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Learning in university technology transfer offices: transactions-focused and relations-focused approaches to commercialization of academic research

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ABSTRACT

University Technology Transfer Offices (TTOs) need a wide range of abilities to facilitate commercial exploitation of research outputs; however, we know relatively little about how these important abilities are developed and refined over time. We draw on practice-based studies of learning to create a novel conceptualization of learning processes and their outcomes in TTOs and show that this conceptualization of learning provides new empirical insights into how learning in TTOs shapes their commercialization practice. We investigate learning-in-practice in case studies of six UK TTOs and find two approaches to commercialization, namely transactions-focused practice and relations-focused practice. We find that both practices co-exist and co-evolve in some TTOs while other TTOs are predominantly transactions-focused. For the latter the development of a relations-focused approach is difficult, but possible if there is strategic direction and if sources of inertia are removed by TTO directors. Given that evolving practice cannot be fully explained by informal learning processes, we suggest that so far separate streams of practice-based literature on learning and strategizing should be brought together. The implications for further investigations of TTO abilities and some recommendations for policy and practice are discussed.

1. Introduction

It is widely accepted in science, technology and innovation studies 'that the innovative capacity of a nation depends not only on the strength of individual "players" (firms, universities, government research laboratories) but perhaps more importantly on the links between those actors' (Morlacchi and Martin, 2009, p. 578). Well-functioning links between universities and firms can stimulate economic growth (Mansfield, 1991; for a review see Salter and Martin, 2001) and help to solve societal problems. These benefits may be delivered through the commercialization of technologies resulting from academic research.

Some universities are relatively better than others at transferring technologies into practice (Cardozo et al., 2011; Chapple et al., 2005; Link and Siegel, 2005; Siegel et al., 2008; Thursby and Thursby, 2002). Universities' commercialization performance depends partly on the abilities of their respective Technology Transfer Offices (TTOs) to facilitate exploitation of academic inventions in commercial applications (e.g. Lockett and Wright, 2005; Markman et al., 2005a; Siegel et al., 2004). Different theoretical concepts have been used to express what TTOs are *able* to do, such as 'capabilities' (e.g. George, 2005; Lockett and Wright, 2005; Markman et al., 2005a; Rasmussen and Jarl, 2010), 'expertise' (Swamidass and Vulasa, 2009), 'experience' (Link and Siegel, 2005; Siegel et al., 2008; Thursby and Thursby, 2002) 'competence' (Alexander and Martin, 2013; Siegel et al., 2007a) and 'practices' (Debackere and Veugelers, 2005a; Resende et al., 2013). These studies reveal a range of abilities that have a positive effect on the university's technology transfer (TT) performance, including the ability to evaluate technological inventions, to secure Intellectual Property Rights (IPRs), to identify commercial partners and to establish new ventures for commercial exploitation of academic inventions. Other studies show that TTOs can constitute barriers to efficient and effective TT, through aggressive IPRs or bureaucracy, for example (Siegel et al., 2003b). Thus, university TTOs can be 'bottlenecks' to or 'facilitators of innovation dissemination' (Litan et al., 2008), and how TTO abilities develop is an important topic that has been under-researched.

Scholars argue that TT managers learn by experimenting and failing (Debackere and Veugelers, 2005b; Zheng et al., 2013), and by sharing knowledge across TTOs (Cardozo et al., 2011). However, our understanding of *how* these learning processes contribute to development of TTO abilities is limited and, to our knowledge, there are no studies systematically investigating how the practices of university TTOs are developed and refined over time. It should

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not be assumed that more experimentation and failure, or more knowledge sharing across TTOs will lead to more effective approaches to commercialization. The link between TTO learning processes and learning outcomes needs to be better understood.

This study draws on practice-based studies of learning to create a novel conceptualization of learning processes and their outcomes in TTOs and addresses two research questions: What do TTOs learn? And, How do they learn? We believe that the practice-based view on learning, which to our knowledge, has not been applied to study university TTOs, could provide new and valuable insights. Drawing on practice-based studies of learning and knowing in other professional services (see Amin and Roberts, 2008 on professional knowing), we theorize about how learning shapes commercialization practices: we identify the learning processes that might result in incremental or radical changes to commercialization practice, and posit that these changes will depend on the existing practices since the existing practice is a medium for learning as well as a source of inertia.

We investigate learning-in-practice in case studies of six UK TTOs and find two approaches to commercialization, namely transactions-focused practice and relations-focused practice. Some TTOs mostly perform and learn to improve on transactions-focused practice. In these TTOs the development of a relations-focused approach through informal situated learning is difficult, but not impossible if there is strategic direction and sources of inertia are removed. Other TTOs perform predominantly relations-focused practice, but adopt transactions-focused practice in relation to technologies that are more market-ready. In these TTOs both approaches to commercialization can co-evolve through informal situated learning. The findings from this study illustrate how path-dependency emerges and is overcome.

This article makes a conceptual and empirical contribution to the literature on university-industry TT. The article introduces a novel conceptualization of how learning occurs in TTOs, and how the learning processes involved shape learning outcomes, and shows that this conceptualization of learning is useful and provides new empirical insights into how learning in TTOs shapes their commercialization practice. The study also contributes conceptually to practice-based theory of organizational knowledge and learning. Specifically, we show that, to understand how practice evolves we need to consider employees' informal situated learning as well as more strategic management practice, and we call for bringing together the so far separate streams of practice-based learning literature and practice-based studies of strategizing (Jarzabkowski, 2003; Johnson et al., 2003; Pye and Pettigrew, 2006; Whittington et al., 2006). The article concludes with a discussion of some implications of our findings for the development of effective practices and policies.

2. Literature review

This section summarizes current understanding of university TTOs' abilities embedded in practice and learning in TTOs. First, we review previous studies looking at the effect of different TTO abilities on TT performance and discuss what can be inferred from these studies about what TTOs learn (learning outcomes). Second, we review the few studies that shed light on learning processes in TTOs and, we point out that they say little about the learning outcomes. We conclude that there are no studies that investigated systematically the effects of learning in TTOs on commercialization practices.

While acknowledging that the remit of a TTO will likely vary over time, we discuss the abilities required for five key aspects of the TTO role: encouraging disclosure of potentially commercializable inventions, managing the university's Intellectual Property, identifying licensees and/or investors, securing resources for IP development and exploitation, intermediating among scientists, firms, and university administrators. Commercialization practice is defined here as the set of activities performed by TTO staff in order to fulfil the TTO's role.

Encouraging university faculty to disclose potentially commercializable inventions (Jensen et al., 2003) has not been studied explicitly although some authors refer to some aspects of it. Thursby and Thursby (2002) argue that the propensity of faculty to disclose their inventions is influenced by the policies and practices of central university administration. To encourage invention disclosure, TTOs need to be able to develop or facilitate the development of effective policies and practices related to royalty sharing (Baldini, 2010; Friedman and Silberman, 2003), 'self-licensing' (Panagopoulos and Carayannis, 2013), academic promotion (Siegel et al., 2007b) and proactive search. The ability to search proactively for commercializable inventions is important because the sooner the TTO can be apprised of a potential commercialization opportunity, the more time it has to assess the invention and develop an exploitation plan. Proactive search by TTOs is sometimes considered to be controversial because it might influence research choices, for example, by shifting efforts from basic to applied research. It is locally negotiated within each TTO what approach to encouraging invention disclosures is acceptable.

TTOs are also considered 'guardian[s] of the university's intellectual property' (Siegel et al., 2003a, p. 31). The ability to manage Intellectual Property (IP) has been described as 'IP capability' (Degroof and Roberts, 2004), and involves assessment of the IP along several dimensions, and securing of and maintaining IPR protection. The TTO must be able to assess ownership of the invention, which requires information on how the research that spawned the invention was funded, who was involved, and whether there is any background IP. The TTO needs an ability to perform a technological assessment, which 'requires the ability to assess the extent to which research results are stable and/or sufficiently developed to lead to industrial exploitation' (Ndonzuau et al., 2002, p. 284). The TT manager often needs to work closely with the academic inventors and relevant external partners since TTOs are unlikely to have expertise in all areas of the university's research. Finally, the TTO must be able to 'verify the extent to which there might be a viable market' for an academic invention (Ndonzuau et al., 2002, p.284) and to estimate its potential commercial value. This involves assessing the dynamics of the marketplace, for example, whether the company commercializing the invention will have the freedom to operate in the marketplace without infringing any existing patent rights (Lockett and Wright, 2005). IP valuation also entails estimation of market size, and the value that the invention potentially will add to the firm's existing range of products, services and processes. This can be difficult in the case of a radically new technology for which there is no defined market. The patentability of an invention can be assessed without a thorough commercial assessment; an invention is patentable if it is capable of industrial application. However, since the value of a patent depends on the scope of its claims, it is desirable to understand the commercial value of the technology and the dynamics of the prospective marketplace before drafting the patent claims. Understanding the technology's value is useful also for licensing and spin-out activity. The choice between necessary and optional activities leaves room for interpretations of how competently to manage the protection and assessment of university IP.

The TTO's remit also includes informing companies about inventions and expertise in the academic community in order to identify licensees and investors for university spin-out companies (Macho-Stadler et al., 2007; Siegel et al., 2003a). Although a few

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