Creating university-industry interactions: how can university management connect various types of interactions?

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Abstract

Purpose of the paper: *University-Industry interactions (U-I interactions) - such as joint collaboration projects - are currently perceived as one important answer to innovation. However, the detailed dynamics of these interactions remain unknown, especially when it comes to universities' efforts to create such interactions (Perkmann and Walsh, 2007). By analysing two interaction-stimulating tools deployed by a Swedish university, this paper addresses two research questions: 1) which different types of U-I interactions are created by these tools? and 2) how does the university management connect different types of U-I interactions?*

Methodology: *Embedded case study methodology comprised of participant observation and over 60 in depth semi-structured interviews.*

Results: *For the first question, we have found that four types of U-I interactions were created, namely "participation", "cooperation", "collaboration" and "relationships". For the second question, we have found that creating successful U-I interactions requires that the university management intervenes on all the various interaction types.*

Research limit: *The research questions posed here are based on two specific U-I interaction tools in one specific context. To be able to draw a more generalizable conclusion, further research is needed from other societal contexts and universities.*

Practical implications: *University management's aim towards achieving deeper and long-term interactions may be hindered by the companies' and academic researchers' emphasis on simply exchanging knowledge or building contact networks, rather than gaining tangible outputs from U-I interactions.*

Originality of the paper: *Current research lacks detailed descriptions and analyses of U-I interactions, especially of universities' efforts to create such interactions from scratch, that is, before they become established relationships. This paper addresses this gap.*

Key words: university-industry interaction; case study; typology; cooperation; collaboration; relationship

1. Introduction

The university's role as knowledge producer in technological advances has been a heated discussion topic, in both the academic and political sphere, for several decades now. Much attention has been directed towards the commercialization of academic research results, involving the patenting and licensing of inventions as well as academic entrepreneurship (see e.g.

Phan and Siegel, 2006; Rothaermel *et al.*, 2007; O'Shea *et al.*, 2008). This literature and discourse focuses on the so called spin-out funnel (Clarysse *et al.*, 2005) reflecting a linear technology transfer from academia to industry. Even though this linear commercialization process has been extensively criticised for its deterministic and simplistic nature (see e.g. Grandin et al, 2004; Balconi et al, 2010), it still influences a functional perspective on an effective innovation-supporting system (Mowery and Sampat, 2005). Markman *et al.*'s (2008) explanation for this focus is that the linear commercialization process generates immediate and measurable results that enable verification of the universities' contribution to innovation.

Nonetheless, many scholars claim that there is a variety of additional mechanisms through which universities contribute to technological advances (Mowery and Sampat, 2005; Bercovitz and Feldman, 2006; Perkmann and Walsh, 2007; Nilsson *et al.*, 2010), and that the linear commercialization path actually constitutes only a small fraction of this contribution (Perkmann *et al.*, 2013). These additional mechanisms are various University-Industry (U-I) interactions which entail a more complex, often intangible, knowledge exchange between academia and industry rather than a linear technology transfer. These mechanisms are often disregarded by policy and in literature because their effects are difficult to measure and they relate only indirectly to innovation and economic growth (Nilsson *et al.*, 2010). Nonetheless, research on U-I interactions is growing, even if according to Perkmann *et al.* (2013) this field remains fragmented and tentative. In contrast to the central role of entrepreneurship theory in the literature on linear commercialization, the notion of U-I interactions is lacking a conceptual framework to build on (Ibid), despite early conceptualizations such as Bonaccorsi and Piccaluga's (1994), building on the economic and inter-organizational theory. Further, Perkmann and Walsh (2007) stress that current research lacks detailed descriptions and analyses of U-I interactions, especially of universities' efforts to create such interactions from scratch, that is, *before* they become established relationships.

Considering this gap in the literature on U-I interactions, we focus our contribution on the role of *university management*, represented by innovation-supporting units such as Technology Transfer Offices (TTO), in facilitating these interactions, which constitute mechanisms of science diffusion other than linear commercialization. This is a relevant question to address as the increasing pressure "to contribute to innovation" is put on the universities as organisations rather than on the individual researchers. Further, Sweden is one of the few countries, among which is also Italy, which applies both 'the third mission' and 'the teacher's exemption' (granting ownership of inventions to academicians) as two parallel regulations (Henreksson and Rosenberg, 2001). The presence of both of these regulations makes the Swedish universities a particularly interesting empirical context for studying additional mechanisms of diffusing science (Nilsson *et al.*, 2010), because the tension between these two regulations forces university management to find mechanisms alternative to the spinout funnel for making science useful to society.

In particular, this paper aims to investigate how university management (TTOs and other innovation-supporting officials) can facilitate alternative mechanisms for diffusing knowledge between academia and industry. Following two interaction-stimulating tools implemented by Uppsala University, Sweden, enabled us to closely observe how university management stimulates and controls the creation of interactions between academic researchers and companies. By analysing the details of how the two tools (called AIMday and SMURF) work and are applied, we can also add more facets to existing typologies of U-I interactions (e.g., Baraldi *et al.*, 2013). We have also expanded the existing knowledge base on motivations to engage in interactions by taking into account the perspectives of *three* parties: not only academic researchers and industry, but also university management. Importantly, we focus not so much on the perceptions resulting from established or completed collaborations, but rather on the perceptions of companies and researchers present *prior to* the formation of collaboration. We contribute to deepen the understanding of U-I interactions by addressing two research questions: 1) which different types of U-I interactions do the tools employed by university management create? and, 2) how does university management connect these different types of U-I interactions? In addressing the second research question, we also consider the perceptions of companies and researchers in terms of the values they obtain from U-I interactions, as these perceptions can influence the university management's efforts to create U-I interactions.

The remainder of this paper is organized as follows: the next section presents a brief review of previous studies on U-I interactions, followed by our methodological approach describing the connection between the two cases, and how and what data has been collected. Following the methodology, an empirical section features our two cases. The next section discusses our empirical data, presenting our contributions to existing knowledge about U-I interactions. The paper concludes by highlighting issues for further research and giving implications for both policy and practitioners involved in supporting U-I interactions.

2. Previous studies on U-I interactions

Labelled as the 'Grey zone' by Nilsson *et al.* (2010), the academic knowledge diffusion mechanisms alternative to patents, licenses and spin-offs can take many forms. These include publications and conference presentations, informal and pre-formal discussions, networking, hiring of students, shared personnel, labour movement, sponsored (contract) research, collaborative (joint) research and consulting services (Bercovitz and Feldmann, 2006; Perkmann and Walsh, 2007; Nilsson *et al.*, 2010; Perkmann *et al.*, 2013). Except for the first two forms, the other mechanisms entail an *interaction* between university researchers and industry representatives, a phenomenon which Perkmann *et al.* (2013) refer to as "academic engagement" in their review.

This concept reflects the focal point of departure for most literature on U-I interactions, namely the individual academic researcher (Ibid). The

literature investigates specifically who these individuals are, such as their position, experience, age, gender, and what kind of interaction (i.e., how) they engage in to diffuse their knowledge and expertise, such as licenses, sponsored/contract research, collaborative/joint research projects or consulting services (see e.g., Link *et al.*, 2007; Boardman and Ponomariov, 2009; Haeussler and Colyvas, 2011).

When it comes to the question of "why" academic researchers choose to engage with industry, the literature mainly focuses on organizational determinants: for instance, the features of the university or department (Perkmann *et al.*, 2013) and group-level norms (Louis *et al.*, 1989; Stuart and Ding, 2006; Bercovitz and Feldman, 2008) as well as institutional determinants, such as career systems (Lee, 1998) and competition intensity (Henrekson and Rosenberg, 2001; Goldfarb and Henrekson, 2003) viewed as factors for motivating researchers. Instead of an organizational or institutional perspective, D'Este and Perkmann (2011) are among those few to have the individual in focus for this "why" question and find that a primary reason for researchers to interact with industry is furthering their research, rather than commercializing their knowledge.

Lee (2000) takes into account the perceptions of *both* individual researchers and industrial representatives when analysing their motivations to engage in interaction and finds that researchers primarily aim to secure funds and further their research, while industry aim to solve technical problems and advance their product development, but also search 'blue sky' research opening for new technologies. Common for most literature is also that it analyses *established or already completed* collaborations between academic researchers and industry with a bias towards experienced rather than anticipated benefits, hence our research aim to investigate U-I interactions prior or during their emergence.

While the role of TTOs and other innovation-supporting units of universities is widely recognized and studied within the linear spin-out funnel (see e.g., Lockett and Wright, 2005; Mowery, 2005), it is less explored in shaping U-I interactions. However, evidence suggests that TTOs and especially universities' Industrial Liaisons Offices play important roles (Bercovitz and Feldman, 2006), such as conducting formal, but intermittent interactions (e.g., negotiations) with industrial partners (Debackere and Veugelers, 2005). Thus, our research aims to penetrate into how university management can shape U-I interactions.

More precisely, it is relevant to analyze which type of interactions the university management can shape, as they greatly differ in terms of motivations of the actors involved and their intensity (Bonaccorsi and Piccaluga, 1994), as well as their duration and depth. In particular, we rely in this paper on the typology of U-I interactions proposed by Baraldi *et al.* (2013), which relies on the inter-organizational theory of relationships (Håkansson and Snehota, 1995) and, based on their *degree of interdependence* and *time perspective*, distinguishes between the following types (see also Table 1): "participation", "cooperation", "collaboration" and "relationship".

Tab. 1: Typology of U-I Interactions

Participation	The action of taking part in something
Cooperation	The action or process of working together to the same end
Collaboration	The action of working with someone to produce something
Relationship	Long-term, deep connection between two or more actors

Source: Adapted from Baraldi *et al.*, 2013

3. Methodology

This paper relies on a qualitative case study methodology (Yin, 2014), based on two cases about two different interaction-stimulating tools devised and applied by Uppsala University: AIMday (standing for Academy Industry Meeting day) and SMURF (Swedish acronym translated into "Small enterprises collaborating with researchers at Uppsala universities"). The two cases are extracted from the same organizational context and reflect an "embedded case" methodology (Ibid). These two interaction-stimulating tools address different types of U-I interactions, which are the focal point of our paper. More precisely, AIMday is a tool stimulating researchers and industry to interact unconditionally, and in its broadest sense, by making them discuss issues that are of interest for both parties. The purpose of SMURF was, on the other hand, to create a platform that facilitated and financed short *collaboration* projects between SMEs and researchers. Like AIMday, the goal of SMURF was to provide commercial values to companies while, at the same time, it expanded the research horizons for the academic researcher(s).

The two cases are part of two separate larger longitudinal studies on how the two interaction-stimulating tools developed and their effects. However, the large amount of empirical data gathered was analysed following an abductive approach (Dubois and Gadde, 2002; Yin, 2014) based on constantly relating newly collected data with theoretical concepts, which in turn led new streams of data collection. During these ongoing data analyses, we saw that both similar and complementary concepts could be extracted from the two tool-specific cases. These concepts were matched with those found in the literature (e.g., researchers' motivation) and with existing typologies of U-I interactions (see Table 1). This led to an iterative process of moving between our empirics and further concept development (Yin, 2014).

The next step of our analysis was searching across both cases for the different types of interactions and using the concepts that emerged to structure our empirical section. Following the logic of Yin (2014), this means that the two cases as featured in our empirical section are not only a description of our data but also, simultaneously, a pre-analysis. The next step in the analysis of the empirical material was to build an outline of the two cases. However, while the two cases were built with a similar structure, it became more evident in our analysis that they were complementary rather than simply comparative. In fact, they provide variation and overlap in the types of interactions featured rather than pure differences.

Our empirical materials were collected between 2011 and 2014 by means of several sources of data: participant observations of 6 AIMday events and of all of the 17 projects and steer group meetings of SMURF. The main motive for partaking in these meetings was to observe the day-to-day workings of the university managers while governing these interaction-stimulating tools, which otherwise are difficult to obtain from documents. We wanted to observe the work in action rather than ex-post, in order to avoid the bias between what is written and what is actually performed in practice (Brown and Duguid, 1991). Secondary sources such as brochures, official applications, internal reports provided by university managers, researchers and companies were used to complement our observations.

Further, over 60 qualitative interviews ranging from 30 to 90 minutes were conducted with university managers, companies and researchers involved in AIMday and SMURF. The interviews were based on a semi-structured approach as this enables flexibility within the interview situations and at the same time permits a comparison of data (Bryman, 2012). All informants were informed of the research purpose before the interview. In the AIMday case, all university managers involved in developing and organizing the event have been interviewed on several occasions as well as a selected number of participating researchers and companies. For SMURF, interviews were conducted twice with all members of the project group, all the participating academic researchers and companies, and with some key actors even more often. The main themes in the interviews with representatives of the university management were the organization and process of the two interaction-stimulating tools, their goals and effects. Interviews with companies and researchers covered instead the actors' perception of the interactions as well as the effects created by AIMday and SMURF.

4. Empirical study

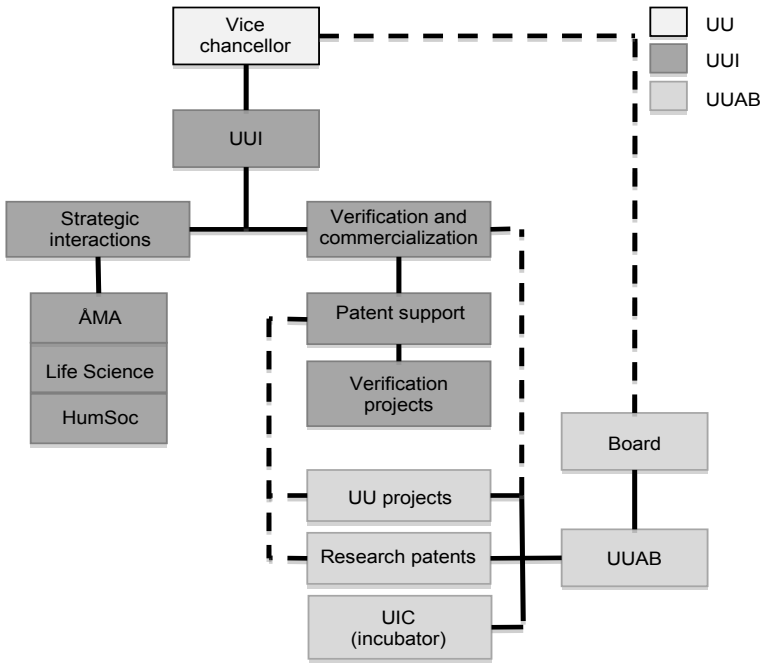
In this section we outline our empirical material, with a focus on the core concepts that will be discussed in the following section: in particular, we focus on how the university managers in charge of AIMday and SMURF stimulate the creation of U-I interactions.

4.1 Uppsala University's strategy for innovation support

Founded in 1477, Uppsala University is Scandinavia's oldest university and amongst the top 100 ranked universities in the world today (topuniversities.com), performing intensive research, spanning all scientific disciplines. With its TTO (UUAB, Uppsala University Development Limited) in place since 1995, the university answered to a governmental directive in 2005, demanding Swedish universities to take greater actions in supporting innovation, by forming an industrial liaison office. The new organization, named Uppsala University Innovation (UUI) and placed within the university, directly under the Vice-chancellor, officially started its operations in 2007 with the support of governmental funding. Manned with about 25 full-time employees, UUI is now responsible to lead and

coordinate the University's efforts to support economic growth in society via the creation of collaborations with commercial enterprises (uuinnovation.se). The coordination of collaboration between academic research and industry works through three cooperation platforms targeted to the areas of materials, Life Sciences and Humanities and Social Sciences respectively, in which interaction activities between researchers and external practitioners are arranged. While, for example, the cooperation platform ÅMA (Ångström Materials Academy) is specific to materials research, AIMday and SMURF are two interaction-stimulating tools embracing several scientific domains.

Fig. 1: Organizational map describing the relationship between Uppsala University's Industrial liaison office (UUI) and Technology transfer office (UUAB)



Source: Uppsala University Innovation

4.2 AIMday and SMURF

With 32 representatives from 11 companies and 67 academic researchers participating to discuss 23 different questions formulated by companies, the first AIMday called AIMday Materials was launched on November 5, 2008. AIMday is a one-day conference composed of a number of workshops running in parallel. In each workshop a multidisciplinary group of academic researchers discusses a problem or another issue formulated by the participating company. According to the managers of UUI, an industrial focus, instead of progresses within research, enables companies and researchers to meet on more equal conditions, and focusing on discussions instead of traditional presentations, means that scientific knowledge becomes directly applied to industrial needs and at the same time it also

facilitates the creation of collaboration projects. Since 2010, AIMday has been trademarked and is now organized as an interaction-stimulating tool in a variety of fields like Materials, Imaging, Energy, Sustainability, Cancer, Diabetes, Food, Patient safety, Aging, and Public management. Today, AIMday is an interaction-stimulating tool implemented not only by Uppsala University, but also by a variety of universities, both Swedish and international, several times a year. Unsurprisingly, AIMday is one of Uppsala University's most important facilitators for U-I interactions.

Conducted between 2011 and 2014, SMURF, was a project that, differently from AIMday, focused directly on the formation of *collaboration projects*. SMURF was officially a joint-program between Uppsala University and the other university in Uppsala, the Swedish University of Agricultural Sciences (SLU), which obtained a total of 2 million euros from the Swedish Agency for Economic and Regional Growth. The goal of SMURF was straightforward: facilitating the formation of collaboration projects between SMEs and researchers by providing smaller grants (about 25.000 euros per project). The strategy of offering funding aimed to provide additional incentives for researchers and SMEs to find each other and engage in deeper interactions. The project had also an outspoken aim to stimulate only new collaborations, in an attempt to reach out to SMEs that had no previous interaction with a university.

Having two tools aimed at creating closer interactions between academic researchers and practitioners, UUI identified the opportunity of strengthening both tools by connecting them and thus making them complement each other. By offering SMURF funding during the AIMday events, UUI hoped to increase the formation of collaborations already via AIMday, a tool which otherwise foremost facilitates information and knowledge sharing between the parties, rather than deeper collaborations. At the same time, UUI could increase the number of applicants to SMURF via AIMday, a tool through which many researchers and companies found common interests. The UUI managers who formulated the SMURF project plan thought that, before engaging in a full collaboration, a researcher and a company might need to evaluate their initial idea. Therefore, each collaboration project could apply for a small "pre-study" grant, which was meant to demonstrate if the idea was feasible and to provide a motive for a larger grant from SMURF, which could support a "full project". As SMURF was in part created to facilitate funding for projects initiated from AIMday, the "pre-study" money was also advertised on most AIMdays as a chance for researchers and companies to further explore shared ideas that emerged during the discussions on an AIMday, and that could possibly lead to full collaboration projects.

4.3 The processes of AIMday and SMURF

Referring to AIMday, the UUI managers stress that a multidisciplinary group of researchers is important to generate more than one point of view on the issue at hand. All companies that associate themselves to the theme of a particular AIMday conference are welcome to participate as long as they submit at least one question. The UUI managers put a lot of effort in

marketing every AIMday and its topic in order to receive questions from the industry. According to the UUI managers, this process requires both a good knowledge about the operations of different companies and a good contact network with the industry. When questions from the industry are received, UUI invites academic researchers with relevant competence to register so as to participate in the discussion of the questions at hand. Researchers from all universities are welcome. However, it often takes hard work for UUI in terms of pitching the questions to make them both understandable and interesting for the researchers. UUI managers often need to contact researchers they think have the knowledge about the question to get some feedback about their perception of the question. Thereafter, the UUI managers contact the company responsible for the question and discuss how to pitch it to the researchers without losing its meaning to the company. This requires some knowledge of the topic from the UUI managers themselves. When all questions are finally defined, UUI still often needs to contact researchers, whose competence may fit the questions' different facets, including reminding them to register, as researchers often prioritise other work than their participation in AIMday. Therefore, a good contact network between the cooperation platform managers and researchers is vital.

Organizing an AIMday requires the work of 3-4 persons over 3-4 months, all of which are experienced of both industry and academia, having often previously worked in both contexts (see Jonsson, Baraldi, Larsson, Forsberg & Severinsson, 2015). The cost for organizing an AIMday varies between 30,000 and 40,000 euros, depending on the size of the events, with the costs for personnel from UUI being the major cost (about 21,000 euros), followed by food, advertising materials and, for other universities, a licensing fee (5,000 euros).

Even though SMURF was targeted directly at the formation of collaboration projects via its funding, there was a process similar to AIMday in order to engage companies and researchers to apply for the available grants, which was however stretched over a three-year period. According to the UUI managers, the project followed a loosely structured work procedure that started with rallying SMEs to the project via information activities aimed at getting them in contact with the universities' researchers. There were two basic ways in which companies were brought into SMURF: firstly, spreading information about SMURF via relevant marketing channels as well as information activities about the opportunity of project funding during an AIMday; secondly, just like AIMday, UUI managers' network of contacts with both researchers and companies played a key role in involving relevant actors. The specific process of engaging a given researcher to interact with a given SME in a specific collaboration project followed two different paths: either the researcher and the SME made a connection on their own (for instance on AIMday), or SMURF project managers exploited their contact network in the university and its scientific areas and asked a specific department or even individual researchers if they were interested in the problem or need expressed by an SME.

SMURF was run by a total of seven "interaction leaders" (5 from UUI and 2 from SLU) under the leadership of UUI's deputy director, the most senior official, who acted as the main project manager. The budget

of SMURF was 2 million euros, with 1 million provided by the Swedish Agency for Economic and Regional Growth and 1 million by UUI and SLU as "in kind" contribution, that is, the working hours of their employees. The bulk of the 1 million in external financial contribution went to finance the nearly 30 collaboration projects eventually accomplished in the three years during which SMURF was operating.

4.4 Perceptions from participants to AIMday and SMURF

In this section, we outline the perceptions from both researcher and companies that participated to AIMday and/or SMURF. Instead of a formal evaluation of these two tools, understanding what the actors have gained from involving in the activities will help us identify the types of U-I interactions created as well as how the university management connects them, including the challenges this involves.

Researchers that partook in AIMday emphasized that the discussions generated mutual knowledge transfer between academy and industry. In other words, discussing industrial problems and issues broadened the researchers' competence by learning from the "real world". Thus, researchers also felt that they could reframe their research agenda to better fit industrial needs. Having a research agenda fitting industrial needs opens the possibility to find collaborations and to be granted funding, and AIMday works as a shortcut for researchers to find favourable industrial contacts. Researchers also emphasized that AIMday promotes learning from other research areas, as the workshops are comprised of multidisciplinary groups of researchers. Another important aspect with AIMday, emphasised by the researchers, is that the activity makes a good opportunity to market and sell the actual use of laboratory equipment to industry.

The researchers involved in SMURF attributed to engaging in a project with an SME several values similar to those of AIMday. Some stressed the value of establishing a long-lasting and deep relationship with industry and at the same time being able to create good connections for their graduate and undergraduate students with relevant business connections. Above all, most researchers considered it very useful to utilize their knowledge in real-life situations, to directly provide a company with useful knowledge. They felt that it was enjoyable to work with a company, that it was fun. Similarly to AIMday, a few researchers felt that it was a "booster" for their self-esteem when seeing that their knowledge was of relevance for practical problems.

There were also some differences in the researchers' perceptions of the interactions stimulated by the two tools, with SMURF-involved researchers preferring the strict and steered form of SMURF collaborations, with a clearly stated start and finish, rather than a more open-ended discussion with an industry partner typical of AIMday. AIMday and SMURF, indeed, operate in different ways, as SMURF requires a *greater commitment* and *longer duration* of interaction from the researcher, while AIMday, per se, is a one-day interaction event.

As for the companies participating in AIMday, their representatives emphasized the value of expanding their network of contacts with

academia, by getting to know new researchers, or strengthening their current relationships with those they already knew. A common perception for these companies was also that there seldom was a direct utilization of science to solve a concrete industrial problem. Instead they underlined that, through the discussions on AIMday they could expand and deepen their understanding of a problem, which could save them both money and time. Most companies also felt that researchers were very good at providing insights on new relevant literature and key articles on a certain topic. Another important value expressed by industrial participants was that AIMday opened the opportunity to utilize analytical methods, tests and state-of-the-art laboratory equipment, which are resources most companies do not possess in-house.

The companies involved with SMURF also stressed a variety of values deriving from these interactions with researchers: they could get new perspectives on the problem they worked on together with the researcher; some of the SMEs involved with solving a technical problem got access to laboratory equipment through the project which they would never afford; many companies also considered that by connecting a researcher to their business, they could increase their reputation. Moreover, the SMEs expressed how useful it was to have the chance to work with a researcher without taking the risk to spend their own resources, as especially the smallest firms would never afford hiring external consultants regardless of the value of the project. It seemed that the value of SMURF for the SMEs was twofold: firstly, it is very important that there is a clear goal to aim at, so that the pay-off of collaborating with a researcher is evident. Secondly, the companies also expressed the importance of establishing a good connection with an expert from a university, "put it on the shelf" and use it later when there is a need for it, or to have someone to use as a reference when doing a sales pitch towards possible investors.

Many of the answers provided by the respondents showed an interesting similarity between the two cases. Even though AIMday has led to a couple of dozen small UI-collaborations, this is not what the majority of participants stress as the most important value emerging from the meetings. Both researchers and companies participating on AIMday emphasise that the main value of AIMday is "networking for networking's sake". In other terms, AIMday seems to foster the opportunity to expand, strengthen and deepen its participants' network of contacts for future needs. This is similar to many of the answers from researchers and companies engaged in SMURF. For example, when asked to value what the most important output from their collaboration projects was, most researchers and companies highlighted the contact network created rather than the project's output.

5. Discussion

5.1 Managerial efforts in creating U-I interactions

The cases of AIMday and SMURF illustrate somewhat different managerial approaches to the process of creating U-I interactions. AIMday is a tool aimed primarily at creating rewarding *meetings* with the expectation

by university management that they will lead to collaboration projects and closer relationships, whereas SMURF is a tool which provides funding with the aim to establish directly *collaboration projects* between researchers and companies. However, taking a broader perspective on the overall process of creating U-I interactions, the point of departure for both interaction-stimulating tools, and for Uppsala University's overall strategy, are *superficial* interactions between the parties, namely meetings, which then the university management aim to transform into *deeper, long-term relationships* involving, next to companies and researchers, also UUI. Below, we review this process, showing that it can take different routes in the hope of creating long-term and deep relationships. Whereas there are researchers and companies that do have long-term relationships with each other, the following analysis focuses on Uppsala University management's efforts of creating *new* such relationships.

5.2 Participation: how UUI shows value and creates interest

UUI seems to play an important role, especially in creating a superficial type of interaction, which Baraldi *et al.* (2013) term *participation*, as it simply entails the action by researchers and companies of taking part in a common event and being present together. UUI has the specific task of contacting and showing to researchers and the industry the relevance of meeting each other, thereby enabling the creation of participation. Interaction-stimulating tools like AIMday and SMURF are fundamental here because they materialize several values of participating in U-I interactions: in fact, these two tools make it possible for the university management to illustrate benefits for both parties, such as deepening one's understanding of a problem, but also obtaining additional funding or even the possibility of starting a collaboration project. AIMday and SMURF both focus on industrial problems, a strong argument for creating interest and attracting companies that are traditionally more hesitant to spend resources on interactions if these do not give them something concrete in return. In other words, by marketing the very AIMday and SMURF concepts and informing both researchers and companies about the advantages of interacting, UUI manages to craft a will to participate from both sides.

By using these two tools as a way to relate to both researchers and industry, UUI also constantly expands its own network of contacts, which acts as the starting point for different types of interactions between researchers and industry that UUI can further stimulate. When interactions between researchers and companies happen through UUI's tools, the university management also gains more knowledge about the specific counterparts, their needs and agendas, which makes it easier to directly connect them to each other on a deeper level of interaction than participation, as illustrated in the next point.

5.3 Cooperation: how UUI promotes exchanges of information and knowledge

When researchers and companies engage themselves to the level of being present together (participation), the next step for UUI is to stimulate

a deeper form of interaction whereby the two parties start to *cooperate*, that is, they exchange information and knowledge (Ibid). UUI stimulates such an exchange via AIMday by strictly orienting the discussions towards industrial problems and then identifying researchers for whom those very same problems are interesting. As explained above, university managers put a lot of effort in reformulating companies' questions so as to reach the sufficient research height but without losing their meaning to the companies. This managerial step is extremely important to ensure that both researchers and companies are not only willing to participate, but also to cooperate and thereby contribute something to the discussions. Even though SMURF seems to aim directly at the creation of an even deeper form of interaction, namely *collaboration* (see section 5.4 below), it still does not get there immediately, but the collaborations it fosters are preceded by some form of cooperation, namely when a researcher and a company engage in a rewarding exchange of information and knowledge while they attempt to formulate a joint project plan hoping to receive funding. Just as the discussions occurring during the meetings on an AIMday, the joint writing of a project application for SMURF is a way for UUI to more actively steer and push researchers and companies towards each other. According to the UUI managers, neither researchers nor companies would ever consider to involve themselves in any type of interaction if they did not recognise some type of benefit.

5.4 Collaboration and deeper forms of interaction

Collaboration means working together to develop or produce something and thus entails something more than just exchanging information and knowledge, which was the hallmark of cooperation (Ibid). This also means that collaboration is more concrete and measurable, when it comes to the utilization of science, than both participation and cooperation. Thus, the creation of collaborations is very important for interaction enablers like UUI. However, looking at AIMday, this is where the managers start to lose control, because the step from discussions (cooperation) to the creation of collaboration between the same researcher and the same company is difficult to steer. Here, at the boundary between cooperation and collaboration, there seem to be other values, such a broader contact network or better technical understanding, that may make the two parties fully satisfied and uninterested to proceed further.

However, by connecting AIMday and SMURF, UUI was hoping to increase its control over the creation of collaborations: in fact, offering funding during an AIMday increases the interest of moving from cooperation to collaboration (especially for academic researchers), which also increases the number of promising collaboration applications coming to SMURF. Thereby, UUI explicitly applies a set of specific incentives aiming to influence the very nature and depth of interaction between a researcher and a company, and makes collaboration implicitly part of a sequence of interactions that, in the hopes of the university management, might prolong into the future and transform into a form of long-term *relationship* (Ibid). However, being a third party in the dyadic interaction researcher-company (Håkansson and Snehota, 1995) reduces the possibility of the university

management to influence the dynamics of the interaction. With its current interaction-enabling tools, UUI does not have the possibility of surgically intervene in a specific researcher-company interaction with ad hoc solutions to boost it. These tools do, however, create a regular basis for interactions, which might increase the chance for some interactions to take the direction of becoming long-term relationships.

Moreover, UUI and especially its AIMday tool constantly generate what may be viewed as the weakest form of interaction, namely *contacts* (i.e., acquaintances) between academic researchers and industry. Contacts are indeed "potential interactions", which may be activated or not in the future, but which in the present result into a broader network of new contacts or deeper existing contacts (Baraldi *et al.*, 2013). Both researchers and companies highly appreciate contacts, simply thanks to their potential to lead to both rewarding cooperation and collaborations and even the development of long-term relationships, but only if needed in the future.

5.5 Connecting the different types of interaction

SMURF and AIMday are very closely connected and display a range of similarities. For instance, like during the preparatory work for every AIMday, the managers of SMURF often needed to reformulate the initial problem specified by the SME so as to establish sufficient research height and be able to engage a researcher. Thus, for any of the interaction-stimulating tools there is no guarantee that researchers or companies are willing to engage from the beginning. Instead, the hard work of reformulating questions and problems is vital for the functioning of both tools. The UUI managers have to act as intermediary to get the parties to recognize that they will benefit from interacting with one another, and then share information and knowledge or involve in collaboration projects.

However, despite these similarities, the two tools are particularly suitable for creating *different* types of U-I interactions. AIMday appears to be efficient in generating two types of interactions: participation and cooperation (see also Jonsson *et al.*, 2015). "Participation" refers to meetings where both researchers and company representatives "participate", in the sense that both parties are present together. This type of interaction is however rather weak, as the counterparts might exchange nothing more than a superficial acquaintance, in the sense that they get to know each other but no resources are exchanged or activities conducted in concerted ways (Baraldi *et al.*, 2013). SMURF, too, generated the interaction type "participation", by arranging events where SMEs and UUI managers participated, but these interactions were relevant only to SMURF's early stages.

"Cooperation" is another type of interaction which appears through both tools: its main feature is that it involves some form of action conducted together towards a goal, which might or might not be shared by both the company and the university representatives (Ibid.). At its most basic level, this joint action is information and knowledge exchange, such as the discussions conducted in AIMday's meetings, whose goal is to address the problem suggested by the company, even if researchers might

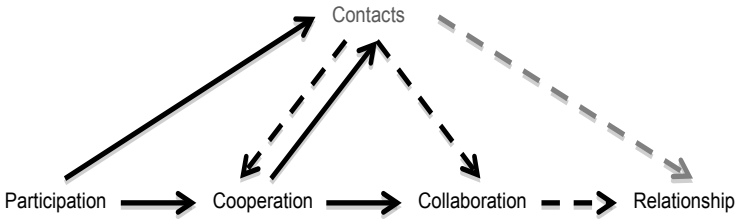
be oriented to entirely different goals, such as finding funding for their own research. SMURF also entails "cooperation", such as when researchers and companies discuss together and jointly formulate the project applications to the SMURF project group. "Cooperation" is accordingly a deeper form of interaction than "participation", even if the activities involved are only of communicative character and the resources exchanged are foremost information and knowledge.

The next type of interaction, "collaboration", entails a stronger connection between the parties than "cooperation", but, so far, it is widely visible only in the SMURF case, and appears more seldom and mostly indirectly in the AIMday case (see also Jonsson *et al.*, 2015). It is in fact a key feature of SMURF to match researchers and companies and have them conduct a joint research project, entailing a common goal, accepted by both parties and which entails conducting some form of work together. This work is also of practical character and includes activities such as research, testing and prototyping, that are not only communicative activities. Next to information and knowledge-related resources, also physical ones such as laboratory facilities and equipment can be involved in collaboration, in addition to financial resources which assume a central role as a large amount of time or other resources that are dedicated to each other and need to be paid for.

The final type of interaction, "relationship", is something that the UUI managers hope will develop as a result of continuous participation in its platforms and interaction tools. This last step in the interaction-creation process is stressed by the managers of AIMday and SMURF as something that they considered to be the end-goal of their activities and also highly sought after.

Summing up, the two reviewed tools stimulate U-I interactions that vary in terms of depth and time orientation: from shallow and time-constrained *participation*, to *contacts* (which are more long-term interactions), *cooperation* and deeper *collaboration*, all in the hope of eventually obtaining long-term *relationships* (Baraldi *et al.*, 2013). Figure 2 shows how the university managers in our cases connect these different interaction types into a process of creation of U-I interactions, which can take on different routes. In fact, this model should not be taken as linear and deterministic, because two interacting parties can always exit from the sequence and delimit themselves maybe to simple "participation" instead of moving towards a relationship, which remains a hard-won trophy in this context. Actually, the key underlying mechanism which drives the movements towards relationship is the parties' willingness to deepen their *commitment*, which in turn depends on their *trust* in each other (Jonsson *et al.*, 2015; Håkansson and Snehota, 1995).

Fig. 2: The process of creation of university-industry interactions and their connections



Source: Adapted from Baraldi *et al.* (2013)

The fact that the creation of U-I interactions is not deterministic depends not only on the will of the involved parties, but also on the *limitations* of the interaction-stimulating tools applied by university managers: for instance, AIMday seems to be a tool more apt to create cooperation but not collaboration, while SMURF was bound to finance only collaborations between researchers and companies without previous closer interactions. Furthermore, SMURF could not finance the next development steps following a concluded collaboration that could lead to more joint activities and deeper resource combinations and even a long-term relationship. The rationale was that, if the parties really value their collaboration and intend to continue for the longer-term, they should be able to commit more resources and either finance the interaction themselves or make the effort to find third-party financing, for which SMURF can provide only consultation. However, an even bigger hinder to moving to deeper types of U-I interactions is that the researchers and companies involved in the two tools see the main value for them in building *contact networks* and *exchanging knowledge* rather than concrete outputs, such as patents or new products: and this applies also for the participants in SMURF, which indeed specifically targeted collaborations.

6. Conclusions

This paper discussed how the university management intervenes in creating university-industry interactions, that is, a set of alternative mechanisms for diffusing knowledge between academia and industry (Nilsson *et al.*, 2010; Perkmann *et al.*, 2013). As for our first research question, we contribute a detailed account of how particular interaction-stimulating tools help university managers create four main types of U-I interactions, namely "participation", "cooperation", "collaboration", and "relationships", characterized by different but complementary depth and duration. As for our second research question, our results stress the importance of devising tools covering all types of interactions and of understanding the connections among them, so that interaction-stimulating tools can be used in concert. However, there seems to be challenges in moving from shallow (participation) to deeper types of interactions (especially collaborations and relationships). The deeper the

interaction becomes the more challenging it is for the university management, as a third party, to control it. Even the step of making the parties cooperate seems to demand a lot of effort from the managers of SMURF and AIMday: this is however a crucial step as this is where university management has an opportunity to steer the parties closer together by making them exchange knowledge and thereby get a better understanding of each other. Moreover, there seems to be, at the boundary between "cooperation" and "collaboration", other values pursued by researchers and companies, such as building a broader contact network or simply improving the understanding of a topic, that may make the two parties fully satisfied and uninterested in proceeding further, which would also require increased mutual trust and commitment. However, providing funding as an incentive which supplements direct commitment can help university managers to increase their control over the creation of collaborations: in fact, offering funding during an AIMday increased the interest of moving from cooperation to collaboration, which also increased the number of promising collaboration applications coming to SMURF.

Further research based on our findings includes firstly validating the process model over the creation of U-I interactions by analysing other cases from other universities. In particular, the "relationship" type of interaction deserves to be investigated more closely, something which the two chosen tools did not cover, as well as the connections between the other types of interactions and relationships: in particular, what are the mechanisms by which relationships emerge from an underlying substrate of collaborations, participations or even simple contacts?

Our results also suggest policy implications for agencies and university units engaged in the diffusion of science to society or in stimulating economic growth based on academic research. A strategy focussing on U-I interactions aiming at building relationships, or at least collaborations, with industry should not be seen as a simpler alternative to playing the "market game" which is necessary for commercializing patented discoveries. While the "market game" is difficult and risky because no licensors, customers or financiers might be found for a scientific discovery, the U-I interaction-centred approach faces the difficulties implicit in creating and controlling inter-organizational relationships (Håkansson and Snehota, 1995): it is relatively easy to create contacts, participation and even cooperation between researchers and companies, but things become more complicated when the goal is crafting actual collaborations and especially long-term deep relationships.

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