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THE PROCESS OF EMERGENCY, EVOLUTION, AND SUSTAINABILITY OF UNIVERSITY-FIRM RELATIONS IN A CONTEXT OF OPEN INNOVATION

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The establishment, evolution, and sustainability of University-Firm relations[♠]

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Abstract

Existing studies on University-Firm (U-F) relations are still excessively centred on the advantages which firms are able to obtain from relations with Universities, failing to take into account the benefits that potentially go to Universities from such links. This paper intends to fill this gap by empirically studying the process of the establishment, evolution, and sustainability of the U-F relations in an open innovation context. Using the case study methodology, we empirically demonstrate how relations between a firm (Brisa) and Higher Education institutions (namely, ISEL - Instituto Superior de Engenharia de Lisboa) were established, how they evolved and have been sustained over time, placing special emphasis on the issue of the mutual benefits derived from these links. Face-to-face interviews with the key-players at Brisa and ISEL, complemented with an extensive analysis of secondary sources, allowed us to conclude that establishing connections between the two entities is a more complex and time-consuming process (requiring large relational and resource investment on both parts) than that which existing literature conveys. Besides the recognized gains for firms when they adopt a more open-led perspective of innovation, our study (also) highlights the benefit deriving to the Universities from links to companies. It is mainly due to the existence of mutual benefits that U-F relations are preserved in the long-term or, in other words, are sustainable.

Keywords: Open Innovation; University-Firm relations; Emergence; Sustainability; Benefits

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1. Introduction

Open Innovation (OI) is one of the areas that has revealed the most growth in the literature on the economics and management of innovation in the last few years, and could be classified as emerging (Teixeira and Silva, 2010). In the OI model, not only are the internal efforts of firms considered but also those proceeding from the exterior, in the sense of speeding the innovation processes and exploring new markets (Gann, 2004; Chesbrough and Schwartz, 2007). In this model, "surplus technologies", that is, technologies in "stock" are economically explored, since the OI model privileges different modalities of accessing the market and therefore commercializing innovation, given the wide range of partnerships which can potentially be established (Chesbrough, 2003). Innovation management through a model which is open to the exterior can be ascertained based on both technology purchase and technology transfer to other organizations (Enkel et al., 2005; Chesbrough and Crowther, 2005; Lichtenthaler, 2008), where its performance is possible based on multiple forms, namely, intellectual property licensing (Sheehan et al., 2004), co-development partnerships (Piller and Walcher, 2006; Van der Meer, 2007; Chiaroni et al., 2008; Belussin et al., 2008), the relationship between the companies and the scientific and technological system (Chesbrough, 2003; Harwing, 2004; Blau, 2007; Perkmann and Walsh, 2007; Link et al., 2008), the launching of new spinoff companies (Parhankangas et al., 2003), and fusions and acquisitions (Parhankangas et al., 2003).

The majority of the existing studies on the OI paradigm is mostly conceptual in nature (Lopes and Teixeira, 2009). In the few empirical studies available, the issue of University-Firm (U-F) relations is analyzed rather superficially, disregarding or not mentioning the mechanisms by which companies may take competitive advantage (via innovation) by exploring a more open innovation model based on relations with Universities (Perkmann and Walsh, 2007; Rothaermel et al., 2007).[1] On the other hand, the existing studies on U-F relations do not mention, at least in explicit terms, the issue of the open innovation model (Perkmann and Walsh, 2007; Rothaermel et al., 2007); such studies still focus on a unidirectional gain perspective, that is, they are extremely centred on the advantages which companies may obtain from relations with universities, failing to explore and analyze the benefits which could derive to the Universities from such relations (Chapple et al., 2005; Collins, 2006; Perkmann and Walsh, 2007; Lichtenthaler, 2008). The perspective of mutual benefit is underestimated by the

[1] We consider 'Universities' in this paper as a broad concept covering all higher education organizations within the scientific and technological system. Thus, apart from universities it includes also polytechnic organizations.

current empirical literature (Harwing, 2004). In fact, from an empirical point of view, there is a lack of detailed evidence on the establishment, evolution and sustainability of U-F relations and the means/mechanisms by which such companies and Universities obtain advantages from such relations (Perkmann and Walsh, 2007).[2]

Taking into consideration the gaps identified above, this paper constitutes an essentially empirical contribution, collecting and analyzing detailed evidence on the process of the establishment, evolution and sustainability of U-F relations in an open innovation context. Given the demand for detail in complex relations, the use of more qualitative methodologies, such as personal interviews and the collection of secondary information, is considered the most appropriate. Specifically, the case of Brisa, a Portuguese company operating in the area of transport infrastructure, is regarded as scientifically pertinent and adequate, as it exhibits in the Portuguese context a remarkably high index of openness in terms of innovation (Lopes and Teixeira, 2009), and given that the relations it maintains with Universities have comprised real value added in the management of its innovation activities.

In terms of organization, this paper is structured as follows. The following section (Section 2) presents methodological considerations associated to the case study – Brisa. Next, in Section 3, based on the case study, the process of the establishment, evolution and sustainability of U-F relations is explored, demonstrating the potentialities which U-F connections represent in companies which share an open innovation model and the economic value which such relations bring to the Universities, an aspect that has been neglected in the literature. Finally, in the Conclusions, we summarize the main research results and contributions.

2. Methodological considerations

The methodology used in this paper is based on a qualitative technique, the case study analysis (Yin, 2004; 2005). The pertinence of incorporating a more qualitative perspective in the research (case study) reflects the need to understand a certain phenomenon in detail and to obtain significant knowledge on certain occurrences and circumstances (Carson et al., 2001). Particularly in areas like innovation and marketing, a methodological approach which is centred on the understanding and analysis of the context in which the problem or situation is located has become increasingly an indispensible requirement (Yin, 2004; 2005), enabling the coexistence of multiple realities and different analysis perspectives.

[2] Pinheiro and Teixeira (2009) present a detailed literature survey on these matters, identifying the main gaps of existing studies.

The major advantage of the case study is that it allows the researcher to concentrate on a specific aspect or situation and to identify (or try to identify) the various processes which interact in the context studied (Yin, 2004; 2005). These processes could remain undetected in large-scale research, but are crucial for the success or failure of the organizations or systems. Additionally, this methodology is centred on the intensity and depth of the analysis mentioned above, which not only permits the absence of limits regarding the number of paths to explore, but also enables the sequential reconstruction of all the phases of the process that determined the current state of the situation or problem (Yin, 2004; 2005). It further enables the study of many different aspects and their analysis in relation to each other, providing an overview of the process in a real context (Gummesson, 2000).

The use of the case study methodology seems to respond to the needs placed by the current research, helping to better understand the setting studied, that is, actually exploring how, in the case of Brisa, relations with given entities, namely with the Lisbon Higher Engineering Institute (ISEL – Instituto Superior de Engenharia de Lisboa), came about detailing their evolution and sustainability over time, itemizing the means and mechanisms used by both institutions which have allowed them to accumulate advantages from such a relationship. Only with basis on a qualitative technique, such as the case study, could we fill in the gap identified in the specialized literature, where our contribution is centred on two analysis levels: (1) to broaden empirical literature at the OI level, namely on U-F relations, based on a case, rich in detail; (2) to contribute to the literature on U-F relations with a case study on OI which rigorously explains the benefits which Universities obtain from becoming more "entrepreneurial" (Teixeira and Costa, 2006).

For the purposes of this study, primary and secondary information sources were explored. Primary information was obtained from on-site visits. On 2nd April, 2009, we visited Brisa and ISEL, where, together with some key players, specifically Jorge Sales Gomes (Brisa's Innovation and Technology director), Tomé Canas (the engineer responsible for the development of new Brisa's products) and Luís Osório (professor at ISEL and interface between the ISEL and Brisa in what concerns R&D Projects), we itemized relevant issues for our study. As for the secondary information, Brisa reports and accounts and specialty sites were analyzed, as well as Brisa's presentations at congresses and assistance in academic dissertations.

According to a recent study by Lopes and Teixeira (2009), Brisa is one of the 5 (in 70) companies which has an open innovation model in the most demanding perspective of

knowledge and technology transfer to other organizations.[3] This not only reveals a critical income-based awareness of "surplus technology" management, but is intimately related to the critical importance attributed to the Scientific and Technological System entities in general and to the Universities in particular, namely the ISEL - Lisbon Higher Engineering Institute. Brisa is also the company from this study sustaining relations with the highest number of Universities (including R&D institutes), 11 in total (cf. Table A1 in Appendix), whereas, on average, each of the other sample companies only relates with 3 Universities. This clearly shows Brisa's superiority at this level. It is also aparent that Brisa is the company with the highest number of contacts with Portuguese Universities (43), whereas contacts by the remaining companies are on average 22. Brisa thus has about twice as many established contacts as other companies. Also in terms of foreign Universities, Brisa stands out in the sample, as the remaining companies in the study do not have contacts with foreign Universities, even though they are labelled as innovating. On the contrary, Brisa maintains contacts with foreign Universities, MIT in particular.

An interesting aspect of the contact network and intensity which innovating companies maintain with Universities is its complexity level. Brisa is the company, among the Portuguese firms analysed, which establishes the most complex contacts with Universities (Table A1), namely regarding established agreements, presenting a total number of 15 contacts (including foreign Universities), considerably higher than the sample average (5). Given the strong pertinence of this type of linkage, it is convenient to mention that the Universities which Brisa mostly relates with in this regard are the ISEL-IPL (5 contacts), Aveiro (4 contacts), Coimbra (2 contacts), Minho (1 contact), Nova de Lisboa (1 contact), Porto (1 contact), Técnica de Lisboa (1 contact), ISCTE (1 contact) and MIT (foreign university with 1 contact). It should be noted that it is with the ISEL that Brisa has the most complex linkages.

Brisa thus shows a high level of openness to Universities, since from among 18 institutions, the company has links with 11. In relative terms this represents an openness level of 61% (11/18). On the other hand, the 70 companies in analysis, only have on average about 3 links with Universities, and hence their openness level is relatively low (17%). Only three companies present a higher openness level than Brisa: PT Innovation, Bullet Solutions and Galp Energy, while the Ensul Meci company presents the same number of different links as Brisa.

[3] The most common perspective (less demanding) is that of the absorption or use of external knowledge (Lopes and Teixeira, 2009).

In light of the considerations put forward above, the case of Brisa constitutes an excellent *locus* to analyze two essential unanswered questions in the OI research (Perkmann and Walsh, 2007): the searching and matching processes which precede U-F relations, and the organization and management of cooperation agreements in this area.

3. Open Innovation and U-F relations. Empirical results of the Brisa case study

3.1. The innovation imperative in Brisa's evolution

Brisa - Auto-Estradas de Portugal, S.A is one of the biggest European highway enterprises and constitutes the "backbone" of the Portuguese transport system, with a concession reaching 1500 km, connecting Portugal from North to South and East to West, operating under contract with the Portuguese State. Employing 2895 people in 2008 and a revenue reaching 770,6 million Euros, the company has a average annual growth rate estimated at about 7.9%. With a stockbroker capitalization of approximately 3 billion Euros, Brisa is part of the Psi-20 index and fits the Euronext Top 100 and Dow Jones Sustainability Stock International index.

The company was founded on September 28th, 1972, with the objective of building, maintaining and exploring highways and their respective service areas under a concession contract. It is also responsible for the study and construction of public infrastructures, having furthermore activities that are to some extent considered complementary, such as transport assistance, customer service, traffic monitoring and control, and equipment design and maintenance.

Among Brisa's most important milestones in terms of innovation, in chronological order (see Table A2 in Appendix for a summary), one of the most notable was the company's pioneering initiative in the development and implementation of an automatic toll collection system, "Via Verde" (Green Lane) which became internationally recognized as an innovation in transport systems, first installed in 1991 in four Lisbon road tolls. It is an electronic payment system which debits the mileage fare from the drivers' bank account, definitely contributing to greater comfort, ease of use and safety (Brisa, 2008). In 1994, due to the merit of the "Via Verde"/Green Lane system, Brisa was awarded the *Tool Innovation Award* by the *International Bridge Tunnel and Turnpike Association*, rewarding the system's viability and innovation. By 1995, the system covered the entire national motorway network, with more than a million users. The Green Lane system is currently implemented in all toll roads, including those of competitor concession companies, and is also used internationally (e.g., Holland and the Czech Republic).

In 2000, Brisa underwent profound internal changes. With the entrance of the Mello Group to the company management and with the hiring of a new innovation director (Sales Gomes, BEng.), the Innovation and Development Department (IDD) is created, visibly committed to promoting and developing innovation policies to improve current and future innovations. For example, the IDD was able to reduce the technological dependence on suppliers (e.g., Q-free – a Norwegian company holder of the software which sustains the Green Lane technology), as well as generate a direct relationship with the Scientific and Technological System in general, and with the Universities in particular, with special focus on the Lisbon Higher Engineering Institute (ISEL).

As a result of the direct relationship between Brisa and ISEL, the ITS-IBus Project (Intelligent Transport Systems Interoperability Bus) was developed in 2002. This new concept encompasses the normalization of services and interfaces, and represents a change from a monolithic approach to a refinement of service infrastructure, from owner systems to open systems, where interoperability is a critical question. The ITS-IBus implies the definition of open interfaces, the use of standards and the implementations of Universal Plug and Play services. As a result, the user organization would not only have the flexibility to use equipment from different suppliers but also, and especially, to organize the services according to their personal needs in terms of business process and technological resources. Furthermore, with the development of this project, Brisa acquired a significant level of knowledge about DSRC (Dedicated Short Range Communication) technologies, on which the Green Lane system already relied, and the LPR (License Plate Recognition), which were also crucial to new IDD Projects (e.g., review of toll booths in terms of modularization and ergonomics). In that same year, and given the knowledge of LPR Technology, the development of an automatic license plate recognition system was started.

With the goal of taking advantage of the potentialities of the ITS-IBus software, a new project, called Brisa Park, which was presented in 2003, aimed at spreading the Green Lane concept to parking lots and petrol stations, adapting the existing technological platforms to permit the integration of different systems, in which ISEL qualified collaborators played a leading role. The project was developed in consortium with Galp (the only refiner and the leading distributor of oil products in Portugal) and Caixa Geral de Depósitos (Portuguese largest Bank), creating to this end Brisa Access, which is already being implemented internationally in a parking lot in Holland. In that same year, ISEL researchers engaged in the introduction of

GPS and GPRS technologies in Brisa's Green Lane system, with the purpose of making the system more uniform, given the goal of the system's internationalization.

The efforts started in 2002 were put into practise in 2005 with the implementation of the ITS-IBus system – "Migrar Project". Similarly, also in the same year, the first works on the development of an intelligent vision system were started, whose aim was centred on improving the automatic license plate recognition process. In the following year (2006), Brisa made significant investments in innovation, of approximately 6.8 million Euros, with the main efforts directed towards toll equipment and transportation telematics, access to parking lots and other infrastructure control systems and even collection systems in service stations. Moreover, part of this investment was obtained from funding of R&D activities by the Universities (e.g., ISEL). In the same period, Brisa participated in the MIT Portugal program, a large scale international cooperation initiative involving MIT, the Government, the academic world and the Portuguese industry, for the development of an educational and engineering systems research program, with Brisa involved in the transport system area. The "SMARTE Project" also started that year, whose objective it was to introduce an internal construction works monitoring system, such as for example, in bridges and flyovers.

Brisa pursued its internationalization strategy quite recently, namely to the American market, in 2007, when it was awarded a 99-year concession in Denver, Colorado, and to the Dutch market, where it is in charge of toll electronic collection in the Westerschelde tunnel. The automatic license plate recognition, started in 2002, became operational in 2007. Last year (2009) was a year of major projects for Brisa. We should stress the continuity of the "SMARTE Project", already materialized in the Sorraia flyover, in the A13 motorway. Also notable are the new research lines with ISEL, such as the development of surveillance cameras to be applied in the Galp petrol stations.

To sustain its wide range of services competitively, Brisa considers strict control of innovation and the development of its equipment and systems extremely important, specifically with regard to toll payment and control and road telematics, which comprise its main line of business. In this sense, a large part of the equipment and systems used in the operation and management of the Brisa motorway network is developed with recourse R&D, both internal (based in its labs) and external (based on a wide network of external partners), thus enabling strict control and compliance to the company's requirements. As for its remaining activities, Brisa's corporate innovation involves such varied domains as civil engineering and public

works, road safety and the environmental management of projects and works and infrastructures in operation.

Brisa has, therefore, developed considerable efforts to enroot its innovation policy throughout its whole structure, with the aim of increasing its competitive capacity based on the renewal and broadening of the products, services and associated market range, the establishment of new production methods, offer and distribution, development of new businesses and the introduction of changes in the management and organization of human resources, always taking into consideration the satisfaction and safety of the users. In 2008, Brisa invested 5.2 million Euros in innovation projects, corresponding to 0.94% of its GVA (Brisa, 2008), clearly stands ahead of the average national company (whose intensity is situated at a moderate 0.26%). The evolution in terms of R&D intensity (R&D ratio in the GVA) has grown (Table 1), more than doubling between 2003 and 2008.

Table 1: Evolution of R&D investment in absolute terms and as a percentage of Gross Value Added (GVA).

	2003	2004	2005	2006	2007	2008
Total expenditure on R&D (€)	2.039.226	2.741.504	5.358.911	6.804.288	4.669.838	5.200.000
GVA (€)	491.240.942	417.429.344	784.112.746	858.632.076	498.001.621	554.539.24
Expenditure on R&D / GVA (%)	0.42%	0.66%	0.68%	0.79%	0.90%	0.94%

Source: Treatment of the authors based on the Reports of Brisa (2008).

In European terms,Brisa is classified as an average technologically-intensive firm, even though the majority of the companies in the activity sector in which it operates have not managed to reach this classification (Brisa 2008).

Another sign of Brisa's innovation imperative was, as mentioned previously, the reorganization of the work group responsible for R&D, with the creation (in 2000) and formalization (in 2002), of an Innovation and Technology Department (ITD). This Department is also charged with the mission of promoting innovation throughout the entire Brisa group, in the search for new technological solutions which support activity development, seeking excellence and the optimization of processes and resources. The ITD's activity is centred on the Research, Conception and Design of Electronic Toll Systems and Toll Control, Intelligent Transport Systems (ITS) and infrastructure access control.

For Brisa, innovation is consequently the creation of value in a changing context, combining the reduction of costs and taking advantage of opportunities in this perspective, always seeking positive and distinct market differentiation. In the pursuit of all these objectives, Brisa

privileges network innovation. Thus, and through ITD intervention, Brisa has constituted and participated actively in partnerships aimed at stimulating innovation, cooperating with their suppliers and competitors in activities close to product development and through Scientific and Technological System bodies, especially the Universities, in activities close to pure research and initial concept development.

The company has created a wide network of partners (Figure 1), having developed several projects with them, some of which are already implemented in its motorway network (e.g., Brisa Park Project).

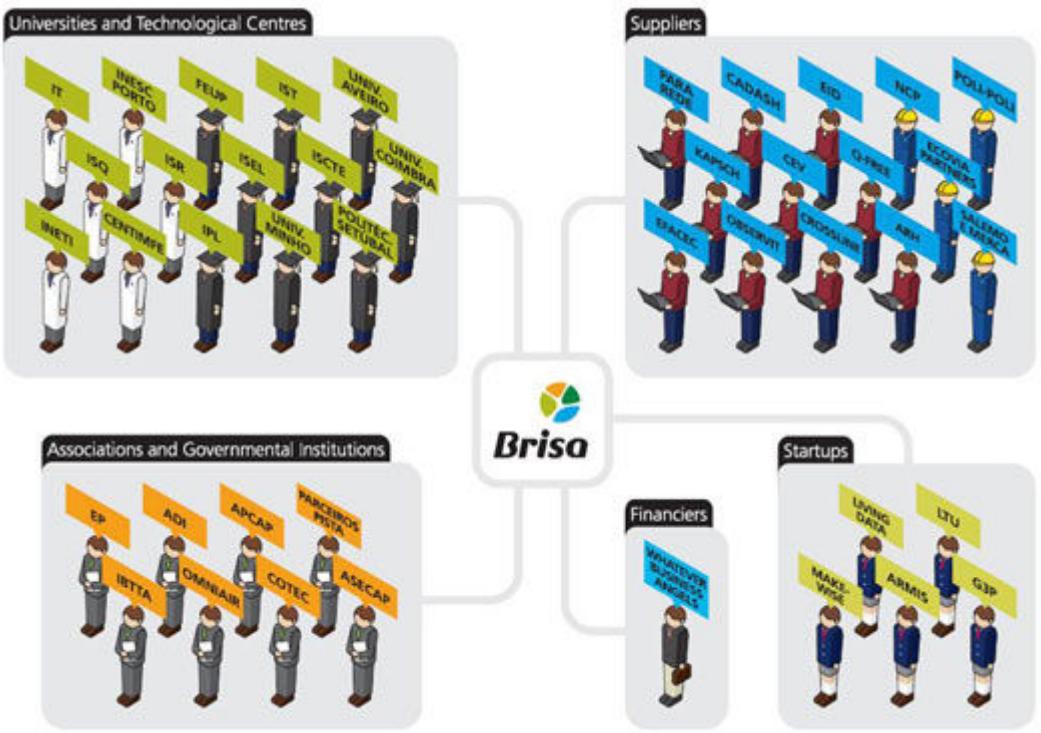

Figure 1: Network of Brisa Partners
Source: Compiled by the authors based on the Brisa website (2009).[4]

The network comprises entities with diverse typologies (cf. Figure 1) from supplier companies (e.g., EFACEC; LTU), Universities (e.g., ISEL; FEUP), government agencies (e.g., COTEC; ADI), to other motorway concessionaires (e.g., AENOR; Lusoponte).

Brisa has also developed efforts to innovate at the level of its image targeting its customers and other stakeholders. One means employed to achieve this aim was the improved representation in the objects which are in contact with motorway users, such as the equipment

[4] In http://www.brisa.pt/PresentationLayer/textosdetail.aspx?menuid=217&textoid=1465, accessed on June 2009.

used manually by the drivers, object of remarkable technological development. However, in terms of aesthetics, this evolution has fallen short, many times constrained by the processes usually used in production. In the course of the aesthetic evolution extolled by the company's administration and the ITD, a pilot-project was developed in 2007, the "ETOLL Project" (Electronic Toll), aimed at innovating the production materials and technology used, seeking to improve the company's image and to create a renewed interface, more pleasant and functional for its users. This innovation was extended to the remaining toll collection facilities as well as to other business support equipments.

Based on a "culture of innovation", the company has expanded internationally, largely on account of the pioneering Green Lane system. In Brazil, Brisa holds 18% of the capital of the Road Concession Company (CCR), the largest motorway operator in Latin America. In America, it holds 90% of the NorthWest Parkway concession capital in the Denver road network, in Colorado. In Spain, it has a participation of 1% in Abertis, one of the largest European operators in the sector, and in the Dutch market the company holds 30% of Movenience, which is responsible for electronic toll collection in the Westerschelde tunnel. In the Czech Republic, Brisa controls 26% of the Kapsch Telematic Services (KTS), the company chosen to supply and operate an automatic toll collection system for heavy weight vehicles. Brisa completes its foreign representation with the opening with an office in Vienna, Austria, aimed at the markets of Eastern and Central Europe, Russia, and Turkey. Within five to ten years, Brisa hopes that 50% of the company's value will come from international market business, where we can include the Asian and Australian markets. Mexico, Poland, Romania, and Slovenia are markets where Brisa awaits answers in relation to road investments.

3.2. The process leading to the establishment of U-F relations

The last phase (1999) in the privatization of Brisa was considered an important landmark in the company's history. As referred earlier, one year later, and already with the Mello Group administration, Brisa's Innovation and Development Department (IDD) was created, under the direction of Sales Gomes (BEng.), who put forward the intention of introducing technological innovation to improve both the current and the future technological applications. The administration further realized the importance of promoting and developing innovation policies at the core of Brisa. Both the company's new administration and the head of the IDD acknowledged the importance of the Scientific and Technological System, in general, and the Universities in particular.

From the face-to-face interviews we conducted with key Brisa managers, we derived that the Brisa/ISEL relations resulted from informal contacts and the resources inherent to networking. More specifically, Sales Gomes played a major role in this connection, given his long-term friendship with Luís Osório, professor and researcher (coordinator) of ISEL, who joined the IDD in 2002. Thus, the evidence collected shows that informal processes (e.g., informal contacts; networking), many times ignored by management teams (Ciborra, 2002), are one of main sources of innovating initiatives.

The informal relation between Sales Gomes and Luís Osório, involving increasing levels of formalization and resources, gradually and systematically sustained and broadened three important competitive vectors for Brisa: 1) the need to reduce Brisa's high level of technological dependence on Q-Free;[5] 2) the aim to expand the Green Lane model to other business areas, which required new technological functionalities from the system; 3) the need to reduce the systems' period of development and significantly reduce their cost structures.

In May 2002, Sales Gomes informally contacted the coordinator of ISEL's Group of Applied Research in Technology and Information Systems (GIATSI), Luís Osório, who regularly discussed possible cooperation scenarios, although they did not at the time define the specifications of the systems they had in mind, nor did they discuss the planning and coordination of future projects. However, in July that same year, an agreement was signed between Brisa and ISEL,[6] to develop a project aimed at solving Brisa's technological dependence on Q-Free (company which owned the Green Lane system software and monopolist antennae supplier), thereby enabling the potential expansion of Brisa's competitiveness.

In close cooperation with the GIATSI, a project called ITS-IBus was started in September 2002. In general terms, its underlying goal was to provide the company with flexibility to use equipment from different suppliers (eliminating dependence on only one supplier) and to organize services according to their internal needs in terms of business and technological resources (e.g., new developments in the Green Lane system and the redefinition of new services). The project's development gave Brisa control over DSRC (Dedicated Short Range Communication) technologies, which the Green Lane system relied on, and the LPR (License Plate Recognition). It was also decisive for new IDD projects, such as resolving problems

[5] Norwegian company which held the Green Lane system software.
[6] The literature (e.g., Rothaermel and Ku, 2008) highlights the importance of agreements in these relations, once informal contacts are in place.

related to the redesigning of toll booths in terms of modularity and ergonomics and the definition of an automatic license plate recognition system. The development team involved Brisa engineers, GIATSI researchers and graduating students with research scholarships, and work was developed on the ISEL premises.

The development of the ITS-IBus system also strengthened Brisa's relationship with the academic world, leading to 3 academic articles and further papers at conferences. As detailed in the next section, a year following the establishment of Brisa's relationship with the Scientific and Technological System, growth and "formalization", in terms of scientific team work between the company's collaborators and university researchers, is noticeable.

3.3. The evolution of U-F relations

The relationship between Brisa and ISEL has intensified until today, since the first (informal) contacts, based on the development of new projects and research lines. It is precisely the opportunities associated to new projects that characterize the Brisa/ISEL relational model (Figure 2).

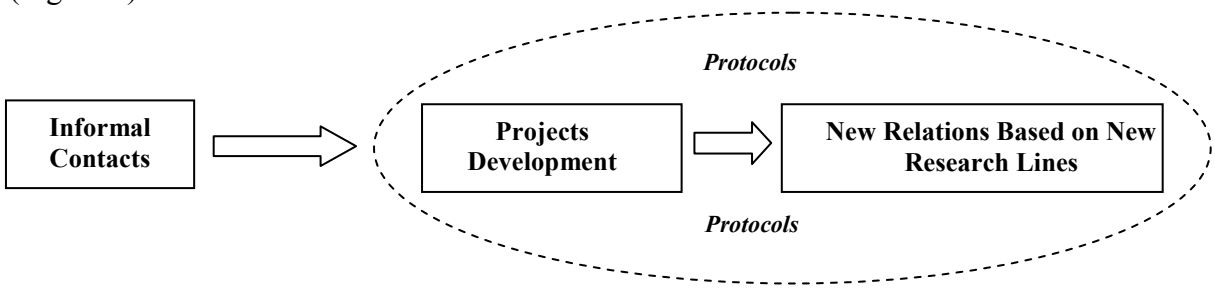

Figure 2: Relationship Model of Brisa/ISEL

Taking advantage of all the potential of the ITS-IBus software, a new partnership between Brisa and ISEL, called Brisa Park, was established in 2003. This new project's goal consisted in expanding the Green Lane concept to parking lots and petrol stations, adapting the existing technological platforms to enable the integration of different systems. It was developed in consortium with Galp and Caixa Geral de Depósitos, creating to this end Brisa Access. The system was, furthermore, internationalized to the Netherlands, and is currently in operation in a Dutch parking lot. That same year, Brisa and ISEL also started worked on connecting GPS and GPRS options to the Green Lane technology, aimed at entering external markets with the standardization of the Green Lane system. Five years into the project, it was concluded that the development of a new technology would be more profitable, given the high costs this project implied, having become, according to Luís Osório, "prohibitive" in terms of costs. Based on new research lines, Brisa and ISEL got involved in another project in 2004, to

develop a license plate recognition system (SRM) enabling the automation and identification of car plate data which is photographed when in violation of the Green Lane, developing also an intelligent vision system (SVI) with the objective of improving the recognition of license plates. Also in that same year, and with the introduction of toll booths on Portuguese motorways in SCUT systems (without user payment), the ISEL developed an automatic collection system in non-canalized roads (SCAVNC), allowing Brisa to acquire skills in this area. In 2005, "Migrar Project" was developed which, after several tests in ISEL parks, was intended to operate based on the ITS-IBus software, developed in 2002. In that same period, the first works on the development of an intelligent vision system were developed, whose aim was to improve automatic license plate recognition, in which Brisa benefited from close collaboration from the ISEL research team.

Another project developed by Brisa in cooperation with ISEL, and other Universities and S&TS organizations, namely the University of Porto, through FEUP and INESC Porto, is the "SMARTE Project" (which took place from 2006 to 2009), aimed at introducing an internal monitoring, prevention and support system in construction works, such as bridges, which through sensors embedded in the concrete enable information to be obtained in real time, with graphs and schemes, where the establishment of safety limits at several levels will generate alarms whenever certain levels are reached.

This system is an advantage in the current construction works management program. It also contributes to the early detection of possible anomalies or critical situations, decreasing the costs associated with travel and inspections and, simultaneously, increasing user and structural safety. It has already been implemented on the Sorraia flyover on the A13 motorway. Still related with this project, we should register the development of new components at FEUP. Also in 2006, two new Brisa/ISEL projects took place. The first, called "WIMO Project", a system which allows micro payments with cell phones in parks using Brisa technology (Brisa Park). This project functions as a payment facilitator, since it reduces the amount of coins kept in parking meters, avoiding the trouble of having to look for coins and does not have network operator costs. The system operates through the use of a computational agent (Java) installed in the cell phone, which, by simply pressing a key, initiates a payment transaction. Agent security is a basic element of this system which only performs if validated by the agent installed in the parking meter or other equipment (POS). The second project – "On Board Unit Interoperability" (OBUI) – is a new type of identifier. Apart from the DSC technology, already incorporated, which ensures communication

between the identifier, in the car, and the 12-meters toll antenna through a 5.8 G link, it enables interoperability with the GPS positioning system. The new technology developed entirely by ISEL offers new services and interoperability between Portugal and countries with automatic toll systems of the Green Lane type.

The automatic license plate recognition system started in 2002 and was implemented in 2007. Once again, cooperation from ISEL was exemplary throughout the whole process, since this system is the result of LPR technology, developed by ISEL researchers, the follow-up to the ITS-IBus Project.

In 2009, two new projects between Brisa and ISEL were expected. In the first, in cooperation with Galp, Brisa will be in charge of providing petrol stations with surveillance cameras (ACV) which according to Luís Osório, "…is a project of high technological complexity". However, he believes the accumulated knowledge from the Brisa/ISEL relationship will help decrease, or at least mitigate, the complexities which characterize the process. A second project (RCP), which also involves the Portuguese transport company "Luís Simões", Brisa and ISEL will work together to recover lost containers. The "SMARTE Project" was also to continue in 2009 (Figure 3).

The portfolio of Brisa's activities is full of innovating projects. In the coming years, very likely still based on partnership with ISEL, Brisa is expected to be involved in the TGV (High Speed Train) support infrastructures in Portugal, together with Soares da Costa (ELOS Project), as well as the construction of the Lisbon airport (CNEL), associated with Caixa Geral de Depósitos and Mota Engil (if these mega public investment projects come to take place).

From the interviews conducted, we understood that innovation is, clearly, a distinctive feature for Brisa, finding in ISEL an effective source of innovation. Relations with ISEL occur with the goal of eliminating, or at least, reducing, the philosophy of low value. The interviewees defended that it is mandatory to see the Universities as a potential source of high increased value, where "honest research" becomes imperative. All players mention that there is full integration between ISEL and Brisa, since ISEL developments are applied to Brisa's reality and there is close collaboration from Brisa in all the research done by ISEL. The company also makes efforts to place employees in ISEL labs, participating jointly in specialty conferences, so that the information and, most importantly, knowledge is completely shared and flows between the organizations.

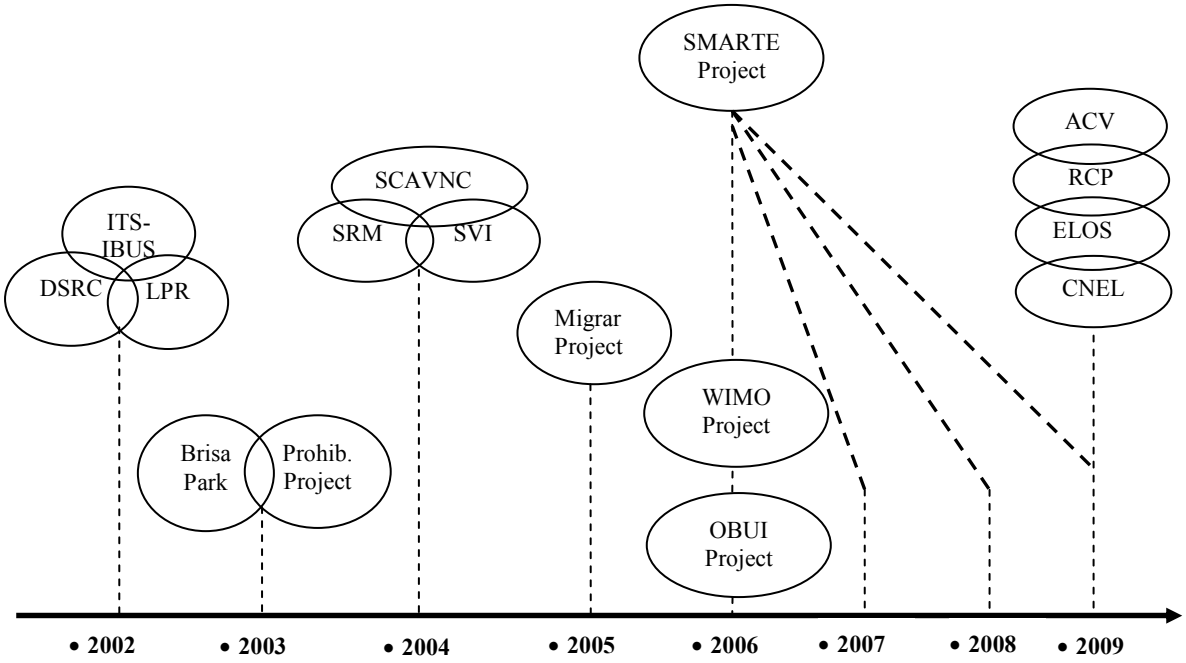

Figure 3: Projects developed within the Brisa/ISEL Partnership

Note: The layout of the various projects is merely conventional. It should be noted that the team of researchers from ISEL (GIATSI) is practically common to all projects.
Source: Compiled by the authors.

It is based on this intense and systematic collaboration from Brisa in relation to ISEL efforts, founded on a high level of (pre)established trust, that the positive evolution of the relationship between Brisa and the ISEL is justified. Other areas, besides the projects, prove the high and increasing involvement between Brisa and Universities, in general and with the ISEL in particular. In fact, we included the dimension of the production and diffusion of codified scientific knowledge, particularly the number of papers/articles presented in co-authorship (Brisa and S&TS entities) at conferences; papers published in co-authorship (Brisa and S&TS entities) in the form of working papers; papers published in co-authorship (Brisa and S&TS entities) in international scientific magazines; support from Brisa, or from its collaborators, in terms of concluding undergraduate degrees or Masters/PhD/Specialization courses in the different S&TS entities.

In terms of papers at conferences (Table A3 in Appendix), Brisa reveals very positive dynamics, with 24 papers, between 2003 and 2007, representing on average 6 articles per year at international conferences in co-authorship with a S&TS entity. We noted that it is with ISEL that Brisa has the largest number of co-authorships in articles presented at conferences, but the range of partnerships at this level with other entities from the S&TS (specifically with the Higher Technical Institute (IST-UTL), the Porto Faculty of Engineering (FEUP-UP), the University of Aveiro and INESC Porto) has been growing systematically over the years.

It is interesting to note that, on the part of Brisa, Sales Gomes and Tomé Canas have been the main speakers, whereas the most frequent speaker from ISEL is Luís Osório. So, U-F relations at this level are relatively confined to a restricted group of people.

Regarding Working Papers (Table A4 in Appendix), we came across a total of 35 papers published between 2004 and 2009 (in relation to this last year, as expected, since it is has just recently ended, the value stated is provisional). In 2004, Brisa was involved in 9 scientific works involving a total of 40 researchers (even though most of them were common to several works). Contrary to articles presented at conferences, when it comes to working papers, the network is wider and ISEL does not present such high hegemony. In fact, in this context, it is the University of Porto, through FEUP (Porto Faculty of Engineering) that appears to be more prolific within Brisa's relations. This network already shows a reasonable internationalization level, which can be seen by the participation of foreign universities such as Girona (Spain), Catalonia (Spain) and São Paulo (Brazil).

In 2005, Brisa's technological projects were studied by 8 researchers from a Brazilian University (São Paulo University – Polytechnic School, EP) and two Spanish Universities (Girona University and Catalonia Technical University – Barcelona), resulting in 2 articles. In 2006, besides the Universities, there was also corporate participation, specifically, "ParaRede", a company operating in the area of information and communication technologies. In 2007, Brisa collaborated with two other Universities that were not considered in the preceding years, the Universities of Coimbra and Aveiro, apart from the expected ISEL. The widening of the network to the corporate sphere intensified in 2008, when two new companies participated, PT Innovation, which cooperated with Brisa and the University of Aveiro and Whatever, (a consultancy company in the area of information technologies) which worked with Brisa and ISEL.

To sum up, in terms of Working Papers, a greater diversity of Brisa relational network is clear, involving both S&TS entities and others. The internationalization aspect is also important, generating knowledge exchange and production at a global scale, promoting expertise not only in scientific terms but also in terms of international corporate competitiveness at a technological level.

Although Brisa is not directly involved in the (co)authorship of articles published in international scientific journals (Table A5), the company directly supported their accomplishment. The renown and high ranking (impact factor) of the journals in which the

articles were published is noteworthy, revealing that the research put forward in the studies is state-of-the-art. Consequently, this indirectly reflects that the technologies associated to Brisa are in fact innovating and important for the research areas at hand, more specifically related to traffic surveillance systems and short-term traffic communications.

Apart from the production of scientific knowledge of international quality, Brisa has played an important role in the training and teaching of future engineers and other professionals in terms of advanced formal education (i.e., at higher education level). In fact, between 2003 and 2007 (last data we had access to), Brisa supported and participated in academic works required to conclude undergraduate and/or Masters degrees (cf. Table A6 in Appendix).

From the data we collected, we found that Brisa supported, in 2003, a student from the University of Minho (UM) (Guimarães campus), in his final-year project to conclude his degree in Polymer Engineering, called "Highway Security Element Analysis – Biker Protection System". Following this cooperation, Brisa turned to the Polymer Engineering Department at the University of Minho so that it could develop new concepts for a biker protection system in plastic material. In 2006, now at the Higher Technical Institute (IST), Brisa actively cooperated once again with 2 final-year projects in the Mechanical Engineering undergraduate degree. In one of the papers, written jointly by two students, Brisa supplied information on the video camera housing system of the ALPR – Advanced License Plate Recognition. This system is used by the company to identify vehicles which are Green Lane users based on license plate imaging, serving also to collect primary misdemeanour evidence, which can be used as proof in court. Brisa actively engaged in this project since it aimed to improve the prototype the company had developed.

In the second project, called "Modal Analysis of Malfunctions and their Effects – Application to a Brisa card reading system", written by two students, Brisa played a crucial role on two different levels: 1) as "supplier" of materials for the good development of the project, having provided access to a card reading system and its test software for the purpose, 2) as a receiver of new information, since the objective of the project was to identify the most important malfunctions in the Brisa system and the components which required intervention so as to decrease the number of those malfunctions, seeing as the system was in operation throughout the concessionaire's motorway network.

In 2007, at the University of Porto's Faculty of Engineering (FEUP) Brisa contributed, once again, to advanced training and the production of significant scientific knowledge, supporting

a student's project to conclude his degree in Information and Computing Engineering. Given the nature of the work - "Development of an Intelligent Business Platform to support Operational Management and Traffic Analysis and the Development of the DATEX2 Gateway" – Brisa tried to transfer knowledge on intelligent business platforms to the support of operational management and traffic analysis.

We can count, therefore, 4 undergraduate projects in which Brisa played an important role (Figure 4), not only as a new scientific knowledge catalyst, but also as a receiver of new and improved techniques which contribute to its constant technological evolution.

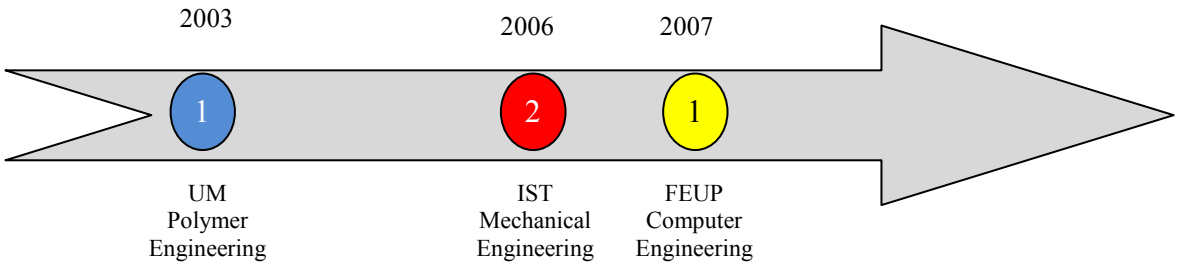

Figure 4: Important periods related to the participation of Brisa in undergraduate projects

In relation to Masters programs, Brisa was involved in 4 dissertation projects in the last few years, both with national and international Universities. The first Master dissertation project in which it was involved was in 2003, in which Brisa was indispensable in the information supplied (quantitative and qualitative) to a student at the London School of Economics and Political Science (LSE). This study was centred on the relational analysis that Brisa establishes with the Scientific and Technological System (S&TS), namely at the level of the construction of infrastructures. In 2006, Brisa contributed to the academic works of a student at the Lusíada University (UL), whose dissertation focused on knowledge management and the Brisa innovation process. At the Lisbon Sciences and Technology Faculty (FCT), in 2007 (see Figure 5), a Brisa employee at the time, studied and applied multidimensional separation (MDSoC) of concerns to the company to understand the composition of Brisa's software, having provided all of the information material necessary, while also benefiting from the results, which were tested and validated within the organization. Finally, also in 2007, but at the Higher Technical Institute (IST), Brisa was indispensable in the dissertation work of one of its employee who, using Brisa as a practical case and all the information background provided by the company, proposed an operational methodology for the network development of Brisa's innovating products and technologies.

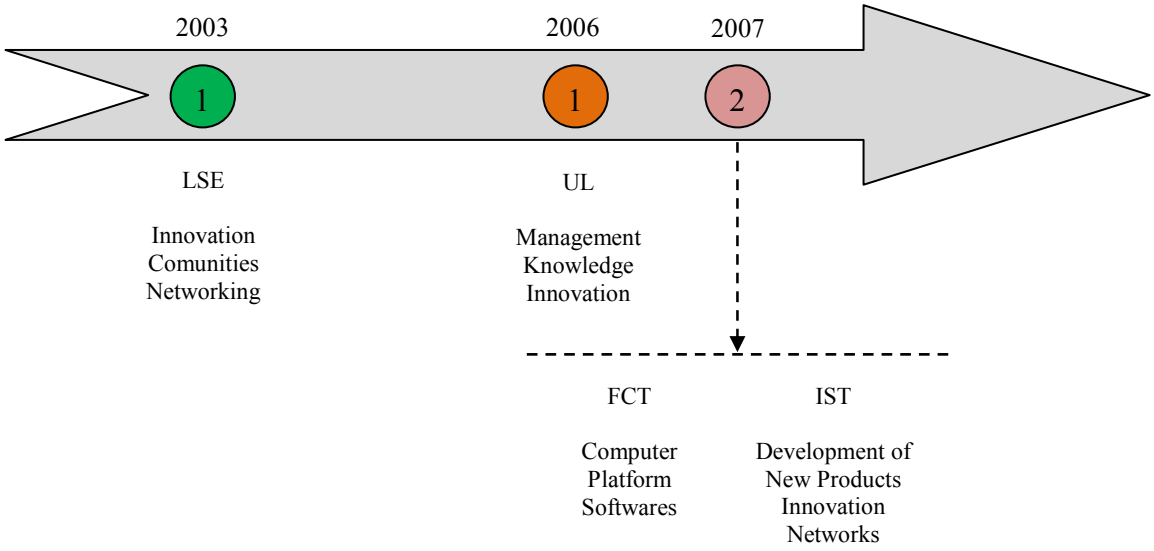

Figure 5: Important periods related to the participation of Brisa in Masters Projects

The information provided by the company and the scientific knowledge it generates, extensively recorded throughout this section, prove Brisa's importance in the Portuguese Scientific and Technological System, as well as the reuse and relevance which the knowledge produced and generated in cooperation has for the efficient pursuit of the company's competitive strategy. It is precisely to detailing these mutual benefits that the next section is dedicated.

3.4. Mutual benefit as a decisive factor for the sustainability of U-F relations

From our field work, we found that the Brisa/ISEL relations accrue, since their emergence, benefits to both parties, which explains, to a large extent, the sustainability of the links between both organizations. Segmenting the mutual benefits into five distinct categories: economic benefits; technological /innovation; scientific knowledge production and transfer; education; and marketing, we concluded that there are common benefits for both organizations and other benefits which are directed to each one in particular.

The mutual benefits listed in Table 2 result from the systematization of the information obtained in the interviews we conducted with key-actors in Brisa (Sales Gomes; Tomé Canas) and in ISEL (Luís Osório).

With regard to the Economic Benefits, we registered three, common to Brisa and ISEL. Concerning the first – *Favourable Financial Return* – and, in Brisa's particular case, the company has had, throughout the years in analysis, average rates of estimated annual growth of approximately 8%. It also registered, in 2008, profits of 770 million Euros, values which

surpassed previous years (e.g., in 2005 the profits were 328 million Euros). These values result, to a large extent, from Brisa's constant technological success which, cannot be furthermore separated from the open innovation policy associated to projects the company has with ISEL, whose results, as demonstrated before, have generated growing and superior innovation. For ISEL, the financial return comes from the funding provided by Brisa in each agreement established. Information we obtained indicates that cooperation with Brisa in R&D has granted ISEL more than 1 million Euros, since 2002.

Table 2: Mutual benefits from Brisa-ISEL relations

Type of Benefits	BRISA	ISEL
Economic	**Favourable Financial Return**	
	Growth in International Dynamism	
	Competitive Appreciation and Positioning	
Technological / Innovation	Cost Reduction	
	Technological Development Time Reduction	
	Technological System Quality	
	Technological Independence Regarding Technology Suppliers	
Scientific Knowledge Production and Transfer	**Increased Flow of Knowledge**	
		Scientific Article Diffusion
		Research Team Motivation
		Future Research Possibilities for the Research Team
Education		Improvement in Education Quality
Marketing	**Increase in Renown/Recognition**	
	Reputation/Brand Reinforcement	
	Word-of-Mouth	

Source: Compiled by the authors based on the interviews conducted in Brisa (April 2009); the bold sets out the mutual benefits.

A second benefit – *Growth in International Dynamism* – favours equally both organizations. Brisa's evolution in international markets (e.g., Holland, Czech Republic; Tunisia[7]), largely associated to the Green Lane system and to the OBUI system, both developed by ISEL, are examples of the strong presence and dynamism of the company abroad. In the case of ISEL, the growth in international dynamism can be seen in the number of papers/articles presented at international scientific conferences, as is the case of *BASYS´04* (which took place in Austria), and *PRO-VE´06* (which took place in Finland). The same dynamism has been felt in the possibility of ISEL establishing contacts with international Universities, to reinforce its

[7] In the Tunisian market the company will turn to Green Lane technology licensing.

networking. From what we found, ISEL has maintained good relations with Universities in Brazil and Holland (more specifically, Amsterdam), increasing, therefore, the diffusion of synergies (e.g., new future conferences). A last economic benefit is "*Competitive Appreciation and Positioning*" which occurs in/for both organizations. Brisa's technological vanguard, provided by projects in partnership with ISEL, give it broad competitive dynamics, enabled by its position as the backbone of the Portuguese national transport system, as well as being involved with future mega projects such as the building of the new Lisbon airport and the TGV (High Speed Train). As for ISEL, the position of this engineering school is strengthened by the competition that is already felt, namely with consultancy companies, which compete for a prominent position (partnership) in Brisa, and with the Lisbon Higher Technical Institute, the main "competitor" in the research "marathons". The relationship with Brisa allows ISEL to obtain a powerful background in its core (engineering) research activities, making this school a "heavyweight" in the partnerships established at the level of transport infrastructures.

With regard to the Technological/Innovation benefits, we found four different benefits for Brisa, deriving from its relations with ISEL. With the creation of the IDD within Brisa, (i) *cost reduction* and (ii) *achievement of quality technologies* were important pillars to be reached, and that was effectively seen in the links established with ISEL. Thus, such relations constituted important cost reducers at the level of technology development, since the values presented by ISEL were very low, when compared to those proposed by other equipment suppliers. As an example, the ITS-IBus Project presented a cost lower in 1/3 in comparison to quotes presented by alternative proposals. As a follow up, Brisa also benefited from significant (iii) *technological development time reduction* with ISEL. For instance, the ITS-IBus Project case, given it urgency, had an estimated development period of 3 years, which, according to our primary sources, seems to be a very satisfactory period. Along with these aspects, it is important to highlight the quality of the technological system supplied to Brisa, based on ISEL's value proposals (e.g., ITS-IBus; Automatic License Plate Recognition; SMARTE Project; Road Malfunction System). In fact, ISEL's excellent research labs and the constant technological advancements presented in the main Portuguese highways is a reflection of the quality which is developed in ISEL labs and supplied to Brisa in the form of innovation. All these remarkable efforts give Brisa one of the most significant advantages arising from its relations with ISEL, i.e., (iv) *technological independence regarding*

technology suppliers, namely Q-Free, which gave it (v) a *new alignment for its business strategies* (e.g., ITS-IBus leads to Brisa Park).

In relation to Scientific Knowledge Production and Transfer, we concluded that both organizations benefit from the *increased flow of knowledge*. For Brisa, and since there is close monitoring from all the company collaborators in the work developed by ISEL, there is strong knowledge mobility to the company.

From ISEL's perspective, the scenario is identical, that is, the research efforts permit a considerable increase in scientific knowledge for ISEL, providing simultaneously (i) *improvement in education quality* (another benefit we discovered, named *Education*) (ii) *scientific article diffusion*, which results from the knowledge acquired, and (iii) *future research possibilities for the research team,* given the trust established and the proven successful results, which will undoubtedly increase, and (iv) *motivation of ISEL researchers to pursue new research lines with Brisa*, since it is a reference company, both at a national and international level.

Lastly, the ISEL/Brisa relationship generates common benefits at a Marketing level. Thus, a first benefit is (i) *the increase in renown/recognition* both organizations obtain, which also allows (ii) *reputation/brand reinforcement*. For Brisa, these benefits are obtained based on solutions the company has offered society in general. Note, for example, the Green Lane system and the WIMO Project, which led to the increased use and flexibility in the payment system. Also, Brisa's collaboration in scientific articles, many of them presented at international conferences, give it greater brand reinforcement. As for ISEL, the institution's renown and brand have been strengthened based on recognition from the scientific community for having become a credible partner at the business level (namely, in the development of quality technological support) and for contributing to scientific knowledge in the area (derived from the scientific papers and constant participation in specialty conferences). *Word-of-mouth* is also a benefit shared by both organizations. Brisa, as a reference at the technological level, based on its Green Lane system, provides it with excellent references and business opportunities, such as the Green Lane technology licensing to Tunisia. ISEL, having become a reference at a national level as a credible and quality technological partner (reflected in Brisa's constant and renewed trust in cooperation in new projects), benefits from systematic references at a business level.

In conclusion, we can highlight that the relationship established with ISEL contributes to the improvement and sustainability of Brisa's innovation policy, benefiting from significant reductions in cost structure levels (at the technological development level) and the acquisition of quality technology. All these results are only possible based on a strategic architecture supported by relations with the exterior, involving Universities and other partners (e.g., suppliers) combining basic and applied research. Thus, Brisa does in fact constitute a paradigmatic case of the Open Innovation Model.

4. Conclusion

Factors such as sudden changes in the needs, desires and taste of consumers (Goffin and Mitchell, 2005), rapid technological developments (Chesbrough, 2003; 2004; Gann, 2004; Smith, 2004; Hemphill, 2005; Blau, 2007), and intense competitive pressure (Goffin and Mitchell, 2005), demand new ways in which to manage innovation, thus explaining the rise of the open innovation model in this context.

Open Innovation is an important if still emerging research area (Pinheiro and Teixeira, 2009; Teixeira and Silva, 2010). The issue of University-Firm relations (U-F), one of the key components of the Open Innovation model, is analyzed in the literature in a relatively superficial manner, disregarding, or not mentioning in the most appropriate way, the mechanisms by which the companies may take competitive advantage (via innovation) by exploring a more open innovation model based on relations with Universities (Pinheiro and Teixeira, 2009). Furthermore, the existing studies on U-F relations do not emphasize, at least explicitly, the issue of the open innovation model, since they are still very much centred on a unidirectional profit perspective, that is, focusing excessively on the advantages that companies may obtain from relations with Universities, failing to capture and analyze the benefits that could accrue to Universities from such relations (Pinheiro and Teixeira, 2009). In fact, Pinheiro and Teixeira (2009) conclude that, empirically, there is very little detailed evidence on the establishment, evolution and sustainability of U-F relations and the means/mechanisms by which companies and Universities obtain advantage in such relations. Consequently, this study aims to explain the establishment, evolution and sustainability of U-F relations in an open innovation context, aspects neglected by the current empirical literature.

Based on a case-study methodology, using Brisa for the effect, a Portuguese company operating in the transport infrastructure sector which reveals, in the Portuguese context, a remarkable index of openness and for which relations with Universities are a major asset in

the management of its innovation activities, we specifically detailed how the relations with ISEL emerged, how they survived through time and which mutual benefits have derived from there.

Relying on primary information sources, namely personal interviews with key people in Brisa and ISEL, which were complemented with secondary information sources (e.g., Brisa's reports and accounts, sectoral/specialized information), we concluded that the establishment of relations between these two entities is a complex process, which requires time and resources from both parties, apart from the relational investment. Brisa's link with ISEL appeared, in a first phase, from informal contacts, based on friendship ties between some of the key-actors. Such relations developed to increased formality and complexity sustaining new projects and research lines, always levered on the trust established between the people intervening from both organizations and the mutual benefit that derived from there. We found that both organizations take advantage of the benefits, part of which are common, namely at the level of increased knowledge flow, increase in renown, brand reinforcement, increase in international dynamism, word-of-mouth, favourable financial return and rise in competitive positioning. We concluded that, on the one hand, ISEL benefits additionally from the higher levels of education quality, increasing the production and diffusion of scientific publications of high impact factor, greater motivation from the research team and the possibility for these researchers to continue future research in a business environment (making, therefore, technology transfer more efficient and effective). On the other hand, Brisa benefits additionally (to the common benefits) from cost structure reduction, technology development time reduction, better quality in terms of technological systems and greater independence regarding suppliers. We concluded that it is based on the existence of mutual benefits that U-F relations are sustained and endure in the long term.

The results systematized above, apart from reinforcing what the literature on University-Firm relations has shown, i.e., the advantages which the companies obtain from being more "open" in terms of innovation, namely the benefits they achieve from connections to the Scientific and Technological System, also accrue advantages to Universities from their links to companies. Thus, the current study contributes to the scientific literature in the area by empirically sustaining a group of benefits disregarded by the majority of the studies on the matter. Additionally, the current work sheds light on the issue of the establishment and evolution of University-Firm relations, contributing to overcoming the idea that these relations emerge like "manna from heaven" almost without any effort and as if by "decree". Our study emphasizes

the need for strong investment (in terms of time and financial and human resources) in "sustaining" these relations as well as the potential they have in economic, technological and marketing terms, both for the entities directly involved, and for other entities within the S&TS, or even in business terms, due to the knowledge spillovers resulting from those same relations.

References

Belussin, F., Sammarra, A. and Sedita, S. (2008), "Managing Long Distance and Localized Learning in the Emilia Romagna Life Science Cluester", *European Planning Studies* 16(5).

Blau, J. (2007), "Philips Tears Down Eindhoven R&D Fence", *Research and Technology Management* 50(6): 9-10.

Brisa (2008), Relatório e Contas 2007.

Brisa (2009), Relatório e Contas 2008.

Carson, D., Gilmore, A., Perry, C. and Gronhaug, K. (2001), *Qualitative Marketing Research*, Londres: Sage Publications.

Chapple, W., Lockett, D., Siegel, S. and Wright, M. (2005), "Assessing the relative performance of U.K. University technology transfer offices: parametric and non-parametric evidence". *Research Policy* 34(3): 369–384.

Chesbrough, H. (2003), "The Era of Open Innovation", *MIT Sloan Management Review* 44 (3): 35-41.

Chesbrough, H. (2004), "Managing Open Innovation", *Industrial Research Institute* 47: 23-26.

Chesbrough, H. and Crowther, A. (2005), "Beyond high tech: Early adopters of open innovation in other industries". *R&D Management* 36: 229–236.

Chesbrough, H. and Schwartz K. (2007), "Innovating Business Models with Co-development Partnerships", *Industrial Research Institute* 50: 55-59.

Chiaroni, D., Vottorio C. and Frattini, F. (2008), "Research Section: Patterns of Collaborationn along the bio-pharmaceutical innovation process", *Journal of Business Chemistry* 5(1): 7-22.

Ciborra, U. (2000), *The labyrinths of information: Challenging the wisdom of systems,* Oxford University Press, New York.

Clarysse, B., Wright, M., Lockett, A., Mustar, P. and Knockaert, M. (2007), "Academic spin-offs, formal technology transfer and capital raising". *Industrial and Corporate Change* 16(4): 609–640.

Collins, L. (2006), "Opening up the innovation process". *Engineering Management*, 14-17.

Enkel, E., Kausch, C. and Gassmann, O. (2005), "Managing the risk of customer integration". *European Management Journal* 23(2): 203–213.

Gann, D. (2004), "Book review – Open Innovation: The New Imperative for Creating and Profiting from Technology", *Research Policy* 10(1): 122-123.

Geenwood, E. (1965), "Métodos de investigação empírica em Sociologia". *Análise Social*: 11.

Goffin, K. and Mitchell, R. (2005), *Innovation Management – Strategy and Implementation Using the Pentathlon Framework*, Palgrave Macmillan.

Gummesson, E. (2000), *Qualitative Methods in Management Research*, London, Sage Publications.

Harwing, R. (2004), "Open Innovation", *Philips Research Password* 19: 1-13.

Hemphill, T. (2005), "Book review – Open innovation: The New Imperative for Creating and Profiting from Technology", *Academy of Management Executive* 19: 164- 165.

Lichtenthaler, U. (2008), "Open Innovation in Practice: An Analysis of Strategic Approaches to Technology Transactions", *Transactions on Engineering Management* 55(1): 148-157.

Link, A., Rothaermel, F. and Siegel, D. (2008), "University Technology Transfer: An Introduction to the Special Issue". *Transactions on Engineering Management* 55(1): 5–8.

Lopes, M. and Teixeira, A.A.C. (2009), "Open Innovation in Firms Located in an Intermediate Technology Developed Country". *FEP Working Paper* n.º 314, Março.

Parhankangas, A., Holmlund, P. and Kuusisto, T. (2003), "Managing Non-Core Technologies Experiences from Finnish, Swedish and US Corporations", *Technology Review* 149: 1-81.

Perkmann, M. and Walsh, K. (2007), "University–industry relationships and open innovation: Towards a research agenda". *International Journal of Management Reviews* 9(4): 259–280.

Piller, F. and Walcher, D. (2006), "Tooklits for ideia competitions: a novel method to integrate useres in the new product development", *R&D Management* 36(3): 307-318.

Pinheiro, L. and Teixeira, A.A.C. (2009), "Bridging University-Firm relationships and Open Innovation literature: a critical synthesis", *FEP Working Paper* n. º 346*,* Faculdade de Economia, Universidade do Porto.

Rothaermel, F. and Ku, D. (2008), "Intercluster Innovation Differentials: The Role of Research Universities". *Transactions on Engineering Management Review* 55(1): 9-22.

Rothaermel, F., Jiang, L. and Agung, S. (2007), "University entrepreneurship: a taxonomy of the literature". *Industrial and Corporate Change* 16(4): 691–791.

Sheehan, J., Martinez, C. and Guellec, D. (2004), "Chapter 4 - Understanding Business Patenting and Licensing Results of a Survey", *OECD Conference Proceedings*.

Silva, J. and Teixeira, A.A.C. (2010), "Identifying the intellectual scientific basis of the Economics and Management of Innovation Management area", *FEP Working Papers* nº 355, January 2010.

Smith, P. (2004), "Book review- Open innovation: The Open Innovation: The New Imperative for Creating and Profiting from Technology", *Journal of Product Innovation Management* 21: 221-224.

Teixeira, A.A.C. and Costa, J. (2006), "What type of firm forges closer innovation linkages with Portuguese Universities?", *Notas Económicas* Vol. 24, Dezembro 2006, pp. 22-47.

Teixeira, A.A.C. and Silva, J. (2010), "Emergent and declining themes in the Economics and Management of Innovation scientific area over the past three decades", *FEP Working Papers* nº 354, January 2010.

Van der Meer, H. (2007), "Open Innovation- The Dutch Treat: Challenges in Thinking in Business Models", *Creativity and Innovation Management* 16(2): 192-202.

Yin, R.K. (ed.) (2004), *The Case Study Anthology*. California, USA: Sage.

Yin, R.K. (2009) *Case Study Research: Design and Methods*. Fourth Edition. California, USA: Sage.

Appendix

Complexity of Contact Type (- → +)

Universities and R&D Institutes	Contact type: Informal contacts			Seminars			Training			Consulting			Agreements			Total contacts by University		
	Brisa (1)	Average Sample (2)	(1)/(2)	Brisa (1)	Average Sample (2)	(1)/(2)	Brisa (1)	Average Sample (2)	(1)/(2)	Brisa (1)	Average Sample (2)	(1)/(2)	Brisa (1)	Average Sample (2)	(1)/(2)	Brisa (1)	Average Sample (2)	(1)/(2)
Univ. Algarve	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Univ. Aveiro	0	1	0	**4**	**0**	**19**	0	0	0	0	0	0	**4**	**1**	**7**	**8**	**1**	**6**
Univ. Beira Int.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Univ. Cat. Porto	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0
Univ. Cat. Lisboa	**1**	**0**	**2**	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Univ. Coimbra	0	0	0	**5**	**0**	**35**	0	0	0	0	0	0	**2**	**0.5**	**4**	**7**	**1**	**9**
Univ. Évora	0	0.5	0	0	0.3	0	0	0.03	0	0	0	0	0	0	0	0	1	0
Univ. Minho	0	2	0	1	0	3	0	0	0	0	0	0	1	1	1	2	3	1
Univ. Nova Lisboa	0	2	0	0	0	0	0	0	0	0	0	0	1	0	2	1	3	0
Univ. Porto	0	2	0	2	1	4	0	0	0	0	0	0	1	1	1	3	4	1
Univ.Técn. Lisboa	0	2	0	3	1	6	**1**	**0**	**4**	0	0	0	1	1	1	5	3	1
ISCTE	0	0	0	0	0	0	0	0	0	0	*0*	0	**1**	**0**	**14**	1	1	2
ISEL-IPL	**3**	**1**	**4**	**7**	**0**	**49**	0	0	0	0	0	0	**5**	**0**	**10**	**15**	**2**	**9**
Univ. Texas Austin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Univ. Carnegie Mellon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MIT	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	**24**	**1**	**0**	**9**
Other foreign Univ.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R&D Institutes	0	2	0	2	1	4	0	0	0	0	0	0	1	1	2	3	3	1
Total Contacts Portuguese Univ.	**4**	**10**	**0.4**	**22**	**2**	**11**	**1**	**3**	**0.3**	**0**	**1**	**0**	**14**	**5**	**3**	**43**	**23**	**2**
Total Contacts Foreign Univ.	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**12**	**1**	**0**	**3**
Number of different Organiz.	**2**	**1**	**1**	**6**	**1**	**6**	**1**	**0.6**	**1.7**	**0**	**0.3**	**0**	**8**	**2**	**4**	**11**	**3**	**4**
Openness compared to the S&TS	**BRISA**									**COMPANIES SAMPLE**								
	61%									**17%**								

Note: the figures for the sample mean and the ratio (1) / (2) are rounded; *Source*: Data provided by Mariana Lopes and Aurora Teixeira resulting from fieldwork on Open Innovation.

Table A1: Brisa's relations with the Scientific and Technological System (S&TS) by Type of Contacts

Table A2: Historical overview of BRISA - Auto-Estradas de Portugal, S.A

Year	Relevant Events

1972	• Creation of Brisa - Auto-Estradas de Portugal, S.A;
	• 1st Concession Contract: construction of 390 km until the end of 1981, including the following motorways:
	  - Lisbon/Porto (A1);
	  - Fogueteiro – Setúbal (A2);
	  - Estádio Nacional – Cascais (A5);
	  - Porto – Famalicão (A3).

1975	• Overcoming a lack of technical road workers, with the hiring of technicians from Angola and Mozambique, however returning to Portugal; • Establishment of the new model of tender documents, governing relations with contractors and suppliers.
Early 80	• Extension of the motorways in operation: 104 km;
1987	• The Aveiro / Aveiro (South) / Albergaria subsections comprise the first large stretch of motorways in Portugal: 115 km; • The network of highways in operation by Brisa reaches 196 km.
1988	• Year of study and planning of works to be launched in the future.
1991	• Completion of A1, a moment in Brisa's affirmation (contract with a completion scheduled for 1994); • **Implementation of "Via Verde" in an open system (single price), in the main toll access to Lisbon**; • Given its capacity to achieve Brisa is awarded a new concession of 229 km of motorways.
1994	• **Tool Innovation Award, awarded to Brisa by the International Bridge Tunnel and Turnpike Association, recognizing the reliability the "Via Verde" toll system**.
1995	• **New "Via Verde" tolling model – a closed system (detail of payments according to the routes travelled)**.
1997	• 1st phase of privatization, with dispersion, in exchange, 35% of capital;
1998	• 2nd phase of privatization, with dispersion, in exchange, 31% of capital;
1999	• 3rd phase of privatization, with dispersion, in exchange, 20% of capital.
2000	• Creation of "Via Verde Portugal" (75% - Brisa and 25% - SIBS); • Creation of "Brisatel", Telecommunications (100% Brisa); • The Mello Group enters Brisa's Board of Directors; • **Creation of the Innovation and Development Department (IDD) - Sales Gomes (BEng.) takes over as Brisa's manager of innovation**; • **Start of a close relationship with the Science and Technology System in general and with the Universities in particular, especially with the ISEL**.
2001	• Acquisition of 20% of the Road Concession Company (CCR), the largest concession of highways in Brazil, with a granted network of 1 276 km.
2002	• Opening of the last three subsections of the A2, completing the Lisbon - Algarve connection. Works that marked the completion of a continuous network of 1 000 km of motorways in Portugal, with two main links to Spain and Europe; • **Development of the "ITS-IBus Project"**; • **Development of a system of automatic recognition of license plates.**
2003	• Reintroduced a toll on the A9 (CREL), returning to its original operation; • **Established the "Brisa Park" project, which aimed to extend the concept of "Via Verde" to parking lots and petrol stations;** • **Innovation in the "Via Verde" system (GPS + GPRS), developed by ISEL.**
2004	• Completion of the A13 - Almeirim / Marateca Highway; • Adjudication of contract for design and construction of the Tagus Crossing at Carregado, the A10 - Bucelas/Carregado/IC3 Motorway; • **Development of an automated billing system in non-channelled roads**; • **Joined the " Migrar Project"**.

(...)

Year	Relevant Events
2005	• Completion of its acquisition of 10% of the Motorways of the Atlantic (AEA); • Acquisition of Tyco Portugal, a project management company and ITEUVE, company car inspections; • Opened 7km on the A10 Highway Bucelas / Carregado / IC3; • Completion of works to extend the Carcavelos / Alcabideche subsection, on the A5 Estoril Coast highway; • First works on the Estoril node on the A5 - Estoril Coast motorway; • First works on the Cartaxo node on the A1 - North Highway; • **Implementation of "ITS-IBus Project" – "Migrar Project"**; • **Development of an intelligent vision system**.
2006	• **Investment of 6.8 million Euros in innovation and participation of Brisa in the "MIT Portugal" project;** • Completed the expansion works of the Feira / IC 24 (A1) and Fogueteiro / Coina (A2) sections, a total of 18 km; • **Joined the " SMART Project"**.
2007	• Inauguration of the Lezíria Bridge, the new crossing of the Tagus River at Carregado; • 2 Million "Via Verde" Customers; • **Advances in the company's internationalization to the United States of America and the Netherlands**; • **Implementation of the system of automatic recognition of license plates**.
2008	• Strengthening of social responsibility based on the campaign "Pégada Ecológica" and in the "CADIn" program; • Joined the second edition of the "Colombo Project" and renewal of the site, with innovations in terms of institutional content; • Innovation on the A5 motorway; • Investment in Highways estimated at 206,9 million Euros, in the Environment 15,5 million Euros, in innovation 5,2 million Euros and in the local communities 1,4 million Euros, in addition to 46,720 hours of training.
2009	• **Continuity of "SMARTE Project" – introduction of an internal system of monitoring works and new lines of research with the ISEL**.

Note: the "bold" set major milestones in terms of innovation and relationship with the Scientific and Technological System.
Source: Compiled by the authors based on the company's website (2009).

Table A3: Papers presented at conferences by Brisa and others entities of the S&TS

Year	Conference (country)	Co-author Entity	Number of articles
2003	PRO-VE (Switzerland)	ISEL (UL)	3
	ASECAP (Slovenia)	ISEL (UL)	1
	Total		**4**
2004	BASYS (Austria)	ISEL (UL)	1
	ICIAR (Portugal)	IST (UTL)	1
	ACIVS (Belgium)	IST (UTL)	1
	ANET (Portugal)	ISEL (UL)	1
	BASYS (Switzerland)	ISEL (UL)	1
	Total		**5**
2005	JAVAONE (USA)	ISEL (UL)	2
	PRO-VE (Spain)	ISEL (UL)	2
	FIB (Hungary)	FEUP (UP)	1
	Total		**5**
2006	EPUSP (Brazil)	FEUP (UP); INESC	1
	APMC (Japan)	U.Aveiro	1
	ASECAP (Slovenia)	ISEL (UL)	1
	BASYS (Switzerland)	ISEL (UL)	1
	PRO-VE (Finland)	ISEL (UL)	1
	Total		**5**
2007	ITS (USA)	ISEL (UL)	3
	VTC (Ireland)	U.Aveiro	1
	PRO-VE (Portugal)	ISEL (UL)	1
	Total		**5**
Total			**24**

Source: Compiled by the authors based on data supplied by Brisa (2009).

Table A4: Working Papers published in co-authorship between Brisa, other entities in the S&TS and business entities

Year	Universities	Number of co-authors from different organizations, excluding the Brisa	Number of articles
2004	FEUP (UP); U.Girona	10	2
	FEUP (UP)	8	3
	FEUP (UP); IST (UTL); ISEP	6	1
	INESC Porto; FEUP (UP); ISEP	6	1
	FEUP (UP); INEGI	6	1
	FEUP (UP); EP(USP)	4	1
	Total	**40**	**9**
2005	FEUP (UP); EP (USP)	5	1
	FEUP (UP); U.Catalonia; U.Girona	3	1
	Total	**8**	**2**
2006	ISEL (UL)	6	2
	ISEL (UL); ParaRede	6	1
	FEUP (UP); U.Catalonia; U.Girona	6	2
	FEUP (UP); EP (USP)	3	1
	FEUP (UP); INESC Porto	3	1
	FEUP (UP)	2	1
	Total	**26**	**8**
2007	U.Coimbra	12	3
	ISEL (UL)	8	3
	U.Aveiro	2	1
	Total	**22**	**7**
2008	U.Coimbra	12	3
	ISEL (UL)	6	2
	U.Aveiro; PT Inovação	6	1
	U.Aveiro	2	1
	ISEL (UL); *Whatever*	2	1
	Total	**28**	**8**
2009	U.Coimbra	4	1
	Total	**4**	**1**
Total		**128**	**35**

Source: Compiled by the authors based on data supplied by Brisa (2009).

Table A5: Articles published in international scientific journals who received direct support from Brisa

Year	Universities	Number of co-authors from different organizations	Journal (Editor)	Number of articles
2005	FEUP (UP); U.Catalonia	3	*Structure and Infrastructure Engineering* (*Taylors and Francis*; Impact Factor: 1.191)	1
	Total	**3**		**1**
2006	IST (UTL)	4	IEEE - *Transactions on Intelligent Transport Systems* (IEEE *Intelligent Transportation Systems Society*; Impact Factor: 0.139)	1
	IST (UTL); CENTIMFE	4	RPD – *Rapid Product Development*	2
	Total	**8**		**3**
2008	IST (UTL); CENTIMFE	2	RPD – *Rapid Product Development*	1
	IST (UTL)	1	RPD – *Rapid Product Development*	1
	Total	**3**		**2**
Total		**14**		**6**

Source: Compiled by the authors based on data supplied by Brisa (2009).

Table A6: Undergraduate and Postgraduate works with assistance from Brisa

Year	University	Type of program			Total
		Undergraduate	***Master***	***PhD***	
2003	University of Minho	**1**	0	0	**1**
	London School of Economics and Political Science	0	**1**	0	**1**
2006	ISEL-IPL	**2**	0	0	**2**
	Lusíada University	0	**1**	0	**1**
2007	ISEL-IPL	0	**2**	0	**2**
	University of Porto	**1**	0	0	**1**
	Total	**4**	**4**	0	**8**

Source: Compiled by the authors based on data supplied by Brisa (2009).

Recent FEP Working Papers

Nº 365	Miguel Fonseca, António Mendonça and José Passos, "*Home Country Trade Effects of Outward FDI: an analysis of the Portuguese case, 1996-2007*", March 2010
Nº 364	Armando Silva, Ana Paula Africano and Óscar Afonso, "*Learning-by-exporting: what we know and what we would like to know*", March 2010
Nº 363	Pedro Cosme da Costa Vieira, "*O problema do crescente endividamento de Portugal à luz da New Macroeconomics*", February 2010
Nº 362	Argentino Pessoa, "*Reviewing PPP Performance in Developing Economies*", February 2010
Nº 361	Ana Paula Africano, Aurora A.C. Teixeira and André Caiado, "*The usefulness of State trade missions for the internationalization of firms: an econometric analysis*", February 2010
Nº 360	Beatriz Casais and João F. Proença, "*Inhibitions and implications associated with celebrity participation in social marketing programs focusing on HIV prevention: an exploratory research*", February 2010
Nº 359	Ana Maria Bandeira, "*Valorização de activos intangíveis resultantes de actividades de I&D*", February 2010
Nº 358	Maria Antónia Rodrigues and João F. Proença, "*SST and the Consumer Behaviour in Portuguese Financial Services*", January 2010
Nº 357	Carlos Brito and Ricardo Correia, "*Regions as Networks: Towards a Conceptual Framework of Territorial Dynamics*", January 2010
Nº 356	Pedro Rui Mazeda Gil, Paulo Brito and Óscar Afonso, "*Growth and Firm Dynamics with Horizontal and Vertical R&D*", January 2010
Nº 355	Aurora A.C. Teixeira and José Miguel Silva, "*Emergent and declining themes in the Economics and Management of Innovation scientific area over the past three decades*", January 2010
Nº 354	José Miguel Silva and Aurora A.C. Teixeira, "*Identifying the intellectual scientific basis of the Economics and Management of Innovation Management area*", January 2010
Nº 353	Paulo Guimarães, Octávio Figueiredo and Douglas Woodward, "*Accounting for Neighboring Effects in Measures of Spatial Concentration*", December 2009
Nº 352	Vasco Leite, Sofia B.S.D. Castro and João Correia-da-Silva, "*A third sector in the core-periphery model: non-tradable goods*", December 2009
Nº 351	João Correia-da-Silva and Joana Pinho, "*Costly horizontal differentiation*", December 2009
Nº 350	João Correia-da-Silva and Joana Resende, "*Free daily newspapers: too many incentives to print?*", December 2009
Nº 349	Ricardo Correia and Carlos Brito, "*Análise Conjunta da Dinâmica Territorial e Industrial: O Caso da IKEA – Swedwood*", December 2009
Nº 348	Gonçalo Faria, João Correia-da-Silva and Cláudia Ribeiro, "*Dynamic Consumption and Portfolio Choice with Ambiguity about Stochastic Volatility*", December 2009
Nº 347	André Caiado, Ana Paula Africano and Aurora A.C. Teixeira, "*Firms' perceptions on the usefulness of State trade missions: an exploratory micro level empirical analysis*", December 2009
Nº 346	Luís Pinheiro and Aurora A.C. Teixeira, "*Bridging University-Firm relationships and Open Innovation literature: a critical synthesis*", November 2009
Nº 345	Cláudia Carvalho, Carlos Brito and José Sarsfield Cabral, "*Assessing the Quality of Public Services: A Conceptual Model*", November 2009
Nº 344	Margarida Catarino and Aurora A.C. Teixeira, "*International R&D cooperation: the perceptions of SMEs and Intermediaries*", November 2009
Nº 343	Nuno Torres, Óscar Afonso and Isabel Soares, "*Geographic oil concentration and economic growth – a panel data analysis*", November 2009
Nº 342	Catarina Roseira and Carlos Brito, "*Value Co-Creation with Suppliers*", November 2009
Nº 341	José Fernando Gonçalves and Paulo S. A. Sousa, "*A Genetic Algorithm for Lot Size and Scheduling under Capacity Constraints and Allowing Backorders*", November 2009
Nº 340	Nuno Gonçalves and Ana Paula Africano, "*The Immigration and Trade Link in the*

	European Union Integration Process", November 2009
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Nº 330	Filipe A. Ribeiro, Ana N. Veloso and Artur V. Vieira, "*Empreendedorismo Social: Uma análise via associativismo juvenil"*, August 2009
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