

**Situated learning in university Knowledge Transfer Offices:
'science push' and match-making approaches to
commercialisation of academic research**

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Abstract

University Knowledge Transfer Offices (KTOs) need a wide range of capabilities to support effective commercialisation of academic research. Our understanding of the learning process through which such abilities are developed and refined over time remains limited. This paper takes a practice-based view on organisational knowledge and learning to address this gap in the literature. The case studies of six university KTOs in the United Kingdom reveal that KTOs develop different approaches to commercialisation. Two type of commercialisation practice are identified – each based on different implicit assumptions about generating science-based innovation and associated with a different set of abilities. The paper illustrates how situated learning of KTO's staff and strategic actions of KTO and university management transform commercialisation practices over time. The implications for future research, practice and policy are discussed.

1 Introduction

Universities have been evolving in order to play a more prominent role in innovation and economic development in a knowledge-based economy (Etzkowitz and Leydesdorff, 1997; Etzkowitz and Leydesdorff, 2000). Previous studies reveal university Knowledge Transfer Offices (KTOs) need a wide range of capabilities to support commercialisation of academic research, including abilities to protect Intellectual Property (IP) (Meyer and Tang, 2007), to perform technical and commercial assessment of IP (Ndonzuau et al., 2002), to market academic inventions to potential licensees and investors (Markman et al., 2005; Siegel et al., 2004), to handle contract negotiations (Siegel et al., 2003) and to develop new businesses (Lockett and Wright, 2005). The development of these abilities is not easy; for instance, Lambert (2003: 55) states that the skills required for commercialisation activities are “difficult to find in a small group of people and are expensive to buy in”. Several scholars note that some university KTOs lack certain abilities, such as marketing (Siegel et al., 2004), which they argue are crucial for identifying suitable licensees and potential investors for spin-out companies. Some university KTOs have developed practices that are bureaucratic and cumbersome and are not taking account of the differences between the academic and corporate worlds (Siegel et al., 2003). This suggests that further learning is required in some KTOs.

The academic literature on an entrepreneurial university offers few insights into how university KTOs develop and refine the abilities required for commercialisation. Some scholars comment in passing on the nature of the KTOs’ learning (Cardozo et al., 2011; Debackere and Veugelers, 2005; Mowery et al., 2002), highlighting the importance of learning on the job. Others look at the costs of capabilities development, but do not analyse the learning process (George, 2005). Few, if any, studies look systematically at how and why the abilities of university KTOs, which are vital for effective commercialisation, are

developed and refined over time. In order to address this identified gap in the literature the study presented here addresses the following questions: What KTOs learn? How KTOs learn? Why KTOs learn?

2 Theoretical framework

2.1 Rationale for a practice-based view of learning

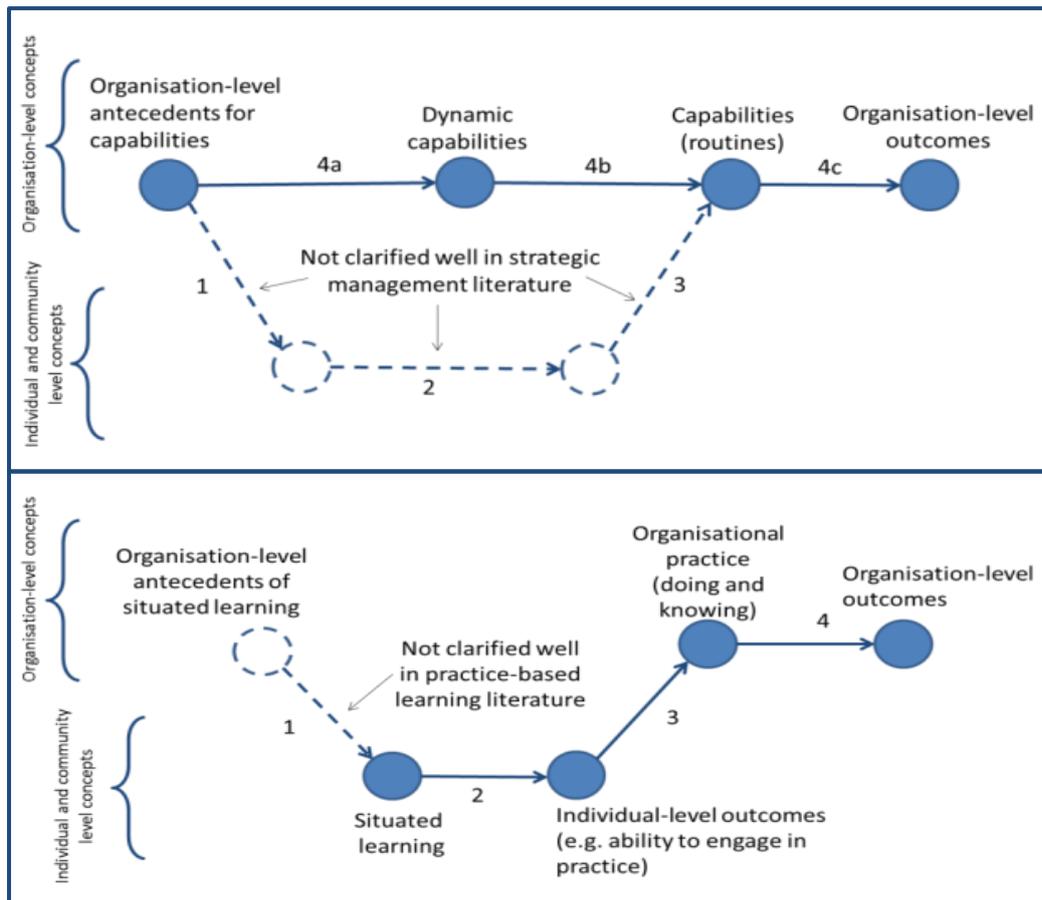
Most previous studies that examine knowledge and abilities required for commercialisation of academic research take the capability perspective (e.g. Lockett and Wright, 2005; Markman et al., 2005; George, 2005; Rasmussen and Jarl, 2010). Such studies imply that certain capabilities will increase the number of licence deals between a university and industry and lead to creation of more spin-outs. Other studies refer to ‘practices’ to express what KTOs are able to do (Siegel et al., 2003) and distinguish practices enhancing and inhibiting commercialisation of academic research. The insights from these studies are very useful in explaining what knowledge and abilities of TTOs enhance commercialisation performance but they do not shed light on *how* these important capabilities or practices are developed. It is argued here that since the importance of the KTO abilities for commercialisation performance was established, it is commendable to understand how they are learnt.

The research questions presented above call for a conceptual framework that explains the learning processes. The comparison of suitability of the capability-perspective and the practice-based perspective favours the latter. The literature on practice-based learning introduces the concepts of situated learning and communities of practice (COPs) and networks of practice, which explain the processes through which new knowledge is created by individuals in social interactions. In other words, situated learning theory pays explicit attention to the learning processes at the individual and group level of analysis, that are typically black-boxed in the capability framework (compare arrows 2 and 3 in the upper and lower parts of

Figure 1 below).

Moreover, the capability framework directs attention towards changes in routines whereas situated learning theory encourages investigation of changes in practice, which comprise changes to routines as well as actions, methods, tools, words, stories, gestures and symbols (Wenger, 1998). It would be inaccurate to assume that the commercialisation of academic research has been routinised in all university KTOs. Some universities have only introduced institutional support for this activity in the 2000s; also, each commercialisation project is likely to be different making it difficult to routinise actions. Thus, the conceptualisation of organisation-level learning outcomes from the practice-based perspective seems to be more appropriate for the purposes of this study.

Figure 1. Comparison of explanatory power of alternative conceptual frameworks



However, it is important to note that the conceptual apparatus of the situated learning theory offers limited insights into the effects of organisation-level phenomena (e.g. strategies) on individual/group learning (arrow 1 in **Error! Reference source not found.**). While the learning initiated in a bottom-up way within COPs is well understood, the understanding of situated learning triggered by the management is limited. This is problematic since the organisational strategies were found to play a significant role in research commercialisation (Degroof and Roberts, 2004; Roberts and Malone, 1996; Powers and McDougall, 2005; Bray and Lee, 2000). In order to address this shortcoming, the theoretical framework will combine the concept of “situated learning” and “strategizing as practice” to account for situated learning triggered in a top-down way.

2.2 Understanding abilities of university KTOs through their practice

Carlile (2002) defines practice as a set of observable activities that are related to a particular organisational function. Practice is social because it is socially negotiated. It's argued here that the commercialisation of academic research is a kind of social practice. There are always a number of actors that engage with one another and negotiate how the commercialisation activities should be performed. The commercialisation practice consists principally of such activities as: (1) identifying commercialisation opportunities; (2) assessing academic inventions (Ndonzuau et al., 2002); (3) if necessary, protecting Intellectual Property (IP) (Meyer and Tang, 2007); (4) marketing academic inventions (Markman et al., 2005; Siegel et al., 2004); (5) managing relations with commercial organisations (Siegel et al., 2003) (6) documenting commercialisation projects.

Gherardi (2000) highlights that knowing and doing are inseparable elements of practice. The term 'knowing' is favoured by some scholars who adopt the social constructivist perspective over the more conventional 'knowledge' (Amin and Roberts, 2008a; Gherardi, 2000; Orlikowski, 2002; Blackler, 1995). Knowing is part of practice (or action) as opposed

to knowledge, which is often understood as an object possessed by individuals or groups (Cook and Brown, 1999). Knowing is reflected in one's doing. Orlikowski (2002) in her study of new product development practice observed work activities and inferred what 'knowing' was necessary to perform these activities. Similarly, examination of work activities performed by university KTOs will allow to identify the knowing (abilities) that is needed to commercialise academic research. Social practices are reproduced and transformed through situated learning (Wenger, 1998). Learning will result in changes to practice, that is, in changes in both 'doing' and 'knowing'. Although Orlikowski looks at 'practice', not at 'change in practice', I argue that her analytical logic can be applied to examine changes to practice. Changes in 'doing' are observable, and changes in 'knowing' (ability to perform an activity) can be inferred from the changes in 'doing'. By examining changes in the KTO's performance of commercialisation activities one can draw conclusions about what has been learnt in a KTO.

A practice-based view of knowledge has a potential to provide a more nuanced understanding of KTO abilities than the approaches in the literature on the commercialisation of academic research. Some previous studies assume that KTOs either have a certain capability or not (e.g. ability to identify licensees (Markman et al., 2005)). A practice-based view suggests that different ways of doing – i.e. different approaches to commercialisation – may reflect different abilities, rather than their lack. Moreover, the analysis of work activities constituting commercialisation practice will offer more holistic view of abilities of university KTOs in comparison to some previous studies that focused on a role of a single capability (Markman et al., 2005; Lockett and Wright, 2005).

2.3 Situated learning in university KTOs

Situated learning occurs when people learn by *participating in social practice*, that is, through interactions with others in the pursuit of shared activities in a particular social and

historical context (Lave and Wenger, 1991). This social constructivist perspective is based on the assumption that “learning occurs, and knowledge is created, mainly through conversations and interactions between people” (Easterby-Smith et al., 2000: 787). This means that knowledge is socially constructed during these interactions, through the active process of meaning construction or meaning inference (Boland Jr and Tenkasi, 1995).

A COP is a social locus for learning (Brown and Duguid, 1991; Lave and Wenger, 1991; Wenger, 1998). The concept of COP was proposed by Lave and Wenger (1991) in their ground-breaking work on situated learning, and was used to describe an informal, emergent group of people who “participate in an activity system [practice] about which participants share understanding concerning what they are doing and what that means in their lives and for the community” (Lave and Wenger, 1991: 98). As the result of interactions, members of a COP develop a shared understanding, for example, about what to do and what not to do, and how to do it, how to engage with others, what routines to follow, what tools to use and how and under what conditions. Social interactions among COP members can be a source of experiences in which an individual learns something that is new to him or her as well as to the whole community (Brown and Duguid, 1991; Lave and Wenger, 1991; Wenger, 1998). It is argued here that KTO staff learn in COPs, that is through interactions within informal groupings of managers engaged in commercialisation practice. This assumption is in line with comments made by other scholars. For example, Debackere and Veugelers, (2005: 339) note that learning in KTOs takes place on the job “through experimentation” while Mowery et al. (2002) argue that KTOs learn patenting “by doing”. It is expected that COPs of knowledge transfer professionals will display the characteristics of a ‘professional COP’ (Amin and Roberts, 2008b), such as, the importance of specialised expert knowledge acquired through education and training, the collocation of COP members, and the development of formal regulatory institutions. Since ‘professional COPs’ (e.g. healthcare or

education professionals) tend to generate incremental innovation (Amin and Roberts, 2008b), it is expected that learning within COPs in a KTO will result in incremental changes to commercialisation practice.

COP members also learn through interactions with ‘outsiders’. First, KTO staff may engage with individuals undertaking commercialisation in other university KTOs, as mentioned in passing by Cardozo et al. (2011). Brown and Duguid (2001) coined the term ‘networks of practice’ (NOPs) to describe the network of loosely connected people who engaged in the same or very similar practice but are dispersed geographically. In such networks, knowledge can be shared relatively easily based on the individuals’ overlapping knowledge bases (Knorr-Cetina, 1999). Tagliaventi and Mattarelli (2006: 296, emphasis added) argue that “networks of practice provide their members with the opportunity to *confront, modify, and combine their practices*, resulting in new knowledge available to their own communities and organizations.” Second, interactions with members of different COPs also create an opportunity for learning (Nooteboom, 2008; Amin and Roberts, 2008b). Sharing knowledge across COPs can be problematic because different practices entail different languages (or professional jargon), values, norms and general worldviews (Brown and Duguid, 2001). Nonetheless, interactions across COPs generate an opportunity for cross-fertilization and for the discovery of different way of working (Tagliaventi and Mattarelli, 2006). In the course of their everyday duties, KTO staff interact with a number of individuals who are likely to belong to different COPs, for example, academics, patent attorneys, venture capitalists, or entrepreneurs.

2.4 Drivers of situated learning in university KTOs

The situated learning theory assumes that even when the practice is influenced by external circumstances, practice, to some extent, is always a collective response of the community to what community members understand to be their situation. This is a constructivist view of

context, according to which context or a situation “is considered to be something that acquires form and springs from the actors involved in the situation, who select the elements of that situation” (Gherardi and Perrotta, 2011: 3). This view highlights the agency of COP members who “select” the problems and opportunities to which they respond and downplays the need to conceptualise the context in which COPs operate. I argue that this approach does not allow realising the full implications of the fact that situated learning occurs within hierarchical organisations (Weckowska, 2013). The impact of organisational context on learning in practice in university KTOs may be significant. For instance, Litan et al. argue that some universities have enabled their KTOs to develop effective support for commercialisation of academic inventions, but “in too many other cases, university leaders have backed policies that encourage KTOs to become bottlenecks rather than facilitators of innovation dissemination.” (Litan et al., 2008: 32). These authors are particularly concerned with the practices of centralised KTOs operating within universities that focus too much on maximising the revenues from licensing rather than maximizing the volume of innovation outputs. It can be concluded that a top-down management strategy can affect what the KTO learns.

In order to conceptualise management practices that potentially trigger and shape learning and knowledge creation by COP members, I refer to studies that take a practice-based view of organisational strategy. These studies understand strategising as practice (Johnson et al., 2003; Pye and Pettigrew, 2006)² and blur the boundaries between strategising and organising by emphasising daily managerial practices involved in making strategic decisions and

² Note that, although studies of strategising and organising look at strategies using a practice lens, they do not fully embrace the practice-based view of learning and knowing. There seems to be an implicit cognitive view of learning and knowledge according to which the role of managers is to provide information and knowledge to be processed by employees and implemented (e.g. Jarzabkowski, 2003). In the practice-based view of learning, the role of managers is to change the patterns of participation and interaction through which learning occurs, or to engage with employees in order to give particular meaning to employees’ activities and, in this way, to try to alter subordinates’ practice. This paper takes a practice-based view of learning and thus rejects the possibility that managers simply transfer their knowledge to employees.

organising work. The strategic practices include: controlling practices, communicating practices (Whittington et al., 2006), direction-setting practices, monitoring practices and resource allocation practices (Jarzabkowski, 2003). These strategic practices may change the cognitive, material and social resources available to COP members and, therefore, trigger and shape the learning trajectories of these communities and the evolution of their practices. Management may play particularly important role in stimulating learning that challenges the status-quo (Swan et al., 2002; Anand et al., 2007; Thompson, 2005). While taking into account the impact of management on situated learning, it's recognised here that some changes to practice may be introduced on the initiative of the KTO staff. The problems and opportunities may arise in the pursuit of practice and COP members may spontaneously respond to them (Brown and Duguid, 1991; Anand et al., 2007).

3 Methodology

3.1 Case study selection

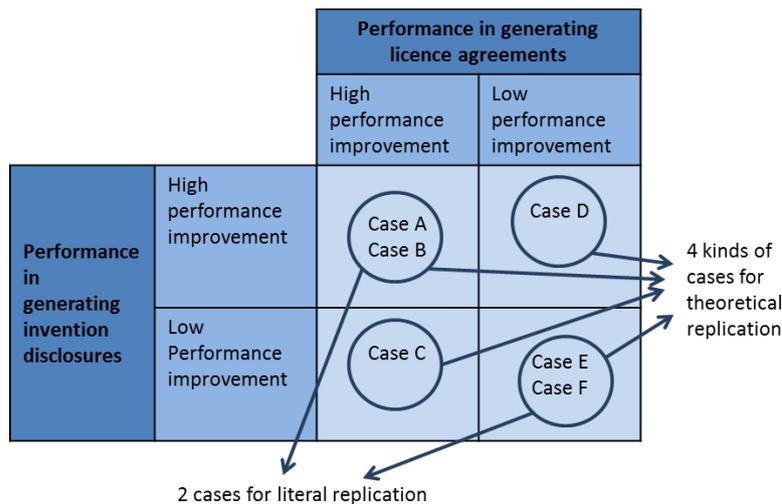
This research is based on case studies of commercialisation practice in 6 university KTOs in the United Kingdom (UK). The UK is among those European countries with arguably the most advanced infrastructures supporting university-industry knowledge transfer, which makes in an appropriate empirical context for this study.

The ideal approach is to select a number of cases with different learning outcomes and show that the differences in outcomes arise for predicted reasons. In other words, it is desirable to select cases of different changes in practice. However, information on changes in each KTO's practice was not available prior to the fieldwork. I use *change in commercialisation performance* as an imperfect approximation of changes in a KTO's practices. Information on commercialisation performance is available in the Higher Education – Business and Community Interaction surveys published by the UK Higher

Education Funding Council for England (until 2009) and Higher Education Statistics Agency (since 2010). Based on the assumption that different patterns of changes in commercialisation performance are related to different changes in commercialisation practice, I looked at two measures of performance: number of inventions disclosed by academics to the KTO, and number of licence contracts arranged by the KTO. The number of internal invention disclosures is strongly correlated with the number of patent applications. It is thus assumed that increases in the number of disclosed inventions will be related to KTO learning to identify and assess inventions and manage IPR. Increase in the number of completed licensing deals is believed to be associated with learning to market academic inventions, identify licensees, and negotiate licence contracts with established companies or spin-out companies.

Selected KTOs differed in terms of commercialisation experience. Two selected KTOs were based in Russell Group universities (KTO A and F) and had more than two decades of commercialisation experience. Three KTOs were located in universities belonging to 1994 Group and were operating for about a decade (KTO B, C and D). One KTO was based in a universities from Million+ Group and had only 3 years of in-house commercialisation experience (KTO E).

Figure 2. Replication logic in case study selection



Multiple cases were selected to show that the same learning outcomes occur for theoretically known reasons (literal replication) and that different learning outcomes occur for theoretically known reasons (theoretical replication). Figure 2 portrays the logic of case study selection. In summary, the selection of KTOs aimed at identifying cases with different learning patterns in order to maximise insights gained from cross-case comparisons as well as at literal replication of findings.

3.2 Data collection and analysis

The analysis is based on data collected from semi-structured interviews with key staff in selected KTOs and on information from relevant documents. Operational definitions of the key concepts (practice, change in practice, learning in a COP, in NOPs and across COPs, strategic practices of management) were created and appropriate interview questions were designed. Different interview protocols were prepared to guide the conversations with KTO directors and KTO staff. Three pilot interviews were conducted in October and November 2010 as a result of which the interview protocols were adjusted slightly in order to deal with time constraints and to ensure clarity of the questions. The main interview programme was carried out between December 2010 and May 2011. A total of 34 interviews were conducted: 31 face-to-face and two telephone interviews. The interviews took place at the KTO's

facilities and were conducted one-to-one. They lasted around 1.5 hours, and were digitally recorded and transcribed. At the beginning of each interview, the purpose of the research project was explained and the structure of the interview outlined. Each interviewee was assured about confidentiality and anonymity. The interviews focused on learning and changes in practice that occurred after 2005.

The data analysis follows the ‘explanation building’ technique (Yin, 2009). First, I examined whether learning took place at all in each case. Next, changes in practice were identified and explanations of how they came about were developed. The last step in the analysis was cross case-study analysis. In accordance with Yin’s (2009) recommendations, each case study was treated as a separate study and the cross-case comparison was aimed at aggregating the findings from all six cases. The analysis was completed with the help of NVivo, a computer assisted tool for qualitative data analysis. The tool was used to code and categorise textual data and to make connection between the explanans and the explanandum. The findings from six case studies are presented below.

4 Findings: two learning trajectories

Analysis of evolving commercialisation practice in six cases shows that KTOs develop different approaches to commercialisation. Two types of commercialisation practice were identified. The different ways in which commercialisation activities are performed (i.e. ‘the doing’) and the associated abilities (i.e. the ‘knowing’) (Orlikowski, 2002) are presented in Table 1.

The first approach to commercialisation is distinguished by (1) the ability identify commercialisable IP (research outputs), (2) ability to assess the appropriability of IP, (3) ability to identify “buyers” for IP, and (4) ability to make one-off transactions with commercial organisations. This type of KTO commercialisation practice is referred to as *IP-*

focused commercialisation practice because of its strong focus on scientific outputs – that is on the Intellectual Property. The IP-focused approach to research commercialisation was observed in KTO D, E and F. The distinctive features of the second approach to research commercialisation include (1) ability to identify research with potential for commercialisable outputs, (2) ability to assess the commercial viability of academic inventions, (3) ability to identify commercial partners for academics, (4) ability to build partnerships between the university and commercial organisations. This type of commercialisation practice is referred

Table 1. The characteristics of IP-focused and match-making commercialisation practice

IP-focused commercialisation practice		Activity	Match-making commercialisation practice	
Knowing aspect of practice	Doing aspect of practice		Doing aspect of practice	Knowing aspect of practice
Ability to identify commercialisable research outputs	Waiting to be informed by academics; raising awareness among academics of support for research commercialisation	1. Identification of commercialisation opportunities	KTO staff develops close relations with academics to keep on top of progress in academic research	Ability to identify research with the potential for commercialisable outputs
Ability to assess appropriability of Intellectual Property	Assessment of legal aspects (ownership of IP, patentability), and technical development (progress and resource needs for further development); desk-based market research to speculate about potential applications and financial returns	2. Assessment of Intellectual Property	Assessment of legal aspects and technical development; early desk-based market research to identify the players in the relevant industry; Early interactions with companies that launched products based on similar technologies in order to estimate the value that the university's technology can add to a product	Ability to assess commercial viability of academic inventions
Ability to record IP and IPR-related information	Keeping records of contracts, IP, IPR-related information and financial information	2. Record keeping	Keeping records of contracts, IP, IPR-related information and financial information and information about market engagement	Ability to record IP, IPR-related and market-related information
Ability to secure financial and human resources for exploitation	Help with identify funding for further development of inventions; identifying commercial teams for spin-outs; mentoring academics during commercialisation process	3. Securing resources for IP development and exploitation	Help with identifying funding for further development of inventions (e.g. proof-of-concept work, seed funding); identifying commercial teams for spin-outs; mentoring academics during commercialisation process	Ability to help secure financial and human resources for exploitation
Ability to disseminate information about academic invention into industry	Online and off-line distribution of marketing materials	4. Marketing of Intellectual Property	Online and off-line distribution of marketing materials	Ability to disseminate information about academic invention into industry
Ability to identify "buyers" for university's Intellectual Property	Reliance on contacts of academics whenever possible; 'First come, first served' approach One-way communication		Identification of potential licensees through the use of an academic's contacts and by means of market research; Talks with a number of potential licensees; Two-way communication	Ability to identify partners for the academics
Ability to make one-off transactions with commercial organisations	Focus on maximising financial gains from licensing; protecting interests of the University; retaining IP ownership whenever possible	5. Managing relations with commercial organisations	Focus on maximising opportunities for research collaborations; licensing as "hooks for research contracts"; securing a win-win deal while protecting interests of the University; Management of the relation with a licensee or a university-owned spin-out	Ability to build partnerships between university and commercial organisations

to as *match-making commercialisation practice* because of its strong focus on building relations between universities and industry. The match-making commercialisation was observed in KTO A, B and C. Situated learning in KTOs with each type of practice is discussed below in turn.

4.1 Learning to perform IP-focused commercialisation practice

How KTOs learn? Learning in KTOs with IP-focused practice occurs through interactions within COPs and NOPs. The interactions across COPs were not found to be a significant source of new knowledge. The COP members share knowledge and improve their shared practice. It is thus important who the members are and what their ‘joint enterprise’ is. A strong COP comprising business development managers was identified in each KTO with IP-focused practice. The main ‘joint enterprise’ of business development managers was bringing income to the university (e.g. increasing research funding, marketing expertise of academic staff, identifying opportunities for consultancy projects or professional development courses for external organisations). Commercialisation activities were not perceived as their core work. Business development managers were involved in identifying commercialisation opportunities and, to some extent, in marketing academic inventions but their engagement in other aspects of commercialisation was minimal or non-existent. In two smaller KTOs, the IP managers were peripheral members of the COP whereas in the larger KTO IP managers responsible for protection of IP and IP contracts formed a separated COP. The COP members seem to view knowledge transfer as sales of the university’s knowledge. With regard to research commercialisation, there is an implicit assumption that the outputs of research can be passed on to industry, which will turn them into innovation. In other words, there is an implicit assumption that the innovation process is linear and that scientific discovery in the university is followed by technological development in companies, and that there is no need for feedback loops and long-term relations. This implicit assumption also underpins the early

model of innovation known as the technology-push or science-push model of innovation (Godin, 2006).

What KTOs learn? KTOs with IP-focused practice were found to learn through interactions within COPs and NOPs to improve or develop *predominantly three activities*. First, learning shaped changes in assessing appropriability of academic inventions (e.g. introduction of a disclosure form or a questionnaire assessing the technological robustness, inventors' motivations and a size of a potential market). Second, these KTOs also learnt to improve the way in which IPRs and income-generating activities are recorded (e.g. introducing databases such as 'My IP' or internal spread sheets). Third, they also learnt how to secure financial and human resources for IP exploitation (e.g. training entrepreneurial academics to run a company or identifying surrogate entrepreneurs to manage a spin-out). No examples of learning how to do marketing of university IP or how to manage the relations with the commercial organisation were identified.

Why KTOs learn? KTO staff identified problems in the way their commercialisation activities were carried out and opportunities to improve them on their own initiative and learnt through interactions in COPs and NOPs to make changes to practice. Learning new activities, on the other hand, was always instigated by the KTO management. One of the KTOs was in the process of institutionalising commercialisation activities which used to be outsourced. In this case the role of KTO management in triggering and endorsing learning in the COP was particularly pronounced.

4.2 Learning to perform match-making commercialisation practice

How KTOs learn? As in the case of KTOs with IP-focused commercialisation practice, learning here occurred through interactions within COPs and NOPs. Additionally, changes to practice in KTOs with match-making practice were informed by interactions across COPs, for example, interactions with venture capitalists, patent agents, commercialisation

consultants, and surrogate entrepreneurs managing university spin-outs. In smaller KTOs, an internal COP comprised managers responsible for all aspects of research commercialisation (points 1-5 Table 1). In a larger KTO, there were (1) a COP focusing on identifying commercialisable know-how and research with potential for commercialisable outputs but also involved in assessing commercial viability of inventions and marketing and (2) a COP focusing on IP exploitation as well as assessing and marketing IP. The overlapping work activities facilitated knowledge sharing across two COPs within the KTO. Thanks to the shared or overlapping work activities COP members had an understanding of the whole commercialisation process. Their practice was underpinned by implicit assumptions that the innovation process is not linear, that scientific discovery must be matched with industry needs and capabilities, and that two-way communication between academia and industry and the collaboration of market and R&D experts are crucial. The same assumptions underpin the 'coupling model of innovation' described by Rothwell (1994).

What KTOs learn? KTO A, KTO B and KTO C were found to learn to improve or develop *all activities* related to commercialisation. KTO B and KTO C were learning to transform their IP-focused practice into a match-making practice whereas KTO A learnt to improve its match-making practice. KTO B and KTO C were found to learn to assess commercial potential of inventions in addition to assessing patentability and technical robustness whereas KTO A learnt to systematise their assessment of inventions. KTO B and C learnt to approach larger number of potential licensees in order to identify a commercial partner rather than a "buyer". KTO A, which already aimed to identify partners, learnt how to make marketing materials more "business friendly". All three KTOs learnt to manage the relations with commercial partners (e.g. negotiating win-win deals (KTO B), improving communication with the licensees (KTO C), managing equity in spin-outs (KTO A)). We also observed examples of learning how to secure financial resources for development of IP

(KTO B) and how to identify research with potentially commercialisable outputs rather than waiting to be informed about the research outputs (KTO B and C). This approach to identifying IP helps to avoid rushed patenting.

Why KTOs learn? On their own initiative KTO staff learnt through interactions in COPs and, in few cases, in NOPs how to improve already existing commercialisation activities. Learning new activities in a KTO with established match-making practice was also triggered and driven by KTO staff (e.g. equity management). KTO management initiated and endorsed learning to perform commercialisation in a way typical for match-making practice in KTOs which used to have IP-focused commercialisation practice (KTO B and C). Once again, the management played important role in triggering learning that challenged the status quo.

5 Discussion

By examining evolving practices of six university KTOs this study contributes to the understanding of KTO abilities supporting commercialisation of academic research and to the understanding of how and why these abilities are developed. This section discusses the significance of the results corresponding to each research question.

This study shows that social learning, previously found to affect behaviour of academic entrepreneurs (Bercovitz and Feldman, 2008), plays also an important role in shaping commercialization practices of university KTOs. To my knowledge, this is the first study that looks in detail at the process of social learning in KTOs. Three new insights into *how* KTOs learn are provided. First, learning through interactions within communities of practice is found to be a great source of new ideas that improve and expand commercialisation practice of KTOs. This finding confirms suggestions made by other scholars that KTOs learn through experimentation (Debackere and Veugelers, 2005), by doing (Mowery et al., 2002) but also extent out understanding. For example, it reveals that commercialisation activities that are not

part of the “joint enterprise” of community of practice (Wenger, 1998) are unlikely to evolve through situated learning. Second, it is found that KTOs learn from other KTOs, as suggested by Cardozo et al. (2011). The interactions with other KTOs typically inform improvements in an established approach to commercialisation but are rarely used when KTOs learn new ways of working. Third, the study reveals that some KTOs, namely, those that develop or improve match-making commercialisation practice, learn also from interactions with other professionals, such as venture capitalists, surrogate entrepreneurs, commercialisation consultants or patent attorneys.

The analysis of KTO knowledge through a practice-based conceptual lens reveals that KTO staff belonging to the same COP share assumptions about the process of generating science-based innovation and develop sets of interlinked abilities embedded in their shared practice. KTO learn to perform either the IP-focused commercialisation practice based on the assisted linear model of innovation or the match-making commercialisation practice based on the coupling model of innovation. Each approach is associated with a different set of abilities. The fact that the abilities of KTOs are interconnected has significant implications for the studies analysing the effects of KTO capabilities on performance in knowledge transfer. A single ability found to have a positive effect on performance (e.g. ability to identify licensees (Markman et al., 2005) is likely to be a part of a broader set of abilities. Thus, the effect of a single capability may be overestimated if other abilities are not controlled for.

There is an assumption in the literature that commercialisation practices evolve along the same trajectory in all universities. Specifically, Etzkowitz (2003) argues that a “traditional university”, operating under a pure linear model of innovation, evolves first into a “transitional entrepreneurial university”, based on the assisted linear model, and subsequently into a “fully-fledged entrepreneurial university”, founded upon an interactive model of innovation with a two-way flow between research and economic and social activities. At the

level of KTO, this could be illustrated by a transition from no internal commercialisation practice, into an IP-focused commercialisation practice and then into the match-making commercialisation practice. The examples of the KTO that introduced IP-focused commercialisation practice (KTO E) and two KTOs that transformed from IP-focused practice into match-making practice (KTO B and KTO C) provide some support for the assumption about the single learning trajectory. However, the example of KTO F shows that some KTOs may remain in the “transitional” state even after decades of performing commercialisation activities.

KTO staff need to be prompted to make a transition from one state to another. This study reveals an important role of university and KTO management in triggering and directing the learning in university KTOs. Learning in COPs is likely to lead to reproduction of practice with some minor improvements because the community members share views on what their work is and how to do it. This study finds that in the context of university KTOs, the management can trigger learning in transitions from no commercialisation practice to IP-focused practice and from IP-focused practice to match-making commercialisation practice. Previous studies showed the effect of KTO strategies on commercialisation performance (e.g. Friedman and Silberman, 2003; Powers and McDougall, 2005). The findings of this study suggest that strategies influence the technology transfer performance, at least partly, through evolving KTO practices and the knowing embedded in practice.

6 Conclusions

In conclusion, this paper changes the focus of scholarly conversation from explaining the effects of KTOs' abilities to explaining how these abilities are developed and offers insights into the poorly understood processes of learning in university KTOs. It introduces the concept of situated learning to the literature on commercialisation of academic research and shows

that situated learning helps to explain how KTOs learn. The practice-based approach allows to identify two types of commercialisation practice – based on different implicit assumptions about generating science-based innovation and associated with a different set of abilities. This finding offers more fine-grained understanding of KTO abilities than is provided in previous studies.

While this study makes a step forward in building our understanding of how organisational abilities necessary to commercialise academic research are developed, it has a couple of limitations. A longitudinal study involving data collection at multiple points in time would have been more appropriate for the research questions posed. Moreover, it would have been helpful to investigate in detail the barriers to and facilitators of informal social learning in KTOs and also the factors facilitating and hindering the process of embedding experience gained through interaction with others, into work practices (e.g. power relations). Perhaps the future studies could follow this line of inquiry and address the aforementioned shortcomings.

This research has an important implication for tackling the problem of inadequate abilities of university KTOs. In the past the UK Government, as well as other governments, supported organisations providing training courses for knowledge transfer professionals, and university and KTO management actively encouraged KTO staff to participate in these courses. While class-based learning is a positive mechanism, it may not be sufficient. This research found that KTO's commercialisation practices are transformed predominantly through learning based on informal knowledge sharing within KTOs, across KTOs and through interactions with other professionals, such as patent agents or venture capitalists. It shows also that such informal social learning may need to be triggered and nurtured. Governments and university management could do more to support these forms of learning.

Government could provide funds for programmes to support knowledge sharing across university KTOs. In the UK, the Fast Forward competition run by the UK IPO is a step in this

direction, but is not explicitly directed at stimulating collaboration among KTOs. Government could create a programme for university KTOs similar to the Beacon Scheme for local government in the UK. The Beacon Scheme, introduced in 1999, identifies good practice and innovative services in local government and supports peer to peer learning across local councils. Such a scheme could help KTOs with less advanced commercialisation practice to catch-up and could diffuse the most innovative practices across the sector.

University and KTO management should create environments conducive to the emergence of communities of practice. This includes space and time for social interactions (e.g. by co-locating staff involved in commercialisation), ensuring continuity of relations (e.g. by reducing staff turn-over) and allowing staff to make decisions about work practices on the basis of their learning. They should also encourage staff to develop and maintain networks of contacts with their peers in other KTOs. University and KTO management should also be aware that their inputs may be required to start developing new commercialisation activities or to trigger significant transformations in commercialisation practice.

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