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How academic entrepreneurship meets the university:

University spin-offs in stakeholder networks

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Abstract

Some universities and departments have been very successful in stimulating university spin-off firms (USOs). It remains an open question whether this is due to unique abilities and circumstances or if it can be stimulated at many universities. This paper seeks to discuss this question by integrating insights from two separate literatures: academic entrepreneurship and university management. We start by taking the firm's perspective to understand the challenges faced by USOs and how universities can assist these firms in developing their entrepreneurial competencies. After that we explore why universities might choose to use their scarce resources to support USOs when the main benefits for success are accrued by the spin-off rather than the university. Here we use a stakeholder perspective to suggest how academic entrepreneurship may be seen as universities' developing service bundles to support an entrepreneurial ecosystem that goes beyond technical and financial support. We suggest a future research and policy agenda arguing for more emphasis on understanding the USO as a university stakeholder, with relationships to a wider stakeholder set, that in turn constitute an entrepreneurial ecosystem.

Keywords: Academic entrepreneurship, Entrepreneurial competencies, innovation policy, university spin-offs, university stakeholders.

1. Introduction

Universities are important producers of new knowledge, with many examples of universities contributing to the creation, development, and growth of technology businesses (Shane 2004). Entrepreneurial universities are increasingly seen as a catalyst for economic and social development at regional level, and the creation of entrepreneurial spin-off companies is a vehicle for creating such spillovers, at least for some universities (Guerrero et al. 2015). Strengthening universities' entrepreneurial capacity has been a key area of most countries' innovation policy with legislative changes, altered university funding and incentives, novel support arrangements for research commercialization (Kochenkova et al. 2015; Slaughter and Leslie 1997). These initiatives have had mixed effects: the degree to which universities and departments create and develop high-growth businesses remains extremely uneven (Bercovitz and Feldman 2008; O'Shea et al. 2005). Early policy efforts involved establishing science parks adjacent to universities (Link and Scott 2003), but their major shortcoming was failing to incentivise universities and academics to increase commercialization activities (Henrekson and Rosenberg 2001). More recent policies aimed to facilitate university engagement through legislative changes and funding universities' internal innovation activities, such as the US Bayh-Dole Act, which gave the intellectual property rights to universities, and spurred similar legislative changes in most European countries (Mowery and Sampat 2005). These changes have led to a rapid diffusion of infrastructure initiatives, such as technology transfer offices (TTOs), proof of concept programmes, and incubators, although there is no consensus in the literature on whether these have been successful.

Some argue that the relatively extensive policy measures to promote university spin-offs (USOs) seems to produce relatively disappointing results (Harrison and Leitch 2010; Mustar et al. 2008), and the ability of universities to create successful spin-offs remains a highly path dependent activity (O'Shea et al. 2008). While the characteristics of successful universities have been extensively studied, a good understanding of how universities can develop their entrepreneurial capabilities is currently lacking. Policy initiatives are mainly top-down or linked to more or less external stakeholders such as regional actors and TTOs, while the key resources to develop new ventures are linked to the individual academics and their surroundings (Clarysse et al. 2011). Hence, designing effective policy

measures is difficult without a clearer understanding of how the entrepreneurship process is aligned with the core tasks of the university.

It is clear that academic entrepreneurship is not unproblematic for universities, with a number of authors highlighting a clash of values between academic research and entrepreneurship (Bozeman et al. 2013). Bruneel et al. note the existence of barriers in any university-company interaction: both differences in outlook between universities and firms, and problems in transactions, that may undermine universities supporting USOs' entrepreneurial capabilities (Bruneel et al. 2010). Bruneel et al. further argue that three characteristics facilitate university-company interactions, mitigating these barriers' effects: experience of collaboration, breadth of interaction channels and inter-organisational trust.

In this paper, we therefore seek to contributing to understand how those barriers can be addressed by conceptualising how those barriers emerge from the ways in which USOs fit into universities' organisational structures. Here we observe the following dilemma: the various ways in which universities can help promote entrepreneurship are well understood and have followed a largely unchanged recipe since the 1980s and yet in practice they remain a persistent policy and practice problem (Berman 2011). Clearly, understanding the barriers that may exist to universities supporting their USOs is not enough to explain how these barriers can be addressed. In this paper we therefore ask the question of "why do universities choose to decide to engage with spin-off companies" to understand the peculiar practical persistence of these barriers.

Our starting point is understanding how and why universities support USOs. We conceptualize USOs as new ventures seeking to assemble a range of resources to create new high-growth firms; their high future potential but low current resources create a problematic characteristic of USO venturing. We note that universities can help promote USOs in accessing these resources but there are also compelling reasons why they might not, and that a model of university decision-making (a stakeholder approach) helps explicate this dilemma and university barriers. On this basis we argue that more consideration need be given to how USOs use their position as stakeholders within networks to access resources critical to venturing. If universities perceive USOs as relevant stakeholders, they may develop an entrepreneurial capacity by developing service bundles to support an entrepreneurial ecosystem that goes beyond technical and

financial support. We suggest a future research and policy agenda arguing for more emphasis on understanding the USO as a university stakeholder, with relationships to a wider stakeholder set, that in turn constitute an entrepreneurial ecosystem.

2. Understanding how and why universities support their USOs

USOs are sometimes defined as all new firms exploiting university-generated intellectual property (Di Gregorio and Shane 2003), or more broadly as firms taking advantage of all types of university knowledge, including for example student start-ups (Mars et al. 2008). In this paper we take a more restrictive definition USOs as new ventures initiated within a university setting, based on technology derived from university research (Rasmussen and Borch 2010). We make this choice because for these kinds of ventures, the university context is important and the extent and type of venture creation is clearly influenced by university-level factors. Some university characteristics associated with USO formation are well established in the literature: spin-off activity relates to universities' intellectual eminence (Di Gregorio and Shane 2003), faculty quality (Powers and McDougall 2005), or scientific productivity (Van Looy et al. 2011). What is less clear is how such university-level factors lead to USOs' establishment and subsequent performance.

Much research on universities' entrepreneurial capability focuses on 'what' universities can do to support USOs (Bruneel et al. 2010; Rothaermel et al. 2007) at the expense of 'why' universities' might choose to use their scarce resources on supporting USOs at a time when they are under many intense competing demands from outside (Ćulum et al. 2013; Damme 2009; Enders and Boer 2009; Jongbloed et al. 2008). University management literature (Clark 1998a; Powell and Dayson 2013) has been at best rather normative, describing supporting entrepreneurship and venturing as something that university leaders can insert into their institutions' organisational DNA. What is missing here is an understanding of how those support activities, which are often at the institutional periphery, fit within university's institutional architectures (Vorley and Nelles 2012). Better understanding what universities can do therefore needs to be better rooted in an understanding of why universities might support USOs given the competing pressures they face. We do this by firstly looking at how the university can realistically support new ventures as seen from the USO's perspective. Next, we look at university decision-making approaches, conceptualised through a stakeholder approach, and then

identify four areas by which these various support activities might become more salient to universities, who then in turn may make them more central to their core institutional missions.

2.1 What kinds of support services can universities offer their spin-offs?

Universities are traditionally not set up to serve the needs of new ventures. The venture creation process is highly complex involving a range of different actors. Recent conceptualization show that universities may support their USOs in gaining three kinds of critical entrepreneurial competencies (Rasmussen et al. 2014; Rasmussen and Wright 2015):

- 1) developing a viable business opportunity (opportunity development)
- 2) involving and supporting individuals that provide meaning and energy to the entrepreneurial process (championing)
- 3) accessing resources necessary to develop the new venture (resource leveraging)

With entrepreneurial competencies consisting of these three elements, university capability can be defined in terms of what universities do to imbue USOs with those competencies.

Firstly, USO founders' and managers' networks and experiences are usually more technologically oriented than market oriented: when exploring possible technology applications, USOs may limit their search to familiar knowledge areas or a few alternative uses (Zahra et al. 2007). Conversely, considering alternative applications more broadly and synoptically increases the chances of developing a high performing business. This ability to improve and alter the opportunity according to new insights can be regarded as an opportunity development competency (Rasmussen et al. 2011). This competency is dependent on high technology expertise combined with industry or market knowledge. Universities may support USO's opportunity development actively or passively (Bozeman 1993; Coursey and Bozeman 1993). Active support may come through TTOs' activities aiming to actively place resources at USOs disposal (Auten et al. 1984; Bozeman and Landsbergen 1989; Di Gregorio and Shane 2003; O'Shea et al. 2005). Passive support involves making resources (more) freely available for firms to access including research,

knowledge, demand for services, complementary firms and human capital (Benneworth 2007; Bozeman et al. 1986; Clark 1998b; Moray and Clarysse 2005; Rothaermel et al. 2007).

Secondly, the role of the local work environment is particularly important for USOs because these firms are usually developed by teams where several persons play an active championing role (Vanaelst et al. 2006). Potential entrepreneurs are discouraged where current local work environments are not actively entrepreneurial (Bercovitz and Feldman 2008). Hence, support from scientific colleagues, university managers, TTO staff, and people in the external network of the university is often critical, particular in early stages (Rasmussen et al. 2011). Few USOs start without significant involvement from the inventors or scientists behind the technology, the university environment can facilitate or hinder such involvement. Moreover, it is crucial for emerging USOs that new individuals with industry and business experience become involved as champions developing the venture. In early stages, the university environment may be an important catalyst for attracting champions with relevant expertise to join or support the venture. Universities may support championing both individually and institutionally (Rasmussen et al. 2011). Academics may champion ventures in which they have a shareholding, or seek to create future employers for their graduates, partners for research projects or customers for consultancy (D'Este and Perkmann 2011; Vestergaard 2007; Zomer et al. 2010). Universities as institutions may enthusiastically encourage venturing and their own stakeholders to support USOs (Braun 2011).

Thirdly, creating a new business activity based on research is typically extremely resource demanding because of parallel needs for technological, market and organizational development along lengthy development paths. A key resource for early stage USOs is the university scientists behind the commercialised technology. Unsurprisingly many studies have confirmed that academics with access to more resources are more likely to form USOs (Landry et al. 2006). Several studies have emphasised the role of academics' social capital and networks (Murray 2004). Where new venture founders have relationships with venture investors they are most likely to receive venture funding and are less likely to fail (Shane and Stuart 2002). In addition to academic scientists' roles, the resource acquisition process is highly iterative involving many different actors with appropriate competencies (Rasmussen and Clausen 2012). Universities contribute to resource

acquisition and leveraging, providing access to physical infrastructure and tangible resources such as laboratories, specific equipment, specific material (cell lines etc.) and even venture financing (Etzkowitz and Klofsten 2005). Universities may also provide intangible resources: directly recommending USOs to investors, formally acknowledging their USOs, or offering locations on a university-owned high-technology site, all of which may function as quality marks for potential stakeholder (Smith and Bagchi-Sen 2012). Universities' wider networks may help USOs to access resources, for example directly organising events to sell into the university's strategic partners, or a cluster of industrial partner firms – with technology needs capable of providing sophisticated demands to USOs – on site (Benneworth and Hospers 2007a; Benneworth and Hospers 2007b).

2.2 A stakeholder approach to understanding university capability

Although universities can offer these capabilities to firms, there is no automatic reason why they would choose to support USOs. For all those areas, it is possible to think of reasons why universities might choose to support their USOs; opportunity development could potentially lead to discussions with businesses leading to applied or joint research projects. But it is likewise possible to think of reasons why universities might choose to avoid supporting USOs – recommending USOs to industrial partners could, if those USOs failed to perform, potentially undermine industrial partners' trust in the academics (Guerrero and Urbano 2012). We therefore contend that it is important to answer this question of why would universities choose to support their USOs to gain a more systematic understanding of university support for high technology entrepreneurship.

Universities are highly complex, loosely coupled organisations undertaking many kinds of activities and with a range of different missions, and therefore to understand universities' decision-making choices in terms of balancing competing interests and demands it is possible to use a stakeholder model (Amaral and Magalhaes 2002). Freeman (1984) defined an organisation's stakeholders as those with a stake in the outcome of an organisation's activity. This interest in outcome became important with the rising importance of new public management pioneered in many countries' higher education systems (Kickert 1995; Landsbergen et al. 1992). In this context, universities were formalised into managerial organisations, shifting autonomy towards managers to manage their resources to best achieve goals set by public actors (Fried 2006). For universities, this shift in managerial culture moved away from collective decision-making

towards hierarchies in universities (Deem et al. 2007). Universities' stakeholders maybe internal as well as external, and Jongbloed et al. (2007) produce a comprehensive taxonomy of these stakeholder sets.

A stakeholder's importance to an actor is defined as 'salience', possession of attributes important to that actor (Mitchell et al. 1997). Mitchell et al. define salience as the consequence of three variables, power (coercive, utilitarian, and normative), legitimacy (individual, organisational, societal) and urgency (time sensitivity, mission criticality). With universities facing pressures from a variety of sources, as well as potential resistance internally, supporting USOs could be far from universities' wider interests given that they are very demanding: with very few USOs ever covering the costs that universities incur in supporting them, they cannot expect to be seen as being important (Auerswald and Branscomb 2003; Dill 1995; Enders and Boer 2009). We conceptualise Bruneel et al. (2010)'s barriers between USOs and universities as manifestations of USOs' lack of salience to universities as stakeholders. When universities are faced with a decision over how to deal with USOs, the interests of the USO are easily overruled when they come into conflict with other interests.

Bjørkquist argues that networks of relationships between stakeholders can institutionalise what she calls 'stakeholder regimes' (Bjørkquist 2009). Pressure from more salient stakeholders in these regimes - such as government regulators and research funders - can encourage universities to shift to become more supportive of USOs (Harrison and Leitch 2010). A variety of classes of stakeholder for the university (both internal and external) can be distinguished who influence the extent to which USOs are seen as important to the universities, or under the class "nice to have but not essential".

The university as an institution has many internal stakeholders with often different interests and aims, and held together through a mix of formal and informal arrangements (Powell and Dayson 2013). University leaders are able to take a strategic view on support for USOs, particularly when they can see that USOs bring resources into the university that strengthen core activities. USOs might also have strong voices in formal governance bodies, whether as members of governing bodies, or as entrepreneurship or technology transfer committees. University support units that are specifically responsible for supporting USOs are a main internal stakeholder for universities, although these are often

peripheral within the university overall structure. Faculties and research institutes typically witness the more problematic side of USOs, taking people away from research, taking up space and researcher time, although benefits may come through contributing to teaching (e.g. through placements or guest lectures) and research (as users, co-researchers, funders). There are also structures that govern university business in areas seemingly unconcerned with USOs, but whose decisions affect the university interest in supporting USOs – if promotions committees see entrepreneurial activity as appropriate for tenure or promotion, then academics are less discouraged in supporting entrepreneurial activity.

External stakeholders are those outside the university who have a strong interest in the outcomes the universities produce, and who have resources that universities require that encourage universities to consider their views (Benneworth et al. 2011). There are firms who are already engaged with the university around technology transfer, shareholders in USOs or partner companies, licensing university technologies or investors in those companies. Innovation support agencies are also stakeholders, as USOs represent potential clients for them, whilst regional and national policy-makers can use USOs to demonstrate their innovation policies success. Research funders have in recent years become increasingly interested in demonstrating the societal added-value of research funding through entrepreneurship and USOs (Vincett 2010), whilst education ministries and university regulators may make supporting instruments (Rasmussen and Rice 2012), and facilitate or hinder universities' intellectual property strategies. Financiers and property developers can regard science parks and real estate developments as potentially profitable, whilst companies and services that provide USOs with services can benefit with increasing customer numbers.

2.3 University capability to promote USOs

USOs are extremely unlikely to be very strong stakeholders for universities (with the exception of the rare cases where they become highly profitable) (Benneworth, 2007). Individual support activities (e.g. entrepreneurship education programmes or start-up venture financing) may have an occasional outside supportive stakeholder (a funder). They are unable individually to be able to mobilise strong networks of stakeholders who can make the university more reactive to and supportive of USOs in their overall stakeholder regime. It is therefore necessary to consider how USO support activities may

attract broad coalitions of support in the overall stakeholder regimes, considering not just single support activities but broader technology transfer ‘service bundles’ (Benneworth et al. 2004; Crow and Bozeman 1987; Miles 2005). These bundles create activities which make resources available to USOs and support their competencies, are supported by powerful (salient) external university stakeholders, and are positively supported (or at least not too actively resisted) by internal stakeholders. Service bundles bring together diverse groups of stakeholders in supporting USOs and hence embodying the value of supporting USOs to the university, hence answering the “why?” question for university support for their USOs.

With service bundles we are here thinking of constellations of activities that are broader than individual projects, but provide coherent ecosystems within which individual projects, instruments or policy interventions add value to the USO competency. An example of this is where a science park becomes more than a physical real estate development project but also starts to function as a knowledge community precinct and thereby provides active incubation to hosted firms, facilitating USOs accessing entrepreneurial competencies (Benneworth and Ratinho 2014). This links firms and the university in different ways (physical, organisational, virtual, financial) and the university directly benefits in terms of its teaching, research and financial interests. This in turn creates a set of automatisms where USOs seeking help are given the benefit of the doubt – in effect the why question is pre-answered for them (“why wouldn’t we help start-ups?”) We therefore argue that university capability to support USOs relates to

“the capability to provide supportive ecosystems which support the development of USOs’ entrepreneurial competencies in a way that also meets the needs of universities’ internal and external stakeholders.”

Service bundles are assembled in response to stakeholder pressures and therefore meet a wider set of stakeholder needs than just those of USOs. Service bundles must fit with internal stakeholders’ needs, both fitting with the universities’ own governance style as well as supporting core activities around teaching & research. Over the past years various approaches have been developed to illuminate universities’ roles in regional development reflecting different underlying models (Goldstein, 2010; Uyarra, 2010). We here distinguish two models where universities have activities targeting regional economic

development, namely the entrepreneurial university (EU) and the regional innovation system university (RISU) model. The EU model claims universities promote regional development comes through their patenting, licensing and academic spin-off activities. The RISU takes a broader perspective, by including “softer” forms of knowledge transfer relating not only to direct innovation activity, but also to improving the policy, intermediary and cultural innovation environment (Gunasekara, 2006; Lundvall, 2007; Trippel *et al.*, 2014).

To address our overall research question, we conceptualise university contributions to regional economic development as coming via “knowledge spillovers” (Benneworth & Charles, 2005; Drucker & Goldstein, 2007). Knowledge spillovers have localised dimensions, creating knowledge resources more easily accessed by physically proximate actors (Ponds *et al.*, 2010). Given that innovation is resource-constrained, ready availability locally of certain knowledge resources can enable innovation activities drawing on those resources, thereby stimulating knowledge based regional development. To date research on university structure and regional engagement has split between small-scale case studies of organisational forms (Healy *et al.*, 2014) alongside quantitative analyses of which kinds of universities produce regional outputs (Drucker & Goldstein, 2007). Few analyses have directly asked how does universities’ underlying internal organisation create localised spillover effects.

3 Discussion: entrepreneurial stakeholder networks where USOs meet universities?

3.1 Towards university entrepreneurship stakeholder networks

We propose modifying Bruneel *et al.*’s conceptualisation to consider orientation-related and transaction-related barriers in entrepreneurial stakeholder networks rather than dyadic co-operations. Orientation-related barriers relate to a mismatch between the orientations of firms and academics hindering the effective acquisition of ‘collective’ assets around the university into USOs. USO entrepreneurs must separate their role as entrepreneurs from that as academics and create the firm as an entity distinct from the university (Lam 2010; Vestergaard 2007). We define the first barrier in university USO systems as a proximity barrier – sufficient proximity to facilitate knowledge exchange whilst allowing sufficient distance between actors to validate different roles in the

network allowing USO entrepreneurs to play distinct roles from universities and their other stakeholders.

Transaction-related barriers relate to different valuations between universities and USOs in terms of various resources. USOs are unable to pay the full market cost of resources and reliant on leveraging collective resources to survive, whilst universities bear the full opportunity cost of providing those resources. Firms may benefit from spill-over effects but excessive individual private benefit being derived from university assets are unacceptable (Audretsch et al. 2005). Therefore, we define the second barrier as a spillover barrier, in which the service bundles prevent these spillovers being fairly derived.

Mitigating factors facilitate better interaction between universities and USOs by permitting better alignment of interests around these service bundles. Extrapolating Bruneel et al.'s three mitigating factors to the wider entrepreneurial stakeholder network, these may represent entrepreneurial stakeholder network capabilities, supporting USO capabilities and meeting stakeholders' needs.

The first mitigating factor – experience of collaboration – involves both experience between groups working together, which helps in subsequent mutual co-operations, but also of working with others kinds of partners, representing future partnership capacity. The experience is in being able to work closely with different partners whilst retaining a critical separation. Our first proposed mitigating network factor is entrepreneurial stakeholder network social capital: actors' capability of actors when approached by others to develop strongly differentiated partnerships, to these roles over time, and then end these partnerships when they have reached their useful conclusion.

The second mitigating factor – breadth of interaction channels – provide many contacts between partners, allowing the overall stakeholder network to retain its capacities even when individual partners leave or connections fail. Service bundles operate as spaces where communities come together and interact, and as ecosystems have a degree of systemic diversity in their activities. Our second proposed mitigating network characteristic is community activity, in terms of the scale (number of participants), scope (number of activities) connectivity (inter-relation of service bundles) and salience (importance to stakeholders) of the service bundles.

The third mitigating factor – inter-organisational trust – is defined by Bruneel et al. as co-operating partners' certainty that they will not behave opportunistically. Opportunistically behaving entrepreneurs create market benefits by disadvantaging their partners around uncertainties ('deviant behaviour'). Collective norms and expectations that deviant behaviour will be punished mitigate against opportunism by providing a cost for opportunism, corroding their network capital. Therefore, our third proposed mitigating network characteristic is shared entrepreneurial stakeholder network norms providing stability and disincentivising deviant behaviour (Jordan and Schubert 1992).

Particular service bundles embody all three kinds of mitigating factors. Consider a university incubator unit where a dedicated office supports a former post-doc to create a new USO based on an output from their former research group. The incubator provides community activity – mentors, advisors and other entrepreneurs in similar positions live and work together in trying to realise their respective commercial ambitions. This experience of working together in a close environment develops shared community norms that those agents transmit back to their organisations (including academic and commercial stakeholders). Shared working experiences also build social capital within the wider entrepreneurial community, facilitating current and future interactions and transactions across the wider entrepreneurial stakeholder network.

The implication is that supporting USOs as a process need be considered both as developing a technology into a commercial idea (building a business infrastructure) as developing entrepreneurial communities within and around universities (a social knowledge infrastructure). University support for entrepreneurship involves both direct support activities and creating dynamic ecosystems that meet the needs of wider entrepreneurial stakeholder networks.

3.2 Towards a more systematic stakeholder approach in university spin-off companies

The structure and main purpose of universities are very different from that of new technology businesses. The transition from being an academic research activity to become a commercial business activity poses challenges both for the university and the USO. It is difficult to explain the rationality for university-USO co-operation as the direct benefits that each party (notably universities) receive from co-operation. Universities' benefits

also include indirect benefits from their wider stakeholder networks. Recent estimates show that about 13% of competitive research funding to universities in the UK can be explained by their USO portfolio (Pitsakis et al. 2015). Understanding these wider entrepreneurial stakeholder networks benefits is critical to understanding why universities work with USOs. The dynamic is not that universities are exclusively trying to meet USO needs: working with USOs meets a range of needs from this wider network. This new perspective has clear implications for research, policy and practice

3.2.1 Implications for future research

A main point in our paper is that the university-USO interface is not a simple dyadic relationship, but actually embedded in a wider set of relationships in the university's immediate entrepreneurial ecosystem as well as the wider higher education systems within which universities operate. The stakeholder approach is well-articulated in research on universities, but much less explicit in research on USOs. USOs are companies created in positions of extreme uncertainty, and the competency approach highlights that universities can play a significant direct and indirect role in helping these firms develop their business opportunities, securing champions and accessing resources (Rasmussen et al. 2014). The stakeholder approach provides further insights into this, by highlighting how actors outside the USO have dependencies upon USOs, or see the companies as mechanisms to achieve their own goals. This can potentially facilitate the accessing of critical resources for the company, and hence provide a useful rationality for understanding USO venturing processes, an area which currently demands further research (McMullen and Dimov 2013).

If the USO is regarded as a stakeholder, then further research should shift the research focus away from the complex environment of the university to highlight the role of the USO as a stakeholder in its own right (See Table 1, Question 1). This requires answering the questions of which stakeholder groups are USOs tied to, in particular internal university stakeholders beyond strategic management ties (Question 2). More attention is required for how powerful are USOs' key allies in terms of these entrepreneurial stakeholder networks, and how do these powerful stakeholder networks regard USOs and the dynamics of the entrepreneurial stakeholder network and wider ecosystem (Question 3)? The understanding of how universities promote USOs is fragmented and the effect of different policy initiatives is therefore highly uncertain. Hence, more research is needed

to understand how entrepreneurial ecosystems can be promoted, as well as how individual interventions shape the power relationships of stakeholders and USOs' positions in those ecosystems (Question 4). Within these four question areas, a number of future operational research questions are possible, and in Table 1 we set out how these might be addressed in practice as well as the kinds of empirical approaches that might provide appropriate evidence to inform our understanding.

Table 1: Potential themes for future research

Underlying research question	Operational future research questions	Possible empirical approach
USO as stakeholder	How does the university in combination with other stakeholders influence the venture creation process?	Longitudinal and multi-level studies of USO creation and growth
USOs and their immediate stakeholders	What are the synergies between USO support and other core university activities? How does USO creation overlap with other forms of university knowledge transfer (stakeholder networks)?	Study USO processes from the perspective of academics and university departments. Follow technologies as unit of analysis.
Network or ecosystem level	Who are the key actors in entrepreneurial ecosystems for USOs? To what extent are different kinds of universities associated with different types of entrepreneurial ecosystems? What are the key drivers in the creation and evolution of entrepreneurial ecosystems?	Comparative studies of the process of USO creation and growth in different contexts. Follow the historical development and evolution of networks and ecosystems around universities.
Policies for managing entrepreneurial stakeholder ecosystems	Where do incentives lie for universities to support USOs? How do policy initiatives influence university capabilities? How do policy stakeholders shape how seriously universities take the USO support 'mission'?	Follow policy changes over time. Study the impact of policy initiatives on different types of university environments.

3.2.2 Implications for policy

Question 4 in the preceding section highlights that more research need be done on the policy dimensions of creating supportive stakeholder environments to stimulate university entrepreneurs. There are already inferences that can be drawn from the preceding analysis that sharpen the nature of the policy problem for USOs and the venturing experience. USOs are trying to access resources in venturing, but there is a clear gap between the potential that their ideas have, if successfully exploited, and their capacity to pay for the resources necessary to realise their ideas into businesses. If this potential gap cannot be addressed then this can lead to a market failure and an under-creation of USOs, and an under exploitation of past investments made in national knowledge capital. The issue is not exclusively financial – financial gaps can be straightforwardly filled as is demonstrated by subsidised venture capital seed funds (Munari et al. 2014). Not all resources are held by actors with a primarily financial interest

(Rasmussen and Wright 2015), and filling the gap between the opportunity cost to the actor and the potential for USO can also be filled by those actors perceiving that the activity is also deemed worthwhile by their most powerful stakeholders.

Second, and related, the policy problem is not exclusively of changing university behaviour, and change is not exclusively the responsibility of universities. Universities and USOs alone cannot achieve this change, and there is a need to incentivising universities' stakeholders to encourage universities to regard supporting USOs as a more important activity. Policy networks may become captured by existing powerful actors who benefit from the current situation and have an interest in preventing the emergence of USO companies. Under this diagnosis, the best returns come from policy makers addressing lost potential by constructing entrepreneurial ecosystems where USOs are more powerful. USOs have power in these networks because others want to access their knowledge and legitimacy, and secondarily their financial resources. Policy-makers should therefore not only ensure that USOs can access financial resources, but also that working with USOs is regarded as a legitimate activity (Rasmussen and Borch 2010).

Third, an entrepreneurial ecosystem is not a place where all actors are busy creating firms all the time (Shane 2009). Entrepreneurs need resources and experience barriers to accessing them, but these resources are often created as the by-product of other activities, such as university research. Too much pressure to exploit research may hinder that research and reduce effective spill-over of that knowledge. Effective entrepreneurial stakeholder networks are those that value other network roles and allow differentiation, allowing the social capital and shared norms to emerge, but also facilitating the right degree of proximity between actors. Although there may have been a need twenty five years ago for policy makers to shake-up academia, continuing emphasis on a primacy for entrepreneurship may be increasingly counter-productive.

3.2.3 Implications for practice

Our framework also implies a number of practical ways that a range of university stakeholder communities could support USO activity in ways that also make entrepreneurial activity contribute more to their own goals. First, university management can sustain a commitment to entrepreneurship and supporting USOs, steering the institution to make management aspirations more achievable within the institutional

structures. This demands building USO support both into universities' formal structures but also into the informal cultures. Leaders can identify successful promising experimental projects and help persuade others of their wider value, influencing critical internal stakeholders, and persuade external parties to value and/or reward the university for its pro-activity in stimulating USO support.

Secondly, universities can create service bundles immediately useful to USOs. Any university technology transfer activity must balance between providing services to external entrepreneurs and creating value of the academic heartland. Both sides may seek to dominate activities, which alienates the other group; if technology transfer is seen as something for firms then academics will shun it, whilst if the TTOs are only concerned with academics' interests and needs then it is hard for firms to work with the university (O'Kane et al. 2015). Making USO interests' visible means ensuring other stakeholders continually validate and affirm the importance of ensuring that technology transfer infrastructure meets USO needs.

Third is explicitly acknowledging and championing the benefits which working with USOs brings to the university (Pitsakis et al. 2015). This facilitates university-USO cooperation becoming a solution to individual problems faced by internal university stakeholders in achieving their own goals. Managers must demonstrate to staff that USO support is valued is for the enrichment that it brings their work. This will ultimately be realised by internal stakeholders, the degree to which tenure, promotion or sabbatical committees acknowledge work with USOs as being valid. University agency can persuade other external stakeholders to explicitly value universities' work for USOs.

Fourth is balancing working with USOs with the university's other commercial interests. At the highest level, this might involve finding a suitable university risk profile allowing different kinds of risks to be managed, comparing and balancing the potential risks of USO involvement against other risks . At the meso-level, the university must balance USOs' future interests against existing partners' current needs in its strategies and policies, to avoid created unintended barriers to USO support. At the micro-level, particular commercial decisions taken by the university must ensure that possible consequences for USO relationships are considered within the university's wider decision-making process.

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