Entrepreneurship and the PhD: A case study of a doctoral mobility program

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Abstract

In the university context we see an intensified co-operation with industry which includes mobility aspects e.g. PhDs increasingly working in the private sector. This is a desirable development since it encourages network formation, knowledge transfer and innovation. Due to that we have devoted our interest to the formation of PhD students' professional networks through mobility as part of doctoral education. The following questions are addressed in this paper: 1) How could a mobility program for PhD students be designed and implemented? 2) How are mobility aspects of PhD studies affected by career plans and existing networks in the students' research teams? The data used in this study comes from a novel Swedish approach to PhD education in life science technologies - a program called AgoraLink (ALP). The results show that ALP is in many cases used to develop existing links with industry in the participants' home country and research organisations abroad. Furthermore, the PhD students admitted to extramural activities tend to have well articulated career plans and use the program to realize their ambitions. Finally, ALP seems to catalyse mobility and development of previously established contacts by providing a framework and legitimacy.

Keywords: Mobility, Entrepreneurship, PhD education, University-industry relations, Education policy

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1. Introduction

The study of formation and change in R&D networks is of vital importance for the understanding of the modern knowledge based economy for several reasons. For instance, most economic behaviour is influenced by networks of social relations, including starting new ventures, change of career paths of individuals or exchange of information and tangible resources between actors (Granovetter 1974, 1985). Entrepreneurial activities are likewise dependent on personal networks, as these can provide for example necessary knowledge, role models, employees or capital under conditions of uncertainty (Aldrich et al 1987, Liebeskind et al 1996, Zellner & Fornahl 2002, Shane & Cable 2002, Fornahl 2003, Lundmark & Waern 2008). Interaction in networks can also provide inspiration and "mental models" – i.e. sets of entrepreneurial behaviours and attributes as well as consequences which can be observed and imitated by other network members (Fornahl 2003, Colyvas & Powell 2007). Moreover, innovations are more likely to be developed in networks of actors from different types of organizations rather than exclusively inside particular organizations, especially in industries with a complex knowledge base (Powell et al 1996). Networks facilitate knowledge and information transfer between actors as well as learning, thus stimulating development and change. Various forms of knowledge can disperse and flow in networks, pertaining to fields such as organizational forms, technology, market, actors' abilities and job opportunities (Fornahl 2005).

Involvement of actors from both academia and industry in R&D networks can be considered a special case since there are considerable differences in norms and modes of operation in universities and firms respectively (Dasgupta & David 1994, Klofsten & Jones-Evans 2000). These differences can impede network formation between academia and industry thus resulting in suboptimal channels for contact and knowledge and information exchange. For entrepreneurially oriented academics for example it is necessary to establish relationships with industry in order to successfully commercialize research results (Gibbons et al 1994, Etzkowitz 2002, Nordfors et al 2003). Likewise, links to university scientists can be an important factor for success of firms, and certainly seem to be critical for biotechnology firms (Zucker & Darby 1996).

Mobility of individuals is an effective mechanism for network development, and can even be deemed essential for initial network formation to take place, since mobility is a prerequisite for face-to-face meetings and interaction (Urry 2002, Bienkowska 2007). Professional gatherings such as conferences and conventions are one form of mobility-driven activities which promote network building (Maskell et al 2006). Job change constitutes another form of mobility which can extend and develop networks (Saxenian 1994). Temporary job change or project work is yet another type of mobility which can generate or deepen links between actors.

There are few studies on the mobility of new PhDs and the associated knowledge transfer and networking effects when leaving university for industry employment (Martinelli 2001, Guellec & Cervantes 2002, Danell & Persson 2003, Stephan et al 2005, Thorn & Holm-Nielsen 2008). These studies have focused on the period after finishing the PhD project and analysed for example regional distribution and the field of the PhD study compared to the characteristics of the employer. In Sweden it has been found that approximately a third of all PhDs with a Swedish exam work in the private sector (Danell & Persson 2003). Stephan et al (2005) found that top US R&D firms hire PhDs from highly ranked programs more often than less R&D intensive firms. It was also shown that top R&D firms attract PhDs from more distant locations and that high R&D spending at universities is not necessarily correlated with the level of incubation of PhDs for the industry. There were also significant differences between regions' industrial R&D spending and its share of recruitment of new PhDs (Stephan et al 2005).

2. Aim and scope

Over the past decade there has been a growing awareness of the proactive approach being undertaken by academic institutions, many of which are adopting a direct entrepreneurial role in collaborating with industry. One example of such an approach is the AgoraLink program (ALP) described in this paper encouraging network formation, knowledge transfer and innovation. There are only a few previous studies exploring mobility aspects during the

doctoral education per se and the impact of existing networks and career plans on the mobility of the individual (see for example Avveduto 2001, Paul & Perret 2001, Gaughan & Robin 2004). Therefore, the aim of this paper is to study the formation of PhD students' professional networks through mobility as part of doctoral education. The following questions are addressed in the paper:

- How could a mobility program for PhD students be designed and implemented?
- How are mobility aspects of PhD studies affected by career plans and existing networks in the students' research teams?

Our hope is that this study will bring more insights in the career development of doctoral students and education policy. Adding a new dimension into the PhD education might increase academic entrepreneurship resulting in increased knowledge transfer and commercialization of R&D results.

3. Method and data

The paper is based on a case study of ALP. We have had the unique opportunity to follow the development of ALP as it has evolved from vague idea to an ongoing program. The authors have been invited to participate in leading core group and board meetings as well as gatherings with ALP participants. Data collected for the paper comes from the following main sources:

- In-depth interviews with 10 out of 14 doctoral students admitted to ALP and with leading core group of ALP
- Written mobility plans of PhD students, stating e.g. contact persons and timetables
- The candidates' application forms describing merits, why they apply to ALP and attitude towards external networking, commercialisation of R&D and entrepreneurship
- The supervisors' letters of support for PhD students' applications to ALP

For collection of data concerning PhD students' activities within ALP semi-structured interviews were used each lasting between 45 minutes up to an hour. A considerable part of the interviews was devoted to discussing the spinning activity (see below) where the doctoral students are supposed to circulate between firms, public health service organizations and research departments other than their own. The interviews were conducted during the process of choosing spinning locations, before the actual visits.

4. Design and implementation of ALP

In 2007 The Swedish Governmental Agency for Innovation Systems (VINNOVA) launched a call for proposals aiming at increased interactivity between existing research schools and commercial and industrial life through excellent research centres. In the guidelines for proposals it was suggested that this should be done through a number of activities such as building networks with businesses and other actors in the public sector, PhD courses directly or indirectly addressing commercialization issues, facilitating mobility of researchers and general inspirational and attitude changing activities supporting innovative thinking. At Linköping University initiatives emerged from two different graduate schools but with advice from VINNOVA a decision was made to jointly apply for funding. A group of eight people representing different areas of research, e.g. medical engineering, applied physics, innovation and entrepreneurship was formed to develop ideas and write a proposal. A half year later the proposal was sent in and got a very positive response from VINNOVA and a contract was signed which allowed the start-up of a new initiative - ALP. The program got a budget of 12 million SEK (1.2 million Euros) for a period of 4 years. ALP became located at the Department of Biomedical Engineering at Linköping University.

The basic idea behind ALP is to strengthen industrial relevance in the graduate education within life science technologies. ALP will through various courses and training schemes educate researchers, who are adapted for the medical engineering industry and simultaneously have solid knowledge about the health care system. This orientation is due to the fact that within the next decade there will be an increased number of elderly people which

will put new and heavy demands on the health care system. This will increase the need for distributed care, while hospitals will become more specialised and will demand more high-tech biomedical engineering-solutions.

One way to make this emerging health care more efficient is to develop novel medical engineering solutions for distributed care and new technical solutions especially in image based diagnostics and therapeutics. There are new possibilities in for example image science, biosensors, nanoscience and molecular biology, and especially in the combination of these. Another reason behind starting-up the program was the belief of the leadership of ALP that industry and academy could benefit from networking and learning more on what is needed to make methods work in the medical care and to that adding skills in innovation and entrepreneurship. The operative plan for ALP includes the following main activities:

- "Spinning" addressed to PhD students to stimulate mobility between industry and university
- "Twinning" targeted to senior faculty in order to facilitate co-operation between disciplines
- PhD courses within a wide range of subjects e.g. medical engineering, cardiovascular physiology, cell and molecular biology, molecular imaging, entrepreneurship and intellectual property rights
- Entrepreneurship program aimed to promote those individuals who have business ideas and plan to start new ventures

ALP has to date been running for 1.5 years and is led through a board of directors consisting of people from research and industry, the initial core group of four researchers (representing fields such as entrepreneurship, medical engineering, image visualization and physics) and a part time director. A first prioritised activity has been to attract new PhD students, organize PhD courses for this group, and start the spinning activity.

ALP got positive attention and a group of 14 PhD students was recruited to the program in 2008. Their educational background varied from engineering and physics to medicine. To be accepted to the ALP each individual had to pass a personal interview and to write a formal application expressing the attitude towards commercialisation of R&D, relationship with industry and entrepreneurship in general. Another selection criterion was that the admitted PhD students shouldn't have passed halfway through their doctoral education. To the application, each student had to attach a supportive letter from the supervisor to participate in the program. During 2008 a handful of PhD courses were organised and especially those dealing with entrepreneurship and intellectual property rights were well attended.

In the autumn of 2008 the PhD students started choosing their spinning locations. The idea behind spinning is that it allows the PhD students to broaden their understanding of commercial processes necessary for business development alongside with their ordinary education at their home departments. According to the program's requirements all ALP students should visit two different external organisations for 2-6 weeks per location over the next coming years. One of these organisations should be a private firm; the other can be for example a research group or a medical clinic. Locations for the spinning visits are chosen by the students themselves, in collaboration with their supervisors. The additional costs for the visits are paid for by the program.

For the moment there is a discussion in the board of ALP concerning a coaching activity as an addition to spinning. This would support the PhD student in selecting spinning locations by giving new perspectives on the choice and helping identify new opportunities, as well as provide advice with regard to potential commercialisation issues and career support in general.

5. Development of PhD students' networks through mobility

The following part of the paper focuses on the spinning activities included in ALP that promote network development and give the PhD students possibilities to experience organizations other than their home department first hand.

Ten of the fourteen PhD students admitted to ALP have been interviewed for the purpose of this paper. The majority had an educational background in engineering, while two students had a diploma in medicine. Half of the interviewees were PhD students at the Department of Medical and Health Sciences and its Center for Medical Image Science and Visualization. The other interviewees were affiliated to the Department of Biomedical Engineering, Department of Physics and Department of Clinical and Experimental Medicine. Three of the interviewed PhD students were female. Out of the ten interviewees four expressed that they would prefer working in industry after the completion of their PhD thesis (among these were all interviewed female PhD students). Three would like to continue doing research as university employees, while three would prefer to start their own firms.

The requirements of ALP demand two spinning visits per student, at least one of these at a private sector firm. Time limit for the visits is set to between two and six weeks. ALP provides the students with a fixed amount of funding (approximately ten thousand Euro) that can be spent on the additional costs incurred by the spinning visits. From the PhD students' point of view the main contribution of ALP lies not only in the generous financial support, but also in providing a framework and motivation for mobility and for developing external contacts with firms and research groups. Due to factors such as pressure to finish PhD thesis within given time limits spinning visits would have low priority for the PhD students had they not been admitted to ALP. Moreover, ALP brings with it legitimacy towards the spinning locations, which makes contacting them and planning to visit them easier for the PhD students. Most interviewees stated that they would have not made spinning visits without the support of ALP, and those who would have visited external organizations anyway believe that they would be there for a shorter period of time than what is required by ALP (i.e. only for a few days).

PhD students' choices of spinning locations provide interesting material for the study of R&D network development. Twenty spinning locations have been chosen by the ALP students (two per student), ten of these in industry, eight research departments, one public organization and one foundation in the process of commercializing research results. We have identified four basic rationales for choices of locations among ALP students.

A majority of chosen locations (twelve out of twenty) were already established contacts of the PhD students' research groups and were often suggested by the supervisors as suitable spinning locations. These were both industry and research department locations. In some cases they were considered to be the leading industry or research actors in their fields, in other instances they were deemed as relevant for the PhD students' projects. The second rationale for choice of locations was the usage of certain technology in research projects (e.g. software platforms) and the willingness to visit the firms providing the technologies without being engaged in any previous collaborative projects. The entrepreneurially interested PhD students were inclined to choose based on this rationale. Another strategy for choosing a spinning location has been to identify a leading research group with some relevance to the PhD project and some contact channels but no earlier cooperation. This strategy was pursued by those who expressed interest in a future career in research. The fourth and least used rationale was to pick a firm or a research group active in the same area as the PhD student, but with weak or no previous contacts.

A particular geographical pattern emerges from the ALP students' spinning plans. Out of ten chosen private firms eight are located in PhD students' home country and three of these are in the same region as their university department. On the other hand, the chosen research departments are all located elsewhere in Europe, except for one that instead is to be found in California. This result points to a strong preference towards national mobility between university and industry and international mobility when it comes to research collaborations involving universities. This is probably in large parts a reflection of existing networks of supervisors and research groups.

Choices of spinning locations were also influenced by the PhD students' career plans, not only their current research projects. We could observe a general match between the type of locations the students have chosen and their thoughts concerning future career after completion of thesis. For example, students interested in working in industry often chose private firms as their first spinning locations. Furthermore, eight out of ten interviewees would

consider taking a job and/or applying for a postdoc at their chosen firms and research departments. The other two interviewed PhD students regarded spinning as an opportunity to gain important experiences and develop contacts, but couldn't see themselves working at their spinning locations.

6. Conclusions and Implications

This paper has focused on one important aspect of university-industry co-operation namely networking and mobility activities within the PhD education aimed to encourage network formation, knowledge transfer and innovation. In particular we have been interested in how such activities could be designed and implemented and how they are related to the career plans of the PhD students and existing networks of their research teams. The literature review showed that studies like these addressing extramural issues of an ongoing PhD education are rare which indicates that there is a need for further research concerning career development of doctoral students and education policy. Moreover, our hope is that this study will advance the development of programs in the spirit of ALP which will increase the level of academic entrepreneurship resulting in successful knowledge transfer and commercialization schemes.

Three major conclusions have been drawn from this study:

- A majority of the candidates have (by their own or through the research group) already established contacts with industry and research organisations. They will use activities such as ALP to deepen those contacts. ALP gave the PhD student both the necessary push and developed the legitimacy to approach the actual environment.
- There are notable geographical differences in the choice of industry and research environment. Students prefer to develop industrial relationship within their home country but prefer to go international when it comes to research based relationships.
- The candidates have a clear vision of their future career and use ALP as a tool to realize their ambitions.

It is important to be aware of the fact that the PhD students that have chosen ALP have a profound interest in extramural activities during their studies and this has naturally affected the results of the study. It might not for example be the case that PhD students in general have such developed network with industry. As shown in Klofsten & Jones-Evans (2000) there are severe differences between academic disciplines e.g. that technical departments have a tendency to work closer with the industry than their humanity counterparts. However, independent if the candidate has a relationship with the industry it seems that there is a real need for an organised framework to promote mobility and networking such as ALP, since it is not the norm in a university to have such organised interaction, at least not with the industry (Dasgupta & David, 1994). To add coaching to the spinning activity might open up new opportunities for candidates to get in touch with organisations that they normally wouldn't consider. Such service would possibly give the PhD student a push forward in they career planning as well. The successful implementation of programs like ALP depends on entrepreneurial intentions within the academic system as well as supportive public financing bodies, and previous contacts with industry, research organisations and other R&D institutions across the participating departments (c.f. Etzkowitz 2002).

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