weak-Strong Ties are more balanced. For the Education/ R&D sector, Consulting and Telecom, most ties are strong. The sectors of Manufacturing and Engineering are characterized by a predominance of weak ties.

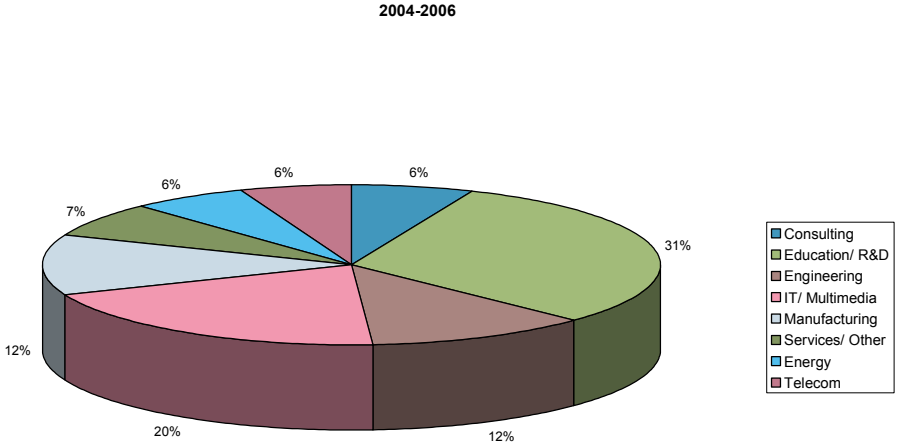

Figure 25: Former collaborators distribution by sector for the period 2004-2006

For this period the number of linked companies increased greatly (Appendix 2). Again the most representative sectors are Education/ R&D, and for the first time there are links to professional and secondary schools, although all weak ties. International links in this sector extend to the United States, where INESC has links to Columbia University and MIT, both weak ties. IT/ Multimedia is another sector in which INESC has ties to the United States, through the company CISCO Systems, also by weak ties. In this sector for this period, there are links to a diverse group of small national companies, for example Vortal, Vanguarda, ClusterMediaLabs, Shortcut, etc. Also there is a strong presence of INESC spin offs such as Bullet Solutions, MOG Solutions, ParadigmaXis and Fibersensing. All links with spin-offs are strong ties.

The sectors of Engineering and Manufacturing have equal shares in this period, and the main companies, i.e. with the higher number of links, are SIEMENS and EFACEC, on Engineering sector and Qimonda[1] on Manufacturing sector.

INESC links in the Energy sector have spread for more companies like REN, Endesa, Electricidade dos Açores, etc. but EDP is still the company with more links in this sector.

[1] This company was going through a process of insolvency at the time when interviews were conducted.

In the Telecom sector PT Inovação is the more represented although the ties connecting this organization to INESC are weak ties.

As for Services/Other sectors, there are some links to City Halls, for example Porto City Hall and associations, like TecMinho, among other kinds of organizations.

The Consulting sector continues to be represented by major multinational consulting companies. This is the case of Accenture, Deloitte and PriceWaterhouse&Coopers, with a strong presence in the Lisbon area.

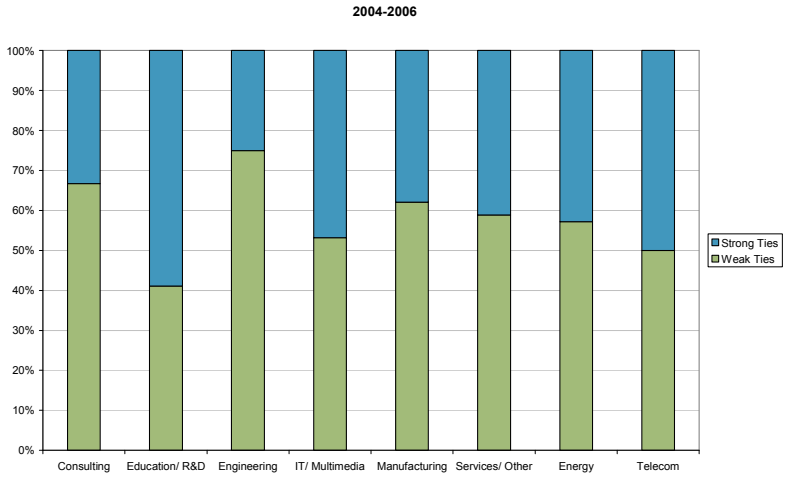

Figure 26: Rate Weak-Strong Ties for each sector in the period of 2004-2006

In this period the Weak ties are increasing when compared with Strong ties for most sectors. For the sector of Education/ R&D the percentage of Strong ties is still higher than that for Weak ties.

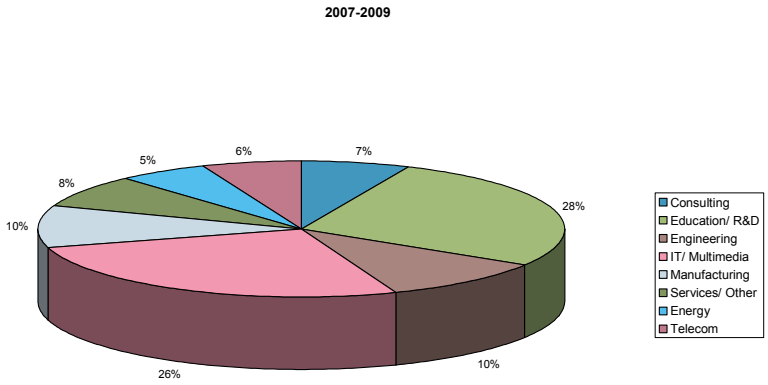

Figure 27: Former collaborators distribution by sector for the period 2007-2009

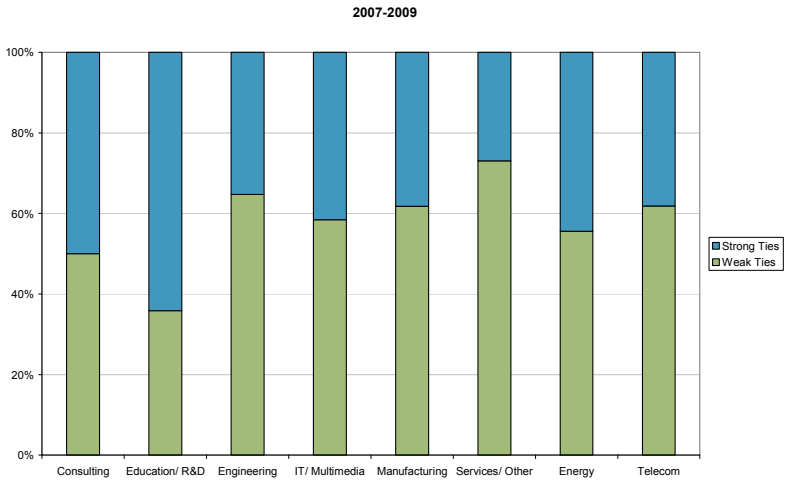

Figure 28: Former collaborators distribution by sector for the period 2007-2009

The figures for this period are very similar to the previous period. The most represented sectors are Education/R&D and IT/ Multimedia.

The number of companies linked to INESC increased but not as much as the increase observed on the previous period. As time goes by, contacts with previous companies may be less frequent, and become weaker. However, on this study, the time since workers left INESC Porto was not considered in the distinction between weak and strong ties. Thus, the INESC Porto strong ties network is always growing, as the number of links is accumulating and we assume that ties remain unchangeable through time. The question of strong ties changing to weak ties with time could only be slightly explored based on the few survey answers from former INESC collaborators who left this organization a longer time ago, but since the number of obtained answers is so small no conclusions were taken.

Analysing the INESC Porto network based on former human resources with respect to sectors in this period there are no significant differences when compared to the previous period.

In Education/ R&D sector there is an increase in the number of secondary schools linked to INESC, again all weak ties. As on previous periods the most representative university is University of Porto mainly through FEUP but also through other faculties. Universities outside the Porto area increase, and INESC influence can be extended to universities like Universidade de Aveiro, Instituto Superior Técnico and UTAD; and the links to private universities like ISMAI remain. At the international level there are connections to Spanish universities, e.g. Universidad Carlos III de Madrid, and links to Brazilian Universities remain high. In Australia there is now a new link to Queensland University of Technology.

Links to other R&D institutions are mostly international and found at organizations like CERN, as on the previous periods.

On the remaining sectors the organizations linked to INESC are mostly the same found on previous periods.

Weak Ties are more than strong ties for almost every sector now, excluding Education/R&D and Consulting.

Crossing the results by sector with the results showed on the mappings, we could observe that the Education/R&D sector is the most international sector, because most international links found are links to universities and other R&D organizations. The sector of IT is also very international, examples are Microsoft in Denmark and CISCO Systems in the USA. The links found in Angola are to Portuguese civil engineering companies.

Summing up, the INESC Porto network has increased and evolved from an almost exclusive academic network to a wide network including national and multinational private companies mostly in Portugal but also increasing in other countries.

The INESC influence through human resources mobility is stronger in the Education/R&D sector, which is also sector in which INESC has more international links. This is due to many INESC resources are already from this sector, and also because INESC is an organization where collaborators are pursuing academic degrees. Thus, the strong ties are more frequent than weak ties in every period for this sector. Universities are the most frequent host for INESC former employees, and FEUP is the University with more links (mostly strong) as it would be expected, given the geographical proximity and the shared infrastructures and resources (also human resources).

Being the strongest area in INESC, IT/Multimedia sector is the second largest sector of INESC Porto human resources network and also the second sector with more international links. In this area we found many strong ties to INESC spin-offs which are maintained through time, indicating some dependency and a high level of informality, according to the studies of Johansson et al (2005).

In other areas like Telecom, Engineering, Consulting and Manufacturing we found some major employers of INESC Porto human resources with many ties to INESC, respectively, PTInovação, Siemens, Deloitte and Qimonda.

3.4. The influence of INESC Porto on individuals' professional trajectories: a personal perspective

As a research institute in Portugal, and especially for the IT sector, INESC Porto has a major role and is seen as a reference. In the last question of the survey we asked about INESC influence on collaborators professional path, after they left the organization. This was an open question so the answers obtained were all different. Still, for some cases it was clear that INESC did not influence their professional path, and for other cases the time spent in INESC was crucial for their career, either because they acquired an academic degree there or because their present job was only possible because they were in INESC. Generally, INESC did not influence collaborators who stayed for a short time, like some interns, and as a first job experience sometimes was useful for them to realize that the academic career was not a good option. Several respondents answered that INESC was important in building technical competences (for example in specific technologies) and also personal competences such as creativity, team work, professionalism and ethics.

For interns the experience at INESC is their first contact with the professional world, and INESC is often referred as the transition between University and the "real world", because the environment at INESC is a mixture of academic and enterprise environment:

"INESC Porto contributed to my adaptation to the work world in the sense that it gave me a bridge linking academic and professional life. It also allowed me to have contact with extremely competent people who served as an example to follow." (former INESC Porto intern, now working as Project Engineer at Critical Manufacturing)

For these collaborators INESC has the importance of a first job experience. INESC Porto is also seen as a reference for enriching their CV and thus contributing for a successful job hunting after they left the institution:

"INESC was recognised on my first job interview, and that contributed for me to get the job" (former INESC Porto intern, his first job was at Qimonda working as Process Engineer)

Other collaborators find great importance in INESC because it was decisive and the starting point for pursuing an academic career:

"INESC Porto influenced greatly my path, it was fundamental for my professional life. I was there for 8 years and only left because of the conditions created for being there."

(former INESC Porto researcher, now working as a teacher/researcher at Universidade do Minho).

Based on the obtained statements we can assume that the INESC Porto influence on individuals is proportional to the time they spent there. The influence is strong at technical and academic levels but also at personal level because INESC's culture of innovation, creativity and team work is passed on to workers. The informal environment at INESC facilitates the internal knowledge transfer between individuals inside the organization. After they leave INESC, human resources, with their embedded knowledge, culture and experience acquired, and also their networks, can be of great value to companies.

Research organizations having knowledge creation as a main function and as institutions where individuals develop their skills and accumulate knowledge will probably have an impact on companies to where workers move, i.e. the knowledge created in the organization flows to these companies. As Lenzi (2006) states "the new firm will benefit from the knowledge generated elsewhere" , in this particular case, these organizations can benefit from the knowledge produced by INESC. Evidently this applies more to cases of long term workers, and less to short term workers; interns probably did not accumulate much knowledge during their stay, and INESC's influence was weak, so the impact on the new company may be insignificant. On the other hand, workers who stayed in INESC for a long time can have a relevant impact on the new organization, because the knowledge transfer and INESC's influence here has bigger proportions. Transposing this assumption to Weak-Strong ties it is reasonable to presume that strong ties links assume a much important role in knowledge transfer through human resources than weak ties, thus having a bigger impact on the recipient company. The level of innovativeness of recipients companies of these strong ties would be an interesting point to explore on further studies.

3.5. The strength of weak or strong ties? A new perspective on the influence of a research and technology transfer organizations

To assess if there are significant differences between weak and strong ties, we analysed the data gathered from the survey in SPSS. For each variable the mean values of weak strong ties were tested and the Kruskal-Wallis test was performed. On the following table are the main outcomes of the statistical tests obtained with SPSS.

Table 6: Statistical results obtained with SPSS – Mean values and Kruskal-Wallis test

Variable	Mean value of Strong-Weak ties								X2 test K-W	p-value	Conclusion
Linkage type	Research Grant		Higher Education Teacher		Internship		Hired Worker		59,553	0,000***	Different
	0,729		1,000		0,152		1,000				
Present sector	Consulting	Education/ R&D	IT/ Multimedia	Telecom	Manufacturing	Services/ Other	Engineering	Energy	2,476	0,116	No differences
	0,4545	0,5517	0,3158	0,3333	0,250	0,1304	0,3529	0,400			
UNIT	UESP		UITT		USIC	USE	UOSE	SS	0,213	0,644	No differences
	0,5		1		0,2041	0,3043	0,3333	0,2727			
Company Nationality	National					Multinational			1,922	0,166	No differences
	0,48					0,3333					
Present Occupation	Intern/ Jr Engineer	Senior Engineer	Manager	Support Services	Owner/ CEO	Consultant	Teacher/ Researcher	No job/ Other	0,699	0,403	No differences
	0,5	0,3019	0,3478	0,2727	0,5	0,3571	0,6316	0,0909			
Region	North		Centre		Lisbon	Island	Foreign Country		4,271	0,039**	Different
	0,301		0,5714		0,3684	0,3333	0,8333				
Contacts INESC	No			Yes, occasionally			Yes, frequently		9,138	0,003***	Different
	0,197			0,48			0,4444				
Contact type	formal			informal			both		0,045	0,832	No differences
	0,6667			0,4839			0,4				
INESC influence	No influence		small	competences (personal/technical)		career/cv	strong		2,751	0,097*	Different
	0,375		0,381	0,3261		0,1622	0,6667				
Nationality	Portuguese					Foreigner			0,203	0,652	No differences
	0,3467					0,5					

Note: statistically significant at 1% (***); 5% (**); 10% (*)

Analysing Table 6, we can conclude that there are differences for linkage type, present region, INESC contacts and INESC influence. This means that hired workers and higher education teachers have strong ties and interns have mostly weak ties with the institution. This is an obvious conclusion because usually internships last from 3 to 12 months and contracts are often established for years or with no term. The obtained results show that collaborators who still maintain contacts with INESC Porto after leaving the organization are the ones who have strong ties with the institution.

In addition to knowledge transfer from R&D organizations through workers mobility, knowledge exchange can also occur through informal links as showed in the study of Almeida and Kogut (1999). If workers maintain informal contacts with the former organizations, these links constitute active channels between the two institutions for continuous knowledge exchange. Taking the results of Cantner and Graf (2006) on a regional network of innovators, that links resulting from job mobility often outcome in formal collaborations, we ca assume that these informal links are potential sources of cooperation between INESC and strong ties recipient organizations. This supposition is reinforced by Ponomariov and Boardman (2007) who also found that informal links are associated with higher probability of future collaboration between R&D institutions and industry, thus having impacts beyond serving as channels of knowledge transfer.

Our findings contradict Granovetters Weak Ties Theory, showing that on knowledge transfer through human resources mobility, strong ties are the key and not weak ties, because strong ties are the ones which can bridge institutions, and evolve to formal collaborations. Trust is fundamental in building new formal links between organizations, and also complementarity (Cantner and Graf, 2006). . Canter and Graf (2006) also showed that technological overlap has an important role for collaboration and future knowledge exchange, i.e. cooperation in R&D settles on a common knowledge base. Again this opposes to Granovetters argument saying that because strong ties are often alike, the shared information often overlaps, thus not contributing for information diffusion.

In the survey the last question addressing INESC influence on personal path was an open question. On analysing the answers, it could be understood the degree of influence in a rough way as “no influence”, “small” and “strong”. After separating the answers into these three categories, we analysed the data on SPSS and from the obtained results it can be stated that collaborators with strong ties were the most influenced by the institution as we

assumed on the previous section. This means that INESC Porto values, philosophies and knowledge can be indirectly transferred to other organizations through these collaborators on everyday actions, because they were strongly influenced by the institution. Also, because most strong ties collaborators still maintain contact with INESC, formal linkages between organizations can be started, triggered by strong ties, so the strong ties network is an active network, where information and knowledge flows through former INESC collaborators links.

Conclusion

With this project we tried to assess the impact of INESC Porto using a new perspective, based on human resources mobility, bringing sociology to complement typical econometric and scientometric impact studies.

We built the INESC Porto geographical network on different periods and found that INESC Porto can have a crescent impact at national and international levels. This can be attained mostly in the Education/R&D and IT sectors, but also in other sectors like Telecom, Consulting, Engineering and Manufacturing. We showed that INESC Porto network based on human resources mobility was initially small and more concentrated and evolved spreading to almost all continents and business sectors. Because most collaborators still maintain contacts with INESC Porto, this network is active with informal links occurring between former collaborations and the organization acting as channels of information exchange. Contradicting Granovetters Weak Ties theory, we showed that strong ties are more important than weak ties in knowledge transfer, thus being potential bridges between organizations. In fact, authors have showed that informal links between R&D organizations and companies often lead to formal links of collaboration.

The influence of INESC Porto on former collaborators, is high for workers with strong ties, both at technical and personal levels, and the accumulated knowledge, competences and culture are imbedded in human resources, being transferred to other organizations. Organizations also benefit from human resources contacts and informal links, especially with strong ties, which can evolve to more formal links. Thus the impact of an R&D organization is extended to human resources recipient organizations, having also an influence in the regions where these organizations are inserted.

These findings may have policy implications in order to facilitate collaborations between research organizations and companies, and also at promoting job mobility.

We hope with this study, to start a discussion on the importance of strong ties, informal links and other sociological aspects in the performance of institutions impacts.

References

Bercovitz, J. and Feldmann, M. (2007), "Entrepreneurial Universities and Technology Transfer: A Conceptual Framework for Understanding Knowledge-Based Economic Development", *Journal of Technology Transfer,* 31: 175-188

Drucker, J. and Goldstein, H. (2007), "Assessing the Regional Economic Development Impacts of Universities: A Review of Current Approaches", *International Regional Science Review*, 30, 1, p. 20-46

Feller, I., Ailes, C. and Roessner, J.D. (2002), "Impacts of research universities on technological innovation in industry: evidence from engineering research centres", *Research Policy*, 31, p. 457-474

Kostoff, R. (1995), "Research requirements for research impact assessment ", *Research Policy*, 24, p.869-882

Lee, Y. (1996), "'Technology transfer' and the research university: a search for the boundaries of university-industry collaboration", *Research Policy*, 25, p. 843-863

Martin, F. (1998), "The economic impact of Canadian university R&D", *Research Policy*, 27, p. 677-687

Martinelli, A., Meyer M. and von Tunzelmann, N. (2007), "Becoming an entrepreneurial university? A case study of knowledge exchange relationships and faculty attitudes in a medium-sized, research-oriented university", *Journal of Technology Transfer*, 33, 259-283

Meyer, M. (2004), "Measuring the impact of science ", *IEEE, International Engineering Management Conference*, p. 377 – 381

Santoro, M. D., Gopalakrishnan, S. (2000), "The institutionalization of knowledge transfer activities within industry–university collaborative ventures", *Journal of Engineering and Technological Management* 17, p. 299–319

Fritsch, M., Franke, G. (2004), "Innovation, regional knowledge spillovers and R&D cooperation", *Research Policy*, 33, 245–255

Yawson, R., Amoa-Awua, w., Sutherland, A., Smith, D. and Noamesi, S. (2006), "Developing a performance measurement framework to enhance the impact orientation of the Food Research Institute, Ghana", *R&D Management* 36, 2.

Spann, M., Adams, M. and Souder, W. (1995), ”Measures of Technology Transfer Effectiveness: Key Dimensions and Differences in Their Use by Sponsors, Developers and Adopters”, *IEEE Transactions on Engineering Management*, Vol. 42, No. **1**

Izushi, H. (2003), “Impact of the length of relationships upon the use of research institutes by SMEs”, *Research Policy*, 32, 771–788

Sable, M. (2007), “The impact of the biotechnology industry on local economic development in the Boston and San Diego metropolitan areas”, *Technological Forecasting & Social Change* 74, 36–60

Shartinger, D., Shibany, A., Gassler, H. (2001), “Interactive Relations Between Universities and Firms: Empirical Evidence for Austria”, *Journal of Technology Transfer*, 26, 255-268

Granovetter, M. (1973), “The Strength of Weak Ties”, *The American Journal of Sociology*, Vol. 78, No. 6, pp 1360-1380

Granovetter, M (1983), “The Strenght of Weak Ties: A Network Theory Revisited”, *Sociological Theory*, Vol 1, 201-233

Granovetter, M (1992), “Economic Institutions as Social Constructions: A Framework for Analysis”, *Acta Sociologica*, 35, 3-11

Granovetter, M. (2005), “The Impact of Social Structure on Economic Outcomes”, *Journal of Economic Perspectives*, Vol 19, Nr 1, 33-50

Howells, J. (2006) “Intermediation and the Role of Intermediaries in Innovation”, *Research Policy*, 35, 715-728

Wolson, R. (2007), “The role of technology transfer offices in building the South African biotechnology sector: an assessment of policies, practices and impact”, *Journal of Technology Transfer*, 32, 343-365

Golob, E. (2006), “Capturing the Regional Economic Benefits of University Technology Transfer: A Case Study”, *Journal of Technology Transfer*, 31, 685-695

Bessette, R. (2003), “Measuring the Economic Impact of University-Based Research”, *Journal of Technology Transfer*, 28, 355-361

Rosenfeld, M., Roth, D. (2004), "The Impact of Public Research Units on Regional Innovation Processes and Regional Economic Development", *ERSA Conference Papers, European Regional Science Association*, ersa04, p160

Sorensen, J.A.T, Chambers, D. A. (2008), "Evaluating academic technology transfer performance by how well access to knowledge is facilitated – defining an access metric", *Journal of Technology Transfer*, 33, 534-547

Sequeira, J., Teixeira, A. A. C. (2009), "Assessing the influence of R&D institutions by mapping international scientific networks: the case of INESC Porto", *UITT – INESC Porto*, working paper nº2

Wagner, C.S., Leydesdorff, L.(2005), "Mapping Global Science Using International Co-authorships: A Comparison of 1990 and 2000", *International Journal of Technology and Globalization*, Vol. 1, Nr. 2, pp. 185–208.

Pinski, G., and Narin, F. (1976), "Citation Influence for Journal Aggregates of Scientific Publications: Theory, with Application to the Literature of Physics", *Information Processing and Management*, Vol. 12, Nr. 5, pp. 297-312.

Tomer, C. (1986), "A Statistical Assessment of Two Measures of Citation: The Impact Factor and the Immediacy Index", *Information Processing and Management*, Vol. 22 Nr. 3, pp. 251-258.

Asai, Isao (1981), "Adjusted Age Distribution and its Application to Impact Factor and Immediacy Index", *Journal of the American Society for Information Science*, Vol. 32, Nr. 3, pp. 172-174

Glänzel, W., and Schoepflin, U. (1995), "A Bibliometric Study on Ageing and Reception Processes of Scientific Literature", *Journal Of Information Science*, Vol. 21, Nr. 1, pp. 37-53.

Moed, H. F., Van Leeuwen, Th. N., and Reedijk, J. (1998), "A New Classification System to Describe the Ageing of Scientific Journals and their Impact Factors", *Journal of Documentation*, Vol. 54, Nr. 4, pp. 387-419.

Schubert, A., and Glänzel, W. (1986), "Mean Response Time – A New Indicator of Journal Citation Speed with Application to Physics Journals", *Czechoslovak Journal of Physics*, Vol. 36, Nr. 1, pp. 121-125.

Moed, H. F., and Van Leeuwen, Th. N. (1995), "Improving the Accuracy of the Institute for Scientific Information's Journal Impact Factor", *Journal of the American Society for Information Science*, Vol. 46, Nr. 6, pp. 461-467.

Moed, H. F., and Van Leeuwen, Th. N. (1996), "Impact Factors Can Mislead", *Nature*, Vol. 381, Nr. 6579.

Braun, T., and Glänzel, W. (1995), "On a Source of Error in Computing Journal Impact Factors", *Chemical Intelligencer*, Vol. 1, pp. 31-32.

Van Leeuwen, Th. N., Moed, H. F., and Reedijk, J. (1997), "JACS Still Topping Angewandte Chemie: Beware Of Erroneous Impact Factors", *Chemical Intelligencer*, Vol. 3, pp. 32-36.

Schwarz, A. Winkel, Schwarz, S., Tijssen, R. J. W. (1998), "Research and Research Impact of a Technical University – A Bibliometric Study", *Scientometrics,* Vol. 41, Nr. 3, pp. 371-388.

Cantner, U., Graf, H. (2006), "The network of innovators in Jena: An application of social network analysis", *Research Policy*, 35, 463-480

Lenzi, C. (2006), "Innovative productivity and job mobility: Evidence from a survey of Italian inventors", *Working Paper, DRUID Summer Conference*

Crespi, G.A., Geuna, A., Nesta, L.(2007), "The mobility of university inventors in Europe", *Journal of Technology Transfer*, 32, 195-215

Almeida, P., Kogut, B.(1999), "Location of Knowledge and the Mobility of Engineers in Regional Networks", *Management Science*, Vol 45, No. 7

Waters, R., Smith, H.L. (2008), "Social Networks in High-Technology Local Economies: The cases of Oxfordshire and Cambridgeshire", *European Urban and Regional Studies*, 15, 21

Hussler, Caroline, and Rondé, Patrick (2007), "The impact of cognitive communities on the diffusion of academic knowledge: Evidence from the networks of inventors of a French university", *Research Policy*, Vol. 36, Nr. 2, pp. 288–302.

Hoisl, K., "Tracing mobile inventors – The casualty between inventor mobility and inventor productivity", *Research Policy*, 36, 619-636

Ponomariov, B., Boardman, P.C. (2007), "The effect of informal industry contacts on the time university scientists allocate to collaborative research with industry", *Journal of Technology Transfer*, 33, 301-313

INESC Porto (2008), Manual de Acolhimento do INESC Porto, Porto, Portugal: *INESC Porto.*

Johansson, M., Jacob, M., Hellström, T. (2005), "The Strength of Strong Ties: University Spin-offs and the Significance of Historical Relations", *Journal of Technology Transfer*, 30, 271-286

Websites:

http://www.LinkedIn.com , profiles published on the Web 2.0 site consulted between May and July 2009

Appendix I: Questionnaire

Assessing the range of influence of Technology Research Institutions. The case of INESC Porto

Este inquérito é confidencial e será apenas usado para efeitos de investigação no contexto da Faculdade de Economia da Universidade do Porto (FEP-UP). Agradecemos que tente responder a todas as perguntas. Por favor responda com X às questões de escolha múltipla.

Nome:

1. Desde que saiu do INESC Porto, por favor identifique, por anos (do mais antigo, para o mais recente) o seu percurso profissional, identificando os 3 locais onde permaneceram mais tempo (anos) e na actualidade (2009)

Anos: __________-___________

Designação da entidade empregadora/empresa:

____

Sector de actividade: ___________________________________

Dimensão (aproximada) (nº de trabalhadores):___________

Nacionalidade da Empresa: _______________________________

Ocupação/Posição hierárquica: ____________________________

Local de trabalho: Cidade: ______________ País: ____________

Anos: __________-___________

Designação da entidade empregadora/empresa:

____

Sector de actividade: ___________________________________

Dimensão (aproximada) (nº de trabalhadores):___________

Nacionalidade da Empresa: _______________________________

Ocupação/Posição hierárquica: ____________________________

Local de trabalho: Cidade: ______________ País: ____________

Anos: __________-___________

Designação da entidade empregadora/empresa:

____

Sector de actividade: ___________________________________

Dimensão (aproximada) (nº de trabalhadores):___________

Nacionalidade da Empresa: _______________________________

Ocupação/Posição hierárquica: ____________________________

Local de trabalho: Cidade: ______________ País: ____________

Actualmente (2009) [se idêntico ao anterior, p.f. não preencher]

Designação da entidade empregadora/empresa:

____

Sector de actividade: ___________________________________

Dimensão (aproximada) (nº de trabalhadores):___________

Nacionalidade da Empresa: _______________________________

Ocupação/Posição hierárquica: ____________________________

Local de trabalho: Cidade: ______________ País: ____________

2. Ao longo do seu percurso profissional, manteve (mantém) contactos com o INESC Porto

☐ Não. ☐ Sim, esporádicos/pontuais. ☐ Sim, frequentes.

3. Se sim, por favor, especifique o tipo

☐ Informais/de amizade com alguns colaboradores do INESC Porto. ☐ Participação em Projectos de Investigação.

☐ Contratação de Recursos Humanos do INESC Porto. ☐ Contratação de Serviços ao INESC Porto.

☐ Prestação de serviços ao INESC Porto. ☐ Outros (p.f., especificar):_____

4. Em breves palavras, por favor, especifique de que forma o INESC Porto influenciou o seu percurso profissional

_____

_____

_____

Obrigada pela Sua Valiosa Colaboração

Appendix II: List of Companies part of INESC Porto Network

Table A 1: Organizations part of INESC Porto network in 1998-2000

Company	Sector	Nationality	City	Country
Cimcola	Manufacturing	Portuguese	Santo Tirso	Portugal
Deloitte	Consulting	Multinational	Porto	Portugal
DTTI Soluções Informáticas	IT/ Multimedia	Portuguese	Porto	Portugal
EFACEC	Engineering	Portuguese	Porto	Portugal
FCUP	Education/ R&D	Portuguese	Porto	Portugal
FEP	Education/ R&D	Portuguese	Porto	Portugal
FEUP	Education/ R&D	Portuguese	Porto	Portugal
Interbolsa	Services/ Other	Portuguese	Porto	Portugal
ISEP	Education/ R&D	Portuguese	Porto	Portugal
ISMAI	Education/ R&D	Portuguese	Porto	Portugal
ISPGAIA	Education/ R&D	Portuguese	Gaia	Portugal
Novabase	IT/ Multimedia	Portuguese	Porto	Portugal
ParadigmaXis	IT/ Multimedia	Portuguese	Porto	Portugal
PTInovação	Telecom	Portuguese	Porto	Portugal
Queen Mary University of London	Education/ R&D	English	London	UK
Universidade Lusíada	Education/ R&D	Portuguese	Famalicão	Portugal
Yazaki Saltano	Manufacturing	Multinational	Ovar	Portugal

Table A 2: Organizations part of INESC Porto network in 1998-2000

Company	Sector	Nationality	City	Country
Accenture	Consulting	Multinational	Lisboa	Portugal
Accor/ Amorim	Services/ Other	Multinational	Porto	Portugal
AEP	Services/ Other	Portuguese	Porto	Portugal
APCER	Services/ Other	Portuguese	Porto	Portugal
Areva T&D	Engineering	Multinational	Lisboa	Portugal
BitMinho	IT/ Multimedia	Portuguese	Braga	Portugal
Câmara Municipal de Oliveira de Azeméis	Services/ Other	Portuguese	Oliveira de Azeméis	Portugal
CBE	Telecom	Portuguese	Lisboa	Portugal
CERN	Education/ R&D	International	Geneve	Switzerland
ChipIdea Microelectronics	Manufacturing	Multinational	Porto	Portugal
Corticeira Amorim	Manufacturing	Portuguese	Santa Maria de Lamas	Portugal
Deloitte	Consulting	Multinational	Porto	Portugal
Edinfor (agora Logica)	IT/ Multimedia	Multinational	Porto	Portugal
EDP - Distribuição	Energy	Portuguese		Portugal
EFACEC	Engineering	Portuguese	Porto	Portugal
EGP	Education/ R&D	Portuguese	Porto	Portugal
ESA	Education/ R&D	International	Hague	Netherland
ESEIG	Education/ R&D	Portuguese	Porto	Portugal
FCTUC	Education/ R&D	Portuguese	Coimbra	Portugal
FCUP	Education/ R&D	Portuguese	Porto	Portugal
FEP	Education/ R&D	Portuguese	Porto	Portugal
Ferreira da Rocha Lda	Engineering	Portuguese	S. João da Madeira	Portugal
FEUP	Education/ R&D	Portuguese	Porto	Portugal
Glintt HS	IT/ Multimedia	Portuguese	Porto	Portugal
INOVInter	Services/ Other	Portuguese	porto	portugal
INTA	Services/ Other	Spanish	Madrid	Spain
IPFEL	Services/ Other	Portuguese	Braga	Portugal
iPortalMais	IT/ Multimedia	Portuguese	Porto	Portugal
IPP	Education/ R&D	Portuguese	Porto	Portugal
ISEP	Education/ R&D	Portuguese	Porto	Portugal
ISMAI	Education/ R&D	Portuguese	Porto	Portugal
ISPGAIA	Education/ R&D	Portuguese	Gaia	Portugal
IT Deusto	IT/ Multimedia	Multinational	Madrid	Spain
JCTel	IT/ Multimedia	Portuguese	Porto	Portugal
LIACC - UP	Education/ R&D	Portuguese	Porto	Portugal
Medidata	IT/ Multimedia	Portuguese	Porto	Portugal
Modelo Continente	Services/ Other	Portuguese	Porto	Portugal
MOG Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
Net Portugal	Consulting	Portuguese	Aveiro	Portugal
NMBS	Engineering	Belgium	Brussels	Belgium
NOESIS	Consulting	Portuguese	Lisboa	Portugal
OHM	Engineering	Portuguese	porto	portugal
ParadigmaXis	IT/ Multimedia	Portuguese	Porto	Portugal
Patricios SA	Engineering	Portuguese	Santa Maria da Feira	Portugal
PTInovação	Telecom	Portuguese	Porto	Portugal
QnS Saúde	Services/ Other	Portuguese	Santo Tirso	Portugal
Queen Mary University of London	Education/ R&D	English	London	UK
Reitoria da Universidade do Porto	Education/ R&D	Portuguese	Porto	Portugal
Shortcut	IT/ Multimedia	Portuguese	Matosinhos	portugal

Company	Sector	Nationality	City	Country
SIEMENS	Engineering	Multinational	Lisboa	Portugal
Siemens Medical	Engineering	Multinacional	Matosinhos	Portugal
Siproflex	Manufacturing	Portuguese	Mindelo	Portugal
Sociedade Electro Ideal de Braga	Engineering	Portuguese	Braga	Portugal
Sony	Manufacturing	Multinational	Berlin	Germany
Sotecnica	Energy	Portuguese	Maia	Portugal
TecMinho	Services/ Other	Portuguese	Guimarães	Portugal
Tecnidata	IT/ Multimedia	Portuguese	Porto	Portugal
TotalEner	Engineering	Portuguese	Palmela	Portugal
Unicer	Manufacturing	Portuguese	Matosinhos	Portugal
Universidade Católica Portuguesa	Education/ R&D	Portuguese	Porto	Portugal
Universidade Federal do Pará	Education/ R&D	Brazilian	Belém	Brasil
Universidade Lusíada	Education/ R&D	Portuguese	Famalicão	Portugal
Universidade Politecnica de Valencia	Education/ R&D	Spanish	Valencia	Spain
UPC Corporation	Telecom	Dutch	Amsterdam	Netherlands
UTAD	Education/ R&D	Portuguese	Vila Real	Portugal
Vicaima	Manufacturing	Portuguese	Porto	Portugal
VPConsulting	Consulting	Portuguese	Porto	Portugal
Yazaki Saltano	Manufacturing	Multinational	Ovar	Portugal

Table A 3: Organizations par to f INESC Porto network in 2004-2006

Company	Sector	Nationality	City	Country
Accenture	Consulting	Multinational	Lisboa	Portugal
Accor Hospitality Portugal	Services/ Other	Multinational		Portugal
Accor/ Amorim	Services/ Other	Multinational	Porto	Portugal
AEP	Services/ Other	Portuguese	Porto	Portugal
Altran Portugal	Consulting	Multinational	Lisboa	Portugal
Amorim	Manufacturing	Portuguese	Santa Maria da Feira	Portugal
APCER	Services/ Other	Portuguese	Porto	Portugal
APD - Associação portuguesa de deficientes	Services/ Other	Portuguese	Porto	Portugal
Areva T&D	Engineering	Multinational	Porto	Portugal
B2F	IT/ Multimedia	Portuguese	Ermesinde	portugal
BizSimple	IT/ Multimedia	Portuguese	Porto	Portugal
Blaupunkt	Manufacturing	Multinational	Braga	Portugal
BSComputadores	IT/ Multimedia	Portuguese	Porto	Portugal
Bullet Solutions	IT/ Multimedia	Portuguese	porto	portugal
Câmara Municipal de Oliveira de Azeméis	Services/ Other	Portuguese	Oliveira de Azeméis	Portugal
Câmara Municipal do Porto	Services/ Other	Portuguese	Porto	Portugal
Carlos Oliveira/ Soltrafego	Engineering	Portuguese	Porto	Portugal
Cast-Info	IT/ Multimedia	Spanish	Barcelona	Spain
CBE	Telecom	Portuguese	Lisboa	Portugal
CEFPI	Services/ Other	Portuguese	Porto	Portugal
CERN - European Organization for Nuclear Research	Education	International	Geneve	Switzerland
ChipIdea Microelectronics	Manufacturing	Multinational	Porto	Portugal
CISCO Systems	IT/ Multimedia	Multinational	San Jose (California)	USA
ClusterMedia Labs	IT/ Multimedia	Portuguese	Aveiro	Portugal
Columbia University	Education/ R&D	American	New York	USA
Continental	Manufacturing	Multination	Trofa	Portugal
Critical Software	IT/ Multimedia	Portuguese	Porto	Portugal
Deloitte	Consulting	Multinational	Lisboa	Portugal
DIALPE Informática	IT/ Multimedia	Portuguese	Porto	Portugal
Edinfor (agora Logica)	IT/ Multimedia	Multinational	Porto	Portugal
EDP - Distribuição	Energy	Portuguese	Porto	Portugal
EDV - Energia	Energy	Portuguese	Oliveira de Azeméis	Portugal
EFACEC	Engineering	Portuguese	Porto	Portugal
EGP	Education/ R&D	Portuguese	Porto	Portugal
Electricidade dos Açores	Energy	Portuguese	Ponta Delgada	Portugal
Enabler	IT/ Multimedia	Portuguese	Porto	Portugal
Endesa	Energy	Multinational	Porto	Portugal
Enercom	Energy	Multinational	Viana do Castelo	Portugal
ENERGAIA	Energy	Portuguese	Gaia	Portugal
Escola Profissional de Gaia	Education	Portuguese	Gaia	Portugal
Escola Profissional Infante	Education	Portuguese	Gaia	Portugal
Escola Secundária Carlos Amarante	Education	Portuguese	Braga	Portugal
Escola Secundária da Veiga	Education	Portuguese	Santo Tirso	Portugal
Escola Secundária Forte da Casa	Education	Portuguese	Guimarães	Portugal
ESEIG	Education/ R&D	Portuguese	Porto	Portugal
Faculdade de Ciências da Nutrição	Education/ R&D	Portuguese	Porto	Portugal
Faculty of Electrical Engineering and Information Technologies in Skopje	Education/ R&D	Macedonia	Skopje	Macedonia
FASE	Engineering	Portuguese	Porto	Portugal
FCTUC - Faculdade de Ciências e Tecnologia da Universidade de Coimbra	Education/ R&D	Portuguese	Coimbra	Portugal

Company	Sector	Nationality	City	Country
FCUP	Education/ R&D	Portuguese	Porto	Portugal
FEP	Education/ R&D	Portuguese	Porto	Portugal
Ferreira da Rocha Lda	Engineering	Portuguese	S. João da Madeira	Portugal
FEUP	Education/ R&D	Portuguese	Porto	Portugal
Fibersensing	IT/ Multimedia	Portuguese	Porto	Portugal
GEG - Gabinete de estruturas e geotecnia	Engineering	Portuguese	Porto	Portugal
Getronics	Manufacturing	Dutch	Lisboa	Portugal
Glintt HS	IT/ Multimedia	Portuguese	Porto	Portugal
GroupFix	IT/ Multimedia	Portuguese	Maia	Portugal
Grupo Visabeira	Telecom	Portuguese	Viseu	Portugal
HBase	IT/ Multimedia	Portuguese	Porto	Portugal
Hotgas	Engineering	Portuguese	Valongo	Portugal
IBS Portugal	IT/ Multimedia	Multinational	Porto	Portugal
INESC Coimbra	Education/ R&D	Portuguese	Coimbra	Portugal
Infineon Technologies	Manufacturing	Multinational	Vila do Conde	Portugal
Infrabel	Services/ Other	Belgium	Brussels	Belgium
Instituto de Telecomunicações	Telecom	Portuguese	Aveiro	Portugal
Instituto Multimedia	Services/ Other	Portuguese	Porto	Portugal
Instituto Superior de Entre Douro e Vouga	Education/ R&D	Portuguese	Santa Maria da Feira	Portugal
Instituto Superior Técnico, Universidade Técnica de Lisboa	Education/ R&D	Portuguese	Oeiras	Portugal
Inta	Education/ R&D	Spanish	Madrid	Spain
IPO - Sistemas e Infrasestruturas	Manufacturing	Portuguese	Porto	Portugal
iPortalMais	IT/ Multimedia	Portuguese	Porto	Portugal
IPP	Education/ R&D	Portuguese	Porto	Portugal
ISEP	Education/ R&D	Portuguese	Porto	Portugal
ISMAI	Education/ R&D	Portuguese	Porto	Portugal
ISPGAYA	Education/ R&D	Portuguese	Gaia	Portugal
IT Deusto	IT/ Multimedia	Multinational	Madrid	Spain
Jaime Ribeiro e Filhos	Engineering	Portuguese	Luanda	Angola
JCTel	IT/ Multimedia	Portuguese	Porto	Portugal
José Lino Dias e Companhia Lda	Services/ Other	Portuguese	Matosinhos	Portugal
KonK Consulting	Consulting	Portuguese	Porto	Portugal
LedComum	IT/ Multimedia	Portuguese	Porto	Portugal
LIACC - UP	Education	Portuguese	Porto	Portugal
Manvia S.A.	Engineering	Portuguese	Porto	Portugal
Massachusetts Institute of Technology (MIT)	Education/ R&D	American	Boston	USA
Matir Internacional texteis	Manufacturing	Portuguese	Santo Tirso	Portugal
Max Planck Institute for Iron Research	Education/ R&D	German	Dusseldorf	Germany
Medidata	IT/ Multimedia	Portuguese	Porto	Portugal
Metro do Porto	Services/ Other	Portuguese	Porto	Portugal
MGRocha	Engineering	Portuguese	S. João da Madeira	Portugal
Microsoft Business Solutions	IT/ Multimedia	Multinational	Copenhagen	Denmark
Microsoft Development Center	IT/ Multimedia	Multinational	Copenhagen	Denmark
MIPS Technologies	Manufacturing	Multinational	Porto	Portugal
Modelo Continente	Services/ Other	Portuguese	Porto	Portugal
MOG Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
Multiwave Networks	Telecom	Portuguese	Maia	Portugal
Multiwave Photonics	Telecom	Portuguese	Maia	Portugal
NATO C3 Agency	Education/ R&D	International	The Hague	Netherlands
Net Portugal	Consulting	Portuguese	Aveiro	Portugal
New Boston Select	Consulting	Multinational	Vila do Conde	Portugal
NextIraOne	IT/ Multimedia	Multinational	Lisboa	Portugal
NMBS	Services/ Other	Belgium	Brussels	Belgium

Company	Sector	Nationality	City	Country
NOESIS	Consulting	Portuguese	Lisboa	Portugal
OHM	Engineering	Portuguese	Porto	Portugal
OMIP	Energy	Spanish	Lisboa	Portugal
Panike	Manufacturing	Portuguese	Maia	Portugal
ParadigmaXis	IT/ Multimedia	Portuguese	Porto	Portugal
Patricios SA	Engineering	Portuguese	Santa Maria da Feira	Portugal
Ph Informatica	IT/ Multimedia	Portuguese	Porto	Portugal
Porto Editora	Manufacturing	Portuguese	Porto	Portugal
PortoGen Energia	Energy	Portuguese	Gondomar	Portugal
Portucel Viana	Manufacturing	Portuguese	Viana do Castelo	Portugal
Preh	Manufacturing	Portuguese	Trofa	Portugal
PricewaterhouseCoopers	Consulting	Multinational	Porto	Portugal
Protecção Civil	Services/ Other	Portuguese	Porto	Portugal
Protic	IT/ Multimedia	Portuguese	Porto	Portugal
PSG GEOPHYSICAL AS	Energy	Norweig	Naval Base	Norway
PT	Telecom	Portuguese	Lisboa	Portugal
PT Inovação	Telecom	Portuguese	Aveiro	Portugal
Qenergia	Energy	Portuguese	Matosinhos	Portugal
Qimonda	Manufacturing	Multinational	Vila do Conde	Portugal
Radio Popular	Services/ Other	Portuguese	Porto	Portugal
Ramalhão	Consulting	Portuguese	Porto	Portugal
Reitoria da Universidade do Porto	Education/ R&D	Portuguese	Porto	Portugal
REN	Energy	Portuguese	Porto	Portugal
RUIUR	IT/ Multimedia	Portuguese	Porto	Portugal
SCYTL	IT/ Multimedia	Spanish	Barcelona	Spain
SENSU	Consulting	Portuguese	Porto	Portugal
Shortcut Lda	IT/ Multimedia	Portuguese	Matosinhos	Portugal
SIEMENS	Engineering	Multinational	Lisboa	Portugal
Siemens Medical	Engineering	Multinacional	Matosinhos	Portugal
Siproflex	Manufacturing	Portuguese	Mindelo	Portugal
Soares da Costa	Engineering	Portuguese	Luanda	Angola
Sociedade Electro Ideal de Braga	Engineering	Portuguese	Braga	Portugal
Sociedade Geotermica dos Açores	Energy	Portuguese	S.Miguel, Açores	Portugal
Sonae Industria	Manufacturing	Portuguese	Porto	Portugal
Sony	Manufacturing	Multinational	Berlin	Germany
Sotecnica	Energy	Portuguese	Maia	Portugal
TecMinho	Services/ Other	Portuguese	Guimarães	Portugal
Tecnidata	IT/ Multimedia	Portuguese	Porto	Portugal
Texas Instruments France	Manufacturing	Multinational	Villeneuve-Loubet	France
TNTVOIP (now NETUNO Portugal)	Telecom	Multinational	Porto	Portugal
Trysystem	Consulting	Portuguese	Rio Tinto	Portugal
Unicer	Manufacturing	Portuguese	Matosinhos	Portugal
Universidade Autónoma de Barcelona	Education/ R&D	Spanish	Barcelona	Spain
Universidade Carlos III de Madrid	Education/ R&D	Spanish	Madrid	Spain
Universidade Católica Portuguesa	Education/ R&D	Portuguese	Porto	Portugal
Universidade de Aveiro	Education/ R&D	Portuguese	Aveiro	Portugal
Universidade do Minho	Education/ Research	Portuguese	Guimarães	Portugal
Universidade do Porto	Education/ R&D	Portuguese	Porto	Portugal
Universidade Estadual de Ponta Grossa	Education/ R&D	Brazilian	Varanasi	Brasil
Universidade Federal de Itajubá	Education/ R&D	Brasileira	Itajuba	Brasil
Universidade Federal do Pará	Education/ R&D	Brazilian	Belem	Brasil
Universidade Lusíada	Education/ R&D	Portuguese	Famalicão	Portugal
Universidade Politecnica de Valencia	Education/ R&D	Spanish	Valencia	Spain
UPC Corporation	Telecom	Dutch	Amsterdam	Netherlands

Company	Sector	Nationality	City	Country
UTAD	Education/ R&D	Portuguese	Vila Real	Portugal
Vanguarda	IT/ Multimedia	Portuguese	Porto	Portugal
Vicaima	Manufacturing	Portuguese	Porto	Portugal
Vortal	IT/ Multimedia	Portuguese	Porto	Portugal
VP Consulting	Consulting	Portuguese	Porto	Portugal
Wavecom	Telecom	Portuguese	Aveiro	Portugal
WIPRO Retail	IT/ Multimedia	Multinational	Porto	Portugal

Table A 4: Organizations par to f INESC Porto network in 2007-2009

Company	Sector	Nationality	City	Country
5ª Sinfonia	IT/ Multimedia	Portuguese	Maia	Portugal
Abaco Consultores	Consulting	Portuguese	Porto	Portugal
Accenture	Consulting	Multinational	Lisboa	Portugal
ACConsulting	Consulting	Portuguese	Lisboa	Portugal
Accor Hospitality Portugal	Services/ Other	Multinational		Portugal
Alert Life Science Computing	IT/ Multimedia	Portuguese	Porto	Portugal
Alstom	Energy	Multinational	Baden	Switzerland
Altran Europe	Consulting	Multinational	Brussels	Belgium
Altran Portugal	Consulting	Multinational	Lisboa	Portugal
APINEQ	Engineering	Portuguese	Matosinhos	Portugal
APOND, Applications on Demand	IT/ Multimedia	Portuguese	Matosinhos	Portugal
AREVA	Engineering	Multinational	Seattle	USA
Auditmark	IT/ Multimedia	Portuguese	Porto	Portugal
B2F - Business to Future	IT/ Multimedia	Portuguese	Porto	Portugal
Bind	IT/ Multimedia	Portuguese	Porto	Portugal
Blaupunkt Autoradios de Portugal	Manufacturing	Multinational	Braga	Portugal
BPI	Services/ Other	Portuguese	Porto	Portugal
Brastec	Engineering	Portuguese	Figueira da Foz	Portugal
Bullet Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
Câmara Municipal de Oliveira de Azeméis	Services/ Other	Portuguese	Oliveira de Azeméis	Portugal
Câmara Municipal de Ponte de Lima	Services/ Other	Portuguese	Ponte de Lima	Portugal
Câmara Municipal de Santo Tirso	Services/ Other	Portuguese	Santo Tirso	Portugal
Câmara Municipal do Porto	Services/ Other	Portuguese	Porto	Portugal
Cardmobili	IT/ Multimedia	Portuguese	Porto	Portugal
Carlos Oliveira/ Soltrafego	Engineering	Portuguese	Porto	Portugal
CBE	Telecom	Portuguese	Lisboa	Portugal
Centro de Formação Profissional de Rio Meão	Services/ Other	Portuguese	santa maria da feira	Portugal
Centro de Tecnologia da Informação Renato Archer	Education	Brazilian	Campinas	Brasil
Cerealis	Manufacturing	Portuguese	Aguas Santas	Portugal
CERN	Education	International	Geneve	Switzerland
Check4 Ld	IT/ Multimedia	English	Slough	UK
CIN	Manufacturing	Portuguese	Maia	Portugal
CISCO Systems	IT/ Multimedia	Multinational	San Jose (California)	USA
Citigroup	Services/ Other	Multinational	Lisboa	Portugal
City University London	Education/ R&D	English	London	UK
Climade	Engineering	Portuguese	Funchal	Portugal
Clínica Monteiro Moniz	Services/ Other	Portuguese	Porto	Portugal
ClusterMedia Labs	IT/ Multimedia	Portuguese	Aveiro	Portugal
Conexus World	IT/ Multimedia	Portuguese	Espinho	Portugal
Controlar	Engineering	Portuguese	Porto	Portugal
Critical Manufacturing	IT/ Multimedia	Portuguese	Porto	Portugal
Critical Software	IT/ Multimedia	Portuguese	Porto	Portugal
Deloitte	Consulting	Multinational	Lisboa	Portugal
DIALPE Informática	IT/ Multimedia	Portuguese	Porto	Portugal
Digitrad	Services/ Other	Portuguese	Maia	Portugal
E3R	Energy	Portuguese	Vila Real	Portugal
ECORYS	Consulting	Multinational	Roterdam	Netherlands
EDF	Energy	English	Cambridge	UK
Edinfor (agora Logica)	IT/ Multimedia	Multinational	Porto	Portugal
EDP - Distribuição	Energy	Portuguese		Portugal

Company	Sector	Nationality	City	Country
EDP Serviços	Energy	Portuguese	Porto	Portugal
EDV - Energia	Energy	Portuguese	Oliveira de Azeméis	Portugal
EFACEC	Engineering	Portuguese	Porto	Portugal
Electricidade dos Açores	Energy	Portuguese	Ponta Delgada	Portugal
Enabler	IT/ Multimedia	Portuguese	Porto	Portugal
Enabler Wipro (agora Wipro Portugal SA)	IT/ Multimedia	Multinational	Porto	Portugal
Enercom	Energy	Multinational	Viana do Castelo	Portugal
ENERGAIA	Energy	Portuguese	Gaia	Portugal
Enermeter	Engineering	Portuguese	Braga	Portugal
EPFL	Education/ R&D	Swiss	Lausane	Switzerland
ESA	Education	International	Frascati	Italy
Escola Profissional de Gaia	Education	Portuguese	Gaia	Portugal
Escola Profissional Infante	Education	Portuguese	Gaia	Portugal
Escola Secundária Alves Redol	Education/ R&D	Portuguese	Vila Franca	Portugal
Escola Secundária Carlos Amarante	Education	Portuguese	Braga	Portugal
Escola Secundária de Marco de Canaveses	Education	Portuguese	Marco de Canaveses	Portugal
Eugénio Branco	Services/ Other	Portuguese	Porto	Portugal
Faculdade de Ciências da Nutrição	Education/ R&D	Portuguese	Porto	Portugal
Faculty of Electrical Engineering and Information Technologies in Skopje	Education/ R&D	Macedonia	Skopje	Macedonia
FARFETCH	IT/ Multimedia	Portuguese	Guimarães	Portugal
FASE	Engineering	Portuguese	Porto	Portugal
FCTUC - Faculdade de Ciências e Tecnologia da Universidade de Coimbra	Education/ R&D	Portuguese	Coimbra	Portugal
FCUP	Education/ R&D	Portuguese	Porto	Portugal
FEP	Education/ R&D	Portuguese	Porto	Portugal
FEUP	Education/ R&D	Portuguese	Porto	Portugal
Fibersensing	IT/ Multimedia	Portuguese	Maia	Portugal
First Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
Fujitsu Siemens Computers	IT/ Multimedia	Multinational	Lisboa	Portugal
Fujitsu Technology Solutions	IT/ Multimedia	Multinational	Lisboa	P
Glintt HS	IT/ Multimedia	Portuguese	Porto	Portugal
GMS Consulting	Consulting	Multinational	Lisboa	Portugal
Google	IT/ Multimedia	Multinational	London	UK
Grupo CS	Services/ Other	Portuguese	Lisboa	Portugal
Grupo Visabeira	Telecom	Portuguese	Viseu	Portugal
HBase	IT/ Multimedia	Portuguese	Porto	Portugal
Hive Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
IBS Portugal	IT/ Multimedia	Multinational		Portugal
IDEAPUZZLE	IT/ Multimedia	Portuguese	Porto	Portugal
IKS - Universidade Karlsruhe	Education/ R&D	German	Karlsruhe	Germany
Iluminações Teixeira Couto	Manufacturing	Portuguese	Paredes	P
INDRA	IT/ Multimedia	Multinational	Porto	Portugal
INESC Coimbra	Education	Portuguese	Coimbra	Portugal
INFOS	IT/ Multimedia	Portuguese	Matosinhos	Portugal
Infrabel	Engineering	Belgium	Brussels	Belgium
INOV - INESC Inovação	Education	Portuguese	Lisboa	Portugal
Institut für Werkstoffe, Ruhr Universität Bochum, Germany	Education	German	Bochum	Germany
Instituto de Telecomunicações	Telecom	Portuguese	Porto	Portugal
Instituto Multimedia	Services/ Other	Portuguese	Porto	Portugal
Instituto Nokia de Tecnologia	Education	International	Manaus	Brasil
Instituto Politécnico de Leiria	Education/ R&D	Portuguese	Leiria	Portugal
Instituto Superior de Entre Douro e Vouga	Education/ R&D	Portuguese		Portugal

Company	Sector	Nationality	City	Country
Instituto Superior Técnico, Universidade Técnica de Lisboa	Education/ R&D	Portuguese	Oeiras	Portugal
Inta	Education	Spanish	Madrid	Spain
IPO - Sistemas e Infrasestruturas	Manufacturing	Portuguese		Portugal
iPortalMais	IT/ Multimedia	Portuguese	Porto	Portugal
IPP	Education/ R&D	Portuguese	Porto	Portugal
ISEP	Education/ R&D	Portuguese	Porto	Portugal
ISMAI	Education/ R&D	Portuguese	Maia	Portugal
ISPGAYA	Education/ R&D	Portuguese	Gaia	Portugal
ISR Institute of Systems and Robotics	Education	Portuguese	Coimbra	Portugal
Jaime Ribeiro e Filhos	Engineering	Portuguese	Luanda	Angola
Joint Action	IT/ Multimedia	Portuguese	Porto	Portugal
José Lino Dias e Companhia Lda	Services/ Other	Portuguese	Matosinhos	Portugal
José Mendes de Sousa	Services/ Other	Portuguese	Maia	Portugal
K2C	Consulting	Portuguese	Porto	Portugal
KonK Consulting	Consulting	Portuguese	Porto	Portugal
LedComum	IT/ Multimedia	Portuguese	Porto	Portugal
LIDL e Companhia	Services/ Other	Multinational	Lisboa	Portugal
Logica	IT/ Multimedia	Multinational	Lisboa	Portugal
LSA - ISEP	Education/ R&D	Portuguese	Porto	Portugal
Manvia S.A.	Engineering	Portuguese	Porto	Portugal
Marlene e Fernandes - Biju	Services/ Other	Portuguese		Portugal
Martifer	Engineering	Portuguese	Porto	Portugal
Massachusetts Institute of Technology (MIT)	Education/ R&D	American	Boston	USA
Max Planck Institute for Iron Research	Education	German	Dusseldorf	Germany
Medidata	IT/ Multimedia	Portuguese	Porto	Portugal
Microsoft	IT/ Multimedia	Multinational	Porto	Portugal
Microsoft Business Solutions	IT/ Multimedia	Multinational	Copenhagen	Denmark
Microsoft Development Center	IT/ Multimedia	Multinational	Copenhagen	Denmark
MIPS Technologies	Manufacturing	Multinational	Porto	Portugal
Modelo Continente	Services/ Other	Portuguese	Porto	Portugal
Mog solutions	IT/ Multimedia	Portuguese	Maia	Portugal
Multiwave Photonics	Telecom	Portuguese	Maia	Portugal
MVM - Serviços de Racionalização Energética Lda	Energy	Portuguese	Porto	Portugal
myPartner	IT/ Multimedia	Portuguese	Porto	Portugal
NATO C3 Agency	Education	International	The Hague	Netherlands
Net Portugal	Consulting	Portuguese	Aveiro	Portugal
New Boston Select	Consulting	Multinational	Vila do Conde	Portugal
Next2U Network Solutions	IT/ Multimedia	Portuguese	Porto	Portugal
NextIraOne	Telecom	Multinational	Lisboa	Portugal
Nintendo	IT/ Multimedia	Multinational	Frankfurt	Germany
NOESIS	Consulting	Portuguese	Lisboa	Portugal
Nokia Siemens	Telecom	Multinational	Aveiro	P
Nokia Siemens Networks	Telecom	Multinational	Lisboa	Portugal
Norlabor	Engineering	Portuguese	Vizela	Portugal
Novabase	IT/ Multimedia	Portuguese	Lisboa	Portugal
OHM	Engineering	Portuguese	Porto	Portugal
OMIP	Energy	Spanish	Lisboa	Portugal
OPT - Optimização e Planeamento de Transportes S.A.	IT/ Multimedia	Portuguese	Porto	Portugal
Optimus	Telecom	Portuguese	Matosinhos	Portugal
Painhas	Engineering	Portuguese	Braga	Portugal
Panike	Manufacturing	Portuguese	Maia	Portugal
ParadigmaXis	IT/ Multimedia	Portuguese	Porto	Portugal
Patricios SA	Engineering	Portuguese	Santa Maria da Feira	Portugal

Company	Sector	Nationality	City	Country
Pontifícia Universidade Católica do Rio Grande do Sul	Education/ R&D	Brazilian	Porto Alegre	Brasil
Portucel Viana	Manufacturing	Portuguese	Viana do Castelo	Portugal
Portuguese Air Force	Services/ Other	Portuguese	Lisboa	Portugal
Preh	Manufacturing	Portuguese	Trofa	Portugal
PricewaterhouseCoopers	Consulting	Multinational	Porto	Portugal
Primavera Software	IT/ Multimedia	Portuguese	Braga	Portugal
Progress	Consulting	American	Roterdam	Netherlands
Protecção Civil	Services/ Other	Portuguese	Porto	Portugal
Protic	IT/ Multimedia	Portuguese	Porto	Portugal
PSG GEOPHYSICAL AS	Energy	Norweig	Naval Base	Norway
PT	Telecom	Portuguese	Lisboa	Portugal
PT Inovação	Telecom	Portuguese	Aveiro	Portugal
Qenergia	Energy	Portuguese	Matosinhos	Portugal
Queensland University of Technology	Education/ R&D	Australian	Brisbane	Australia
Radio Popular	Services/ Other	Portuguese	Porto	Portugal
Reitoria da Universidade do Porto	Education/ R&D	Portuguese	Porto	Portugal
REN	Energy	Portuguese	Porto	Portugal
Samaritanos IPSS	Services/ Other	Portuguese	Gaia	Portugal
SCYTL	IT/ Multimedia	Spanish	Barcelona	Spain
Seegnal Research	IT/ Multimedia	Portuguese	Maia	Portugal
SENSU	Consulting	Portuguese		Portugal
Shindler	Engineering	Multinational	Warsow	Poland
Shortcut	IT/ Multimedia	Portuguese	Matosinhos	portugal
SIEMENS	Engineering	Multinational	Porto	Portugal
Skinkers	Telecom	Multinational	London	UK
Soares da Costa	Engineering	Portuguese	Porto	Portugal
Sociedade Geotermica dos Açores	Energy	Portuguese	S.Miguel, Açores	Portugal
Sonae Industria	Manufacturing	Portuguese	Porto	Portugal
Sonae sierra	Services/ Other	Portuguese	Porto	Portugal
Sonaecom	Telecom	Portuguese	Matosinhos	Portugal
Sony	Manufacturing	Multinational	Berlin	Germany
Sotecnica	Energy	Portuguese	Maia	Portugal
Stream	IT/ Multimedia	Multinational	La Coruña	Spain
Swedwood	Manufacturing	Swedish	Paços de Ferreira	Portugal
Synopsis	IT/ Multimedia	Portuguese	Porto	Portugal
Tecnidata	IT/ Multimedia	Portuguese	Porto	Portugal
Texas Instruments France	Manufacturing	Multinational	Villeneuve-Loubet	France
Texas Instruments UK	Manufacturing	Multinational	Northampton	UK
TIPS	Services/ Other	Portuguese	Gaia	Portugal
TNTVOIP (actualmente NETUNO Portugal)	Telecom	Multinational	Porto	Portugal
Tomorrow Options	Manufacturing	Portuguese	Porto	Portugal
Trap You	IT/ Multimedia	Portuguese	Matosinhos	Portugal
Trysystem	Consulting	Portuguese	Rio Tinto	Portugal
Unicer	Manufacturing	Portuguese	Matosinhos	Portugal
Universidade Autónoma de Barcelona	Education/ R&D	Spanish	Barcelona	Spain
Universidade Carlos III de Madrid	Education/ R&D	Spanish	Madrid	Spain
Universidade Católica Portuguesa	Education/ R&D	Portuguese	Porto	Portugal
Universidade de Aveiro	Education/ R&D	Portuguese	Aveiro	Portugal
Universidade do Minho	Education/ R&D	Portuguese	Guimarães	Portugal
Universidade do Porto - SASUP	Services/ Other	Portuguese	Porto	Portugal
Universidade Estadual de Ponta Grossa	Education/ R&D	Brazilian	Uvaranas	Brasil
Universidade federal de goias	Education/ R&D	Brazilian	Goianas	Brasil

Company	Sector	Nationality	City	Country
Universidade Federal de Itajubá	Education/ R&D	Brasileira	Itajuba	Brasil
Universidade Federal do Pará	Education/ R&D	Brazilian	Belem	Brasil
Universidade federal são João del rei	Education/ R&D	Brazilian	São João Del-Rei	Brasil
Universidade Lusíada	Education/ R&D	Portuguese	Famalicão	Portugal
Universidade Politecnica de Valencia	Education/ R&D	Spanish	Valencia	Spain
UPC Corporation	Telecom	Dutch	Amsterdam	Netherlands
UPIN	Services/ Other	Portuguese	Porto	Portugal
UTAD	Education/ R&D	Portuguese	Vila Real	Portugal
Vanguarda	IT/ Multimedia	Portuguese	Porto	Portugal
Vicaima	Manufacturing	Portuguese	Porto	Portugal
Vieira e Filhos Lda	Manufacturing	Portuguese	Freamunde	Portugal
Vortal - Portais electrónicos	IT/ Multimedia	Portuguese	Porto	Portugal
Wavecom	Telecom	Portuguese	Aveiro	Portugal
Wedo	IT/ Multimedia	Portuguese	Braga	Portugal
widescope - Sistemas de Optimização Lda	IT/ Multimedia	Portuguese	Lisboa	Portugal
WIPRO Retail	IT/ Multimedia	Multinational	Porto	Portugal