

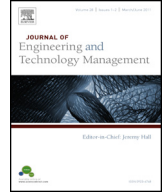


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University–industry cooperation: Researchers’ motivations and interaction channels

Mário Franco ^{a,*}, Heiko Haase ^{b,1}

^aUniversity of Beira Interior, Management and Economics Department, CEFAGE-UBI Research Center, Estrada do Sineiro, 6200-209 Covilhã, Portugal

^bUniversity of Applied Sciences Jena, Department of Business Administration, Center for Innovation and Entrepreneurship, Carl-Zeiss-Promenade 2, 07745 Jena, Germany

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ABSTRACT

The objective of this study is to examine the interface between researchers’ motivations and interaction channels concerning university–industry cooperation. For this purpose, we conducted a case study in a medium-sized higher education institution in Portugal. Interviews with university management and documentary analysis served for data-collection. We found that the traditional service and bi-directional channels play an important role in interaction with industry. Use of these channels depends on researchers’ motivations and disciplinary affiliation. Moreover, we make an argument for the relevance of intermediators in the interaction. Several implications are presented.

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Introduction

Cooperation between universities and industry is becoming increasingly important, because this can create reciprocal benefits for all parties involved and for society in general (Muscio, 2010). Interaction can take a variety of forms, including both direct and indirect mechanisms (Guenther and Wagner, 2008), recently being labelled as ‘academic engagement’ (Perkmann et al., 2013). From the 1980s, university–industry (U–I) cooperation has intensified and therefore received growing attention from researchers, policy-makers and practitioners (Etzkowitz, 1998). Government initiatives and

* Corresponding author. Tel.: +351 275 319 636; fax: +351 275 319 601.

E-mail addresses: mfranco@ubi.pt (M. Franco), heiko.haase@fh-jena.de (H. Haase).

¹ Tel.: +49 3641 205 573; fax: +49 3641 205 551.

changes in the institutional framework have facilitated cooperation (van Looy et al., 2003; Guenther and Wagner, 2008).

However, there is still a gap between the knowledge produced by university researchers and what is used in practice (Siegel et al., 2003). Indeed, a great amount of knowledge created in academia does not come to be applied and consequently create value (Sedlacek, 2013). Given this situation, the literature has progressively dealt with the phenomenon of U–I cooperation (Barbolla and Corredera, 2009; Gulbrandsen et al., 2011), taking different perspectives which vary significantly according to the mechanisms/interaction channels and the units of analysis considered. Since people are considered as the universal drivers to ensure successful U–I cooperation (Plewa et al., 2013), most research has focused on the individuals acting in the field.

In this connection, a great number of investigations concentrated on the academic side of U–I cooperation, and attention was mostly paid to the individual researchers (e.g. Landry et al., 2007, 2010; van Rijnsoever et al., 2008; Ponomariov, 2008; Boardman and Ponomariov, 2009; Giuliani et al., 2010; Franco et al., 2014). Although research efforts have addressed many facets of academics' characteristics and behaviour, the interface between the motivations of academic researchers and interaction channels used by them remains underexplored. Among the exceptions, Arza (2010) proposed a conceptual framework including researchers' motivations and channels of interaction, and D'Este and Perkmann (2011) and De Fuentes and Dutrénit (2012) examined these aspects by adopting a quantitative approach.

Nevertheless, as U–I cooperation is a highly controversial topic (Siegel et al., 2004) and researchers' motivations are likely to play a crucial role in the type of U–I cooperation adopted, we believe that only a qualitative approach will allow an in-depth view of the relationship between researchers' motivations and interaction channels. Instead of surveying the individual actors themselves, who were usually targeted, our study seeks to understand U–I cooperation from the perspective of university management and executive board, because we believe this expert group possesses structural knowledge (Jonassen, 2000), providing a view of the issue from the top. For this purpose, we undertake an explorative case study in a higher education institution, scrutinising simultaneously important facets concerning U–I cooperation from the university management side.

By taking this perspective, our study contributes to the discussion on what influences U–I cooperation. Deeper knowledge of academics' general motivations and the underlying reasons for engaging with industry is relevant to shape the organisational and institutional conditions, in order to improve knowledge and technology transfer between the academic and business world. Our research also complements previous research by shedding light on the perceptions and opinions of university management regarding U–I cooperation. Overall, the potential insights gained from such an approach are relevant for both theoretical debate and practical configuration in terms of policies and measures for enhancing U–I cooperation.

The remainder of the paper is structured as follows. The next section presents an overview of U–I cooperation, in terms of researchers' motivations and interaction channels. Section *Methods* describes the research methods, i.e. the case study approach adopted in this study. In *Results and discussion* section, we present and discuss the outcomes of analysing a medium-sized academic institution in Portugal. Finally, section presents conclusions, implications, limitations and lines for future research.

Literature review

In this section, we provide a literature review on the dimensions of U–I cooperation, the subject of our analysis. In doing so, we firstly refer to the motivations of academic researchers. Afterwards, we elucidate and categorise U–I interaction channels. These categories will frame the presentation of our results presented in *Results and discussion* section.

Researchers' motivations

The motivations of researchers to engage in U–I cooperation are quite heterogeneous. Faced with shortages in public funding, interaction with industry can be instigated by the need to find complementary resources to finance academic staff as well as equipment, laboratories, material and

students (Meyer-Krahmer and Schmoch, 1998; Lam, 2007; Welsh et al., 2008; Ankrah et al., 2013). In fact, in a study of science and engineering faculty members in the United States, Lee (2000) found that one of the most significant drivers to collaborate with private partners is securing funds relevant to their research activities. A similar study in the United Kingdom by D'Este and Perkmann (2011) revealed that accessing resources is predominant in prompting academics to cooperate with industry.

U–I cooperation can also help to improve the quality of research and teaching through learning in the context of application (Arza, 2010). In his empirical study, Lee (2000) found evidence of researchers' personal ambitions in U–I cooperation, to access learning opportunities such as field-testing practical application of their research outcomes and in this way obtaining new insights. Likewise, D'Este and Perkmann (2011) made an argument for learning in order to support research activities as a key motivator. In a recent study, Ankrah et al. (2013) examined academics in the United Kingdom and detected as the most frequently cited determinants the application of ideas/theories, exposing student and faculty to practical problems and ensuring the up-to-date level of academic research. By cooperating with industry, researchers can gain access to state-of-the-art techniques (Santoro, 2000), up-to-date equipment (Acworth, 2008) and feedback from practice on research ideas and results (Arvanitis et al., 2008). They can also gather new ideas for future research and gain new inspirations for problem solving (Meyer-Krahmer and Schmoch, 1998; Lee, 2000; Welsh et al., 2008).

Moreover, U–I cooperation is likely to enhance the institution's and the researcher's reputation and recognition. In this sense, Dietz and Bozeman (2005) specified that academia is intrinsically motivated to enhance the university's image and personal prestige. Siegel et al. (2004) stated that industry support allows academics to conduct research that contributes to their academic eminence. The reputational effects of U–I cooperation are particularly relevant when it comes to increasing promotion perspectives and for professional development outside the higher education sector. In many countries, due to fixed-term positions in universities, researchers must seek out career opportunities outside academia in a near or distant future (Franco et al., 2014). In particular, Lam (2007) highlighted the importance of career-related motives driving academics to build links with industry.

U–I cooperation can also be driven by researchers' individual desire to complement their personal income (Dasgupta and David, 1994; Nelson, 2004; Perkmann and Walsh, 2008). This is particularly relevant when the university offers a monetary incentive or reward system. However, D'Este and Perkmann (2011) found in their survey the desire for personal income as the least important motivation for engaging with industry. Among other motivators important to academics when engaging in U–I cooperation, Ankrah et al. (2013) found, on the one hand, service to the industrial community and promoting innovation through knowledge/technology transfer, and on the other, responsiveness to government policy and the university's own institutional policy.

However, it is also noteworthy that these motivations to cooperate with industry can be hampered by several institutional and/or organisational barriers. Among the most frequently cited is the lack of organisational support for transfer tasks and encouragement for researchers to engage in adapting new knowledge and in the transfer process (Debackere and Veugelers, 2005). Furthermore, insufficient resources for establishing interaction with private businesses are also among the most frequent obstacles researchers encounter (Siegel et al., 2003; Mudambi and Swift, 2009).

Interaction channels

The empirical evidence suggests that during U–I interaction, knowledge flows through multiple channels. They comprise the exchange of codified academic research results in the form of publications, licensing and patents (e.g. Agrawal and Henderson, 2002; Landry et al., 2006; Lach and Schankerman, 2008). Other frequently cited proxies for U–I cooperation are basic and applied R&D projects, meetings and conferences, student, graduate and researcher mobility, consultancy and training, joint supervision of final degree theses and informal contacts (Rynes et al., 2001; Cohen et al., 2002; Mora Valentin, 2002; Landry et al., 2006; D'Este and Patel, 2007; Bekkers and Bodas-Freitas, 2008; Wright et al., 2008). Moreover, academic start-ups are becoming increasingly important as a transfer channel (Di Gregorio and Shane, 2003; Landry et al., 2006; Guenther and Wagner, 2008).

These interactions can take place without the direct involvement of the university. [Bodas Freitas et al. \(2013\)](#) brought to light that personal contractual agreements between firms and individual academics amount to at least 50% of U–I cooperation. [D'Este and Patel \(2007\)](#) added that informal relationships between business-people and academics are also very relevant aspects of U–I interaction and, in many cases, underlie the establishment of more formal collaboration.

Interaction channels can be grouped in different categories. Relevant criteria for differentiating these channels are the formality of agreements ([D'Este and Patel, 2007](#); [Landry et al., 2006](#); [Perkmann and Walsh, 2009](#)), the length of agreements ([D'Este and Patel, 2007](#)), the degree of interaction ([Perkmann and Walsh, 2007](#); [Santoro and Saporito, 2003](#); [Wright et al., 2008](#)), resource deployment ([D'Este and Patel, 2007](#)), the direction of knowledge flows ([Arza, 2010](#)) and the potential for application of results ([Perkmann and Walsh, 2009](#); [Wright et al., 2008](#)).

Nevertheless, for the purposes of our research, we believe that the categorisation proposed by [Arza \(2010\)](#) is the most appropriate. This scholar distinguishes four types of interaction channels, namely service, traditional, bi-directional and commercial channels. According to [Arza \(2010\)](#), the service channel is associated with providing scientific and technological services for a fee (e.g. consultancy, use of equipment for quality control, tests and monitoring). Here, the knowledge flow is mainly from universities to firms and the interaction is generally short-term. The traditional channel covers conventional forms of firms benefiting unidirectionally from academic activities (e.g. employing graduates, conferences, publications). The bi-directional channel, where knowledge flows in both directions, covers collaborative research and project development, participation in networks, science-technology parks and similar activities. Lastly, the commercial channel refers to academic spin-offs and business incubators, also including technology licences and patents.

Methods

Research design

Given the exploratory character of this study and the research objective, we adopted a qualitative research design and conducted a case study, in order to gain an in-depth understanding of the interface between researchers' motivations and the interaction channels of U–I cooperation. [Siegel et al. \(2004\)](#) described the issues associated with this area as both ambiguous and highly contentious, so that qualitative approaches are indeed useful. Nevertheless, only a very small number of studies in the field have adopted this method, as revealed by the systematic literature review on academic engagement by [Perkmann et al. \(2013\)](#).

The case study is a form of qualitative research that analyses a phenomenon in its real environment, based on multiple sources of evidence, being recommended when the social and personal context is fundamental in understanding and interpreting the phenomenon ([Neuman, 2010](#); [Yin, 2013](#)). A single case or multiple cases can be selected as the unit(s) of analysis. The present research corresponds to a single case study, as it focuses on a medium-sized polytechnic institute in Portugal, hereafter named 'Polytechnic Institute'. This unit of analysis was chosen for its technological and commercial orientation, making it a suitable subject to study U–I cooperation.

Description of the Polytechnic Institute

The Polytechnic Institute subject to analysis is one of the youngest state higher education institutions in Portugal, located in the north of Portugal. It defines its mission as to “*contribute to the sustainable development of society, stimulate cultural creation, applied investigation and research, and encourage reflective and humanistic thought*”. Its structure takes the form of two organic units of teaching and research – the School of Management, since 1996 and the School of Technology, since 2004, – where degree, master and post-graduate courses are taught in the daytime, in the evenings and through distance learning, Specialised technological courses and short lifelong learning courses (e.g. freely-available language courses and courses to prepare for professional exams) are also offered. This diversified and eminently practical educational supply in the areas of business science, technology and design has shown itself to be appropriate to the training needs of the region's business

sector, resulting in relatively high rates of employability. Concentrating on a theoretical–practical approach in its teaching and service-providing projects, the Polytechnic Institute has sought to consolidate its links with industry, prioritising the transfer of knowledge and technology as a means to promote regional development and job creation.

In the academic year 2012/2013, the Polytechnic Institute received a total of 3755 students in the various courses. Teaching staff has grown considerably over the last years: from 9 lecturers at the beginning in 1996, this has risen to 193 in 2013. Regarding academic qualifications, in 2012, 42% of lecturers had a master degree and 25% a first degree, 27% had a PhD and 6% were specialists. Despite the predominance of invited lecturers (69%), these percentages will tend to invert in the medium-term, due to reforming the judicial regime in higher education institutions and the significant number of lecturers (75) in PhD programmes.

Besides (1) teaching/learning, the Strategic Plan 2011–2015 defines as the principal strategic axes or central areas of action in the Polytechnic Institute to comply with the essence of its mission: (2) research and development (R&D), and (3) relations with society, employability and entrepreneurship. The main research interfaces are the Centre of Research in Accountancy and Taxation in the School of Management and the Digital Games Research Centre in the School of Technology.

The Centre of Research in Accountancy and Taxation is a unit of scientific research in the School of Management at the Polytechnic Institute, created in 2007 and becoming the first centre to be recognised in this area by the Foundation for Science and Technology. Its main objective is to develop R&D activities in the scientific areas of Accountancy and Taxation, in an interdisciplinary context including other areas, such as Law and Management.

The Digital Games Research Centre is a multi-disciplinary research centre in the School of Technology, formed by a group of researchers from different scientific specialisations related to solutions for games and digital interfaces. Its main objectives are to develop applied research in the different domains of computer graphics and to transfer knowledge and technology to society and the business world. At present, the Digital Games Research Centre has two main areas of research and project development: serious games and graphical health applications.

Data collection and analysis

The sources of empirical evidence used in this exploratory case study were personal semi-structured interviews (primary sources) as well as documents and materials (secondary sources). The semi-structured interview is one of the most commonly used methods in qualitative research, aiming for thorough comprehension of a given social phenomenon, based on interviewees' personal experiences (Patton, 1990). The interviews used as a guide items of the questionnaire developed by Davey et al. (2011), consisting of a set of open and closed questions with scales of (dis)agreement, which were partially answered in a free and moderately directed way. Among the main questions and besides demographic information about the respondents, they were asked about interaction channels and strategies, approaches, structures and activities to promote U–I cooperation, the legal framework ruling U–I cooperation as well as about drivers, motivations and barriers related to U–I cooperation.

For this case study, two extensive interviews were held in May 2013 with the following experts: (1) the Vice-President of the Polytechnic Institute for the areas of Assessment and Quality, at the same time acting as President of the Scientific Council of the Centre for Research in Accountancy and Taxation (hereafter named as Interviewee A), and (2) the Director of the School of Technology, also Director of the Digital Games Research Centre (Interviewee B). In these positions, the interviewees belong to the university's top management; however, they also have a certain workload as academic lecturers in the Polytechnic Institute. The interviewees are under 40 years old, completed their PhD less than 5 years ago and are actively involved in U–I cooperation. At their request, the interviews were not recorded, and so it was necessary to make detailed notes that were later organised and transcribed. This material was subject to content analysis (Weber, 1990), which let us define and analyse categories of information. For this purpose, we demarcated segments within the transcribed text, codified the relevant information with a word or short phrase and summarised/compared the codes obtained across the interviews.

The information collected/generated in the interviews was checked, complemented and contrasted with analysis of various documents and materials. The objective of this documentary analysis was data triangulation (Blaikie, 2000) and so greater external validity of the results obtained (Yin, 2013). The documents and materials used for data triangulation were the following: the Polytechnic Institute's statutes, its strategic plan for 2011–2015, the report on carrying out the strategic plan in 2012, activity and accounting reports of 2011 and 2012 and news published on the Polytechnic Institute's website. Summarising, data interpretation was based on the interviewees' opinions/perceptions (first order interpretation) and subsequent validation (second order interpretation) to confirm the coherence of all the information gathered. Lastly, a theoretical meaning (third order interpretation) was attributed to complete the empirical evidence (Neuman, 2010).

Results and discussion

Researchers' motivations

Regarding the motivations of the Polytechnic Institute and its researchers towards involvement in U–I cooperation, the interviewees' opinions coincide greatly. In the same line as other empirical studies (Lee, 2000; Welsh et al., 2008), the two members of university management strongly pointed out with a high degree of agreement that successful U–I cooperation is vital for their own research and even more so to fulfil the mission of the Polytechnic Institute. At the Polytechnic Institute in fact, there is a documented mission covering U–I cooperation, top management (vice-presidents and directors) committed to that strategic axis and a general council that includes members co-opted from outside with close links to industry. The interviewees also stressed that the interaction increases academic reputation among peers and status within the institution, a frequently cited motivation (Siegel et al., 2004; Dietz and Bozeman, 2005). However, interestingly both disagreed with the possibility of U–I cooperation being a way to progress/be promoted in careers, since interaction with industry interferes with teaching and research responsibilities, a fact already reported by Nelson (2004).

Indeed, for Interviewee A, the main motivation of the Polytechnic Institute and its researchers is “the reputation and market image provided by U–I cooperation”, and “the possibility to apply research developed within the institution”. For Interviewee B, “the opportunity to apply topics of research, publish, be recognised, and be at the forefront of technology and knowledge is part of the mission of the researcher and the higher education institution”. As already demonstrated by other scholars, learning in the context of applying research results in practice (Lee, 2000; D'Este and Perkmann, 2011; Ankrah et al., 2013) seems to be a main motivator for academia to engage with industry.

Despite the youth of the institution and its teaching staff and the heavily restricted budget, the number of PhDs from both schools has shown a considerable increase in the last three years, resulting in a significant growth of scientific publications and participation in national and international conferences, as confirmed by the Activity and Accounting Report of 2011 and 2012. Irrespective of the more or less practical and applied objectives of U–I cooperation, both interviewees said that the academics at both schools seek to exploit cooperation for research purposes, through publicising the results in scientific journals and conferences, due to the importance of this component in assessing performance as academics. As an outcome of analysis of the reports of the Polytechnic Institute's research centres, we found that those researchers who cooperate most or who are most willing to cooperate with industry are the most qualified and most productive in terms of publications. Here, our study is in line with others (Gulbrandsen and Smeby, 2005; Bekkers and Bodas-Freitas, 2008; Haussler and Colyvas, 2011; De Fuentes and Dutrénit, 2012), providing evidence that academics' scientific productivity is generally positively related to propensity to cooperate with industry.

Nevertheless, in the opinion of Interviewee A, researchers at the School of Management are less motivated towards U–I cooperation, because “it requires great investment in terms of time and dedication” and “it is still not given much value in the assessment parameters of academics' performance, compared to teaching and research”. Interviewee B added “academics have excessive teaching workloads and are too involved in administrative work, which ends up harming the activity of research and links with industry”. The bureaucracy, the legal framework, and the lack of organisational support and of responsibility by the researchers in charge of projects were reported as major obstacles. Such barriers

to interaction were already reported by other scholars (Siegel et al., 2003; Debackere and Veugelaers, 2005; Mudambi and Swift, 2009). In fact, the income received from U–I cooperation is a complement to the budget for the institution and its researchers, but its weight is quite residual (according to the report and accounts of 2012, studies, opinions, projects and consultancy only represent 1% of the Polytechnic Institute's income).

The two university managers agreed that obtaining more financial resources through U–I cooperation is an incentive for the institution and its researchers, particularly in a context of economic and financial crisis. This finding underpins the evidence from other empirical studies (e.g. Lee, 2000; D'Este and Perkmann, 2011; Ankras et al., 2013). Interviewee A expressed the institutional intention of more intense U–I cooperation through the Centre of Research in Accountancy and Taxation in the following way: “we want to concentrate more on this aspect in the short-term because we feel the market needs and shows interest in greater proximity between the academic world and the business world; the activities carried out by the Centre of Research in Accountancy and Taxation are, without a doubt, a way to stimulate the region whether through attracting national and international researchers or through forming partnerships with other higher education institutions and research centres, both nationally and internationally”. However, he was sorry there is no actual incentive policy on the part of the Polytechnic Institute, through greater appreciation of the U–I cooperation component in assessing scientific performance or reducing teaching hours for the academics who cooperate most.

Interaction channels

Regarding the School of Technology, a relatively high level of U–I cooperation exists. On the one hand, relations with the business sector are established directly with firms in the region through teaching/training and the supply/demand for curricular and professional work placements. On the other hand, interaction with the Digital Games Research Centre occurs indirectly through collaborative and contracted research projects and signing cooperation partnerships and protocols with firms. The cooperation protocols are formed through firms granting premises, material or software to support practical classes and training courses for students and lecturers.

Interviewee B highlighted the School's Consultative Committee, formed in 2013 and made up of a restricted group of individuals and firms that stand out due to their high business and industrial value in the specific areas of this school's activities. Among the firms included in the School's Consultative Committee are some large international companies. The principal mission of this committee is for the various decision-making organs of the School of Technology to give direct advice on matters central to their activity, namely teaching, research and service provision to the community. The composition model of the School's Consultative Committee is unique in Portugal, aiming to bring the Polytechnic Institute and firms closer. In the opinion of Interviewee B, “many of the problems which in the past caused firms to look on higher education with mistrust have now been overcome”, and “unlike what happens in other institutions, this Consultative Committee is more open to the outside, with a view to developing and following up activities in cooperation”. He went on to say, “teaching, research and innovation are the three main vectors of any higher education institution, and so they should be in line with what companies are doing”.

Regarding the area of action of the School of Management and Centre of Research in Accountancy and Taxation, Interviewee A foresaw relatively less U–I cooperation. In his opinion, “the business sector in the region is not really suitable for more intense and beneficial U–I cooperation”, and “the social sciences and humanities do not offer such immediate/obvious possibilities for industrial application as the case of Technology and Design”. In this case, the relationships and partnerships with industry are established preferably through local authorities and Portuguese professional associations representing the area of Accountancy and Taxation. This cooperation has resulted in countless juridical, economic and financial opinions, and various extremely relevant consultancy projects, which has given the Centre of Research in Accountancy and Taxation great visibility. Besides publication of studies of a technical and scientific nature and communications at international congresses, the Centre of Research in Accountancy and Taxation seeks to publicise the results of its activities through promoting a regular series of workshops and seminars and organising national and international conferences. Table 1 summarises the relevant insights gained from the interviews.

Table 1

Analysis of the interviews.

	Interviewee A	Interviewee B
Motivations of researchers	<ul style="list-style-type: none"> • Increasing academic reputation and status, even among industry partners • Practical application of research outcomes • Publications in scientific journals and conferences • Assessing performance • Obtaining financial resources • No career effects 	<ul style="list-style-type: none"> • Increasing academic reputation, status and recognition • Practical application of research outcomes • Publications in scientific journals and conferences • Access to up-to-date technology and knowledge • Assessing performance • Obtaining financial resources • No career effects
Interaction channels	<ul style="list-style-type: none"> • Relatively less U–I cooperation: <ul style="list-style-type: none"> – lacking fit with regional business sector – reduced possibilities for industrial application • Consultancy • Publication of studies • Workshops, seminars and conferences • Local authorities and professional associations as intermediators 	<ul style="list-style-type: none"> • Relatively high level of U–I cooperation • Teaching and training • Curricular and professional work placements • Collaborative and contracted research projects • School's Consultative Committee as an intermediary

From the above, and following [Arza's \(2010\)](#) categorisation, for the Polytechnic Institute analysed it can be seen that the main interaction channels are the traditional and service ones. Analysing the reports of the activities of the research centres at the two schools, publication of articles in scientific journals and communications at conferences are found to be the traditional channels most commonly used to transfer knowledge, as was demonstrated in other empirical studies (e.g. [Dutrénit et al., 2010](#)). The result obtained also reveals that those researchers with the greatest scientific productivity tend to engage in collaborative research projects through the bi-directional channel, whereas the remainder are more oriented to contracted research and consultancy through the service and traditional channels.

Nevertheless, there are also noteworthy differences in the interaction channels used by the academics of the two schools. In fact, the intensity and types of interaction vary according to the disciplinary affiliation, namely the scientific area, school or faculty academic staff belong to ([Bekkers and Bodas-Freitas, 2008](#); [Martinelli et al., 2008](#); [Franco et al., 2014](#)). Compared to management, in our research context U–I cooperation is more pronounced in technology. Previous research had already stressed that applied and science/technology-based areas show a higher propensity for U–I cooperation ([Meyer-Krahmer and Schmoch, 1998](#); [Lee and Bozeman, 2005](#); [Bozeman and Gaughan, 2007](#); [Landry et al., 2007](#); [D'Este and Patel, 2007](#); [Boardman, 2008](#); [Ponomariov, 2008](#)).

At the Centre of Research in Accountancy and Taxation at the School of Management, consultancy (requested by firms) is the predominant service channel. At the School of Technology, we found a larger number of collaborative and contracted research projects that fall under the realm of the bi-directional channel, and a strengthening of this type of interaction is the key activity of the School of Technology's Consultative Committee. At present, the bi-directional channel is determined more by the effort of this school and its researchers towards reputation, high-quality research and its application. In the Digital Games Research Centre at the School of Technology, the bi-directional channel is more developed: besides contracted research projects, there is more collaborative research which allows an avenue for researchers' motivations (applying research in practice, accessing up-to-date technology and knowledge) and more long-lasting relationships with firms. These results are indications that the emphasis on a given channel or channels of interaction depends on the motivations of the actors involved ([Arza, 2010](#); [D'Este and Perkmann, 2011](#)).

Conclusions and implications

The objective of this paper was to provide an in-depth analysis of the interface between researchers' motivations and interaction channels used for U–I cooperation. For this purpose, we performed a case study in a medium-sized academic institution in Portugal. From analysis of the

interviews with representatives from university management and the Polytechnic Institute's reports and other documents, we found that U–I cooperation is a highly relevant issue for the institution and its academic staff. Regarding researchers' motivations to engage with industry, on the one hand our results give ammunition to the frequently cited prompts such as reputation, publications, application of research in practice and obtaining financial resources.

On the other hand, in this exploratory study we could not reveal an effect of U–I cooperation on researchers' career prospects. Here, our outcomes are contrary to previous empirical findings (e.g. Lam, 2007). It also emerged that, compared to teaching and research, engagement in U–I cooperation, though recognised, is not sufficiently used and implemented as an indicator to assess individual performance. This could be an explanation for underappreciated career effects of U–I cooperation. Furthermore, in the Polytechnic Institute analysed, we did not find evidence of U–I cooperation being relevant for complementing researchers' personal income.

Regarding interaction channels, we found the traditional, service and bi-directional channels seem to play an important role, and seem to be in line with researchers' motivations for U–I cooperation. Nonetheless, use of the interaction channels differs considerably according to the scientific area, as propensity towards U–I cooperation is higher among academic staff from technological areas. We found that those academics with the highest qualifications and greatest scientific productivity tend to engage more in interaction, also pursuing collaborative research projects through the bi-directional channel. In addition, developing the commercial channel was identified as a rather difficult undertaking. Bureaucracy, legal framework and lack of organisational support were identified as the main barriers hindering U–I cooperation. On the contrary, intermediators such as inter-university agencies, local authorities and professional associations appear to be highly relevant as facilitators enabling U–I cooperation.

These outcomes allow us to draw several implications. From a theoretical point of view, our study contributes to enhancing knowledge about the moderating effect of researchers' motivations on the various types of interaction channels. It is important insofar as it explores in depth this interface from the perspective of university management. The insights gained should be tested in quantitative approaches and allow outlining new streams for future investigations.

In practical terms, the results of this and other studies (e.g. Wright et al., 2008) suggest that medium-sized academic institutions should concentrate on creating research of excellence and a critical mass in their areas of specialisation, as well as using different types of intermediaries and forms of cooperation. In addition, polytechnics are institutions traditionally oriented to more practical and applied teaching/research, so that the bi-directional and the commercial interaction channels appear to be particularly relevant. In this connection, the main challenge for universities of applied sciences is to effectively combine their research agenda with institutional supply, and the active involvement of academics in research projects with industry. This should be accompanied by recognition of engagement in U–I cooperation through appropriate incentive policies.

Besides the limitations inherent to the case study method (preventing generalisation) and the subjective perceptions of the interviewees, the approach pursued only explores some, though important, facets of U–I cooperation. Researchers are challenged to find and explore other mediating factors of interaction with industry, such as culture or structure of the academic institution. Owen-Smith and Powell (2003) and Giuliani et al. (2010) have already found certain evidence that institutional factors affect U–I cooperation. In addition, U–I cooperation is generally based on the assumption that the benefits are greater than the (social) costs or risks associated with interaction. Some recent studies (e.g. Arza, 2010) have already drawn attention to the potential risks that can affect the creation and spread of knowledge. These aspects require more qualitative and quantitative studies, and in conjunction with our research will allow improved knowledge and technology transfer in the realm of higher education institutions.

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Mário Franco is an Assistant Professor of Entrepreneurship and SME Administration at the Department of Management and Economics, Beira Interior University, Portugal. He received his PhD in Management from Beira Interior University in 2002. In 1997, he was a doctoral candidate and participated in the European Doctoral Programme in Entrepreneurship and Small Business Management in Spain and Sweden. His research focuses on strategic alliances, business networks, innovation and business creation. He is a member of the CEFAGE-UBI Research Center and currently involved in several research projects on SMEs.

Heiko Haase is a Full Professor of Entrepreneurship and Innovation Management at the Department of Business Administration, University of Applied Sciences Jena, Germany. He studied Industrial Engineering and received his PhD in Economic Sciences from the Ilmenau University of Technology in 2003. His research fields comprise entrepreneurship, small and medium-sized enterprises, innovation management, technology transfer and intellectual property. He is the director of the Center for Innovation and Entrepreneurship at the University of Applied Sciences Jena.