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Walking The Plank of The Entrepreneurial University

The little spin-out that could?

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Abstract
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Creating spinout companies (USOs) from university research is one focus of innovation policy. The phenomenon features in two main fields of enquiry: academic entrepreneurship studies, and literature on academic capitalism and the entrepreneurial university. Studies have explored the academic entrepreneur, the development stages of these nascent ventures, and the tools universities can provide to encourage and assist in the spinout process. This literature is however limited in that it is overwhelmingly concerned with resources, and little is known about how the USO relates to the parent research institution over time.

The purpose of this study is therefore to explore social forces in research linked to a USO, and the main research question is: how can a social lens help us to understand some of the forces at play in research commercialisation, specifically through the early development of a USO from a parent research organisation?

The case study is based on interviews and observations of university researchers, USO actors, and representatives from state agencies and a multinational corporation involved in a technology demonstration project. The sociologist Robert Park's concepts of social groups, the individual within the collective, and social forces are used to explore the experiences of actors involved in academic research and industrial development throughout the changing relationship of a research group and USO.

Five social forces were identified around the border between academia and industry, based on some of the concepts that seem to inform the actors' understandings of the case at hand.

An exploration of these forces helps to develop an understanding of how actors experience and negotiate various forces, and positions the results of the study in relation to the dominant models in academic entrepreneurship and academic life. Park's concepts of specialised roles moves the discussion forward by considering how social forces might be handled within research and research commercialisation, and how such forces might in turn motivate the movement of individuals within and out of a particular social group. This discussion leads into the metaphor of the theatre, connected to project management literature, and research commercialisation as a performance by actors to safeguard the collective's interests.

Keywords: University spinouts, research, academic capitalism, entrepreneurship, commercialisation, social forces

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To my family,
old and new

Acknowledgements

If you had asked me in 2011 to be do everything I have done as a doctoral student, especially in writing this thesis, I would have laughed and quite possibly refused. What a strange task! I'd think. But today it's not strange at all – it's rather normal and, I daresay, comfortable. That usually means that it is time to move on to something new.

The work of the last few years has resulted in the text you're about to read. There are some things that seem strange here too, and I hope you enjoy discovering them with the same enthusiasm as I did, if not more. But even if moments felt a little lonely this book and the departmental home from which I produced it were not isolating, and I have a long list to thank for that.

Thanks go first and foremost to David Sköld, my abstract and provoking supervisor. He pushed me to think harder and further than I suspected was possible and has been a valuable part of my growth as a researcher and a thinker, but I don't think I can write a statement anymore without seeing a tiny note encouraging me to expand on it. My second supervisor Marcus Lindahl provided more practical guidance, and his care for his subject and students is, I believe, probably exemplary. Together they have been the source of occasional frustration, but they have also been excellent guides in my navigation of a new set of academic and national cultural norms, and in the many moments of stress and doubt they have been by my side, supporting my efforts, and ultimately teaching me to find that little spark of something unexpected and prod it until it becomes something really interesting. I started out here looking at technology and business, but ended up working to include the voices of the hardworking people who are so often silenced in descriptions of research and development, and produced something that could also be seen as a political and social piece of work.

As talented as my supervisors are, sometimes it takes a fresh pair of eyes and a different voice to fully articulate how to develop a text into a thesis. I would like to thank Anette Hallin for her incredible effort in reading an earlier version of this text and for helping me so clearly and so patiently to move forwards in my research.

This thesis is the result of an in-depth study of lots of people and, although they will remain nameless, they have contributed in uncountable ways. I never thought that research involved laughing so much, nor that so many could demonstrate such levels of trust of a woman one of you once called "the Russian Spy". Someone told me that I could never write a thesis

that would satisfy everyone but I sincerely hope that those in the case in question all feel that, whatever follows in these pages and whether they have been quoted or not, their stories have been told to some extent.

The Industriell Teknik doctoral group is a funny mix, and I don't think I'll find such a group again, nor feel so at home. Special thanks must of course go to Jolanda, because if she hadn't listened to my incomprehensible analyses and provided regular hugs throughout this process I never could have written what I have. Kristofer was one of the first friendly faces at the start, and between us we have muddled through, shared what we have learned, and tried to enjoy this process. Mostly though, he deserves thanks for doing this whole thing just ahead of me so that I can learn from his example.

Mum and Dad, thanks for nudging me in the right direction. Thanks for filling our childhood with so many opportunities to learn – books, renovations, craft projects, trips to interesting places, discussions on so many topics from healthcare and politics, local histories to technologies. Thank you for supporting me through so many of my bad decisions and the eventual good ones that led me here. I think I struggled for a long time with what I should do in life because I identified with so many things and at the same time found it hard to limit myself to one. I hope you read this because I think it is an exploration of so many of the things you opened the door to.

Ethan, the real engineer in the family, you and I are driven by many of the same forces, and I often regret not following the path you took. Think what we could achieve if we had two engineers in the family! But thank you for being what I couldn't for those we love, thank you for being interested in what I do, and thank you for being my friend as well as my brother.

Last but not least, Nicklas. You have listened and come with suggestions, encouraged me to stand for my work, and kept my eyes on the target even when I didn't know what it was. Others have struggled with maintaining a research-life balance and although I can't claim to have avoided late nights, you have defended my right to rest and play during this demanding process. I know that I have sometimes suggested that this doctoral period has put our lives on pause. I realise that while this may be true in terms of where we want to be in the world, my academic journey brought you to me and gave us the time to create the foundation from which we will build our future together.

Contents

Abbreviations

Parent research institution (PRI):	University or other formal organisation where research is one primary activity and from which a USO emerges
Parent research group (PRG):	An informal or formal but smaller arrangement of people and other resources within a PRI, where research is one primary activity and from which a USO emerges
University spin out/off start-up (USO):	A commercial venture started by a university researcher or based upon research performed at a university
UITT:	University-industry technology transfer
TTO / TLO:	Technology Transfer Office or Technology Licensing Office, an organisation attached to the university often performing incubator or broker activities to aid the movement of academic research to application in commercial settings
Academic entrepreneur:	Individual engaged in the commercialisation of university research, usually taking a leadership role in a USO
Professor entrepreneur:	As Academic entrepreneur, but simultaneously retaining the role of professor and active within the university and / or PRG
Researcher:	Individual engaged in university research, position not indicated
Post-doctoral researcher:	As Researcher, but having obtained a PhD and where specific title could help in identification

1. Introduction

2010 saw the launch of the KIC InnoEnergy programme, a European Union initiative to encourage innovation. It was in its early years when I enrolled at Uppsala University through the KIC PhD school, a part of the programme designed to educate and encourage young researchers to start their own businesses:

> "This component works to ensure that each doctoral candidate gets grounding in underlying principles of business and entrepreneurship, to provide an early stimulus to see the doctoral candidate's own research in the light of a business-oriented approach and to provide contacts with potential business-advisors, sponsors and incubator networks, that could help commercialise the research during or after the PhD." (KIC Innoenergy 2012, 4)

KIC imagined the process of new business creation being stimulated through a process of identifying PhD students with entrepreneurial ambitions, educating them in key entrepreneurship and business skills, and providing funding to this effect in return for a convincing declaration of intent by these individuals to commercialise their research either during or soon after the completion of their research training. Although my research area was not expected to produce technologies that could be commercialised, a key output of it was considered to be important to understanding, or monitoring, the everyday practicalities of the commercialisation process. My initial task, roughly defined, was to create an understanding of the economic development of an academic research project and its sister development at a company founded by the research leader, both of which focused on a technology of particular interest to the KIC InnoEnergy program. The main research project was to develop from this cost mapping exercise, and was briefly summarised as follows:

> "By studying the development of the test site, and the transition from scientific … to commercial application, this project strives to develop an understanding of the (many different) dynamics involved in this kind of innovation process – potentially illuminating mechanisms that are key for achieving commercial success, and overcoming barriers into the (…) industry." (Sköld 2011)

Sweden has been making a number of efforts to increase academic research commercialisation activity, and national policy interests are supported through organisations such as Vinnova, a programme tasked with supporting research, development, and innovation in Sweden. They offer financial support both to researchers working with research topics that could have commercial applications and to nascent ventures (European Commission, cases N 560/2007 and N 561/2007, 2008.). On a more local level in Uppsala efforts have been made partially through innovation policy development at the university, including the creation of an innovation support office and a holding company, both of which have offices in or nearby to the natural science buildings. Less explicit support for entrepreneurial endeavours can also be seen for example through the creation of the department within which I am writing, which places a heavy emphasis on developing knowledge and teaching students in the area of connecting the technical and natural sciences to commercial activities, with one focal area being the creation of new companies. This thesis takes the form of a case study of such commercialisation efforts, and presents an example of this.

The university also seeks to support academics commercialising research from the Natural Sciences faculty through more traditional academic means; one way they demonstrate this is through the awarding of academic prizes. Honouring academics who commercialize their research is one way to incentivize this kind of activity, and in Sweden it is particularly necessary because, unlike UK and USA universities for example, Swedish universities are not automatically granted the right to intellectual property linked to research at these institutions due to the Teachers' Exemption, a law which grants researchers at Swedish higher education institutions the right to intellectual property arising as a result of their research (Lag om rätten till arbetstagares uppfinningar 1949:345).

Alongside universities' own press, a national popular science and technology newspaper often reports on research that is either commercialised or might be understood to offer commercial possibilities. A recent article (Kleja 2016a) highlighted a popular understanding of how new ventures should develop when it criticised a company for receiving too much help from the academic research department run by the company's founder. In particular the article suggested that the blurring of the line between academic and commercial organisations was bordering on the unethical, and argued that researchers and their findings were being exploited for the financial gain of a few key individuals at the company, suggesting of course that the company should have separated completely from the research organisation, and not continued to utilise academic research outputs. The journalist argued that the research should have been fairly compensated for, and thus that it was quantifiable in nature.

In theory the creation of companies based on academic research is mainly understood through academic entrepreneurship literature, which seeks to

understand the various ways in which university researchers become entrepreneurs. Klofsten and Jones-Evans identified eight types of academic entrepreneurship from previous literature and defined the spin off as "the formation of (a) new firm or organisation to exploit the results of the university research" (2000). Studies into this particular area have sought to understand how such ventures are created, resulting in contributions describing different types of ventures emerging from academic institutions, the people who might choose to commercialise their research, various motivations for doing so, and support structures within or close to universities that, alongside engaging in other technology transfer activities, assist researchers in starting their own companies.

In describing the phenomena discussed in this thesis, scholars and practitioners have collectively been somewhat undecided between the terms "university spinout", "university spinoff", and "university start-up", and it appears to be a matter of personal preference. Shane for example, in focusing on an American context, preferred spinoff but noted that his definition more closely matched the definition of spinout used by British scholars (Shane 2004, 6). However Minshall, Wicksteed, Druilhe, Kells, Lynskey , and Širaliova (2008) suggested that a company originating from a university in which the university had no claim on the intellectual property (IP) would be called a university start-up; given the context of this case study and therefore the applicability of the Swedish teachers' exemption (Lag om rätten till arbetstagares uppfinningar 1949:345), this term could also apply. However, for brevity's sake I will use the term "USO" unless it is a direct quote or a reference.

USO's are typically viewed as emerging through a series of developmental stages separated by stage gates or critical junctures, such as those described by Vohora, Wright and Lockett (2004), beginning with the identification of a solution to a market need and a decision to commercialise a technology through the creation of a company. The nascent venture then appears through the gradual acquisition of resources such as capabilities and investments, and the organisation of these to produce value, eventually ending somewhere around the point at which the venture is deemed to be sustainable. Van Geenhuizen and Soetanto (2009) suggested that USO's will be unable to progress through these development stages if they faced obstacles "perceived as poor or non-availability of key resources" at the time they are needed.

One such resource is the committed academic entrepreneur, and academics themselves are one object of study for researchers trying to understand why some research is commercialised through the USO process in particular. Early descriptions of entrepreneurial universities suggested that the beliefs of academic researchers played a key role in research commercialisation, having undergone a change that allowed research organisations to behave more like "private business firms" (Etzkowitz 1983). Academic entrepreneurs

have been described as scientists with university affiliations who start commercial enterprises (Samsom & Gurdon 1993), who may run it in parallel to their academic responsibilities (Franklin, Wright & Lockett 2001), but face a greater chance of success if they leave their academic positions behind (Doutriaux 1987). A potential venture requires the commitment of an individual or group who possess(es) the capabilities required to perform all of the tasks necessary in new company creation (Franklin, *et al*., 2001). Some studies have suggested that the "entrepreneurial type", motivated by a desire for wealth or independence for example, is likely to start a USO, and there are also suggestions that those more likely to start a new venture can be characterised through their high university status or as previously experienced entrepreneurs (Shane 2004).

Many studies of USO creation also include universities' technology transfer offices, often abbreviated to TTO or TLO (technology licensing offices), and these often form a key part of the system within which USO's are supposed to develop; Etzkowitz (2006) described them as an integral part of the assisted linear model, performing as a facilitator for very early stage spinouts (Shane 2004). They are sometimes treated as one of the resources that could be of poor quality or missing at critical stages, and studies have set out to investigate the different characteristics that influence how helpful they are for USO's, considering for example their connection to start-up networks, investments from the parent research institution (in this discussion the university, and sometimes abbreviated to PRI), and expertise in key areas (Shane 2004).

We can see therefore that both practise and theory share a number of key assumptions about commercialising research through the creation of USO's, and the practise can be understood as part of the innovation system, the emergence of which has been described by Magnus Eklund (2007). Eklund outlined the influence social science research had on the innovation policy in Sweden from the early 1990's and onwards, and we can reasonably assume then that the models in the literature, and the assumptions underlying them, are carried into more practical understandings of how such processes should occur, be managed, improved, and so on. Even my own research objectives at the outset of my doctoral studies carried similar assumptions.

How might this be a problem?

There might however be a number of problems with a widespread adoption of the ideas dominating both literature and practise, firstly because these ideas rely heavily on work examining resource needs, and secondly because they seem to assume that the process is, or should be in an ideal world, linear and unidirectional in character.

In practice, the efforts by KIC InnoEnergy and others to encourage and support USO creation and development would suggest that the process is in need of assistance, and therefore that USO's are not "spinning out" as we might expect. Early interviews with researchers involved in the case I started collecting financial information on suggested that the research commercialisation process could not be a simple hand-over from one group of people in academia to another in industry. Reports of movements between a research group at a university (hereafter referred to as the parent research group, or PRG, to distinguish it from the wider organisation of the university and the research department) and an associated USO quickly amassed: while researchers moved to the USO at the end of their doctoral studies, engineers at the USO moved to the university to begin their research careers; the professor who had founded the USO was torn between his academic responsibilities and USO development activities; researchers employed at both the research group and the USO found themselves taking on their industrial role whilst seated in their university office and thinking of academic research questions whilst trying to solve industrial problems at the USO, and so on. The empirical case taking centre stage in this thesis also revealed a similar contradiction to the ideas outlined earlier, with movements occurring in the opposite direction rather than solely from the university to the USO, and indeed my early inquiries suggested that even after five years of research and innovation support, the USO was not "spun off" but rather remained attached and entangled with the parent research group at the university.

Such an on-going relationship between a research group and a USO is of course mentioned and social relations enter into literature on USO development, but it is addressed only as a possible resource for the university (in for example arguing why USO's are good for universities) or the USO (in terms of resources moving to the company). For example, Samsom and Gurdon (1993) examined cultural issues between science and business, and suggested that in USO creation, perhaps more specifically in the earlier stages of development (Vohora, *et al.* 2004) demands are placed upon academics to adjust from a culture in which "peer recognition and tenure provide motivation and security within academic structures" to one in which "financial performance principally influences rewards, a clear hierarchy exists and security is limited at the best of times" (Samsom & Gurdon 1993, 65).

Addressing the USO and the university more specifically, Stuart and Ding (2006) described the social changes and structures that lead to commercial activity in the Life Sciences, but focused specifically on the causes of the initial decision to become an academic entrepreneur rather than the on-going social forces at play within or between research groups and USOs. Shane (2004) suggested that USO's derived important support from parent research institutions through the access they had to resources such as university laboratories, a claim supported by Van Geenhuizen and Soetanto (2009) who also found that USO's wanted a relationship with universities for

collaborations with research professors, as initial customers for USO outputs, and to lend additional credibility to the nascent venture. USO's could also use their connections with universities to source future employees. For universities and students on the other hand, there is a clear educational benefit from the presence of a USO, in that they can provide industrial experience important for students' careers after graduation, for example. This component of the USO-PRI relationship is also beneficial for the university in terms of attracting more students because the education they provide can be viewed as being relevant to industrial concerns (Shane 2004).

While these perspectives might help scholars to describe (or help practitioners to evaluate) the progress or potential of a venture or academic entrepreneur, with the driving questions being concerned with how a bundle of resources can be acquired, organised, and exploited to move from a given position to a future desired position, such perspectives are limited by this resource based view. Firstly, the empirical case in this study showed almost immediately that the constant movement of people, objects, etc., between the research group and the USO was difficult to follow even for the people performing those movements; even the same meeting could shift between academic and industrial concerns in a matter of minutes, and resources were shared, split, or fragmented between the two.

Secondly, even defining these resources can be difficult as they come in so many different forms; how for example might we define a researcher as a resource for a USO? They might bring with them their specific knowledge or a patent, but they also bring less easily quantifiable benefits to a USO such as knowledge from on-going interactions with other researchers, or ideas that might be sparked from having a different perspective on a problem. Further, does a resource operate in the same way across different realms, or might they work differently as they engage with different sets of social entanglements?

In turning to the empirical case suggested at the outset of this study, academic research commercialisation, it becomes clear that the current descriptions in academic entrepreneurship literature and popular understandings suggested by policy and program descriptions do not take into account the various relationships between people and the groups to which they (aspire to or already) belong beyond their usefulness in the initial and resource-dependent stages of development of a USO. A closer examination of the social aspects of academic research and associated USO organisations offers therefore a contribution to the existing literature in terms of an understanding of how USOs continue to relate to the parent research organisation as they develop; how research and research commercialisation are entangled, and therefore how current conceptions of academic entrepreneurship fail to describe how USOs can remain linked to, and perhaps dependent upon, their parent research organisation, and thus fail to spin out as expected.

The phenomenon of USO creation and development is mainly understood in theory through academic entrepreneurship, which incorporates USO creation, academic entrepreneurs, the Triple Helix, etc., and many of the policy tools from the EU level down to the university administration level suggest that the popular models in academic entrepreneurship literature are dominant also in practise. However, the existence of these policy tools and continued attempts by scholars to explain low USO creation and survival rates suggests that USOs are not spinning out as expected or desired.

One limitation of these conceptualisations, and therefore the eventual policy and organisation efforts to improve USO activity at Swedish universities, is their reliance on a resource based view, explicitly or otherwise. There are of course good reasons why literature on the topic does not address the social, and instead remains focused on the resources at the centre of the phenomenon. Practitioners still seem interested in the question of resource use, if my own initial research task is any indication. In terms of research though, firstly the question of resources is one which appears to be rich in potential, both for scholars and practitioners alike; studies into the effects of resources have not yet been able to demonstrate that initiatives have had any particular effect over the long term for example. Secondly, concepts are of course just one way of discussing and working within the world around us and those presented in the literature are both specific, in that they focus on resources, and vague enough to allow for such discussions.

However such a view misses the social perspective of the phenomenon: knowing that a qualified and capable researcher has moved from the university and into a USO tells us that a resource, a bundle of technical knowledge and familiarity with the peculiarities of a new technology, can now be used to develop that same technology for a commercial market. According to existing (resource based) understandings we can perhaps be satisfied that, given a reasonable monetary supply, a well-equipped workshop, and the rights to use the IP associated with the technology, it's only a matter of time before the commercial product is launched.

Unfortunately the case presented in this thesis describes a quite different collection of experiences: that some of the researchers moved to the USO, tried to produce a working commercial prototype and received limited feedback from the CEO of the USO until they began building a complete unit, upon which they were hastily chastised by both the CEO and the research leader, the professor entrepreneur, eventually resulting in several returning to the university or leaving the project entirely. We can see quite clearly that a focus on resources, or lack thereof, does not help us in understanding what happened here. Rather, we can see that there may be some potential in seeking to understand how the researchers and their understandings of the commercialisation process occurring close by became distanced from those of the professor entrepreneur, or how the CEO and the researchers appeared to be in agreement until quite a late stage in the technology development –

experiences which seem to be social in their nature, and which shaped the USO and technology development both during these moments and in their on-going relationship.

In short, literature on creating companies from academic research does not acknowledge social forces, and the purpose of this study is therefore to explore the social forces that matter in research linked to the commercialization of research. The overarching research question is therefore:

> 1. How can a social lens help us to understand some of the forces at play in research commercialisation (specifically through the early development of a USO from a parent research organisation)?

Social forces as an approach

One scholar who addressed individuals, social groups, and movement, was Robert Ezra Park. His concept of social forces, particularly with regard to migration and the marginal individual (1928), will be used in this thesis to complicate and explore academic research commercialisation. A more thorough description of the epistemic background to this choice will be provided in the methodology section of the thesis to further explain why certain elements of Park's work were chosen to assist in exploring and talking about the research question, but since the choice of language informs the research focus it is necessary to outline the approach at this early stage.

Park drew on two prominent scholars of the pragmatist approach, Dewey and Mead, in his work on communication, and came to view "technological innovation, ideological changes, migration, and alterations in natural resource use and availability as forces of change" (Maines, Bridger & Ulmer 1996). Social forces could be a useful concept through which to discuss the activities being observed in the case because it helps to explore how social interactions between group members, movements into social groups, and social groups' movements into new contexts give rise to individuals' attitudes and behaviours that alter, stabilise, or otherwise change those social groups and the activities therein.

One way in which social forces might help us to better conceptualise USO creation is through one of the key assumptions made in the approach, that forces arise and are enacted through and between individuals who are entangled in the social context. This sits in direct contrast to the notion of forces as they are implied in more traditional concepts, explored later, in which it is the (constant, perhaps unchanging) forces present in the ether that appear to shape the development of the USO, or, it is forces already present in the commercial realm to which the USO and the academic entrepreneur must react and adapt to accommodate.

Park provided two notions that will be of use here; the first concerns that of community, and the second that of the individual who moves from one community to another whilst carrying elements of the original community. This will be explored in more depth later in the thesis, but Park's social forces, particularly in terms of the relationship between the individual and the community to which they belong at a given time, helps us to understand how forces arise through actors as these individuals and groups move within and between different social settings, and how this in turn shapes the development of the USO. In other words, the concept of social forces can help to deepen our understanding of research and its relation to a USO by highlighting the active nature of individuals as they selectively relate to social groups and the various forces that might arise through different kinds of interactions. This is particularly important as we consider actors relating to the spheres of academic research and industry, and the process of research commercialisation as it is driven across them.

The concept also offers a language through which to talk about the academic entrepreneur, the individual migrating from the academic community to industry, and the classification of societal groups, academic and industrial. It might for example allow Etzkowitz' work on entrepreneurial scientists (1983) and the Triple Helix (Etzkowitz & Leydesdorff 1995) to be expanded to consider the way in which state policy enactment activities moving into academia or industry, or actors moving between these spheres, might carry elements of one sphere to the next.

Perhaps more importantly it also offers possibilities with regard to language for describing the experiences of individual researchers, engineers, and maybe even other actors, and with regard to the communities and the influence of migratory actors on these collectives. The empirical case, hinting at a research group still connected to the entrepreneurial activity but separated, by their group status for example, from the individual academic entrepreneur described in the literature (Shane 2004, Shane, Dolmans, Jankowski, Reymen, & Romme, 2014), suggests that there are interesting things to say about the movement of non-faculty individuals, knowledge, etc. between the different collectives in the case. What might we observe if an individual moves from the university research group to the USO, and back again? What might they carry with them? And how might other actors' observations of this movement, other researchers, state funding agencies, etc., influence beliefs about the different spheres? Slaughter and Leslie (1997) talk for example in the neighbouring research field of Academic Capitalism about the entry of a capitalist dynamic to academia and describe the influence such a force has on university researchers. Linking this back to Park's notion of social forces it could be fruitful to consider what forces emerge, both as movements occur and after they have occurred. To the first research question we can add:

> 2. What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?

It would be reasonable to assume that the researchers have some sense of the different forces acting on them, particularly if they are formalized in procedures or the meeting of two or more forces present the researcher with a dilemma. Park's work on communities offered some notes on the concept of knowledge; what does knowledge about a collective and about an individual from a certain collective do when collectives meet, through for example migration or process? Relating this more specifically to the case study, we could ask what does knowledge (here used loosely, referring to what people might believe they know) about the realms of academic, industrial, university research commercialisation projects, etc., do? Since we cannot directly observe a link between what the researchers know about their experience and the communities around them and the influence such knowledge might have on them, we cannot say much conclusively. However, we can hear from the researchers and observe in their actions how they respond to such forces, and from this perhaps hypothesize about how these actors encounter and learn to negotiate the research space in their everyday activities. This leads to the final research question:

> 3. How do university researchers within the research group experience and negotiate these social forces?

Contribution to literature

The literature explored in the thesis began with academic entrepreneurship, an area of theory populated by a group of key authors often co-authoring articles including Andy Lockett, Stephen Franklin, Scott Shane, Mike Wright, and Ajay Vohora. They explored themes such as the USO development process, characteristics of academic entrepreneurs, organisational resources in academic entrepreneurship, and structures surrounding it such as TTO's.

If academic entrepreneurship leaned towards the entrepreneurial act and its antecedents in the environment external to the university, academic capitalism examined the environment inside the university. This area of literature emerged in early works by Henry Etzkowitz (1983) and was described in Sheila Slaughter and Larry Leslie's book of the same name (1997). They considered the university as a resource-hungry institution and research commercialisation as one avenue through which researchers increasingly tried to obtain research resources.

These areas of literature were, although describing almost identical activities in some respects, nearly completely isolated from each other. This seems quite strange given that they each try to explain certain – and often similar – activities and yet ignore the structures and forces that inform the other perspective. Some scholars have bridged the two areas with regard to specific questions: Etzkowitz has produced a long list of articles describing the Triple Helix, an over-arching view of the relationship possibilities between the three realms of academia, industry, and state as a wider discussion concerning innovation, and Lam has considered motivations for academics to engage in entrepreneurial type behaviour, for example. However, attempts to understand academic research commercialisation as a process and to understand the interplay between a research group and a USO remain in the separate areas of academic entrepreneurship and academic capitalism.

Thus, one of the contributions of this thesis is to bridge these areas of literature, and try to conceptualise how combining them can illustrate the processes they both try to describe in a more coherent manner. However, even combined it became clear that they missed some of the forces influencing the activities taking place in the case study. Here Robert Ezra Park and Ernest Burgess' (1921) work on actors and their efforts to enact their will within a social group is taken up to conceptualise these social forces. This contributes to the literature by illustrating research commercialisation and research connected to a USO as a social process.

A further contribution comes through a difficulty presented by the empirical data. As data was collected it quickly became apparent that, in contrast to descriptions offered in literature, there were many different and often conflicting potential understandings of the activities taking place. Individuals within the same research group and USO seemed to relate to different concepts not only in their descriptions to me, but also in their everyday activities. This case study presents then not a single, cohesive narrative of research and USO development, but explores a multitude of narratives. The contribution to literature is therefore a complication of the academic entrepreneur's narrative, implied through existing literature to be the only narrative that can offer anything of value to our understanding of the USO process.

Outline of the thesis

The thesis begins with an outline of two main areas of theory underpinning scholar's understanding of the USO creation from university research, academic entrepreneurship and the entrepreneurial university. Research question two informs the search for relevant literature (*What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?*). Some key limitations are

then described, and the section ends by asking how USOs are understood in terms of social aspects. The final section in the theory chapter outlines more clearly what research focus the thesis addresses, and how it will do so. At this point, a key author whose connection to the thesis will be outlined in more depth in the methodology section is introduced, Robert Park, along with his notion of social forces, a concept that informs much of the analytical approach in this study, answering the first research question (*How can a social lens help us to understand some of the forces at play in research commercialisation (specifically through the early development of a USO from a parent research organisation)?*).

Forces working upon and between the realms of research and USO, or rather the resolution of conflicting forces such as between the academic and the commercial, is a key component of the USO development process, wherein uncertainty and academic research must make way for decisive entrepreneurs and resources secured through the demonstration of realistic development strategies, for example. Park's work is therefore suggested to help in understanding the phenomenon through considering forces as they relate to collective organisations and the movement of individuals from one to the next. However, it also offers a language through which the narratives of individuals within the case study can help us to understand them as actors who are members of, or excluded from, a collective organisation, and as observers and reporters of forces as actors move between groups. Park's other contribution to the thesis is presented briefly next, with questions concerning actors' knowledge of ideas of academia, industry, and research commercialisation, raised in connection to his epistemological grounding in pragmatism, asking what such knowledge, again a loosely used term, does in this case.

Having outlined why the thesis has been written and what questions it seeks to answer, chapter three outlines the methodology informing the thesis and methods employed to gather and analyse the research data. A brief exploration of pragmatism reveals some themes that are central to the thesis, including knowledge or beliefs and actors' relationship to these, forces arising in social groups, and what actions might result through these being enacted. A pragmatist approach also guides the methods selection, where Corbin and Strauss' (2008) ideas concerning the self-reflective actor and their interactions with other actors guided decisions around data collection. One important part of forming the study was the decision to build a case study and limit this to the specific social and physical setting. Some ethical issues are discussed at this point, motivated mainly by some actors' reluctance to take part in the study unless certain conditions were met, conditions which mostly pertained to data handling. In light of this, the methods used to file data, both raw and my own observations made during these early stages, are outlined.

As the data was collected, the seeds of an analysis were forming, and the reasoning behind decisions regarding how to slice the case in a good way is presented here. The main motivation was to present a case study that made sense both to readers new to the case and to actors who might be involved in the kinds of activities described within it, and this was achieved by returning raw data to research participants for their comments and clarifications where they felt they were appropriate, and discussing some of my anonymised observations with other researchers.

Chapters four, five, and six begin to explore the case study by examining the social groups in and around the PRG, and begin to sketch out some findings that speak empirically to research question two (*What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?).* At the outset of chapter four the case is presented in terms familiar to scholars of the entrepreneurial university and USO creation to introduce readers to the empirical material at hand and to allow readers to return after they have read the thesis to see how the limited understandings of the reviewed literature might look in such constructed narratives. The voices of the actors in the case study enter immediately after this, revealing how they describe the forces driving their research and commercialisation efforts forwards, reflecting perhaps popular concepts of research, USO creation, and the industrial realm.

Chapter five introduces a project that forms a central part of the thesis, a multi-actor demonstration project of the commercial version of the technology the PRG takes as its focus. This episode introduces some actors sitting outside of the PRG and the USO but who were key to an important series of events for the technology and its development journey, not least because they controlled resources essential to the USO at the time.

In chapter six the installation of a single device forms the empirical basis for this chapter's analysis. Park's concepts of the migrating individual, movement between social groups, and specialised roles, informs the analytical component of this section, which explores how some researchers were able to move between the PRG and the USO in order to further their own interests, as well as those of both social groups. It also hints at the difference forces individuals might be subjected to as a consequence of their social group memberships.

Chapter seven considers one attempt by the actors in the PRG to establish structure, one way Park suggested groups could establish stability and permanence (Park 1927). The episode at the centre of this is a meeting of the PRG actors, one of the first events I observed and the most explicit attempt by the actors to structure the research group. This chapter also addresses question two. However, in this chapter Park's concept of social forces furthers the analysis by helping to frame the multiple group memberships of the

actors and the forces these entail as one possible reason for the eventual perceived failure of these and subsequent structuring efforts.

One key individual emerged as an apparently influential figure in the actors' narratives, and chapter eight seeks to draw out these descriptions in an analysis of the professor entrepreneur and his absence from one of the social groups, the PRG, as a neglected aspect of the case study (and literature) so far. This chapter continues exploring the second research question, and also moves the analysis onto research question three (*How do university researchers within the research group experience and negotiate these forces?*).

Chapter nine adapts Park's notion of the migrating individual as they enter a foreign social group to explore how individuals from outside of the research group have the potential to exert social forces on social groups. Here, a description is offered of a meeting at the university. During this event, actors sought to find an appropriate way to respond to commercial-type questions to academic research funding applications in order to obtain research resources, whilst maintaining their integrity as a separate organisation from the USO.

The thesis turns away from analysing specific empirical episodes at this point, and begins the final analysis by outlining the forces that have been indicated by previous chapters in the thesis. Chapter eleven presents two empirically-driven examples of ways in which these forces might combine and conflict, and in which actors within the social groups may choose to try to cope with these various forces, and chapter twelve presents some final conclusions.

2. Theory

The literature review begins with an outline of two main areas of theory that address the creation of USOs from academic research, namely academic entrepreneurship and the entrepreneurial university, and some key limitations are described. The research questions then begin to more explicitly inform the literature review as the central theories are explored with regard to forces they describe or imply are influential in the creation of USOs, both in terms of the spinning out process and any on-going relationship between the USO and the parent research institute (PRI) and parent research group (PRG), which links to the second research question (*What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?*).

Having explored the current understanding of the forces in USO creation and relation to the PRI and PRG, the first research question is addressed (*How can a social lens help us to understand some of the forces at play in research commercialisation (specifically through the early development of a USO from a parent research organisation)?*) as Park's work on social forces, the collective, and the individual, is presented as the conceptual framework through which the remainder of the thesis will explore the empirical case.

Outline of the main areas of theory addressing the development of USOs from academic research

How are academic research commercialisation attempts conceptualised in the literature? The literature can usually be considered as having two main approaches; the structural approach which seeks to understand the context surrounding academic entrepreneurship, mainly concerned with "access to resources and environments rich in institutional support", or the approach which places the individual as the focus, and seeks to describe the characteristics, motivations, and experiences of individuals who act entrepreneurially (Colyvas & Powell 2007).

The main field of research to address this is that of academic entrepreneurship, which focuses on mechanisms by which select university generat-

ed intellectual property is transferred to commercial application, through for example licensing or the creation of university spinout organisations (USOs). One of the earliest books with a focus on academic entrepreneurship is Shane's *Academic Entrepreneurship: University Spinoffs and Wealth Creation* (2004), and due to its high citation count, it is assumed to be particularly influential within the field. The concept is typically approached with nods to research on economics (Schumpeter, Von Hippel, Freeman, Nelson, Rosenberg, and Schmookler), strategic management (Abernathy, Pavitt), and sociology (Latour, Weber, and Merton), and also claims to employ a historical approach (see for example Etzkowitz (1983)).

Another theory that offers potential insights into the commercialisation of university research (but that seldom crosses paths with academic entrepreneurship) is the entrepreneurial university, an area outlined in for example Becher and Trowler's Academic Tribes (2001), Etzkowitz and Leydesdorff's triple helix (1995), Slaughter and Leslie's *Academic Capitalism* (1997), and Slaughter and Rhoades' later book, *Academic Capitalism And The New Economy* (2004). In contrast to the academic entrepreneurship field, this theory considers changes to academia and economic policy in the national context to problematize entrepreneurially acting academics, both in terms of creating USOs but also with respect to entrepreneurial efforts within academia, such as securing research funding and securing student revenue.

In examining the commercialisation of university generated knowledge, particularly when there appears to be a connection with the university during the commercialisation activity, it would seem prudent to consider an alternative approach that could consider the interaction between the worlds of business and academia. One such theory is that of the entrepreneurial university and the Triple Helix, a model described by Etzkowitz (1983, Etzkowitz & Leydesdorff 1995) and referred to, at least in passing, within both academic entrepreneurship and academic capitalism texts.

Academic entrepreneurship

Whilst academic spinouts in which the university retains equity are somewhat easier to keep track of (although by no means unproblematic) and are therefore easier to research, articles rarely identify that the study in question is limited to such cases (Wright, Clarysse, Mustar & Lockett, 2007). This is particularly important to note when making comparative studies involving academic research commercialisation taking place under different legal contexts; the teachers' exemption in Sweden for example, by granting IP to the researchers and not to the university, means that cases would be excluded from any such studies. Wright *et al.* (2007), in describing academic research commercialisation in Europe, are therefore explicit about their inclusion of cases in which the university does not hold equity.

In *Management Science* Mowery and Shane (2002) described scholars' understanding in the field of academic entrepreneurship as fragmented and limited in development, in part due to the wide variety of analytic frameworks and methodologies that have been employed, and shortly afterwards Shane provided an answer to this problem in *Academic Entrepreneurship* (2004). Here he gave an account of his findings from his empirical investigation into spinouts from Massachusetts Institute of Technology between 1980 and 1996, using theory from a range of management disciplines to try to understand the phenomenon and establish a framework for USO theory. His study is geographically limited to the USA, Canada and the UK, which means that it is a study only concerned with cases where the entrepreneur must license back the knowledge from the university itself. As such, its findings do not necessarily apply in countries such as Sweden in which the university does not automatically claim the rights to the intellectual property developed within its walls. The book examines several different components of academic entrepreneurship, but focuses explicitly on university spinout organisations.

Gartner (1990) said that entrepreneurship included organisation creation, and Shane described academic entrepreneurship in terms of creating a university spinoff, defined as "a new company founded to exploit a piece of intellectual property created in an academic institution" (2004). Wright *et al.* (2007) presented a similar view, outlining their study as having considered "new ventures that are dependent upon licensing or assignment of an institution's IP for initiation" and also included in their definition "start-ups by faculty based in universities which do not involve formal assignment… but which may draw on the individual's own IP or knowledge" (p. 4).

Academic entrepreneurship is easily identified as being connected to entrepreneurship research. It is therefore not particularly surprising to find that the academic entrepreneurship research field is divided into much the same areas as entrepreneurship: characteristics of the individuals who start the venture, the organization that they create, the environment surrounding the new venture, and the process by which the new venture is started (Shane 2004). The connection between the two fields can be drawn through two aspects of the research fields, the first through the content of the theories and the second through scholars moving between both areas.

Factors influencing USO creation

The creation of the organisation could be influenced by factors such as social ties to venture capitalists, scientific talent (Mowery & Shane 2002), patent effectiveness and entrepreneurial skill set (Shane 2001), and successful USO creation depends on, amongst other things, a decision to commercialise (Vohora *et al.* 2004) and acquiring the resources and capabilities to gain access to and serve markets (Wright, Vohora & Lockett 2004, Rasmussen & Borch 2010).

Another focus on the academic entrepreneur came from Brennan and McGowan (2006), who explored the factors that affected academic entrepreneurship within a single UK university. They presented a conceptual model of different kinds of knowledge production, comprising of two circles of activity which are characterised as Mode 1 and Mode 2 knowledge production (Gibbons, Nowotny, Limonges, Trow, Schwartzman, & Scott, 1994) broached by three entities: the individual academic, the academic field, and the discipline domain. Brennan and McGowan argued that it is "the intensity of switching between the two modes of knowledge production that can be used to characterise an academic as an academic entrepreneur" (2006). This movement occurred through processes they identified as novelty seeking, opportunity seeking, and advantage seeking.

Krabel, Siegal and Slavtchev (2010) sought to understand how international mobility related to entrepreneurial activities of Max Plank Institute scientists, taking into account a number of variables such as the entrepreneurial culture of the foreign country, income and reputation vales, attitude to risk, patents granted, and career stage of respondents. They found that as well as international mobility being positively associated with entrepreneurial activities, directors and group leaders, individuals that associated entrepreneurial activity with increased reputation, and less risk-averse scientists, were over-represented in the group of nascent entrepreneurs.

USO creation as a process

Academic research commercialisation can be understood as a linear phase development process, such as that famously modelled by Vohora, Wright and Lockett, in *Critical junctures in the development of university high-tech spinout companies* (2004). Vohora *et al*., who characterized USO's as "new ventures in transition" (p.147), described USOs as being distinct from other new ventures in two main ways. The first concerns the movement from the academic to a commercial environment, and means that the USO faces an additional obstacle in gathering commercial resources, in particular in adapting the skills of the academic entrepreneur to commercial challenges. The second revolves around the possibility that key stakeholders (the university, the academic entrepreneur, and finance providers, for example) might have conflicting objectives which need resolving.

Their model addressed two main questions: what phases do USOs go through and what key challenges do these ventures face in their development? The case-based research on which they built their model was inductive but grounded in a resource-based view of the firm (RBV), and explored USOs from seven universities in the UK. The aim of these USOs was to provide a return on the investment of their finance providers within a reasonable timeframe. The model described a series of five phases interspersed with four junctures. Each phase builds on the activities performed in the preceding phases, with the development iterating through the activities with

successively increasing stocks of resources, summarized as physical, financial or technological resources, social capital, or internal dynamic capabilities (Vohora *et al.* 2004). To continue to a succeeding phase the USO must pass through critical junctures, after which they are qualitatively different. Failure to resolve issues in a timely manner, which presumably varies from one USO to the next, leads to stagnation, resources will become depleted and the venture will eventually fail. Failure to advance could be attributed to obstacles, which Van Geenhuizen and Soetanto characterised as being resource based (2009).

During the first phase there is only one activity: *research* at the university. This phase has no explicit limit in Vohora *et al*.'s (2004) model, although it would be sensible to assume that it can continue as long as the resources are available to do so within the university. The first critical juncture, *opportunity recognition*, marks the change from academic research, lacking the necessary human entrepreneurial and social capital for commercial awareness, to the presence of these capitals and an accompanying understanding that some research finding may be applicable in the commercial realm. How these capabilities arrive has been suggested as through university support functions such as technology transfer offices, or encountering a commercially minded individual (2004).

Once the opportunity has been identified the development phase of *opportunity framing* can occur. Here the academic entrepreneur seeks an appropriate commercial proposition and attempts to define the resources required to continue the commercialization process. The academic may iterate between activities that could be characterized as opportunity framing and others more closely related to research activity, this iteration is performed to try to adapt the research to a more applied direction. The opportunity framing phase was described by Vohora *et al.* (2004) as "dealing with the intense uncertainty surrounding the technology", and one of the key requirements for advance to the next development phase is for an individual to be emotionally committed to the USO creation, a critical juncture known as *entrepreneurial commitment*. Obstacles to the academic succeeding in passing this juncture could be the human capital he or she possesses, or a culture at the research department or university that dissuades entrepreneurial action. One way to counteract such issues is through the separation of the academic researcher and the entrepreneur tasked with developing the USO, a strategy otherwise known as taking on a surrogate entrepreneur (Franklin *et al.* 2001). However, other obstacles could still emerge. Vohora *et al.* (2004) listed for example insufficient resources from the university for USO activities, unclear university policies or guidelines, and failure to develop an external network with financers and industry in general.

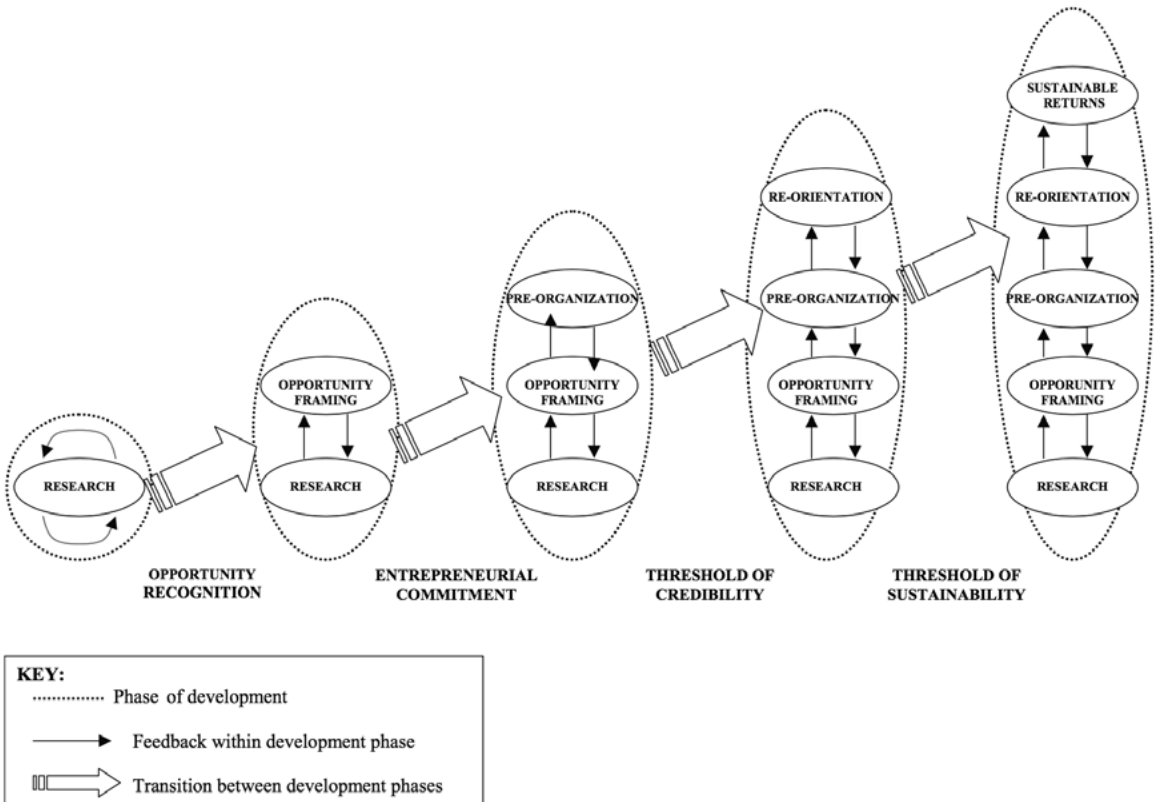


Figure 1. The critical junctures in the development of university spinout companies. (Vohora *et al.* 2004)

After the entrepreneur has committed to the venture, the search can begin for resources necessary for the USO to develop. Those identified earlier may still be required, but opportunity framing activities continue to develop the list of identified requirements as research continues and more knowledge enters the commercialization process, such as through increased connection with the commercial world. This phase is known as the *pre-organisation phase*. Insights gained here are essential for the next critical juncture, *credibility*. Vohora *et al.* (2004) said that credibility is a "key issue in obtaining seed finance to establish the venture". USOs are described as facing a greater challenge in this area compared to other business start-ups because their offerings are seen as intangible, and their academic origin could mean that the academic entrepreneur lacks experience of working in a particular market or developing a commercial product. Again, a conflict may arise due to the different natures of academia and industry, this time with respect to culture and values. To enable the USO to advance beyond the juncture of credibility Vohora *et al.* (2004) suggested the recruitment of a surrogate entrepreneur if this has not been done earlier, and to further demonstrate the credibility of the USO by demonstrating proof of concept and locating the venture off-campus, for example.

Once the USO has demonstrated credibility it enters the *re-orientation phase*. The key task in this development phase is to re-organise resources to better align the USO with the market using knowledge accumulated during the previous phases. This could also include recognizing new resources and networks to combat newly identified weaknesses in the USO. The aim in this phase is to pass the final critical juncture, the threshold of *sustainability*, by developing a key dynamic capability: the ability to re-configure existing resources in order to produce financial returns as the USO continues to grow. In the final phase, *sustainability*, the USO has developed a good range of resources, human capital, capabilities and networks. Vohora *et al*. (2004) suggested that the USO should maintain a relationship with the university in order to facilitate a technology pipeline and to open the possibility for increased opportunity recognition in future research activities at the university.

Vohora *et al*.'s (2004) critical junctures model appears to have helped shape more recent studies into USOs. Ziaee Bigdeli, Li, and Shi (2015) for example built on it when they analysed three cases to conceptualise the evolution of USO business models over their development. All three USOs had spun out from UK research institutions and reached what Vohora *et al*. (2004) would describe as the sustainable returns phase. They concluded that the business models developed through a series of decisions made at key stages, decisions that could be classified as: "*organizational structure consolidation* during the pre-organization phase, *innovative value composition* in the reorientation phase, and *value network extension* during the sustainability and scalability loop phases" (Ziaee Bigdeli *et al.* 2015, 10).

The entrepreneurial university

In contrast to the entrepreneurial epistemology of academic entrepreneurship, the entrepreneurial university literature approaches the idea of creating new ventures from academic research from the angle of higher education research. The study of higher education can be divided into several key areas that address pedagogy, undergraduate learning, graduate student socialisation, and research as part of the university mandate.

In a well-known description of academia, Becher and Trowler (2001) sought to understand the different academic disciplines and their relations to conceptualise how themes such as globalisation and capitalism manifest in different academic contexts. Here they suggested that scholars needed to pay more attention to the differences between disciplinary groups, emphasising that "both theoretical understandings and practical policies cannot be assumed to relate equally to all academic contexts" (p.21).

Although their work did not address USOs, in this second edition they moved a little closer to the topic by presenting their research as an attempt to connect the entrepreneurial university concepts to the different academic contexts they discussed. In introducing their work they provided a summary of their understanding of the entrepreneurial university, turning to the Triple Helix (Etzkowitz & Leydesdorff 1995)[1], Mode 1 and Mode 2 knowledge production (Gibbons, *et al.*, 1994), academic policies concerning entrepreneurialism (Clark 1998), and academic capitalism (Slaughter & Leslie 1997). However, it is Slaughter and Leslie's work that Becher and Trowler credit with bringing attention to the commercialisation of academic research (2001).

Academic capitalism

Slaughter and Leslie (1997) turned to resource dependence theory and process theories concerning professionalization to establish a link between national policy and the development of the entrepreneurial academic, and their work can be seen in later studies of academia.

They argued that the university, and the market in a wider sense, have undergone dramatic changes over the last century, most markedly from the 1980's onwards. They suggested that academics are the ultimate professionals because they hold the monopoly on training for and awarding advanced degrees, and historically have been therefore isolated from the market. A gradual slide into closer relations with the market from the 1950's onwards was accelerated by 1980's globalisation, whereby increased competition from the Pacific Rim countries led to companies in industrialised countries

[1] Becher and Trowler refer to *Etzkowitz, H., & Leydesdorff, L. A. (1997). Universities and the global knowledge economy: a triple helix of university-industry-government relations, London:Pinter*. Unfortunately such a book appears to have been published in 1995, and I assume this is a mistake in their text.

(America, Australia, the UK, etc.) turning to universities for science-based products. While doing so, these companies also pushed for governmental support of this academia-to-industry innovation activity. The US and UK governments responded by creating industry-university cooperative research centres in the 1980s and Australia followed suit in the 1990's.

Changes in national economic and education policies across the nations in Slaughter and Leslie's (1997) study, specifically with regard to education and economic policies, were instrumental in promoting academic capitalism. As the research centres opened funding to universities was changing: global financial markets opened up new possibilities for capital, and government borrowing meant that funding for state services, including postsecondary education and research and development, was decreasing. Gradually student grants were replaced with loans, moving the cost from the government to the individual students, and what little money remained for research and development activities was selectively granted to research deemed to be closest to the market. When not competing for state finance, academic researchers were forced to compete for industry funding in order to survive.

Another to focus on higher education, Clark (2004), described how this became institutionalised in Sweden through the creation of innovation centres reporting directly to the university President, supported by NUTEK and the Wallenberg foundation at Chalmers for example, to assist with university-industry collaboration and highlight the innovative nature of the university. Corporations such as Volvo were consulted to design education, from undergraduate and onwards, to suit the needs of industry, and financing of doctoral studies and research had shifted by 1998 to be dependent not on state funds but on industry grants and sponsorship.

Clark considered the environment surrounding the *academic heartland* as the *developmental periphery*, and although this was mainly described in terms of university-industry interaction to draw in financial resources to academic research, he presented the case of Twente University (1998). Here, a programme called Temporary Entrepreneurial Placements was founded in 1984, wherein would-be entrepreneurs were "offered an interest-free loan, office space and connection to a university research group, advice and training… a faculty mentor… and courses in how to be an entrepreneur" (p.48) in the hope that their spinouts would survive to move into a nearby business park.

In *Academic Capitalism* (1997), Slaughter and Leslie described the emergence of USO's as a result of an increased profit motive in academia. Specifically, they suggest that USO creation could be seen in two distinctly different market behaviours: profit driven, which include patenting and licensing activities, and research resource driven, in which entrepreneurial academics compete for resources such as grants, contracts, university-industry interaction partnerships, and investments in spinout companies. However since the

work here is focused on the changes occurring within the university, there is little more said about the USO itself.

Notably, for the purposes of this thesis, is the use of the terms *academic capitalism* and *entrepreneurial academic* (Slaughter & Leslie 1997). The terms respectively describe the act of decision making close to the market and trading on the capital of academics, and the academic who engages with industry in order to secure capital. In both descriptions it is at least implied that the behaviour is grounded in the practices of securing financing for university research, or in other words, the activities taking place, such as USO creation or other knowledge transfer mechanisms, are framed as being of secondary importance to the funding entering the university.

One fairly obvious problem with the academic capitalism literature is that it is limited to the research object of the university and its employees, and addresses them as reactionary to the forces acting on them from actors such as the state, research funding agencies, or university policy makers. Like academic entrepreneurship, it stops short of considering the relationship between university and industry beyond the effects that may be felt in academic research organising activities, for example. However, academic capitalism and academic entrepreneurship draw on the work of Henry Etzkowitz, one of the originators of the Triple Helix, a model that was created to try to conceptualise the relationship between industry, state, and academia.

The Triple Helix

Etzkowitz and Leydesdorff considered entrepreneurialism and academia on two levels: a macro level, conceptualising how academia, industry and state influence the movement of knowledge between realms (1995), and a micro level, describing how the beliefs of university researchers concerning the commercial application of academic research have changed over time (Etzkowitz 1998).

On a macro level, Etzkowitz and Leydesdorff developed the Triple Helix model (1995), which suggests that industry, academia and state work together to advance their own, and each other's, endeavours. They argued that policy under this model should be directed towards encouraging industry-academia interaction, industry should both perform research and utilise academic results, and academia should both perform science and commercialise it. Together with Leydesdorff, Etzkowitz (2000) further divided the model into two possible configurations: the first describes the three realms of activity clearly separated from one another with defined borders, and another suggests an overlapping between the three, with areas between them characterized more as hybrids than as distinct areas.

Etzkowitz also considered the entrepreneurial academic, and tried to describe how the individual academic might fit into the Triple Helix model. Etzkowitz (1983) considered incentives in terms of how university financing has been viewed as an incentive for independent research, and how govern-

ments have offered money to encourage university-industry collaboration (Etzkowitz, Webster, Gebhardt, & Terra, 2000), but did not consider this with regard to USOs. He also described some consequences of the entrepreneurial university on the individual, focusing for example on the effect of pursuing industrial activity on academic careers, and suggested that scientists who straddled the academia-industry border in their research activities were respected and given credit in their academic career for their ability to draw in funding from both industrial and academic financers (Etzkowitz 1998).

One strong characteristic of Etzkowitz's work is a focus on historical data; he drew on historians of science throughout his work, particularly in the post-second world war era (1983), and therefore posited his model as a conceptualisation of how university-industry-state relations had functioned in the past.

In considering Etzkowitz's work alongside academic entrepreneurship literature, it becomes clear that both imply a directional movement, with knowledge travelling from academia to industry. However, while academic entrepreneurship literature suggests that the drive for this movement is based in the academic realm, emerging from incentives affecting the academic entrepreneur or tools such as university technology transfer offices, and only mentions market needs in terms of whether they can be aligned with university research findings (Vohora, Wright & Lockett 2004), Etzkowitz's (1998) entrepreneurial university is, although arguably still technology push inclined, involved in the technology transfer process through a collaborative effort from industrial actors, and the movement may even be characterised as technology pull as industrial actors seek to fund the research areas they find interesting.

However, the strength of Etzkowitz's approach is also a weakness. Although a historical approach provides a good empirical grounding for the theory, it also limits the theory developed from it. As Slaughter and Rhoades (1996) argued, it assumes that the commercialisation activity is taking place under a social and political regime similar to that of the historical context upon which the studies focus. Secondly, they argued, it assumes that the effect of these kinds of activities upon the science research itself is negligible, and they rarely discuss the university itself, preferring instead to ignore the institutional effects to focus on the relationship between researchers and industry.

Limitations and digressions

With a focus on activities so close to the university, it is perhaps little wonder that empirical data concerning topics of interest to USO scholars such as academic entrepreneurs, the local policies at play, and so on, seems to be so

readily available. Having said that, the type of empirical evidence is often limited according to what data university administration departments collect. The studies that exist typically attempt to understand one small element of the USO (such as the junctures through which it advances as it develops (Vohora, Wright & Lockett 2004), the institutionalisation of academic entrepreneurship within the context from which USOs emerge (Colyvas & Powell 2007), and a small selection of the actors performing the USO activities (Shane 2004) for example) or to identify how the academic context can better support entrepreneurial efforts, and this leads to a few important limitations.

Limited temporal focus

Some of the main works in the field, assumed from their citation figures, such as Vohora *et al.*'s (2004) USO creation process model, Shane's (2004) academic entrepreneurship framework, and to some the academic capitalism paradigm (Slaughter & Leslie 1997, Slaughter & Rhoades 2004) share one limitation in particular, and that is their focus on what could arguably be said to be a very small part of the USO creation process. Further, of the small area they focus on, the area concerning drivers for the process is smaller still because these drivers are clustered around the decision to initiate a commercialisation process, rather than extended to consider the PRO and the USO in the aftermath.

This limitation appears in more recent work too: Shane *et al.* (2014) expanded upon on what we might term, according to Vohora *et al.* (2004), opportunity recognition from the perspective of TLOs for example (Shane *et al.,* 2014), Lam (2011) sought to understand academic scientists' different motivations for the initial decision to commercialise research, and even in searching for new areas to explore through performing a literature review, Carrick (2014) failed to reach further than the university as a springboard for starting the USO process.

However, there are a number of issues with this limited scope, not least in that it fails to address the parent research organisation, the USO, and the relationship between them, after the initial commercialisation initiative.

Limited activity focus

The university itself is typically described only in terms of the policies and actions of the administration and faculty in both academic capitalism and academic entrepreneurship, although, as could probably be expected, the portrayals of these actors vary considerably between the two conceptualisations.

Under the academic capitalism model universities are problematized as individual organisations, competing against each other for resources, stu-

dents, and reputation, or as an administrative force dictating resource allocation amongst individual faculty. Universities are subject to national policy in part through their dependence on government funding, increasingly issued through state funding agencies with specific areas of concern, such as innovation agencies. Tools such as technology transfer offices are suggested to be part of the university's own policy mechanism through which faculty are encouraged to engage in entrepreneurialism, and thus secure state resources for the institution (Slaughter & Leslie 1997).

For Shane (2004) and academic entrepreneurship however, the university is not such a reactionary agent but rather a helpful springboard for new technologies, and whilst university policy might lead to the creation of technology transfer offices, these are a necessary and important part of the support system surrounding the budding entrepreneur. Administration, whilst still acting to distribute resources, are portrayed as a marketing function in terms of making the entrepreneurial potential of the faculty known outside of the university in order to help them acquire the resources the entrepreneur needs for their ambitions.

While these descriptions offer insights into the administration, departments, and faculty at the university, and their power is conceptualised in terms of change implementation and resource allocation (or resource denial, depending on which angle is taken), the knowledge production function of the university is barely touched upon in connection to USO creation. In literature on the entrepreneurial university it is discussed for example in Becher and Trowler's (2001) work in terms of differences between disciplines, or in Slaughter and Rhoades's (1996) suggestion of knowledge as a commodity, and Slaughter and Leslie (1997) discussed how academic researchers secure the resources vital for research activities. In academic entrepreneurship, Vohora *et al.* (2004) and Shane (2004) acknowledge that the research at the university is a key component of the academic entrepreneurship paradigm, but accounts of the actual production of this knowledge and connection to technology development in USOs is extremely limited.

Studies in the wider field of technology transfer typically address the movement of technology or knowledge from academia to industry in terms of intellectual property, citation of research articles in patents (Szu-chia 2010), articles co-authored across the boundary of university and industry organisations (Zucker, Darby & Armstrong 2002), or the movement of key personnel (usually senior) (Slaughter & Rhoades 2004). In all of these descriptions, there is no mention of further development of the intellectual property into a marketable product.

However Colyvas, Crow, Gelijns, Mazzoleni, Nelson, Rosenberg, and Sampat did state that of the cases they presented "six… did require further development before they were usable by industry or other academic scientists" (2002), Jensen and Thursby (2001) argued that additional effort in development by the inventor is required for a reasonable chance of commer-

cial success, and Carrick (2014) suggested that early-stage investment for USOs often comes before the technology is mature enough to garner the interest of larger firms for joint venture partnerships, and hinted at the use of university facilities for industrial product development activities such as testing. This would suggest that not only does product development occur alongside business development in the USO process, but that it may also involve some link back to a university research department. Further, if larger firms are not interested in newly-spun out technologies, this could suggest that there is some awareness in the industrial realm of the need for product development before an emerging technology is mature enough to invest in. If it is important enough for investors to take into account when making decisions that could affect the USO process, it would be reasonable to assume that it, or expectations of it, have an impact on the USO and, by extension if a relationship exists between the USO and a university, the research division.

Product development

Thinking of Vohora *et al*.'s critical junctures (2004), many of the stages and junctures describe resolving uncertainties or arranging resources – activities that could be understood to be related, if not even dependent upon, the creation and development of a new product. Although not considered in any depth in the literature on USO creation and development, scholars do occasionally hint at its existence: Vohora *et al*. (2004) identified that development and testing of prototypes had taken place during the pre-organisation and re-orientation stages in four of their nine cases, Doutriaux (1987) mentioned one of their cases as a company that produced a prototype but did not specify whether this was a prototype for their own business development, i.e. proof of concept, or whether their business was to produce prototypes for other venture, Colyvas *et al.* (2002) noted that it was not clear whether the embryonic inventions of the Bayh-Dole act could be understood as "proof of concept" or "prototypes", and Jensen and Thursby (2001) suggested that at the point of licensing, most university inventions are a proof of concept and nobody knows if they could become a successful commercial product or not.

Research into product development has been described as fragmented, varied and difficult to analyse (Trott 2002) and will not be covered in detail here; the purpose of this section is to briefly examine some aspects of product development that might emerge in USOs and in a case study such as this, based upon some commonalities with the USO literature.

Utterback and Abernathy (1975) described a widely cited model of product and process development in which they tried to conceptualise how a company's innovation attempts varied with differences in its environment and competitive strategy. The early stages of development are characterised by a high rate of product innovation with a focus on product performance, which gradually drops and levels as the product or products being developed become more standardized and cost reduction takes priority. Simultaneously

the low rate of process innovation gradually increases over time as functions are specialised and organised, and innovation turns to scaling up and rationalisation.

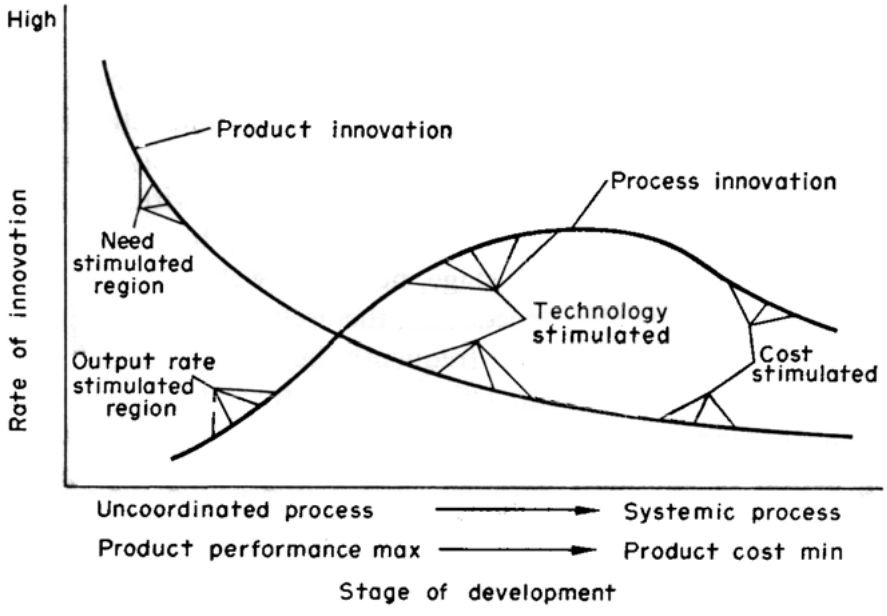


Figure 2: Innovation and stage of development, A Dynamic Model of Process and Product Innovation (Utterback & Abernathy 1975)

Successful financial performance can be linked to the performance of product development activities by cross-functional teams organised according to the demands of the development task; specifically, a productive development process can lead to lower costs and a faster process creates strategic flexibility, which may lead to financially successful products (Brown & Eisenhardt 1995).

Takeuchi and Nonaka (1986) described a "rugby" approach to the product development process, a term which later became popular as the SCRUM approach, or agile methodology, in industrial settings (Sutherland 2001). This approach features a multidisciplinary team working together throughout the development process, moving in an iterative fashion between activities, for example product design and feasibility tests, and reconsidering earlier decisions as knowledge arises later on. This is in contrast to older conceptualisations in which product development occurs like a relay race as one group of specialists passes the product development to the next team from phase to phase, through for example concept development, feasibility testing, product design, development process, and pilot production to final production (Takeuchi & Nonaka 1986). Trott described this approach as a de-

partmental-stage or “over-the-wall” model (2002), and this traditional approach was linked to product development failure (Dougherty 1990).

Similarities could be drawn between the traditional approach outlined here and assumptions made in USO literature concerning the activities throughout the development process. In other words, the USO literature contains an inherent implication that the technology development could be performed at an earlier stage, and then “handed off” to the USO team. This is in contrast to the more iterative approach to product development also presented here, in which we could understand the product development activity as continuing in an iterative development throughout the USO process, and performed both by USO actors and perhaps those still located near to earlier developmental tasks, i.e. university researchers.

Given that the successful completion of the product development process is key to the resulting product, what factors can influence its success? According to Brown and Eisenhardt (1995) the product development process is dependent upon the amount and variety of information and the resources available for the project. The success of the resulting product depends on the input from leaders and customers into a clear product vision, commitment from top management, and existing corporate strengths.

The leader and management both bear the responsibility for the final outcome. The leader needs to have both power (significant decision making responsibility, organization wide authority, high hierarchical level) and the cognitive ability to create a vision from a variety of factors and then communicate this to the development actors (Brown & Eisenhardt 1995). The role of management is to organise the activities and actors, through checkpoints for example, to ensure stability, but to at the same time avoid rigid control that could constrain the creativity required for a successful outcome (Takeuchi & Nonaka 1986).

Pre-planning in terms of development stages is therefore important, but internal organisation is also critical to success (Brown & Eisenhardt 1995). This is particularly important in product development processes because the various functional departments within which the development actors are drawn can be seen as different "thought worlds" (Dougherty 1992) and the ability to handle the barriers between these was suggested to be a key factor in successful development projects (Dougherty 1990). Development projects in which functional groups handle the development in sequence, so that each phase of the process is dominated by a particular group’s worldview, often lead to a failure of the product development process (Brown & Eisenhardt 1995).

In understanding the key role organisation plays in the (product) development process, it becomes perhaps quite difficult to understand why the USO literature, in describing a process to which development is so central according to Vohora *et al.* (2004) for example, appears to have a very nar-

row focus with regard to the actors it considers to be important in the USO journey.

Limited character focus

The character problematized to the largest extent, both in academic entrepreneurship and academic capitalism, has been the academic performing the entrepreneurial role, whether seeking resources for activities taking place within university research or commercialising their research through a USO. This problematisation has been in the form of direct characterisations, for example as "entrepreneurial types" (Shane 2004) or on a scale from "traditionalist" or "entrepreneurial" (Lam 2010), or through indirect descriptions such as the traits desired by actors surrounding the entrepreneur.

In the field of academic entrepreneurship, understanding and even predicting the type of person to perform this role has been a strong theme for many researchers, and the starting point for Shane's (2004) exploration for example is connected to whether the individual is able to secure resources vital to the potential USO. He began to look further into how to predict the behaviour of those in and around the practise of academic entrepreneurship, for example looking at the reaction of technology licensing officers to academics based on whether or not the prospective entrepreneur "fit" the academic entrepreneur mould. The study was conducted at 87 US universities and asked 239 technology licensing officers to evaluate invention disclosures made by fictitious inventors with randomly assigned characteristics (Shane *et al.* 2014). It found that licensing officers recommended commercialisation to a significantly higher degree if the inventor was described as an immigrant male, with industry experience, and easy to work with. Vohora *et al.* (2004) identified a further attribute of the academic entrepreneur, suggesting that social capital, the stock of partnerships or linkages an individual has, is required to identify how their research findings could meet market needs.

Vohora *et al.*'s (2004) article makes a further point, that social capital and competencies of the academic entrepreneur are both positive indicators of USO success (success being determined here as passing the sustainability returns juncture) and factors that can be developed through the entrepreneurial process. Shane (2000) also identified that entrepreneurs utilise the information they already possess, therefore individual differences influence the opportunities discovered and the organisation of the entrepreneurial activity. One possible way to increase the success of USO's would be to introduce more information and more varied experiences. Clarysse and Moray (2004) focused on the entrepreneurial team in one case study, providing a qualitative description of management organisation and experiences during the start-up phase. They contributed to the field with an alternative understanding of USO creation by suggesting that the academic entrepreneur might not

be one single person, but a combination of people with skill-sets useful to the new venture.

In academic capitalism on the other hand, the entrepreneurial academic was not defined by the characteristics they possessed, but rather by their decision to act in a certain way and portray themselves as inventors (Slaughter & Leslie 1997). It could be argued that whilst academic entrepreneurship suggests academic entrepreneurs are individuals born as such or changed into the entrepreneur, academic capitalism reflects more of a split approach, framing the entrepreneurial academic as a sub-group of academics who choose to perform in a particular way, in this case entrepreneurially, without being changed as individuals in order to secure the resources they need for their research activities.

However the academic reaches the entrepreneurial act, nature, nurture or performance, there are a number of actors surrounding them such as technology licensing officers (Shane *et al.,* 2014), surrogate entrepreneurs (Franklin *et al.* 2001), or academic peers (Lam 2011, Obschonka, Goethner & Silbereisen 2012). In academic capitalism the university administration is one main power, but this has relatively little direct effect on the USO creation, and what effect it does have beyond pressuring the academic to perform entrepreneurially is mediated through organisations such as technology transfer offices. Descriptions of these and their work are few in academic capitalism, but when viewed as a tool to assist in USO creation they occupy a much larger space within academic entrepreneurship. However, these descriptions are limited to what they do, rather than how they can be characterised. Specifically with regard to USO creation technology transfer offices can act as patent holding companies, useful for example if the entrepreneur cannot hold the patent in their own name as a result of regulation or lack of financial resources, or as a means to connect surrogate entrepreneurs with the USO (Franklin *et al.* 2001), and to provide investments for equity in the USO (Lockett, Wright & Franklin 2003). They can also act to help keep university activities and business activities separated through acting in a boundary-spanning role to formalise relationships between the USO and research groups (Rasmussen & Borch 2010), for example.

One critique levelled at both research areas is that they "are built on the presumed inevitability of the entrepreneurial university" and therefore that academics are reactionary in nature. In doing so, "it fails to take account of the strategic role of actors, namely scientists themselves, in interpreting and shaping change" (Lam 2010, p. 308). From our own experience we can assume that there are many different types of individuals who could be involved in the USO process, all driven by their internal desires and beliefs about what such activity might provide for them, and indeed Lam (2010, 2011) sought to describe some of these motivations and their links to traditional beliefs concerning academia, which will be explored later.

However, one limitation of examining the researchers who can choose how to behave, entrepreneurially or otherwise, is that these are possibly just a fraction of the actors who find themselves engaged with the USO and its development. One clear reason for the partiality of the literature is evident in the definitions provided and centres around the issue of faculty. Faculty is the term applied to senior research staff at the university – research leaders at the least, but often professors. In academic capitalism, Slaughter and Leslie (1997) framed their discussion on faculty, this time only considering professors and those on tenure track, in terms of market actors within the university. Although Shane (2004) briefly addressed the issue of exploitation of graduate students, this is framed as a discussion of faculty attitudes towards using graduates as a USO resource and a few select cases of faculty obtaining patent rights for the research of their students.

One study that did consider non-faculty researchers was by Mendoza (2007), who used a cultural socialization perspective to explore how graduate students responded to industrial involvement in their academic research group. She found that overall students were satisfied with the financial support, as well as the research problems they approached, and that the level of freedom they perceived was high. However, her study reduced these individuals to students upon which the industrial worked, reactionary rather than autonomous, and did not consider them to have any influence in their wider context. Further, her study did not actually consider graduate students in relation to USOs.

Secondly, once "faculty" has progressed to "entrepreneur" within academic entrepreneurship the academic has either proven themselves committed to the venture, been replaced by a surrogate, or been complimented by an entrepreneurial team (Vohora *et al.* 2004), and appears to take on the role of spokesperson to external actors, such as investors or casual observers.

What drives these actors?

Both academic entrepreneurship and academic capitalism appear to focus on the activities taking place at the university level, and in particular address university policy and tools in entrepreneurship, and as such these take centre stage in conceptualisations of motivating entrepreneurship, albeit for very different reasons. Whilst it is clear that TTO's and investors need to be persuaded to engage with a USO through the demonstration of viability for example (Vohora *et al.* 2004, Shane *et al.* 2014), providing the incentives for the academic to commercialise their research has taken a much larger place within literature on USO creation.

Both academic entrepreneurship and academic capitalism offer some reasons as to why an academic may decide to act entrepreneurially or why they might be reluctant to do so. Many of these can be classified in terms of resource acquisition, some tangible such as research or innovation funding,

graduate students or facilities, and others as less tangible such as reputation, perceived career rewards, intrinsic satisfaction, or beliefs about the difficulty of obtaining resources for the entrepreneurial activity.

The Schumpeterian model of entrepreneurship suggests financial reward as one of the possible incentives for individuals to behave entrepreneurially (Schumpeter 1947), and Shane (2004) hypothesised that academic entrepreneurs were similarly motivated by a desire for wealth. Financial resources appear as a motivating factor for entrepreneurial activity in academic capitalism, but rather than a personal desire for wealth the desire takes the form of a need to secure essential resources, such as research funding, facilities, and graduate students, to continue research activities (Slaughter & Leslie 1997). Establishing the resources to support a growing venture, a research department, or indeed both, could of course be linked with some ease to another of Schumpeter's concepts, that of empire building (1934).

As well as a desire for wealth, Shane (2004) offered two further psychological explanations: a desire to bring technology into practise and a desire for independence, but he acknowledged that these were suggestions based on anecdotal evidence rather than tested hypotheses. Lam (2011) found a similar pattern in an empirical study. In *What motivates academic scientists to engage in research commercialization: 'Gold', 'ribbon' or 'puzzle'?* she questioned 735 scientists from UK research universities. She found that financial rewards are only a small factor when compared with the possibility to obtain resources essential for academic career success for scientists holding traditional beliefs about the separation between science and business. When scientists identified more closely with entrepreneurial norms they were more intrinsically motivated, i.e. they were motivated by the opportunity to solve a new puzzle (Lam 2011). A further motivating factor, reputational or career rewards, is also connected to academic capitalism through the ease with which it can be associated with purely academic endeavours, such as solving a research problem or being rewarded through promotion to a professor role (Slaughter & Leslie 1997).

The motivating factors outlined so far have been described by Lam as being part of a "resource frame" (2010, p. 326), but she extended her framework to include elements that can't be measured quantitatively such as culture, formal policy, and so on. Her study examined the effect of beliefs concerning the relationship between industry and academia, and she found that while "traditionalist" scientists, characterised as believing in a strong separation of the two spheres, were unlikely to create a USO, 29% of scientists with "entrepreneurial" beliefs, seeing "the boundary between academia and industry as highly permeable" had founded USOs (Lam 2010, p. 317).

But it is not just beliefs about the boundary between academia and industry that inform a decision about creating a USO. Other beliefs can also act as incentives or disincentives for entrepreneurial action.

One disincentive to USO creation could be the perceived difficulty of obtaining financial support. Wright, Lockett, Clarysse, and Binks (2006) described venture financing and the issues USOs face in attracting sufficient funds at various stages of development. For example, while venture capital investors prefer to invest in USOs after the seed stage, universities' TTOs and USOs want venture capital finance earlier. Further, VC investors are "likely to be interested in generating financial returns within a specific time period" but TTOs anticipate a much longer time period in comparison (Wright, *et al.,* 2006, p. 495). This difference in expectations is just one of the signs that there could be a number of issues in the academic entrepreneurship practise. Siegal, Waldman, Atwater and Link (2003) outlined a number of areas in which barriers to university-industry technology transfer were observed. Here the different motives, environments and behaviours of the stakeholders (in Siegel *et al.*'s explanation university faculty, university administrators and private sector management) provide the ideal background for disagreements and misunderstandings about how university-industry technology transfer (UITT) should be managed.

Slaughter and Leslie's (1997) conceptualisation of faculty financing could offer a potential incentive beyond a simple search for resources; an academic's *beliefs* about the availability of research funds may inform their actions with regards to entrepreneurial activities, as could their beliefs about the appropriate qualities they should demonstrate within a given research community (Henkel 2005). Stuart and Ding (2006) found that proximity to colleagues engaged in commercial activity positively affected academic scientists propensity to follow suit, and they argued that this was because the proximity to entrepreneurial individuals altered the scientists beliefs about the appropriateness of for-profit-science. However, these studies all considered academic researchers who were in a position to seek research or innovation funding, and had a secure position within the university. Other researchers are also involved in USO ventures, from graduate students to new graduates of education programs. How are they motivated to engage with the USO process?

There are very few studies addressing non-tenure track academics and their involvement with USOs, but one study considered the affect of working close to the university-industry boundary. Mendoza (2007) suggested that graduate students motivated to work with industry could see opportunities in patenting during their studies, whereas more academically inclined students may find the publication delays associated with patenting of academic research findings an extra hurdle to their career. In a study of industry-sponsored graduate students she found that doctoral students were typically positive to the effects of industrial sponsorship, and it was found that they perceived industrial partnerships as a "vehicle to achieve the traditional outcomes of the academic profession" (2007, p. 90).

One issue that is not addressed in literature on the entrepreneurial university nor academic entrepreneurship is that of market-like activity in group settings; research is rarely performed by a single researcher in isolation, and yet aside from competition between universities (Etzkowitz 1998), meritocracy with regards to students (Slaughter & Rhoades 2004), or technology licensing officers selection of inventors (Shane *et al*. 2014), there is no discussion of competition between individual researchers or USO actors.

However, in turning to explorations of individuals' relationships to group activities in classic literature on product development however, the framing of the issue of resources and group behaviour in industrial settings raises some possible issues. To take one example, Teece and Pisano (1994) suggested that there is a problem in reconciling market or market-like incentives (such as financial rewards, career advancement, etc., which are discussed in both academic entrepreneurship and entrepreneurial university literature) with the development of internal dynamic capabilities required for group activities, such as collaborative research projects or USO development tasks. This is because, Teece and Pisano argue, the only motivators for individuals to engage in group-benefitting activities are "unleveraged or low-powered incentives" (1994, p. 539). This means that activities related to these activities can only be rewarded on the organisational level, making it very difficult to reconcile group rewards with the individual rewards outlined in the USO literature.

But actual rewards might not be so important for understanding how some academics are driven to act entrepreneurially, and then other concepts can enter the debate. These might include perceived rewards, beliefs about the ease with which USOs could be created, the culture of the immediate context in which the academic acts, or even exposure to other academics acting entrepreneurially might influence an academic researcher's decision to create a USO.

Social aspects of USO creation

One area only recently emerging within the field can be loosely grouped as considering some social aspects of academic entrepreneurship. Although much of the literature suggested social capital as a relevant factor in commercialising academic research (Shane 2004, Vohora *et al.* 2004), this can be seen as a resource which the academic entrepreneur can acquire, bundle, and exploit in much the same way as any other resource available to them. That social aspects can be important for USO formation is discussed in terms of the social context from which the venture emerges, social identity, and strength of social ties from the perspective of the academic entrepreneur and from external actors' perspectives.

Colyvas produced two articles from her case study of Stanford University, one together with Powell that examined the transformation of the academic

social context, or the structural aspects, from which academic entrepreneurs emerged (Colyvas & Powell 2007), and the other a study of the emergence of the Stanford technology transfer program during the 1970's (Colyvas 2007). In the first study, Colyvas and Powell examined inventive behaviour over 31 years to describe how entrepreneurial activity changed over time. They identified the 1990's as the period during which contact with industry became important, and suggested that financial rewards were a consequence, rather than a driver, of contact outside of academia. Secondly, first-time academic entrepreneurs tended to invent with an experienced academic entrepreneur, and the authors argued that immediate context, those within the research environment that an individual collaborated with, were highly influential in the decision, or opportunities, to disclose inventions (Colyvas & Powell 2007).

In the second of these Colyvas (2007) alone considered the development of policies and practices of technology transfer at Stanford over a shorter period, the early 1980's, identifying four main factors that influenced the later, standardized, policy. These included *advocacy and authority*, wherein higher status faculty were vocal about financial resources, and *legitimacy and organizational routines*, under which scientists considered how resources arising from commercial activities could affect basic science enquiry, and eventually arrived at a "clear boundary" relationship with the technology licensing office (TLO). The TLO entered again into studies addressing obstacles to research commercialisation, as Braunerhjelm (2007) argued that Sweden faced a difficulty in capitalising on university researchers' positive attitudes towards academic entrepreneurialism due to the support functions at universities (in this case Linköping University) lacking a strong connection to the surrounding market.

However, the social context around a USO will change as the USO progresses; Gübeli and Doloreux (2005) presented a case study of three USOs from Linköping University in an attempt to describe their characteristics and network activities. They identified that university support was important in the pre-incubation stage, particularly with regard to mentorship, but as the USO developed, actors in the wider context at the regional and municipal levels became more important.

Along with a changing social context, the strength of ties to a certain context can also play a role. Rasmussen, Mosey and Wright (2015) focused on four cases in the early stages of venture formation in UK and Norway to try to understand how social networks related to competency development in spinouts. They found that weak and strong ties were important at different stages; for example weak ties were important in enabling a transition from research to business activities, whereas strong ties contributed with regard to research acquisition.

Social ties in academic entrepreneurship have also been explored through the social identity concept. Obschonka *et al.* (2012) defined this as "scien-

tists' group identification with their academic workplace peers" (p. 139) and argued that studies of academics' intention to commercialise their research should not be studied solely through the lens of personal identity *or* through that of social context, but that they should take into account the interplay between the two levels. They found that variations in individuals' relation to the social group revealed two main classifications of academic entrepreneurs. In the first, academics with low group identification, researchers would engage in entrepreneurial activities when they perceived they had the means to control the entrepreneurial effort, and the social norm had a somewhat weaker effect than their perceived control. In the other the individual had a strong identification with the group and tended to engage in entrepreneurialism when the social norms of the group were entrepreneurial.

Returning to Colyvas (2007), she described how the acceptance of technology transfer required the co-mingling of the contradictory domains of the industrial and academic. She discussed individual scientists' negotiation of these contradictions as being guided by institutional logics or cultural norms to frame their decision making activities, and suggested that academic entrepreneurs are aware of possible mismatches between their parent research organisation and future commercial setting during the USO development process. Samsom and Gurdon (1993) also examined cultural issues between science and business, and suggested that during USO creation, perhaps more specifically in the earlier stages of development, demands are placed upon academics to adjust from a culture in which "peer recognition and tenure provide motivation and security within academic structures" to one in which "financial performance principally influences rewards, a clear hierarchy exists and security is limited at the best of times". The idea of shifting and accommodating to a new social setting builds on an earlier observation that academic entrepreneurs face a greater chance of success if they leave their academic positions behind (Doutriaux 1987).

For other actors in the USO process though, social ties can influence how they act regarding a particular venture. They can be seen as one way to reduce uncertainty for investors for example (Shane 2004), and Shane and Stuart's (2002) earlier empirical study of MIT spinouts indicated that spinouts with a third party able to refer a founder to financing sources were 2.8 times more likely to receive venture capital support.

This is important given Van Geenhuizen and Soetanto's (2009) finding that USO's will be unable to progress through these development stages if they faced obstacles "perceived as poor or non-availability of key resources" at the time they are needed; if resource-controlling actors such as potential investors are making decisions based on their perceptions of a USO or academic entrepreneur's social ties, forming the appropriate relationships at the appropriate stage in the USO development could be key to its survival. They also found that USO's wanted a relationship with universities for collaborations with research professors, as initial customers for USO outputs and to

lend additional credibility to the nascent venture, suggesting that an on-going relationship with the parent research organisation could, in contrast to Doutriaux's (1987) findings, be seen as a positive indicator for success (Van Geenhuizen & Soetanto 2009).

Social aspects have not been ignored in USO studies, and they continue to follow the same division as the wider USO literature, with scholars asking what structural aspects of the surrounding context can influence the propensity to commercialise and the survivability of the USO. However, these studies do highlight an important feature of the topic, and that is that although social aspects and their effects on the academic entrepreneur and the USO vary considerably in each case and over time, and there is disagreement over what effect they have, they do play a somewhat key role for actors making resource allocation decisions. This would suggest that they are important to study not only for expanding upon this area of the literature but also for practitioners.

Taking a step back from USO creation and into the entrepreneurial university in a wider sense does however offer some social analysis that is lacking or limited in USO creation literature. Becher and Trowler (2001) for example, although concerned with higher education rather than USO creation, argued that the way that academics social practices, values, and understandings of their discipline and their relation to others, are related in important ways to their activities. "The relationship (between disciplinary knowledge and academic cultures) involves a mutually dependent interplay of, on the one hand, the structural force of the epistemological character of disciplines that conditions culture and, on the other, the agentic capacity of individuals and groups for autonomous action, including interpretive acts" (2001, pp. 23-24). They highlighted the movement of individuals into academia as possible carriers of "norms, values and recurrent practices… deriving from the wider environment", and the role of individuals in enacting and constructing culture through structurally-provided scripts (p. 24). However, the approach is limited in that they focused only on suitably "prestigious" individuals (identified by other academics, and supposed to have gained their degrees at elite universities) and upon reflection they amended the initial focus of their research to include teaching experiences reported in interviews with these individuals, but did not subsequently expand their empirical base to include less prestigious individuals.

Their influence in the literature on the entrepreneurial university can be seen in the scholars citing them: Mendoza (2007) for example used their notion of different disciplines to argue for the socialisation of doctoral students to specific disciplinary cultures, Henkel (2005) suggested that the disciplinary domain was a key component of academic identity, and more recent explorations of the relationships between different disciplines as a part of academic entrepreneurship have turned to academic tribes to try to under-

stand the distances between these groups (Wright ,Piva, Mosey, & Lockett 2009).

Conclusion

The literature on USO creation is limited in three main ways: in terms of time or development stage, the activities described, and the actors performing them. Studies tend to focus on USOs as they emerge from the university, or on the context immediately prior to their emergence such as the decision to commercialise. This leads to many conclusions that seem to offer guidance for incentivising entrepreneurial commitment, but that ignore overall or longer-term development assistance.

The somewhat obvious actors also feature heavily in the literature; the academic entrepreneur, the TTO, investors, and so on, and their characteristics, competencies, and ability to acquire resources are considered to be central to the USO phenomenon. However these actors are usually either high status (star researchers, professors), somewhat secure (tenured), or resource-controlling (TTOs, investors, etc.) and therefore are not necessarily subject to the same demands of the social context as others might be; we could quite easily imagine that a postdoctoral researcher on a temporary contract might be more concerned with securing funding to pay living and research expenses than with expanding their responsibilities into commercial activity, for example.

Following this, the literature on drivers is limited to considering what drivers (and conversely what disincentives) affect those at the centre of these descriptions, with scholars debating the issue of personal financial rewards versus resources for research as a motivator for research commercialisation, or considering individual differences in academics' reasons for starting a company such as the anticipated satisfaction at solving a puzzle, or even beliefs about the availability of resources.

The activities described within the literature are also limited, with scholars examining policy development within university administration or faculty efforts to secure their research projects' financial futures, or the different organisational development stages the USO might pass through and the resources and capabilities they need to acquire to do so. However, the research and product development activities for example are notably absent or only mentioned in passing, and yet they would appear to be quite important; what should a USO commercialise, and how might the activities surrounding the technology influence the ability of the USO to continue moving towards sustainable returns, for example?

Finally, despite prominent models of the USO development process including an unexplored activity labelled research, and therefore implying a continuing and possibly unchanging relation between the research and the commercial entities, and despite claims that USOs and PROs benefit from

maintaining a relationship throughout the development of the USO, this relationship has not been problematized beyond the initial decision to commercialise.

In terms of the social aspects at play here only those in literature on the entrepreneurial university are described, for example in Becher and Trowler's work (2001) or Mendoza's (2007) approach to socialisation of doctoral students, and there is no real discussion of what relevance they might have for USO creation and development. Currently there are no case studies of a USO and its relationship with its parent research organisation, nor are there any explorative studies seeking to understand how the wider organisation around the academic entrepreneur can influence the USO process at later development stages, nor how social forces acting within and between the PRO and the USO might influence the mid- to longer-term development of the research or activities.

Analytical framework

One concept that Trowler and Becher sometimes referred to is that of forces; those of the social background, disciplinary epistemology, gender (2001), policy and market (Trowler 2002) are mentioned for example, but they never appear to have defined what was meant by these terms. One scholar who worked somewhat more extensively with social forces, although not in terms of academics and their tribes, was Robert Ezra Park, and it is to his work that I now turn to advance this thesis. How did he conceptualise social forces? How can I use this to further our understanding of the different collectives primarily involved in research commercialisation through the creation of new companies; the parent research group and the USO? And how did he view movement between different collectives? His work and some connections to the thesis will be outlined shortly, but first comes a brief presentation of his influences.

Robert Park, one of the founders of the Chicago school of urban sociology, first came into contact with the pragmatist approach in the 1880's when he attended the University of Michigan, where Dewey was an instructor. Dewey's approach to communication and its importance to social life resonated with Park, who later began a career as a journalist. After a decade in this career he returned to academia, studying first at Harvard, meeting James, another prominent pragmatist scholar, and then at Heidelberg where he earned his Ph.D. and came into contact with Simmel during the latter's lectures at the University of Berlin (Goist 1971).

Shortly after his doctoral thesis he, together with his University of Chicago colleague Ernest Burgess, published *Introduction to the science of sociology* (Park & Burgess 1921) and it is primarily from this work that the con-

cepts in this thesis are taken, with supplementary material taken from his article *Human nature and collective behaviour* (Park 1927).

Throughout the late 1930's and 1940's, Park's was subjected to "intensive and targeted critiques", during which he was accused of dualistic conceptualisations, underemphasizing cultural factors, producing work which were a form of biological determinism, and work which was empirically inadequate, "mythic facts" which were legitimised by a group of scholars repeatedly citing one another (Maines, Bridger & Ulmer 1996). One of the main criticisms for example was centred on Park's notion of the sociocultural and the biotic spheres, which scholars argued was evidence of his dualism; "a symbiotic society based on competition and a cultural society based on communication and consensus" (Park, 1936, as cited in Maines *et al.* 1996, p. 533). However, immediately after describing these he described how the two were in fact simply different, and co-dependent, aspects of one society (Maines *et al.* 1996).

This criticism, Maines *et al.* (1996) argued, effectively re-wrote the field of human ecology without Park. However, the authors argued that these criticisms reflected a misreading of Park, and that they could be dismissed by understanding Park as viewing the interactions in the social as the observable unit of attitudes, and thereby fusing individuals to their societies.

We begin with an outline of Park's notion of the collective, or social group, followed by his work on the individual and its relation to the collective, and finally outline the notion of social forces as he described it.

Collective

Park and Burgess defined a group as a "number of persons whose relations to each other are sufficiently impressive to demand attention" (1921, p. 196). This rather wide definition can be made more precise with the specification that a gathering of individuals does not automatically make them into a group; rather, they must possess "the capacity for concerted action" (Park 1927, p. 735), or in other words, they must be able to collaborate in working towards the realisation of a common interest. In order to act as a unit the group members must be sensitive to the other members and the normal collective behaviour; for example any leader deviating too far from the norms of the group is likely to be ignored (Park & Burgess 1921).

Collective action may include the struggle against an external enemy or against internal disorganisation, and may result in some form of internal organisation, such as establishing a division of labour or some specialisation of the individual members' activities, for example. Repeated specialised activities and the role of the individual group members may eventually become recognised in custom and tradition, and this leads to a stabilisation of the group which can be passed to the next generation of group members (Park 1927).

For customs and tradition to become permanent though, the group also requires structure. Park and Burgess (1921) saw structure as the instruments of a group to transform its purpose, interests or functions into activities, and Park later defined this as a "division of labour, and … some degree of specialisation in the individuals who compose the group" (Park 1927, p. 735). The individual and their relation to the other members of the social group appear to be crucial to the purpose, activities, and permanence of the social group. But how did Park understand the individual and the collective?

The individual and the collective

One issue central to the notion of the collective is how the individual relates to the group(s) of which he or she is a member. Particularly relevant is Park and Burgess' observation that the social lives through it's members, that is, "there are no social sensations" which exist in the ether between group members; collective experiences exist within the individuals in the group (1921, p. 27). One reason for the perceived experience of sensations as being "collective" is that they are communicated beyond the individual: "the characteristic product of a group of individuals is… something objective and understood, that is, a gesture, a sign… a concept in which an experience or purpose that was private becomes public" (p. 38). Public expressions can be observed through actors' actions and interactions (Corbin & Strauss 2008), which provide the researcher with opportunity for data gathering, but it also allows for other effects; with every act being publicly performed, the individual is subject to their actions being "anticipated, checked, inhibited, or modified by the gestures and the intentions of his fellows" (Park 1927, p. 738). This may extend further into the individual, with this modifying force of the collective working to influence the very opinions the individual holds (Park & Burgess 1921).

It must be noted that an individual may be a member of several different social groups, concurrently or sequentially, and the interests of the individual in one collective may conflict with the interests of the same individual in another (Park & Burgess 1921).

Some later work suggested that Park and Burgess' "marginal man" was a copy of Simmel's "stranger", along the way misinterpreting the focus of Simmel's work to be the effect of the newcomer to the organisation of a social group, when Simmel was more concerned with the effect on the individual who was not fully accepted to the group (McLemore 1970). In translating Simmel's work however, McLemore argued, Park and Burgess used his concept of the stranger to further their own argument for the "migrant's role as a generator of… innovations" (p. 89), and their concept of the marginal man refers not to an individual not fully accepted, but rather to an individual who has had or continues to have contact with other social groups. This is quite easily related to Vohora *et al.*'s (2004) USO process, since their

discussion suggests the movement of the academic entrepreneur between academia and industry, from the parent research group to the USO company.

Despite moving from one group to another, the individual will carry with them concepts from the origin group. Park and Burgess discussed the individual in terms of isolation, agreeing with Aristotle that: "human nature develops within and decays outside of social relations", and coming to the conclusion that absolute isolation is, from a social perspective, impossible (1921, p. 226). Instead, the individual may be isolated in a relative sense, carrying with them social norms from the group they withdraw from (or are removed from) until successfully replaced by concepts from a new social group, for example. This is perhaps why Etzkowitz and Leydesdorff's' Triple Helix (1995) is slightly problematic when discussing academic activities for example; the individual is not simply subject to forces from academia, state, or industry, but is rather a member of multiple social groups which may span these. Further, as this case study will argue, the individual may be subject to forces from groups in which the individual has never been a member as other members of their collectives carry with them concepts from other social groups.

Social forces

As already mentioned, individuals' internally held concepts are altered through their interaction with other social group members (Park & Burgess 1921). The influence the other group members exert on the individual can also be discussed in terms of social forces, forces to which an individual must respond to engage in social interaction, or risk becoming isolated or a "lost soul" according to Park and Burgess (1921).

Forces are enacted through individuals in the social group, but may also be exerted through formal organisation, for example of the state, administrative devices, or technology, which may be regarded as "artificial extensions of the social group" (Park & Burgess 1921, p. 30). But what are forces? Park and Burgess argued that a central component of social forces are desires, and that the individual may be aware of these. However, the individual may not be aware of the underlying interests to which a particular desire relates, nor may they be aware of the nature of that relation, i.e. if a desire is complementary to or contradictory to an underlying interest (1921). Desire, according to Park and Burgess, arises as an "unsatisfied capacity" for an as-yet-unrealised condition (1921, p. 456). When the interests of an individual of multiple social groups are in conflict, it could be argued that the resolution of these is an unrealised condition, and therefore that a desire arises within the individual to resolve the conflict. This then reveals itself as a force within the social group through the public actions of the individual.

Applying Park's social forces

With an understanding of some of Park's work, specifically his concepts concerned with forces, these ideas must be translated into an approach to the empirical case and the research questions at hand.

Each section will begin with a short narrative from the empirical case, with each chapter taking a different slice as described earlier in the thesis. Following this mainly empirical description, an analysis will begin by outlining the different social groups that are presented within the narrative. This is an important starting point because we know that the social groups play a key role in the forces to which individual actors are exposed, and we know that actors can and often move between these social groups, carrying aspects of them from one to the next. This will however be limited to groups observed during the study: groups according to meetings observed, boundaries described in interviews, and economic boundaries. Some social groups will re-appear in subsequent chapters and so their presence will not be elaborated on beyond their first description unless there is a particularly interesting difference to note.

Movement is an underlying theme in the thesis, and therefore the next point is to identify movements (or migrations, to use Park's term (1928)); movements of people, objects, and so on. There might also be reported movements of intangible resources such as knowledge, ideas, etc.

The next step is to consider what actors "know" about these social groups and their relation to them. Being part of a social group means being sensitive to the other members (their actions and expressions) and the normal collective behaviour (Park & Burgess 1921). Individuals may therefore be aware of specialisations of individual members' activities, attempts to organise the research group, and perhaps even particular roles and traditions that characterise the research group over a longer period. They may also be able to describe how their individual membership of the group helps them in achieving their individual desires; what do they describe as having driven them to become a group member, and what drives them in their everyday activities? What are these "unsatisfied conditions" to which they aspire? Outside of their own social group, what do actors "know" about the different spheres of industry, academia, and state, and how do they describe the interaction between these spheres?

These descriptions are interesting because they lead us into the main analytical part of the thesis following the empirical chapters, what these "knowledges" do, in pragmatist terms, and what forces can be inferred arising within and between the different social groups, both when they meet and when actors move between them. Park suggested, amongst others, "ideological changes, migration, and alterations in natural resource use and availability as forces of change" (Maines *et al.* 1996), and these will be the main areas of interest in the analysis. What forces might arise within a social

group that we might perhaps expect to see after reading about a particular sphere, and what forces might be unexpected, or seem to be misplaced? Are any forces modifying actors' expressions in a public setting that they might privately express otherwise (Park & Burgess 1921)? Could any forces been carried though a movement, such as an individual crossing from one social group to the next, as Slaughter and Leslie (1997) might recognise in their academic capitalism concept?

Once some forces have been suggested the analysis can move on to consider whether these forces might act in such a way that they move a given social group forwards to a common goal or if they are conflicting forces. Secondly, recalling that an individual actor can be a member of more than one social group at the same time, what conflicts could arise as a result of those two (or more) social groups interacting with an individual's interests (Park & Burgess 1921)?

Finally, with a picture of the social groups and the forces we are interested in, the analysis can begin to suggest how actors deal with these various questions. One limit to the case study sits at around this point because it is impossible to discover the individual actors' internal interests and concepts (and thus how they might handle forces in the pursuit of these), but it could be possible to hypothesise based on their expressed interests, both publicly and in private interview, and based on their eventual actions.

The next section outlines the practical methods through which this research project was performed and the methodological underpinnings of the methods chosen and the analysis to follow.

3. Methodology

The USO and the parent research group (PRG) were identified as potential objects of study before my enrolment to the university. I entered my PhD studies as part of a KIC Innoenergy project (KIC Innoenergy 2016a) that had been outlined in a funding application some time prior to my application to the KIC organisation. The project contained a number of work packages concerned with technology development and the sub-project to which I had been recruited was intended to produce a description of the economic development of the technology over the years to date.

My main task therefore was to try to establish some financial background to the technology development. For two weeks I photocopied every invoice from the beginning of the technology research until the day I had arrived, and I became something of a fixture in the research group's copier room. At first people gave a little smile of greeting or awkwardly shuffled around the space I occupied while they tried to gain access to their departmental printer. Some eyed the large trolley of files and enquired as to whether I would be copying the whole lot. My experience during this period directed my approach later in my research and helped me to identify a strategy I used for making contact with the participants. The research group was housed in a long corridor on a single floor; this made it very easy to wander, either searching for someone specifically or looking out for opportunities to make contact.

Once I had my own copies of all the financial documents related to the technology at the university, I began to try to sort them to provide the information required as part of the project – just how much did each new development cost? As I sought information from the researchers as to which invoice related to which device, I began to hear some stories surrounding components or the organisation of the research group, and I made notes of these observations as soon as I returned to my desk. Later some of these would become the basis of some thesis chapters.

After poring over the financial documents I realised that there were sometimes no clear indications of which component or tool was purchased for each generation of the technology, and there seemed to be instances of sharing tooling or materials between constructed devices or even cannibalism of old machines to build new ones. The researchers themselves seemed limited in their ability to describe how their own invoices fit into the economics of the technology development, and there occasionally appeared to be some

confusion regarding which researchers were responsible for various parts of the technology, for example when the researcher who was trying to recall the names of those involved in a development was not themselves present during the time or specific event they were trying to describe.

These qualitative issues marked the beginning of a deeper interest in the case, and it naturally followed that in the absence of a specific research problem I needed to conduct some initial observations of the case (Corbin & Strauss 2008) to find an interesting question to address.

One of the first tasks was to meet with the head of the technology research group. During this meeting he outlined the function of the spinout company and how it related to the university research group, pointed to his idea that the development was progressing more slowly than he would like, and suggested his own theory for this. He named two individuals of interest and I interviewed the first of those people shortly afterwards to try to get a feel for what was happening both at the research division and at the spinout company.

Outside of these two initial contacts, the research group was to attend a conference together, and the professor was keen for me to follow. The research group was to hold a meeting of their own over the two days prior to the conference, and this was the first time that I was formally introduced to the whole group.

Taking a case study approach

One strategy for conducting and presenting research is to produce a case study, defined by Yin as the study of "a contemporary phenomenon in its real-life context" (1981, s. 59). Miles and Huberman suggested that the context should be bounded, that the case occurs within a specified social and physical setting (1994). Limiting the study, through for example defining the population, helps to control variables and defines the limits for generalizability of the study findings (Eisenhardt 1989).

The strength of this approach lies in the range of methods that may be employed, as both quantitative and qualitative data may be used, and material can be gathered from any combination of fieldwork, archival records, verbal reports, and so on. However, this broad scope of possibility does suggest some problems, from the way research participants feel about the use of their evidence to the tendency for case studies to result in lengthy, unstructured narratives (Yin 1981). Further, participants may react negatively to the presentation of individualised data, arguing perhaps that the questions posed were too simple to allow for a comprehensive answer or that their answers were misinterpreted.

Yin does however point to several strategies for avoiding or limiting these pitfalls. Firstly, the researcher should have a "sense of what the case study is

all about" (1981, 61) and build the study on a clear conceptual framework. At this point it might be helpful for the researcher to understand what they wish to achieve with the case study: is it exploratory, descriptive, or explaining, as categorised by Yin (1981), or descriptive, theory testing, or theory generating, as summarised by Eisenhardt (1989)? In this case study the original aim was to freely explore and describe the activities surrounding the research and commercialisation of a particular technology, but as my research progressed it became clear that the literature describing the phenomenon was not only lacking an in-depth description, but that it could also benefit from new theoretical contributions.

Once the aim of the study is understood, structure can be created, making it both easier for the researcher to write and for the audience to read (Yin 1981). To do this, the researcher should present the facts of the case, consider some explanations of these facts, and provide a conclusion based on the explanation that "appears most congruent with the facts" (61). In dealing with research participants Yin proposed that respondents reacted more positively to aggregate, rather than individualised, data. Further strategies for working with research participants will be explored later as part of methods for collecting and working with data.

Data gathering

The data gathering approach can be characterised as ethnography, due in part to the long period of exploratory fieldwork. Alvesson described ethnography as a study in which:

> … the researcher tries to get close to the community (organization, group) being studied, relies on their accounts as well as on observations of a rich variety of naturally occurring events (as well as on other material, e.g. documents or material artefacts) and has an interest in cultural issues (meanings, symbols, ideas, assumptions). (2003, 171)

Describing something as ethnography can however refer both to the empirical work activity and to the completed study (Corbin & Strauss 2008). In this case it refers only to the empirical approach, since although the case study strives to describe everyday life there are many aspects of the everyday life, which, although a part of research commercialisation, are rather a part of a much wider practise (Schatzki 1996). These could include fetching a cup of coffee – something that some of the participants in this study do on a regular basis – but this is an act that is also mirrored across a wide range of other activity sites that have nothing to do with research commercialisation, and so would not be interesting to include. A researcher sitting down to a discussion with a USO employee in the university break room could include coffee, but

it would be the interaction between the two that would be the focus of any descriptive work in this study.

Whilst an ethnography has many positive qualities, offering as it does a limited setting within which the researcher can find "obscure meanings, … images, interpretations, facts, that allow for an informed debate" (Kunda 2006, 23), it is perhaps less suited to the analysis of a particular issue within an organisation. However, when an ethnographic method is taken together with the case study approach, it provides an opportunity to use the practical research tools, observations, interviews, searching for meanings and so on, with the context-bounding of the case study to establish a focus on a particular issue or question, driving the study beyond simply describing to an attempt to explore and explain a phenomenon, and therefore to contribute to the research field through positing a theoretical development. So what exactly constitutes this particular case?

The case study

The case was followed from the spring of 2011 until the end of 2014 and one meeting in 2015. The research group had between twenty and twenty-four individuals during that period, of which twelve were interviewed. The production company of the USO had sixteen employees in 2011 and fifty-two in 2014. Of those in the engineering or business development functions at the USO, nine were interviewed.

In the years prior to 2011, several individuals reported being both research group members and USO employees, either sequentially or simultaneously. The individuals crossing between the two appeared to be the most interesting, and so their descriptions began to form the backbone of the case. The other research group members interviewed provided good insights into how the two related for individuals who were not (officially) present in both.

The USO also included a parent patent holding company with no employees, but this thesis pays little attention to it for two reasons: firstly actors rarely referred to its existence and seemed focused on the daughter company (here referred to as the USO), and secondly because the lack of social interactions (and lack of social actors) taking place within the parent holding company made it uninteresting from a social forces perspective. Similarly, many of the employees at the USO were engaged with non-technology development tasks such as environmental studies, administration, or legal functions, and so were excluded from the main focus of the thesis.

From an actor perspective, the case was therefore limited to individuals who had been involved in the technology development, either from a research or an engineering point, or who had been named as influential in the technology development, such as the CEO.

In terms of natural environment geographic sites for the technology, the university research group had a few short-term projects and the USO had

several potential installation sites. However, the bulk of the discussions focused on two neighbouring sites, a single region which could be understood as a test bed shared by the research group and the USO. Other test sites were therefore excluded.

From a technology standpoint, only versions of the technology being constructed at the university or the USO during the limited timeframe were considered. This was primarily because older machines were only sporadically addressed as research objects for the university and did not appear to garner as much attention from the actors as the newest version (at the time of data collection) could.

Finally, although much of the work was discussed in terms of "projects" only one project at the target site had a limited timeframe, budget, and set of partner organisations. This extended the range of actors that could be interviewed to those directly involved in the project at those partner organisations, and also helped in forming a cohesive narrative in the thesis that suitably describes the scale and risks of the case.

The study has now been limited to a particular context, issue, and approach, outlined in the earlier sections and in the methodology, but how was it performed from a practical standpoint?

Practical considerations

Both secondary and primary data was collected, with secondary data such as media publications offering entry points to some forms of primary data collection, such as interviews. Interview data formed the bulk of the data gathered, but observations of meetings and activities, as well as use of documents (such as annual financial reports, calls for funding, or email correspondence) produced by the University, the USO and other actors directly involved, such as state agencies, helped in forming a richer narrative. Corbin and Strauss (2008) suggested that data gathering could be systematic or based on convenience, speaking to anyone who walked through the door. Data gathering in this case was somewhere between the two: while target participants were identified through secondary data or suggestions made by existing participants, I also actively searched for individuals who fit certain criteria that I was curious about at the time; for example people who were, or had been, active within the organisations during a time that appeared to be particularly interesting, or having recently become involved with one organisation after spending time with the other. Some individuals were unwilling to talk, others wanted to talk but not on record, and others were wary of me, which I will come to later.

Interviews were conducted with individuals within the research group and the USO. The selection of participants was varied; the research group used an email list, and group-wide communications sometimes originated from an individual who was concerned with an issue and such individuals were often

happy to be interviewed. Other times I used the group mailing list myself to request interviews with those in the research group and received some positive responses. During interviews the names of other individuals came up either in conversation or in response to a direct request for the names of people the interviewee thought had some more information, and this is sometimes called a snowball method. These names could belong to people within the research group, people working at the spinout, or individuals who had left the organisation(s) completely.

To assist in recalling details and providing accurate quotes, interactions with individuals and groups, and observations of any activities taking place were recorded in as much detail as possible. This data collection usually took the form of audio recording, but video, photographic, and participant created media was also collected, and, where appropriate, with the permission of those being interviewed or observed. Although no participants raised objections during the data gathering, several interviewees continued to talk after the audio recorder had been switched off. This phenomenon has been noted in qualitative research guides, and so I was prepared to take notes. Following each instance, notes were taken to record any observations made which could not be recorded digitally, such as indications made by individuals towards objects or sketches.

Although careful checking of the data helps to minimise attributing great significance to data that might be an isolated extreme, it is important to consider the interview method as a data collection technique in terms of the implications for the case study. For example, data gathered in an interview is determined by (co-created in) the situation, limiting the ability of the participant to reflect both the phenomenon they experience and their own subjective world. A range of factors, including the questions posed and the reaction (or interaction) of the interviewer can affect the data creation (Silverman, 1989, 1993, in Alvesson, 2003,169). Alvesson suggested a number of further drawbacks, including for example the participant choosing what discourses to use during an interview, and assuming what the researcher is up to (2003) – with so many problems with this methodology it is unsuitable to be used as the sole data collection method.

However, drawing on a wider range of research materials such as those outlined in the ethnographic approach, posing questions in slightly different ways, allowing the participant to describe their own experiences in open interviews, and so on, can provide a broader range of research data to analyse, and it is within the analysis that the researcher can determine what data is relevant to the story they wish to tell. When the researcher makes such decisions they are acting from a position of privilege – and the implied power here points towards the next issue to be discussed, that of ethics.

Ethics

During the study I encountered multiple instances where ethics became more than a passing consideration. One such scenario that cropped up repeatedly was the sensitive nature of the data. I therefore had to consider the ethical repercussions of my research on individuals within the group, the university research department, the spinout company and the external partners.

Throughout my work with the university research group, permission was granted by the professor entrepreneur for observations of meetings and public events, and as well as having full access to the funding application records, a sizable collection of files created over the nine years prior to my arrival, many of the researchers I approached were happy to share some technical details and discuss issues facing the research and development activities. Observations of group activities and interviews were recorded with permission where appropriate. Examples include sharing CAD files, describing their on-going problems in procuring materials and issues concerning the location of equipment.

An important element of the research activity was that I was able to demonstrate that my respect for the world I was unofficially granted access to, through interviews and observations, was an integral part of my own approach to research. Whilst a large number of documents pertaining to the case were or are still publicly available, others, such as details of funding applications, internal history documents and so on, contained information of which public disclosure could have negatively affected some of the actors. After discussing the question of anonymity, the decision was taken to avoid citing or otherwise referring to material that could directly and immediately lead to the research group, USO, or individuals involved, and sections that could identify persons or other entities in cited material have been replaced with italicised text in parentheses.

When conducting interviews with individuals, such as university researchers, representatives from external partners, or USO employees, most interviewees were concerned about the use of their comments. For the external partner representatives this concern was centred on the reputation of the particular project they were a part of, and these individuals offered information on the provision that the professor entrepreneur approved my inclusion of this data in my research. In many of these cases, he had corroborated these accounts in his own descriptions, and in other accounts it became potentially quite easy for those familiar with events to identify a source, and so descriptions that did not emerge in multiple sources were omitted from the case study.

In presenting the data collected through the interviews in this thesis, certain power has been granted by the interviewees. They trust that they will not be “outed” or misrepresented, and the negotiation of the use of their words has lead to the decision to present this case study in the way it is today: as a

somewhat generic research group with an associated spin-out, both engaged in the same technology field. As such an anonymised case study, the research then presents a problem: how can the case be presented as a truthful account of a technology development when certain details, episodes, or descriptions, which interviewees discuss as important to the understanding of the case, are either removed or scrubbed so as to prevent the reader from being able to identify it, or worse believe that they have uncovered the views of individuals? To resolve this issue, it must be acknowledged that those familiar with the case will most probably be able to recognise it – in fact, in seeking to present the case it is perhaps desirable that they do. To prevent a reader from identifying, or suspecting that they identify, an individual is more of an ethical issue, since it concerns both the consent granted by the participants and their concerns that very real harm could result to their reputation or careers. Here the decision has been made to avoid descriptions of specific events for which only one individual could have been the source, and to use quotations only when they add to the description and articulate some observation or sentiment expressed in more than one source.

To try to build a rich narrative then, descriptions are offered of the events to which multiple individuals were witnesses. Although not a strict triangulation (see for example Jick, 1979), this serves the purpose of blurring the exact location of the knowledge source. However, such an approach ignores the multiple and different experiences of the actors at the expense of trying to reach a somewhat "unified" concept. Ethically this is problematic since such a concept would not reflect the multitude of "truths" present in the empirical material. As the later discussion on pragmatism explains, my purposes in presenting the case study mean that the intended outcome, an improved concept and vocabulary for the phenomena in the case study, could provide the individuals in such cases with new tools with which to discuss and work with the world around them, which is arguably a more ethically desirable outcome than a collection of scattered, possibly conflicting "truths". However, some of the "truths" contrast to such a degree that their very difference is itself interesting to note, and possibly consequential for the final outcome, and therefore will be described.

Handling data

How was the raw data handled to allow the creation of the narratives offered in the study? Alvesson noted "only a very small portion of all that which has been said by the interviewees and observed… can appear in a publication or even (be) fully considered in analysis" (2003, 173). During data collection I often witnessed behaviour, or shared in behaviour, that was difficult to include in the analysis. For example, should one describe the researcher who walked around the research object absent-mindedly waving a spring in the air? Is it relevant to talk about how research participants mourned the news

that they would not be eating cake as a result of a failed test, or describe the moments at which it felt that the researcher-participant relationship broke down into two students laughing over coffee? Some can be captured in text whilst others cannot, and therefore cannot be included as data.

Raw data was filed digitally, sorted first according to the type of data and then according to the source: published media was filed together and then divided into material published by the research group, the USO, any organisations working with the two, and finally any external observers' reports; meetings were transcribed and stored as individual instances, with the audio files, transcriptions, and my notes for each instance filed together; and interview data was organised in the same way. Corbin and Strauss (2008) prescribed writing about what seems to be going on, and as the data gathering progressed I compiled a number of "episodes" which described the events and participants' observations of these, as well as tentative thoughts regarding my questions of the data.

Alvesson pointed out that one difficulty for academics studying other academics is that much of the organisational life is too familiar (2003), and that the research will face difficulties because of "taken for granted assumptions, blind spots, taboos and the want to avoid upsetting colleagues" (p.183), and he proposed that distance was necessary to try to avoid these. In this case study, distance from the empirical material was certainly important – some of the research participants were doctoral students and therefore faced some of the same questions, for example: what am I trying to do in my research project? How can I organise my time effectively between individual research and collaborative efforts? However, my own doctoral research activities differed quite substantially, not least because I was from a slightly different academic tribe (Becher & Trowler 2001), and consequently my research time was not spent learning construction-specific skills, nor chasing suppliers for essential components, as some in the case reported.

In terms of trying to avoid upsetting colleagues I was lucky in that they may just have been in a "Goldilocks zone" of being close enough to encounter on a daily basis, close enough to share the same environment sometimes, and close enough to welcome into their meetings and trips as a colleague, yet far enough away that they did not view me as knowing their personal lives as closer colleagues might have. Further distance can be achieved through the use of literature to stimulate questions and concepts, which can enter the research process early in data collection (Corbin & Strauss 2008). Although this can be performed throughout the data gathering process, this gradually becomes more analytical over time. So how was the analysis approached?

Analysis

Earlier I described writing throughout the data gathering process, and how I moved back and forth between literature and the raw empirical data as I col-

lected more. Eventually though this data collection had to stop, and analysis had to become the main focus rather than a tentative side line. Many have recommended that the researcher stop when saturation is reached; this is often a subjective judgement of the researcher, but can be characterised as being when no new categories or themes emerge (DiCicco-Bloom & Crabtree 2006). In this research project, the data collection ended when the narratives offered by the research participants appeared to be repeated.

Since this case study is limited to the research and commercialisation activities surrounding one technology, the question then becomes how to slice it most appropriately to produce in-case dimensions. Once these have been identified, suggested by the researcher or by existing literature, the researcher can look for within group similarities and inter-group differences (Eisenhardt 1989), and from this create a series of concepts. Corbin and Strauss (2008) turned to theoretical sampling to create their concepts, and this is a process I see as being analytical of the established literature and of historical data, searching for concepts in much the same way that Eisenhardt suggested with regards to raw data. The important thing at this point, regardless of which type of material is being searched for concepts, is that the target population remains the same (Corbin & Strauss 2008). Another way of exploring the meaning of data is to try already-established theory from a completely different area of research, which can increase "the internal validity, generalizability, and theoretical level of theory building from case study research" (Eisenhardt 1989, 545).

So what is the result from all of this categorising? Rather than being overwhelmed by "voluminous" data, the researcher can arrive at an overall perspective (Eisenhardt 1989). However, it is important to remember that it is also a perspective constructed by the researcher (Corbin & Strauss 2008), and therefore efforts to ensure the validity are important at this stage too. Eisenhardt argued that the result of the case study was a "development of testable hypotheses and theory" (1989, 546), but rather than wait for future researchers to establish the reliability of these hypotheses the case study researcher has a responsibility to describe the case with enough depth and clarity to allow readers to decide that if it sounds reasonable. The researcher can also test the findings against the raw data from the case, wherein most of the data should be explained by the new schema, and return to the source of the raw data to ascertain if the research participants can recognise themselves (Corbin & Strauss 2008).

So how did I try to establish validity at this point? Towards the end of my data gathering, when concepts had begun to be drawn and higher-level categories became pencil marks in the margin, I began to discuss the new schema I had in mind with others in the wider population, typically academic researchers who had worked closely to research commercialisation activities. These conversations, although not recorded as data for the research, were positive towards my assessment. In one instance, with an assistant professor

in chemistry, he completed the story of research and USO creation according to my analysis - but before I had told him.

The pragmatic approach

The research described in this thesis was performed over four and a half years, and evolved as I developed as a researcher. This meant that the empirical data often influenced the areas of theory I was interested in; conversely theory discovered through recommendations, courses, or merely curiosity, also impacted which parts of the empirical case I became aware of and interested in pursuing further. This parallel progression can be likened to Kathleen Eisenhardt's theory building (1989) and a later version of grounded theory as developed by Juliet Corbin and Anselm Strauss (2008), and it is from Corbin and Strauss' work that I begin. They claim to take a pragmatist approach, and, finding this useful for both the methods selection and the questions underpinning this thesis, it would be appropriate to outline how pragmatism informs this thesis.

Why Pragmatism?

Pragmatism is an area of philosophy that emerged in scattered form during the late 19th and early 20th century in the USA. It originated through the lectures and writings of William James and Charles Sanders Pierce, and was developed from 1925 onwards by John Dewey through his efforts to unify the work under a single theory (Margolis 2009). Their influence can be seen today in the social sciences in for example method guides (Corbin & Strauss 2008) and discussions on theory (Corvellec 2013).

One of the central tenets, if not *the* central tenet, of pragmatism is its attempt to eliminate dualities associated with terms such as "truth" "objectivity" "false" etc. (Jensen 2013). In the pragmatist context this means that there is no absolute experience, a concept that James morally objected to on the grounds that the single experience, which includes everything that exists, was the understanding of absolute idealism, a philosophy that regarded the world as a perfect whole and any evil to be necessary to the completion of that whole (Sprigge 2009). However such objections to the discoverable existence of an absolute truth have also been made with reference to the ability of the individual or society to "know". Corbin and Strauss said "what is discovered about "reality" cannot be separated from the operative perspective of the knower" (2008, 4), or in other words, experience is individual and truth can only exist within "our own actual or hypothetical processes of testing and utilising our beliefs" (Suckiel 2009).

For James, truth is an idea that "works for us" across our experiences, linking things together and saving labour; truth is instrumental (Misak 2009), and if it is not useful then it is just wordplay according to Rorty (Jensen 2013), an American philosopher who revived interest in pragmatism, and particularly Dewey's work, in the late 20th century (Margolis 2009).

Suckiel highlighted a contradiction in James' discussion on the notion of truth. James had argued that "absolute truth… is constituted by the ideal consensus of an ideal community of inquirers", and yet his other works suggested that such a consensus is impossible since it would require the multiple and varied "truths" of the individuals within a given community to be accommodated (38, 2009). Such a problem can be solved, at least for the time being, with his explanation of the absolutely true, that which "no farther experience will ever alter" as the "vanishing point towards which we imagine that all of our temporary truths will some day converge" (*Works Prag*, pp. 106-7: *Writings*, p. 438, as cited in Suckiel 2009, 37).

Pragmatism offers therefore a somewhat calming voice for the nervous researcher in that it clearly defines research outputs as having two main characteristics; that they should be a step towards absolute knowledge rather than being themselves a final solution, and that they should be useful in terms of guiding us through the world of immediate experience.

It also, perhaps, makes us kinder in our choice of words to those with whom we wish to engage. One piece of guidance I received early on in the research process was to find a model or concept that I could stand against, and I found that particularly troubling as I struggled to find one that I disagreed with. Perhaps the language was too strong or I misunderstood and I should have been searching for something I wished to extend instead, but that is something I don't particularly worry about now. Rather, I found lots of concepts, ideas, and narratives, of a process that I could understand, agree with as a basic description of the world I had experienced, and accept to a limited degree, and I was confused. What was the purpose of them as concepts, and what was my purpose in trying to stand against them?

When I began to read texts describing the phenomena I was interested in I felt that their concepts did try to guide me through my experiences and those I heard reported in my empirical material (Sprigge 2009). At the same time I found that the models and concepts in literature on academic entrepreneurship and the entrepreneurial university only spoke to a few select communities: researchers seeking to understand research commercialisation, researchers seeking to commercialise their scientific work, university administrators, policy makers, and the like – people interested in building businesses, innovation systems, and competitive regions.

The familiarity with which researchers, even those not involved in my main empirical case, spoke of their understanding of their own experiences highlighted the need for something that was relevant and perhaps interesting to a wider audience than my immediate peers in both the fields of practition-

ers and of scholars, something I felt could be achieved through taking an approach grounded in pragmatism.

There was however a theoretical argument for a pragmatist approach too. Pragmatism encourages collaboration across disciplines to reach a fuller understanding (Jensen 2013), and with the literature on research and USO creation and development divided into two separate approaches (academic capitalism and academic entrepreneurship) it was clear that there were differences in the kinds of concepts used to understand experiences of the same phenomena. Researchers engaged in this area need therefore to be sensitive to issues both inside the commercialisation process and outside of it, and we need a vocabulary to better understand the experiences of actors involved in these activities (Jensen 2013).

Taking a pragmatic approach

Returning to the methods used and their relation to the research question, one criticism levelled at the USO creation literature in this thesis has been the over-simplification of the phenomenon through the removal of certain actors (such as non-tenure track academics) or activities (research at the parent institution), for example. The phenomenon under observation is of course much more complex than the descriptions presented in the literature might suggest, and this thesis strives to capture some of that which is absent from the earlier conceptualisations, from the experiences of doctoral students and engineers to ideas about the technology development and how these might impact the activities being performed.

> "It is important to capture as much of this complexity as possible, at the same time as knowing that capturing it all is virtually impossible." (Corbin & Strauss 2008, 8)

The question then arises: since we cannot capture all of this complexity, what, and how much of it, are we interested in? The appropriate depth of complexity probably lies somewhere between adding some inconsequential detail to the current literature and boring the reader with a seemingly endless dive into the minutiae of the case. Since the first achieves neither an empirical nor a theoretical contribution and the second is impossible, not to mention increasingly irrelevant for the field of study, this thesis aims to pick out and describe some details that expand upon some underlying themes in the current conceptualisation. In doing so, I will also explore how their inclusion in understanding university research commercialisation can help to position the phenomenon in a new way.

Knowledge emerges through examining a phenomenon in front of us, and for social scientists working with grounded theory this is not limited to the researcher conducting their inquiry, but to the participants themselves. They

are, according to Corbin and Strauss, self-reflective beings. Specifically, it is through actors' action and interaction that knowledge arises (Corbin & Strauss 2008). This presents the first practical action the pragmatic researcher can take, that of simple observation of actors and their (inter)actions, but it does not tell us which moments to focus on.

To observe a self-reflective actor the researcher must find "problematic situations" during which the actors "can't act automatically or habitually" (Corbin & Strauss 2008, 3), and are therefore forced to consider their actions in some way. To be aware of an action implies that an actor is aware of their previous actions and the system of meaning within which they have previously and are currently acting.

This emphasises the importance of past memories and the transformation of them in the present, according to Corbin and Strauss' reading of Dewey (2008), and leads to a key assumption in their development of grounded theory, that:

> "Interactions may be followed by reviews of actions, as well as projections of future ones. The reviews and evaluations made along the action course may affect a partial or complete recasting of it." (Corbin & Strauss 2008, 6)

This is particularly important when we consider that actors are members in multiple social worlds (Unruh 1980) and so could arguably be recasting their actions or thoughts based not only on the social group to which they might refer at any given moment, but also with regard to other social groups to which they belong. When an actor faces a situation in which these multiple memberships conflict, this leads to two main activities which we will return to later: the actor's consideration of their individual, internally held interests, and their consideration of which of the social worlds available to them offer the best possibilities for the realisation of these, a process often achieved through interaction with other group members (Park & Burgess 1921). The first is a problematic situation that can usually only be accessed through talking to the individual actor, the second is one that can be accessed through observation. Both have their drawbacks in the social, since the actor can choose what parts they wish to express, either in an interview or in a group discussion, both of which are social interactions.

An important note to make at this point is to define the intended outcome of the case study; although an ethnographic approach was taken to data collection, the case presented here is not an attempt to describe an objective history of the research group, the USO, or the technology development. Rather, I wish to draw out the multiple, and sometimes conflicting, understandings presented by the actors in the case, and use these varying descriptions to try to see how these actors have worked with the numerous interpretations and assumptions throughout the research activities and the technology development processes in the case study.

Having just discussed the pragmatists' focus on experience and concepts and the methods by which the remainder of the thesis was produced, the next chapter presents the first empirical findings from the case study, expectations and contrasts between these and experiences of some of the actors.

4. Actors on the research and the USO

Having described the methodology underpinning the thesis and the methods through which the case study was performed, it is now time to consider the empirical case. One of the key assumptions I'm making here, based on Park's concepts outlined earlier, is that researchers are part of a social group or relate to the idea of there being a research group to which they might, under certain conditions, belong, and that they are aware of that to a degree. A further assumption is that, in order to remain a member of that group (assuming that they wish to do so) they must have knowledge, in a pragmatic sense, of that world.

Each person has their own knowledge - of what the group does, specialisations within their group, of what nearby groups do (e.g. USO), and of movement between their group and others. To gain this knowledge they must be sensitive to the other individuals in the group, public expressions and actions, and they must also relate to that group in some way, e.g. through their own public actions. We can then assume that there are certain "knowledges" about the social group that are public and form concepts for practitioners to work around in their everyday activities. These may or may not be linked to popular ideas regarding research, research commercialisation, the industrial realm, and the relationship between the research group (PRG) and the USO, and pragmatism reminds us of course that these knowledges do not reflect an absolute truth. Individuals might also be aware of some underlying drives - what is the purpose of the group, what is the purpose of certain actions or expressions, and then, loosely connected to these concepts, the analysis later in the thesis will outline some forces that I think actors may or may not be aware of.

In describing this case I wanted to explore as many different angles as possible, and this resulted in the different "slices" or "mini-cases" which take centre stage in each chapter. However, for this first empirically-based chapter I felt it was important to try to describe the case, firstly to introduce the case from which I have so far only given small snippets of text, and secondly to demonstrate how comfortably the existing concepts can be used to provide a cohesive narrative of a case. The narrative I present here is a constructed version of events, and mirrors the presentation of the case in USO media, university press releases, and business articles from other news outlets. Although not used explicitly, the reader can see how concepts from the literature, particularly that of USO creation (Franklin *et al.* 2001, Vohora *et*

al. 2004), such as opportunity recognition, entrepreneurial commitment, credibility, resource acquisition, etc. emerge in a compelling growth narrative. This could perhaps be interesting to re-read at the end of the thesis, although it will not be repeated in the text, for readers curious to see how their reading of this narrative could develop.

Starting out and spinning off?

Although some specific principles of the technology area were well established, the area was broad and unexplored enough to establish patents on a systemic level. The professor described how early discussions with key figures concerned with national innovation were influential in his coming to understand that there was a state level interest in establishing not just new technologies, but whole new industries.

A parent company was created and a board established in 2001. The professor needed someone he could trust to handle the business side of his interests and so he appointed a CEO. The new business partner was an old colleague; recently retired from the corporation both men had spent a large portion of their careers with, and at the time was acting as a consultant on financial negotiations worth several billion US dollars. In academic entrepreneurship literature this individual is also given the name of the academic entrepreneur, not because he is an academic but because he deals with the entrepreneurial activities surrounding the academic research to be commercialised.

Whilst the professor was committed to commercialising his technology, his partner took a little more convincing. Describing the decision he made in 2001 he said: “after 20 minutes I was in the board of directors... they solved the two main problems”. Between the two of them they possessed a wealth of knowledge about the technology and the market into which they hoped it would break, and in doing so they seemed to be ideally qualified to identify opportunities, and plan and execute the venture. Typically the professor would be called the academic entrepreneur in case studies such as this, but to recognise his continued role as the head of the research group, and due to the enrolment of the business partner who also fit the academic entrepreneur definition, the label of professor entrepreneur, which will be used from hereon out, allows us to more clearly distinguish between two of the more senior roles in the case addressed in this thesis.

The first patent was filed in January of 2002, and research outputs were published for the first time later the same year in the form of two Master theses and a small number of peer reviewed articles. By 2005 the research group at the university had just a handful of graduate students, but the USO had five patents and the annual report described positive discussions with potential future customers, partners and suppliers. The USO was organised

into two legal entities, the patent-holding parent company and the company that would eventually produce and supply the technology to customers.

In 2005 the first PhD thesis was defended, and in 2006 the first full-scale prototype from the parent research group (PRG) was installed and the USO began operations, as the daughter company from the 2001 established holding company, in a science park close to the university. The first assignment for the company was a pre-study in anticipation of an order for a commercial demonstration of the technology in the near future. The customer was a multinational corporation based in Sweden, and the pre-study was jointly financed by a government agency. Twenty employees were hired in the latter half of the year to perform the task, two of which had come directly from defending their doctoral theses at the PRG, and entered the USO as its new production manager and head of design.

The pre-study was delayed by approximately a year due to the work requiring the detailed examination of a protected area, and permission was required from the Swedish state to continue, but in June 2007 the results were presented. Following the pre-study, the corporation wished to see a component test and a government agency agreed to part-finance the demonstration. The remainder of the financing for this project was provided by the parent company, which raised 17 million Swedish kronor (SEK) through the sale of shares to investors and from a pension investment fund. During 2007 a local company placed an order for a pre-study and the USO secured six million SEK funding for factory facilities from an investment firm specialising in collaboration between small companies and universities, according to the annual reports. It was also decided that two devices would be tested on the British Isles, however the financing for this venture never materialised.

A multinational corporation ordered the first full-scale industrial test of the technology to be installed in Norway, bringing in eight million SEK, and a further international corporation placed an order for three million SEK. Patents were extended in key regions. The USO was acquiring resources, making decisions regarding which resources to develop, and so on. They were beginning to organise resources and produce desired outputs such as pre-study reports. The USO only needed to demonstrate that they could secure regular income, and a big contract could reassure potential investors and customers that the technology and organisation could be scaled up to provide a technology that could perform economically.

In 2009 a state agency announced that they intended to support projects building technology demonstration sites and invited applications. They received nearly 40 project descriptions. The USO collaborated with a second multinational corporation, who had previously been involved in funding the university research on the same technology, in one of those applications.

By February 2010 the state agency decided to support the USO and was to provide around 130 million SEK for the project, with the estimated total cost of close to 250 million SEK met through the finance provided by the

corporation, who would then own and operate the eventual site. In January 2011 the matter was relayed to the EU commission for approval, and the first meeting in Brussels was held in February 2011. The EU had confirmed in November that there was no objection to the support from the state agency for the project and in December two contracts were drawn up between the USO and the corporation with regard to the project: one for the delivery and installation, and one for the service agreement. The successful bid to obtain this support was possibly a contributing factor in the decision by the investment arm of a global corporation to invest just over one million GBP in 2011, money that the USO needed for further expansion of the production facilities to fulfil their new contracts.

Immediately prior to this narrative I explained that it reflected elements of the concepts in literature on academic entrepreneurship, but the text itself did not use the exact terms in the literature. This was a deliberate choice for a number of reasons. Firstly, I wanted to present the case as it might be presented to an audience familiar with the practise of USO creation but not with academic terminology (i.e. Vohora *et al.*'s critical junctures (2004), etc.), and secondly I wanted to enable the reader to return to this text after reading onwards in the thesis and see for themselves how limited such a construction can be.

Experiences of research and the USO

My narrative of the research group and the USO in the previous section suggests two growing and thriving organisations, learning, innovating, and perhaps even succeeding in their respective areas, producing for example knowledge in the form of theses and peer-reviewed articles, and patents respectively.

But what do the actors in this case study, the individuals engaged in the research group and relating to the USO and its development journey, have to say about this? How do they describe the activities of producing knowledge, maintaining and growing the research group, spinning off a (commercial) organisation, and balancing the relationship between the PRG and the USO?

The research

Perhaps research participants enjoy using interviews to complain or maybe a fellow researcher's tape recorder acts as a confessional device, but the researchers in the PRG had a lot to say about the shortcomings of their organisation: too big, unstructured, confusing, lacking social bonding, and forgetful.

Forgetful? Are we not discussing an organisation where knowledge is a central pursuit? Perhaps this was only something those around long enough to witness it, such as professors within the research group, could notice:

> "That's why we can do the same mistake over and over again. New ideas frequently come up with three years in between because people forget or don't read past work." (Professor entrepreneur, 2012)

But others had been in the research group for several times longer than the three-year memory suggested by the professor, and yet different frustrations and reasons for repeated work were suggested. For example:

> "I'm trying to adopt a (*part of the technology*) but then someone says something completely different and you're not sure what's happening. I'm not sure who is supposed to be responsible for what. I think I'm responsible for this." (Doctoral student, 2012)

Many of the researchers complained that information flowed slowly or not at all, and suggested that the size of the group or a lack of clear knowledge transfer structures could be to blame. Although the doctoral student in the last quote had tried to take responsibility for a part of the research and then later found that someone else had made the same claim, some knowledge regarding the activities of the individual researchers had not been communicated. Had she told others in the research group of her plans or had it been an agreement made with her supervisor? Had another researcher with a contesting claim notified others in the group at the time they had begun working with the specialised area, or had they worked quietly until the two found themselves face to face over a component, wondering who would get to continue?

When the professor suggested that ideas presented years ago were repeated, were these ideas noted when they materialised the first time and made available to the group, or were they presented to a room of individuals who listened, maybe jotted notes on the back of a scrap of paper and then lost it in the recycling? Or are we perhaps suggesting that ideas were tested, results found to be disappointing, and published quietly in a footnote to an article that newer researchers simply didn't have time to read?

> "At the university we've been horrible at documenting stuff, because people always have so much other things to do… it's more like we're making another prototype and I really should be teaching right now and reading this course and writing this paper, you don't really have time so, and when things are finally in… people don't sit down for a few weeks to summarise what's been going on, it's more like running towards the next fire and trying to get that." (Researcher, 2014)

The issue of storing, recalling, and sharing knowledge can be related to the suggestion of another researcher, that the group was simply too big for an individual to seek contact with other individuals who might possess the knowledge that the searching researcher didn't know existed, but needed to have in order to avoid repeating work:

> "And that's also a result of us being so many. You can't build that strong bonds if there's twenty in the group." (Doctoral student, 2012)

With the group being so large in the estimates of some researchers structure was seen as essential for organising research activities, and the rapid growth of the research group was suggested as a reason for the lack of this.

> "The main problem is that we don't know how to organise, we have grown too fast." (Doctoral student, 2012)

This might be a risk because the lack of structure and the resulting proliferation of ideas (which were not based on the knowledge of other researchers in the group) could create an organisation in which their individual interests pull the members so far from each other that the group of individuals fails to act as we might expect a research organisation to perform. In Park's terms, the interests of the individuals might be so divergent that they become unable to engage in concerted action as a collective (1927).

> "It's inevitable, but mostly I think it's a problem for the continuation of the project in a quick way, the more people you have with differing ideas the less likely it is that a project will keep going rather than pulling in one direction, but with benefits of course of finding new ideas and ways of doing things." (Doctoral student, 2012)

The PRG and the USO

One difficulty often described by actors dividing their time between academic research and the USO concerned the ability to organise their work according to their different roles.

> "… But of course email I did at both places, and things like that." (Researcher, 2011)

> "People from companies calling me on my cell phone, I had to work with that here and of course my people that work under me at (*the USO*) called me and asked questions and stuff, then I work with it here, so it's more like that I worked with (*the USO*) at the university than vice versa." (Doctoral student, 2011)

Even though the idea that knowledge should move in a single direction was clearly contrasted by experiences of a more fluid, multi-directional movement of knowledge, the ideal of the PRG being "ahead" remained prevalent. Experiences though were sometimes to the contrary:

> "When you think about it you thought that it should be that the university is in the front line and that (*the USO*) only can take things, but actually it was the opposite, the other way around that it was like that at (*the USO*) we were doing (… *network*) connection and here we were only doing some connection to some (…)." (Researcher, 2011)

Regardless of how the two were connected or which seemed to advance furthest, the idea that knowledge was being transferred between them remained. However, there were reports of the USO not accepting university-generated knowledge, and other reports of some actors "translating" knowledge as they transfer it, along with criticism of this.

There were also conflicting views on the necessity of the relationship between the two organisations:

> "It's hard to define the relationship between (*the USO*) and (the research group) because in one way we try to keep them separate, especially economically, for the outside viewer it's supposed to be separated. At the same time we need to cooperate a lot, practically, making those relations work, making (*the USO*) realise they need us to work, they need to help us to get our help, and for us to see that we need to do research that will help (*the USO*), because otherwise they won't survive and get money. To see the mutual interests, I think that's hard because we get envious of each other, through the lack of attention or money or whatever." (Doctoral student, 2014)

The division between the two seems to be problematic, not least because some researchers appeared to believe that they were inextricably linked.

> "We need to make (*the technology*) work, and (*the research group*) and (*the USO*) are so closely connected, so if they fail, if they go bankrupt we won't carry on for many years." (Doctoral student, 2014)

As described earlier, the USO and the PRG shared a variety of resources, including those already discussed in this section such as ideas and knowledge. One of the important tools located at the university was simulation software.

> "When we went down, for example even now when we are going down for the university site (…) we are using their factory. If we would need to build something before we will install it we can use it and we can also use their factory and things like, and their stuff can also help us and things, like that, and I know that I think that (*the USO*) used one, a few of our computer tools that we had, simulation tools that we have here at the university, that they

> were sitting and working here, that they were renting it, those persons here instead." (Post-doctoral researcher, 2011)

Developed in-house, the software allowed the researchers to estimate the behaviour of a particular design under various environmental conditions, potentially identifying risks and possible improvements before any physical device was constructed. The development of the tool occurred in conjunction with the testing performed on the physical devices, so there were a number of critical factors that were only best estimates rather than values based on data from physical tests. Employees at the USO came to the university to use these simulation packages, thus saving costly prototyping activities at the company. Through the use of this software by USO employees, research results from physical tests performed by the PRG were transferred to the USO, albeit mediated through the software.

The USO offered the PRG the use of the factory facilities for certain construction needs. Previously, some devices were manufactured by the USO for the PRG and then deployed at the university research site. Employees at the USO also assisted in the construction of the latest research device at the university and immediately before deployment during the final assembly process. However, doctoral students helped at the factory occasionally, perhaps as an "in-kind" but unofficial payment:

> "I noticed when I first came there was an annoyance between (*the USO*) and the university, we are all new PhD students and we know nothing when we arrive, so we've always been a bit of a burden for (*the USO*), but I think we've improved our relation a bit actually. It's them helping us the most, but we help with practical stuff. We try not to be in the way too much." (Doctoral student, 2014)

Despite their cooperation and sharing of resources, there were however disagreements. One PhD student was tasked with removing equipment stored at the factory because the USO was apparently upset about the PRG's use of storage space there. At the same time she suggested that the company didn't want to pay for research but they were also trying to make the PRG perform research that was not interesting for doctoral students.

Social groups and movements

The first step towards an analysis using Park's work is to identify the social groups in the empirical description. The assertion that the USO should pay for research and that the PRG could decide that research topics originating from the USO were not interesting suggested that there were two social groups. The first, the PRG, appeared to consist of researchers at the university, doctoral students, and the professor entrepreneur. The second, the USO or

more specifically the technology and business development function at the USO, seemed to consist of engineers and the academic entrepreneur.

Most of the reported movements occurred between these two groups, and many of these have already been suggested: researchers and engineers changed employment, knowledge about the technology and ideas for research also moved between the two, and sometimes movements were incomplete (when doctoral students spent time constructing research devices at the USO facilities, but were never USO employees for example) or faced some restrictions (such as when doctoral students at the USO facilities felt that the USO employees were irritated).

One area of difficulty with regard to knowledge transfer was made apparent through the reactions of some actors' to being interviewed for this case study; discussing their experiences and understandings was a difficult and risky undertaking, and some declined to be interviewed.

Those I did speak to fell into two main groups when discussing the use of their responses; those who expressed confidence that their viewpoints were already known by other individuals in the research group or USO, and those who were explicitly worried about how the presentation of their responses could harm either the company or, on a more personal level, be used to harm them.

The first group was small, and consisted of a select few who had or were occupying positions in which they had acquired a wealth of experience and a reputation outside of the research group or USO. Their personal security was, they explained, based on their open communication with the professor entrepreneur – any view points they had expressed in our interviews they had also expressed to him, and so they were not concerned that he might discover anything sensitive in any eventual research outputs.

The second group was revealed to be more of a problem, and perhaps provided an indicator of one possible reason for difficulties faced in gaining access to interview individuals – in one instance an interviewee gave the name of an individual and described him as one who would provide a critical voice, but immediately commented "I don't think he will talk to you!" But for many of those that were willing to be interviewed, particularly if they strayed out of talk about the technology, anonymity was swiftly requested. This was common both to individuals still active within the project and to those who had left. Why this lingering cautiousness about being "found out" or doubt that other individuals would talk?

The reasons for this, as discussed with interviewees, were focused around the professor entrepreneur. In nearly all interviews in which he was mentioned he was described as an energetic, charismatic and inspiring man, and interviewees often commented that they liked him. Many had retained a relationship with him after their involvement with the group had formally ended, citing the supervisor-student relationship underlying their subsequent friendship. Their admiration for him was tempered with some concern about his

tendency to "interpret things in some ways" and his sensitivity. One interviewee even commented "it's probably impossible for you to write your thesis without upsetting him!" Others stressed that they were worried that readers of the thesis could misunderstand their comments. Their concerns appeared to be not that their words would be misused, but rather that they perceived that another actor would be able to influence their career and reputation and they were unwilling to stand out as potential targets; a scenario that some feared might happen if some actors interpreted their interviews as portraying the organisations or individuals in a negative light.

These actors appeared to define two different groups: those who feared that they as individuals would face negative consequences for critical comments from others, and those who were concerned for the reputation of the USO. However these could not be argued to be two social groups under Park's concept because they did not bear the hallmarks of a Parkian social group: the individuals did not form a group that was capable of "concerted action" (Park 1927, 734), i.e. a collective able to work together to realise a collective interest, nor did they appear to want to perform such actions under these "groups" rather than through other social groups such as the PRG or the USO.

Actors' knowledge

Popular discourse often provides inspiration for expectations of academia and industry, as well as the relation between the two. From our own experiences of academia we can understand that these concepts could sometimes be discovered or reinforced through structures to which the researchers and engineers may have been exposed, such as introductory or methods courses, or publishing guidelines. Other structures surrounding academic research might also inspire fantasies of the relationship between academia and industry for those engaged in academic research; these might include objects such as technology transfer offices or funding agency calls for potentially commercially viable research. It is also possible that these have emerged from more academic discussions on such concepts; Slaughter and Leslie (1997) hinted at a "pure" academia being polluted by capitalist ideals, and traces of Merton's (1973) academic values can be found in many studies of scientific research for example. In this chapter actors appeared to demonstrate knowledge of some concepts associated with "pure" academia, and of other concepts that had a distinctly entrepreneurial character.

The research

Many of the comments made by the researchers on the research activity came back to the way they perceived the research group itself: if only my

colleagues behaved in a certain way we would have a perfect organisation. Was there a collection of beliefs about how this might look that could be drawn out from the complaints?

If a perceived lack of structure was a common complaint then a reasonable assumption could be that some researchers thought the research group should be structured. They wanted to know who was responsible for areas of the research, and who they could turn to for answers about a particular component or finding – they were searching for some indication of a division of labour and specialisation in individuals' activities. But this idea of responsibility also conveys the idea of ownership, and this ties back into a central theme of academic research, the idea that a researcher can claim ownership of a finding through writing about it, and publishing it to their peer audience, the wider research community. So based on the descriptions suggested by some researchers' frustrations the "ideal" research group should be a collective within which individuals (and maybe smaller research groups) take responsibility for developing and disseminating knowledge of particular areas of research.

Continuing the theme of the collective, some researchers seemed to believe that those within the research group should help each other. This assistance required firstly that the individuals knew if they could be of help, and secondly that they knew how to help. This returns us to ideas associated with research in general: that we create a collective knowledge to which everyone, particularly within a given community, might have access.

> "It must help because hopefully people know a little bit of what other people are doing too and then they of course they can help each other, and know what they're doing," (Doctoral student, 2011)

Finally, if the researchers within the group were at risk of deconstructing the group as their ideas diverged, this would suggest that having a common aim is central to some researchers' beliefs about how the research group should be. What this goal might be is unclear, but the research should form the central part:

> "If we are doing good research on the things that we have got the topics on, and really try to publish it and have that as a focus and try to work together in the group is really important." (Researcher, 2011)

The research group was perceived as messy, unstructured, and potentially unstable, according to the researchers within it. But in discussing what it should be, actors suggested a structured group with clear areas of individual responsibility, mutually supportive, a repository of collective knowledge and with a common aim around which its members pull together. In short, they appeared to be reflecting Park's notion of the collective: an aggregate of

specialised individuals (Park 1927) with structures such as those enabling knowledge collection, and a common interest (Park & Burgess 1921). Presumably, this common aim might be related to doing good research in relation to a particular topic, an idea pointed to by several of the interviewed researchers. So what is good research according to the researchers in this group, and do they believe that they are doing it?

Already we have seen that one researcher saw publishing as a possible key indicator of good research. This relates further to the idea of a wider research community and therefore also to producing research that has some value within that community. In turn, this might suggest that researchers should be surveying the research being performed in that community and determining what kind of work is considered to be interesting in order to identify possible research topics for their own work.

But simply publishing relevant research results is just one way of trying to relate to a research community.

> "I would encourage and make assure that you have more collaboration with, around the world, not only with your division, you will not really question the technology side, so it's surprising they haven't cooperated and learned from all those universities in England whose very good in simulations and have good (*equipment*) and etcetera." (Engineer, 2014)

Other benefits of inter-group collaboration could include new learning opportunities, exchange of ideas, and resource sharing, particularly useful with large-scale, difficult to transport equipment, for example. In widening the exposure of the researcher to other research groups the researcher could also move closer to another concept suggested, product development:

> "… He has a plan with it, with giving wide assignments because he wants the student to develop his or her own mind over what he or she wants to do." (Doctoral student, 2012)

Research should, according to several of the respondents, be curiosity driven. This is easy to connect to a recognisable traditional academic concept: that of the autonomous researcher, part of which is for the student to master certain skills and achieve defined goals.

> "Because at the university your main goal is to take your PhD and so on, and that is more like you are doing your own planning, how you will, what you will spend your time on and so on, what you are feeling it, ok I feel this is important and things like that." (Researcher, 2011)

However, judgements of what is important, although conceptualised by some as being dependent on the individual researcher, are sometimes contrary to some of the ideals already outlined.

> "If we are doing good research on the things that we have got the topics on (…) then it also will come out that we also will have something that could be really good for (*the USO*) to use or, that could be commercial innovations that will come up if we do it in the right way." (Researcher, 2011)

Suddenly the concepts presented before, where research is related to a wider research community, publishing is important, and researchers are driven by their individual curiosity, are accompanied by a suggestion that all of these should, if done well, lead to commercial innovations. This might be likened to Etzkowitz and Leydesdorff's (1995) notion of the Triple Helix, that the university plays a crucial role in supporting innovations in industry. However, the experiences reported by researchers in the PRG suggests that the commercial connection goes further than providing innovation possibilities for industry, in that it might even stretch to the way in which the industrial market, or researchers' assessment of it, influences research choices:

> "The main driver for changing the system is the (*material*) prices, that they didn't want to be depending on the (*material*) from China." (Doctoral student, 2014)

Rather than engage in a research activity driven purely by curiosity, the researchers reported being driven instead to perform research on materials determined by what market-dominant actors might do with the price if the materials were used in a mass-market technology, for example.

Had the device been the focus of university research with no existing or intended commercial application this question might not have been relevant. However, with the USO sitting nearby the suggestion could be made that commercial concerns had influenced university research activities, and this of course has raised, and can raise, questions about the value of the research being performed by the group.

> "But from a societal point of view I believe that the research carried out where you have a dedicated company to your research, it's not beneficial to the outside world, at least not as much as it should be… If you don't do any general, generic research, your research is not so valuable to others in the area… from a societal point of view I think you can question it." (Engineer, 2014)

So although there are clearly some ideals present in the research group expressed by several of the researchers, there is a clear indication that the connection to the USO has either direct or presumed effects on the concepts the actors used to describe the world of academic research. How this might have come about is difficult to determine, but it would perhaps not be unreasonable to suggest that researchers might simply be repeating ideas reproduced through popular concepts about the relationship between science and society, such as those presented by academic entrepreneurship scholars. What ideas

exist then within the research group about how the actors believe the group and the USO should relate to one another?

The PRG and the USO

Many of the expectations of the relationship can be understood as reflections of widespread conceptions of academic knowledge transfer to industry: linear, university to industry, and unproblematic.

> "The research was built up at the department and (*the USO*) bought research, that's typical." (USO board member, 2014)

However, some other descriptions complicated the concept of unidirectional knowledge transfer, as individuals described what they had observed and connected that to their understanding of the relation between the PRG and the USO.

> "The positive thing is that hopefully the technology can wander back and forth and that you, if it works right, if it works as it should at the university you should have your spear technology, (…) so you have an idea at the spin-out and you (*focus on*) small things (*at the PRG*) and then you can hopefully put it directly in the spinout (*technology*) without any bigger problems, because we have people that work at both places here too, so it's easy to transfer the technology." (Doctoral student, 2011)

The relaxed, collaborative concept of interaction between the research and commercial worlds presented here might not be too controversial, since with a little imagination we could imagine that researchers might have become curious after observing something at the USO – this goes back to some of the concepts presented earlier about academic research, particularly with regard to autonomous science (Merton 1973).

Often the researchers described how knowledge should travel between the organisations via the movement of people: graduates who might be employed at the USO, researchers contracted to the USO on temporary assignments, and so on. This still relates somewhat to the linear movement of knowledge that has emerged in academic entrepreneurship literature. Despite their descriptions of the difficulties they experienced in establishing and maintaining such divisions, in pointing to individual figures stepping between the organisations the researchers appeared to be describing the existence of a clear dividing line between the research group and the USO and between the roles the individuals might adopt, as exemplified here:

> "When I was working at (*the USO*) then I always was at (*the USO*), and when I was working for the university then I always was here, just to skip some confusion, ok today I have my (*USO*) day so to think of and ask any questions here and so on and it's much better because you need to go there and find persons." (Researcher, 2011)

Conclusion

This section set out to capture some of the actors' experiences and understandings of the parent research group. They described their ideals of the research group in terms similar to what might be called traditional scientific values (Merton 1957) but also with regard to the group as a collective. In doing so, they hinted at concepts such as structure, specialised roles, and internal organisation, which are key to Park's conceptualisation of the collective (1927). However, they recounted their experiences in a rather different light, describing the research group as too big, lacking structure, with weak social bonds and diverging interests, the opposite of what Park might define as a collective rather than simply an aggregate of individuals. Perhaps worryingly for a research group, researchers reported that they sometimes lacked the knowledge they thought they needed, both in terms of research findings and in terms of what was happening or had happened in the research group.

Researchers also discussed the concept of good research and again they referred to Mertonian (1957) ideas concerning scientific research, suggesting that their work should be relevant and disseminated to a wider research community, collaborative, curiosity driven, and performed by autonomous researchers. However, for some it seemed that the end result of good research should be commercial innovation or the survival of the USO, and some reported that their research was driven in a particular direction by the anticipated price of materials on the commercial market. This could be read as commercial forces at work in academia, similar to the ideas presented by Slaughter and Leslie (1997).

One question central to this thesis concerns the relationship between the USO and the parent research organisation, and the researchers had both ideals and experiences of this too. Firstly there were expectations that the two would be separate, then that there would be a linear movement of knowledge from the PRG to the USO, but the actors found that knowledge sometimes moved in the other direction and that the PRG was not always ahead in developing the technology. The USO and the PRG had to be perceived as separate organisations according to some of the responses, but many realised that the two were linked, either through the sharing of resources (individuals moving around, software, or the USO factory, for example) or through the actions of external actors (who failed to recognise that an individual was not

acting as a USO employee during their days at the university, to take the example from the text).

The next chapter explores this relationship using Park's terms, but through the story of a large-scale project undertaken by the USO with two external partners, a state agency and a utility company, and considers a key activity in research commercialisation, product development.

5. Tensions in a project

The previous section considered some of the concepts the researchers and the engineers within the case used to describe both their everyday experiences and expectations of their work, but there are also other actors involved with the technology, both through connections to the research group (PRG) and to the USO. These actors, often acting within the industrial and state spheres (Etzkowitz & Leydesdorff 1995) can exert their own influence on the activities taking place in this case study, and this section aims to explore the interests and expectations of some of these actors, specifically representatives from a state organization involved in innovation support activities and an international utility company. Both of these organisations had invested in a large-scale demonstration of the technology at the centre of this case study, providing not only state and corporate finance but also expertise from their employees.

As in the previous chapter, this section addresses research question two (*What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?*), and the empirical story picks up at the project at the end of the first empirical narrative of chapter four. This is performed through an empirical slice through the case, through the identification of the social groups and movements that can be observed or inferred from the empirical description, and by outlining some of the concepts to which the actors refer (directly or indirectly) in their descriptions of the activities taking place. This lays the groundwork for later analytical work that will seek to answer this research question and address the third research question (*How do university researchers within the research group experience and negotiate these forces?*).

The technology development project

In 2010 a state agency announced through their innovation department that they were to support a large-scale demonstration of the technology at the centre of the activities in this thesis through the approval of a grant worth just over 130 million SEK to the USO. In conjunction with an international utility company, the USO was to construct a demonstration plant, close to the university test site, at a total cost of around 250 million SEK. Here three

organisations, the USO, a utility company, and a government agency, were drawn together with a common goal: to undertake a project to demonstrate, in a commercial setting, the USO's technology. The state agency's support was based on the condition that the utility contributed the remainder of the funding.

In December 2011 two design decisions were made regarding firstly two experimental units at the university funded by a recent grant secured by the professor entrepreneur and secondly one prototype for the demonstration project at the USO. The professor entrepreneur's directive for both detailed how the devices should:

1. Have a significant improvement in output (otherwise they would have to renegotiate the contract with the utility)
2. Have no problems with the components
3. Have a significant cost reduction for the manufacture
4. Undergo a significant material change to a central component, based on anticipated material market developments.

This design brief was directed to both the PRG and the USO, and although given by the professor entrepreneur, there was no expectation expressed that the university should be involved in the USO development work. However, some earlier instances of PRG researchers persuading USO constructors to help assemble their research devices suggested that there was perhaps some expectation that practical aspects of the research work might stray, without permission perhaps, into the USO.

The academic entrepreneur (the CEO and the professor entrepreneur's business partner) had implemented a new organisation structure, placing experienced managers above the USO engineers, which included individuals moved from the research group and external consultants contracted for the project, and hired a managing director for the USO. Seemingly confident in the new MD's ability to lead the development he moved from being the CEO of the daughter production company to the CEO of the parent holding company, distancing himself from the daily activities. For the engineers, apparently happy that they had experienced and trusting managers in the organisation, the USO became a place where they could develop the technology according to the specifications and without too much interference from the old CEO.

From the perspective of the USO engineers, the divide became even more obvious when the MD took time away on holiday, and communication between the USO engineers and the professor entrepreneur suffered. Despite the good intention to let the USO handle its development autonomously, at the end of July a status update revealed that the construction department at the USO had not met the design specification: the unit that was now intended by the USO for production only delivered one quarter of the output promised

for the demonstration project units, and so work began at the university to develop the next generation of the research devices.

As luck would have it, and as already mentioned, the professor entrepreneur had received a grant that enabled the development of two new university devices. PRG researchers had been working throughout 2012 – separately from the USO development – on a new build of an older research device, which included the new material. However, whilst the majority of the researchers at the division worked on this unit, the professor entrepreneur selected a small number of PhD students for a parallel development of the next generation technology, stipulating that their work should not be shared with the entire PRG.

Development work at the USO continued in parallel, which caused several problems. In particular, one PhD student reported being frustrated by the PRG's relationship with its material suppliers. The USO and the university shared many of the same suppliers and when the two organisations placed orders for materials or components that the suppliers could not fulfil concurrently, the USO engineers would apparently contact the suppliers and claim that their needs took priority. This meant that the research device development work was often delayed. Here, the USO tried to establish an advantage over the university research group using the division between the university and the USO, which we could imagine as being through the construction of the USO as the "legitimate" industry buyer, and the university group as the time-rich, lower consequence buyer, for example.

At the start of October 2013 it was decided that the USO units could not be used in the demonstration project because of their failure to produce the required output, but the USO had already told the utility company that they were the final designs for the installation. At the end of November the professor entrepreneur took over as the head of engineering at the USO, a move prompted by the utility company according to the professor entrepreneur, and stepped down from this position in the following spring. Many of the USO engineers left the development at this point, some returned to the university to continue their research activities, others remained within the USO but performed tasks in preparation of the manufacturing of the devices, or chose to leave the venture entirely.

From the original goal to have a USO unit installed by June 2012, the missing of which led to the university project, the professor entrepreneur hoped to have five to eight units installed (preferably at the USO site) by Christmas 2012 because he was expecting potential customers from abroad and he had hoped to have a working demonstration. The project continued, and it will re-enter the thesis a little later when we look at the installation of the first prototype of the university design in this section.

Here we have seen the initiation of two projects, one at the PRG and one at the USO, swiftly followed by drastic changes to these projects. Firstly the PRG project, unfortunately faced with a failure early in the construction, was

sidelined somewhat for a secondary development project for a small selection of the PRG. Secondly the USO development was unable to meet the demands of the design specification and was scrapped in favour of advances made during the secondary development project at the university.

Now though it is time to try to conceptualise the activities just described. This early analysis begins by exploring some of the concepts hinted at or described by the two actors external to the research group and the USO, the representatives of the state agency and the utility company, and will consider some conflicts in the concepts present in the demonstration project. But first, what social groups were revealed during this empirical description?

Social groups and movements

As this chapter describes many of the same actors already featured in the first empirical chapter, the outline of the social groups in this section will be quite short in order to avoid repetition. The two described earlier are the PRG and the engineering and business development actors at the USO, again comprising researchers and PhD students, and engineers, managers, and a CEO respectively, and it is the second of these that takes centre stage at the beginning of this chapter.

However, the demands placed upon the USO through the demonstration project and some driving forces within the PRG research activity appeared to necessitate the creation of a new group of individuals at the periphery of the PRG. Could this group be considered a social group under Park's definition? It could actually be quite difficult to assert this. On the contrary, although the individuals involved had common goals (outlined by the professor entrepreneur) and they were capable of concerted action (Park 1927), they lacked many of the characteristics Park identified as defining a social group. While there was a characteristic concept of the group in the form of the device built through the efforts of some select individuals, these individuals acted within the formal structures of pre-existing groups (Park & Burgess 1921); for example, the initial request for the PhD student to assist in the development work was made through a relationship that we might expect could only be found in a PRG, that of professor and student, and they worked with reference to a typical academic schedule (which includes a long summer break during which many researchers are away at conferences or on holiday) to avoid their project being recognized and accessible for all the members of the PRG and USO during the early work.

The USO social group underwent a significant change in losing many of its engineers who had been performing the development work (back to the university, to other functions within the USO, or to other companies), but it could be seen as yet another change in a series of changes. After all, the entry of engineers into the USO to try to satisfy its demonstration project

commitments was a movement of individual actors (researchers from the PRG, engineering consultants, and direct hires to the USO), migrants to use Park's terms, into a social group, and the organization had undergone a structural change when the management implanted a new reporting structure and thereby altered the ways in which social interactions could occur, to take two examples.

From the empirical description offered in this chapter we can understand that knowledge played a somewhat central role; the design specification and the difficulties surrounding the USO's work towards it was one example of knowledge being handled in a sometimes confusing manner, with some actors privy to knowledge at different times, or not at all. The next section moves forward by considering knowledge, or more specifically concepts, to which some of the actors appeared to relate during and around the demonstration project.

What different concepts do actors relate to?

Some main, and perhaps expected, concepts are outlined first and with regard to how actors appeared to relate to them. These were concepts of academia and industry, and concepts concerning how academia and a USO could relate to one another. The section moves forwards by asking how concepts associated with research commercialisation could give rise to certain expectations and tensions within the demonstration project. An argument is then made that suggests that concepts which seem to feature heavily in the events in this chapter, but which remain absent from literature on USO development or academic research commercialisation, could compliment the understandings reported by some of the actors in the demonstration project.

Industry and academia

Many of the actors, from university researchers to USO engineers and management, reported tensions not only between the USO and the research group, but between the concepts characterising each environment when, for example, individuals moved from one part to the other, or undertook activities one might automatically associate with roles situated elsewhere within the venture.

One tension that seemed to occupy much of the actors' descriptions was often related to assumed or perceived differences between industry and academia. For example, delays were reportedly a problem at the USO, and one reason for delays was reported to have been due to the making of mistakes. This problem could be attributed to actors moving from the PRG to the USO, from a place where mistakes are a part of learning to an environment where graduates feel pressured to prove – to the academic entrepreneur, and

to USO colleagues perhaps – that they are capable of performing industrial work. The professor entrepreneur also however encountered problems when using industrial consultants at the USO:

> "We had a consultant being head of design, but he couldn't understand this… even though I was there saying look here, we are doing this. We have to put it, no way… Here I sit with all this activity and also be chairman of (*the USO*) and also be major shareholder, I still can't get changes in. It's just engineers that keep things for themselves, secret." (Professor entrepreneur, 2012)

Industrial logics did however provide learning opportunities for doctoral students. Problems also occurred for example when suppliers failed to live up to their promises to manufacture to within certain tolerances. In one example provided during an interview, one part was one meter long and was supposed to have a curve of 30 degrees, but when it was delivered it was found to have a curve of 32, which represented a large deviation from the acceptable tolerances. A PhD student working on the technology development at the centre of events in this chapter estimated, perhaps somewhat jokingly, that she had spent more time correcting mistakes than simply constructing the unit; however during later conversations it was revealed that the unit constructed first was an experimental piece designed to learn about the mistakes that may occur during the real construction process.

Part of the learning described as taking place here concerns the way in which the engineers related to their suppliers; as a consequence of tolerance problems just described, the decision was taken with regard to the development of a stabiliser system to develop it in conjunction with the manufacturer in an attempt to ensure that the manufacturer did not commit themselves to a design they were incapable of mass producing. Other areas for learning involved economic considerations; one example given was the change from steel to stainless steel components, wherein researchers learned that the new material cost more not only because the material itself was more expensive, but also because more gas was required to cut the harder material.

Knowing, or learning, how to deal with suppliers is not typically associated with a more traditional view of graduate education. One PhD student summed up the difficulties of being an academic working with industrial considerations: "If you had 20 years' experience you'd be ok, but for me…" This suggests that when academics are required to venture into industry they lack the experience of dealing with industrial partners. Perhaps part of the development process, along with the activities outlined by Vohora *et al.* (2004) is also the development of the researchers' ability to move from academia to industry, and also to recognise when the distinction between the USO and the PRG might cause new issues to emerge, as exemplified by a

reported instance in which the USO engineers persuaded suppliers that the USO needs were of a higher priority than those of the research group.

Academia and USO's

One key concept that will be explored later in the thesis is that concerning the relationship between the university research group and the USO. In an earlier chapter a few of the researchers' beliefs were outlined, and it was suggested that their descriptions were quite close to what might be viewed as autonomous science (Merton 1973), with a linear relationship between scientific knowledge production and innovation efforts. The researchers reported, as we might recall from the previous chapter, experiences which helped them to describe the PRG and the USO as almost inextricably linked, either through their individual work activities or the inability of external actors, in their experience often suppliers, to distinguish between "research" and "company" time and activities with regard to these contractors' relationship to the two organisations.

The demonstration project was conceived of, applied for, and granted, as a co-financed activity with just three organisations: the state agency, the utility company and the USO. This was a project imagined and designed by industrial and state actors to be performed entirely in the industrial setting, rather than with, for example, Etzkowitz and Leydesdorff's third sphere of academia (1995). The PRG at the university was not included in the original project plan or the funding application made to the state agency, yet despite this, the research group was never quite absent from the project even from the beginning. A representative from the utility company explained:

> "After the funding to university then we were contacted by the (*USO*) owner about the possibility to continue the development (…) these results were quite promising so we decided to continue the funding and going for something bigger than what was proposed." (Utility company representative, 2014)

The utility company, at least from the representative's account, held a belief that a positive outcome for the project with the USO could be inferred from previous positive results of the PRG. Having been involved in funding the university research prior to the proposed industrial demonstration project, and having conducted their own evaluation of the research according to the professor entrepreneur, the utility company apparently saw possibilities for future work with the USO. We cannot take the word of a single individual to reflect the beliefs of others in the organization with regard to such a huge investment decision, and so although we can accept that such a belief may have influenced the investment decision by the utility company, we cannot say much more. However, for the representative, his account of his experi-

ence of the demonstration project appeared to mirror an earlier identified concept that suggested that the USO and the research group should be closely linked, at least in terms of knowledge:

> "I think there the university should maybe put some more efforts trying to bring that knowledge more in to the partners involved in the project from the beginning, and then fine tuning during the process when the product itself is built and when you get more information." (Utility company representative, 2014)

Since the university had apparently, in the state agency's estimations at least, already proven that the concept worked, they expressed the belief that the USO would perform well because it was linked to the research group. However, they were clear in their estimations that this was not a research project, but rather the aim of the project was to construct and operate a productive installation; representatives of the state agency and the utility described scaling up and "fine-tuning", and these expectations of development work, extending only so far as minor adjustments, do not seem unreasonable in a commercial demonstration project.

In contrast, and as suggested by the empirical description offered at the outset of this chapter, the professor entrepreneur and the USO's academic entrepreneur had determined that a much greater change was necessary to move the technology closer to the goal of being a commercially viable product. It was clear from these early descriptions that there were conflicting beliefs within those of the various actors involved with the demonstration project, specifically with regards to the development required to take the technology to the state it needed to be in for the demonstration to have a chance at success.

The idea that a technology is proven and just requires a little up-scaling development work upon its movement to a USO is contrasted by the understandings suggested by those much closer to the technology, actors who described how significant work was required as a result of changing a fundamental component in the device. However, this is perhaps not something that we should find so surprising – the empirical data described how the state agency and utility company representatives were involved only in a limited capacity compared to, for example, the professor entrepreneur who made key material decisions.

However, despite apparently conflicting understandings of the connection between the PRG and the USO, it is hard to ignore events that would seem to suggest that there was some kind of connection. For example, within this project there were clear issues with the USO's efforts to solve these technology development questions which became apparent shortly before the first device for the demonstration site was due to be installed. At approximately the same time, a PRG development had a reportedly catastrophic failure

early in the process, and research funding was then partly diverted into a parallel research project when the professor entrepreneur began the task of constructing a new device at the university. Key findings from this research project then found their way into the USO's units for the demonstration project.

Looking to Park and Burgess' (1921) social forces concept it could be argued that the pressure to produce the USO device, arising through the contractual agreement in the industrial realm between the USO and the resource-controlling state agency and utility company, had led to an activity that could be seen as a re-organisation of the actors and activities across the USO and PRG groups. With the financial resources the USO desperately needed placed at risk by the failure of the USO management and engineers to produce a device that would satisfy the technological requirements of the demonstration project, and with the resources and an opportunity to re-think the research device, the design and construction of a device with reportedly the same design specification – in itself a highly specialized task – appeared within the research group. Alongside these different conceptualisations of the academic research its connection to the USO, the product development itself seemed to be a particularly contentious issue. So how was the product development conceptualised, and, turning a little to pragmatism, what could these different concepts do for a demonstration project such as this?

Problems with concepts from literature

Interpreting the re-assignment of the technology development to actors at the PRG as a re-organisation of resources could fit into Vohora *et al.*'s (2004) critical junctures model at the pre-organization phase for example, wherein "the entrepreneurial teams faced the challenges of continuously identifying, acquiring and integrating resources and then subsequently re-configuring them" (2004, 157). However, popular conceptions of research commercialisation such as Vohora *et al.*'s model are quite unclear about where product development and research might fit into the USO process and how it might relate to the research activity. Actors in the cases upon which they base their model of academic entrepreneurship are described as producing prototypes, and designing product development plans, for example. However, in the re-orientation phase, where activities such as market identification and customer interaction are described for example, the actors were labelled, rather ambiguously, as the "team" rather than the more specific "academic team" or "team of chemists" used in descriptions in the research phase. This prompts of course the question of what happened to the university researchers from the research phase – did they develop into marketing and business professionals along with the academic entrepreneur, present in case technology development needed their scientific expertise, or did they remain in their

university roles as the academic entrepreneur hired the competencies he needed during these later USO development stages? This question remains perhaps unanswered, but it leads into the following. In considering the re-orientation phase and the technological development activity as part of a USO development strategy, in other words seeking to understand the events described in this chapter in terms of the models presented by scholars such as Vohora *et al.* (2004), it could be argued that re-allocating the technology development from the USO engineers to the university researchers could lead to two very different ways that we could understand the USO and its capacity to deliver on the promises made for the demonstration project.

The first would be to picture the decision to shift the technology development as an emergency measure, and thus that the USO was not organised appropriately to act to provide those products and services it was contracted to provide, making it difficult for the USO to pass the threshold of credibility (Vohora *et al.* 2004). This would suggest potential difficulties for the USO and possibly lead to serious consequences such as delays or constraints applied to payments from the state agency and utility company, or even cancellation of the project.

The second reading would be that the USO and the research group were linked in such a way that they could react to outside influences, such as the change in availability or price of the material required for an important device component, by re-organising their respective internal resources, better understood through Utterback and Abernathy's (1975) dynamic model of product innovation, a brief summary of which is provided earlier in the thesis. The changes in the demands upon an organisation throughout the product development process can help in this case to describe the (partial) return of the product development activity to the university. Additionally, such a reading can be inferred from the empirical case: having invested a large amount of money already, it could be argued that many of the actors in the project would choose to make interpretations of these events, and therefore the relationship between the USO and the PRG, in such terms as to safeguard the future of the project, if they still saw a possibility to complete it.

Understandings such as the two briefly outlined could be likened to those found in much of the literature concerned with university-industry interaction, such as Mode 2 science (Gibbons, *et al.*1994) or the Triple Helix (Etzkowitz & Leydesdorff 1995), insofar as such concepts also describe academia in a supplier-like relationship to the industrial sphere, or seek to explore the crossing of the university-industry boundary without much consideration of the activities focused on the technology, for example.

A similar concept of academic research commercialization, suggesting that knowledge flows from the research group to the USO and other external actors, was reflected in the accounts of the state agency too. Both the state agency and the utility company representatives seemed to express the belief

that the relationship to the university indicated the preparedness of the USO for commercial or industrial activities.

> "We all know that (*the technology*) can (*function*), the university has already shown this; the question is can it work on this scale." (State agency representative, 2014)

However, product development was clearly a key activity for both the PRG and the USO. In turning to more traditional notions of product development such as those presented by Utterback and Abernathy (1975) regarding product and process innovation and the drivers of such, the events described here can be explored in a different light.

Product development in research commercialisation

There is some suggestion from the empirical material that the episode was interpreted with relation to concepts of product development. In the early stages of development the rate of product innovation is typically high and the rate of process innovation is low, and cost, rather than performance, increasingly stimulates the innovation process around the later part of the development process, when process innovation is the main activity (Utterback & Abernathy, 1975). During this large-scale demonstration project one of the key questions was cost:

> "What is very important for going forward actually the (…) production and the cost because both the [capital expenditure] and the [operating expenditure] cost that we understand them, but what they are and what they could be in the future then maybe the most things (…) there's a lot of pictures related to new innovations and pilots that are challenging and you make one unit you can be lucky, you can have good luck (…). It's also a question of cost that you should be able to lower the cost, be competitive on the market with other sorts of (…), so there's a lot of different aspects what you should consider in this case." (Utility company representative, 2014)

Cost can also be seen as one factor in the university research technology. This was intended to have a large increase in output, doubling that of previous generations and effectively doubling the cost effectiveness of the device, however in an early attempt the increased forces caused a collapse of the device in experimental laboratory tests. Previous versions used a material in a key component that the professor entrepreneur estimated would see a significant cost increase in the years to come, and so the university research technology featured a different material. In this design change, the influence of market forces outside of the university is particularly clear; the new material was substantially cheaper than the earlier choice and so cost, primarily

an industrial concern, was a driving force in the re-design of the university device.

This cost focus would suggest that some actors, in particular the external actors involved in the demonstration project in this chapter, understood the technology development to be in the later stage of product and process development, and maybe the project relied on this assumption; after all, the two external organisations were interested in commercial applicability of the technology and the capability of the USO to provide a scalable system for a commercial market. Reading this in Vohorian terms, this would suggest that the external actors had not opted to interpret the events described here as a sign that the USO had failed to spin out from the research group at this point, but had instead interpreted (or accepted them) as part of a, possibly strategic, decision to maintain a link with the PRG.

However, such an interpretation could be strongly contested by those closer to the technology development activities and the organisations involved. For example, the professor entrepreneur adamantly denied a close relationship between the research group and the USO, both in personal interviews and in meetings he held with the researchers. Further, he had maintained careful records detailing the organisational, financial, and not least legal, division between the research activity and the USO, to satisfy legal requirements regarding for example the use of research funding.

The empirical description in this chapter is also littered with product development terms and norms. The utility company entered into an agreement to purchase a working demonstration of a product, the professor entrepreneur created and communicated the intended outcome as a set of design specifications, the USO engineers communicated their plans through the medium of technical drawings (rather than patents or articles, as in earlier descriptions in the thesis), and individuals worked with suppliers to ensure that they could produce required components according to agree-upon tolerances. Therefore, it could be suggested that some actors, the professor entrepreneur, the academic entrepreneur, and perhaps the representatives from the state agency and the utility company, had turned to concepts more closely related to the product development process rather than to concepts associated with models of technology transfer to work with the world around them.

Conclusion

In this chapter we have seen a multi-partner project in which a state agency, utility company, and the USO, set out to build a pilot site to demonstrate the feasibility of a large-scale installation and operation of the technology offered by the USO. The project required large investments from the first two partners, which came in the form of state and corporate financial support as well as more practical support such as project management competencies.

However, a number of conflicts between concepts referred to by various actors emerged through this early analysis. The state agency and utility company representatives appeared to view the technology as already-proven and simply in need of up scaling and minor adjustments. This was perhaps unsurprising given that, as controllers of essential resources for the project and the requirement that the USO deliver the technology on time and to specification, earlier held understandings may have been influenced by actors that could be seen as optimistic and designed to secure their interest in the project. These descriptions were starkly contrasted by those working more closely with the technology, the professor entrepreneur and USO engineers, who knew after the early attempts at the USO that the change from one material to an new material in a core component meant significant design changes. Similarly, the presumed close relationship between the research group and the USO, suggested by the utility company and state agency representatives as one motivation for extending their earlier involvements with the PRG to the USO through this demonstration project, was less apparent for those working near to the technology development despite assertions, suggested in for example chapter four, that such a relationship should exist.

Pragmatism suggests that the specific knowledge and understanding a particular actor has of a phenomenon guides their actions (Misak 2009, Jensen 2013). A number of understandings of the USO and the research group, the relationship between the two, and the state of the technology were revealed through observations of actors' interactions and interviews with individuals involved in the project. These included the idea that the research group was an important indicator of the potential success of the project, and that the research group and the USO should be, and were, closely linked, echoing ideas that can be found in some literature on university-industry relations, such as Mode 2 science (Gibbons, *et al.* 1994) and the Triple Helix (Etzkowitz & Leydesdorff 1995). Such an understanding seems aligned with concepts from what we might recognise as academic entrepreneurship.

However, it became clear that the actors involved also understood the demonstration project in terms more recognisable as concepts of product development; a cost reduction focus, expectations about the readiness of the technology for commercial application, and so on. In other words, these actors appear to have assumed that by the time the technology reached the USO the product development activity had progressed to the stage where the technology needed only minor product adjustments, and engineers were mainly concerned with process innovation and cost concerns (Utterback & Abernathy 1975).

This chapter has explored two concepts as they appeared in a multi-actor demonstration project, and has complicated a simplistic view of research commercialisation by highlighting the presence another, although perhaps unsurprising, concept has in the demonstration project, that of product development.

More pressingly is the question of individuals moving between the USO and the research group – these are reported to be responsible for knowledge transfer both from the university to the USO and in the reverse direction, they are able to experience the relationship between the two rather than form their understanding based on second hand knowledge or concepts present in their immediate social group, and yet they are also reported to be a complicating factor in establishing a clear boundary between the two collectives since they are active in, and carry within them the interests of, both the USO and the research group (Park & Burgess 1921). The next section considers this movement of individuals.

6. Temporary migration between the research group and the USO

The movement of individuals between the USO and the research group is reported to be an important factor in the transfer of knowledge between the two realms, yet it also complicates any effort made to discern a separation between the two. The divide between the individual researcher and the research collective is the underlying theme of the empirical episode in this chapter, in which the technology development presented in the previous chapter is followed by a story of the first device's installation.

Vohora *et al.*'s critical junctures model (2004) hinted at the necessity of resolving, or of actors appearing to resolve, uncertainty in the USO creation process, as they move from research to commercial activities. In arriving at a state of certainty, be it committing to a commercial venture or deciding which resources to leverage in the pre-organisation phase, a distinction must be made between scientific research and industrial development activities – Shane (2004) for example spoke of the risks of USO founders having conflicts of interest arising through their dual commitments to academic research and industrial activities, Rasmussen and Borch (2010) described universities' roles in fulfilling the need to separate academic and commercial activity, and looking at the research activity Slaughter and Rhoades (2004) reported the difficulties faced by professors for example in maintaining disinterestedness when conducting academic research into areas in which they had financial interests.

How such a distinction is made though is not elaborated upon in the reviewed literature. Park and Burgess' notion of specialised roles (1921) could instead be used to consider the forces at play when the line between research and commercial development activities is unclear. Although perhaps an extreme case within the case study, this section demonstrates how concepts from different realms can emerge around one event, the installation of a university research device.

This episode also suggests how individuals can act in a public setting in the interests of a particular social group, in this example the parent research group (PRG). Witnessed by members of the public and with the media present throughout the day, the PRG was observed in a way they were not normally subjected to through mechanisms such as research publishing and teaching. Rather, concepts identified earlier in the thesis help to understand

how distant observers such as research funding agencies appear to necessitate researchers' efforts to claim the device as being the result of research activities.

Installation day

The first of the next generation devices was due to be installed at the university test site, and it was a significant milestone – if it performed well it would be the design upon which the USO based its first network-connected project. It was also the device designed at the university and its anticipated performance had caused the USO's in-house design to be scrapped. As such it can be understood that this was a device surrounded by a lot of tension, both amongst the researchers and between them and the USO engineers.

One PhD student who had been primarily responsible for the design and construction of the device had travelled to the USO factory some days earlier to finalise the assembly and perform pre-installation testing, and, together with ten researchers from the PRG, I travelled the six-hour drive to observe the installation. The full list of observers also included local media, including a local radio station. The schedule for the day was to travel together to the installation site at around mid-morning, observe the deployment, and then celebrate as key figures gave interviews to the press, but plans swiftly went awry.

At 9:30am on the morning of the installation the researchers gathered in the lounge of a house near to the factory, purchased for the use of PRG researchers and USO employees who needed to visit the USO factory for short periods of time. The news was not good: the device needed more work, and one of the vehicles hired for the installation had been delayed on another contract and was not expected to arrive until after lunchtime, a good five hours late.

The delays meant that the installation could not be performed during the planned time frame, and the researchers began to wonder if it could go ahead at all that day – the installation site became dangerous under certain weather conditions, and the conditions were expected to deteriorate the next day. At what time would it become unfeasible to proceed with the installation as planned?

The researchers immediately logged onto their phones, each selecting the weather forecast they hoped would provide the best answers, and started to shout out the numbers to the group, along with their estimates of the risks involved. One of the more senior researchers had the telephone number for one of the specialist contractors involved in the installation, and called for silence while he dialled. The answer was even less favourable than the researchers had guessed: if the installation did not go ahead today it would be

impossible for a few days. They would have to return to the university without having observed this exciting event.

One researcher, acting that day as the media liaison for the installation, was left in the lounge to telephone the journalists and update them on the situation. Worried that delaying the interviews would mean the journalists could miss their scheduled broadcasts and publishing deadlines, the researcher persuaded the PhD student working on the installation to give her interviews mid-way through the preparations for the installation instead.

Without being directly involved in the construction or installation there was nothing the researchers could do but wait for further news, but an hour later, just as they were discussing taking a walk into the town centre, they received word that the device was nearing readiness. The group split into cars and drove to a car park near to the installation site.

When they arrived they found that the device was still at the factory and would not be leaving for a few more hours, so they went off in search of coffee. I accompanied the researcher acting as media liaison, a relative newcomer at the senior level, to try to understand her part in the research group while she fielded calls from the media and tried to find out the status of the device.

Eventually the researchers convened at a hotel near to the installation site, unfortunately closed for the winter, where the local media had been promised an interview with the PhD student before the installation proceeded. The researchers jumped up and down in the cold to keep warm and amused themselves by playing with my audio recorder while three journalists stood to the side and talked amongst themselves.

There was a brief flurry of activity as the PhD student arrived and was directed up the hotel steps to give some privacy as she gave interviews, first to the national radio, then to the local newspaper, then to another radio program. During the interviews she noted that despite the device being university-owned, both organisations could learn from it, and in doing so she also stressed the distinction between the university and the USO. When she had finished and left to continue the preparations the media took some comments from the senior researchers.

As the researchers considered taking another coffee break a phone call announced the imminent arrival of the device, and the group quickly moved to get a good view. After even more waiting the top of something huge could be seen above the rooftops, moving its way at a crawling pace through the town. Eventually the truck carrying it came into sight and the researchers saw the device for the first time: gleaming with fresh paint and strapped to four points on the flat bed truck, the enormity of the venture suddenly became clear for me in a way that it hadn't before, despite my having seen similar devices at the university. This was a physically huge piece of machinery, heavy and difficult to manoeuvre, and some cost estimates had

placed it somewhere near to a small family home in the area. Local residents had gathered to watch it, and stood some distance from the researchers.

When it arrived at the loading spot a small crane lifted it carefully from the truck and positioned it on its concrete base, ready to be secured before being lowered to its final position. The sun was going down as the bolts were aligned and tightened, USO constructors and the PhD student guiding it with hands and feet as it inched into place. Some researchers assisted occasionally with equipment where they could, and the other PhD students and researchers observing looked sadly at the celebratory cake they would now never get to eat: the late hour meant that they, and I, would have to depart before the installation could take place.

When the last bolt was tightened the PhD student stepped down from the concrete base and joined the other researchers, smiling tiredly as she posed with them for photographs in front of the device. There were still hours of work ahead as the contractors had agreed to push ahead with the installation before the bad weather arrived. This meant that it would happen at night, and so the researchers would be unable to see anything from the observation vehicle. Realising we would not be witnessing the installation that day, the researchers and I returned home.

Social groups, knowledge, and movements

In an earlier section on researchers' expectations of the relationship between the PRG and the USO there was little support for the existence of a clear dividing line between the two organisations. Rather, the researchers suggested that while there should be a clear division, and that artefacts, people, and knowledge, should be able to move between them, when they considered activities they had been involved in or the experiences of those they had worked with the boundary between the research group and the USO seemed unclear, and activities which spanned both the industrial and the academic realms were difficult to define in such terms or contrary to their linear and directional expectations.

Unlike the empirical descriptions offered in earlier chapters, the installation was conducted in a public space. Under the gaze of the public and some reporters, the researchers trying to observe it were themselves also being watched. This episode again demonstrates the different social groups of the PRG researchers and the USO engineers, and the necessity to separate the research and USO activities, hinted at in literature on the USO, was reflected here.

The installation was a significant milestone because if it worked well it would be the design upon which the first devices of the huge demonstration plant were based. Those involved may have expected that the installation would also have been observed, from a distance, by the utility company due

to run the demonstration plant and the state agency co-financing it, and so there was also a pressure to have the device identified as being from the USO rather than with the research group in this respect. But in being observed by the public and, from afar, research funding organisations, the researchers may also have felt pressure to emphasise the university's role in bringing forth the technology in order to maintain or to raise the perceived importance of the research group, identifying the PRG as perhaps deserving of support from organisations that view a strong link to industry as a positive factor in determining university research quality. Slaughter and Leslie's *Academic Capitalism* (1997) invites such an interpretation, but the state agency supporting the demonstration project described in this chapter and chapter five indicated a similar understanding of the importance of commercial connections in their assessments of qualifying research projects for similar research programs, for example:

> "Research projects with a clear connection to business facilitate the dissemination and further development of research results. Such a link may be for basic research through reference groups with representatives from the industry concerned or recipients of results, or through direct collaboration and innovation development aimed at future commercialization of research results."[2] (Swedish Energy Agency 2014)

There were some researchers present during the day who were unclear about the status of the device at the centre of the day's activities – was it a research object or a commercial prototype? Did it belong to the PRG or the USO? "Knowledge" was already a tense issue with regard to this device: events reported in the previous chapter described how the professor entrepreneur designed the device initially without those at the PRG or the USO being informed and so it wasn't a project the other researchers were really involved with. It only really became "public" within the research group when large components started showing up in the university workshop, and some of those at the PRG had reportedly suspected that the device was intended to replace the USO's effort at a commercial design. That it was designed at the university seemed to be of little consequence when it came to determining its origins however, since many in the PRG were excluded from the entire project. As such it didn't really seem to belong to the PRG for some, nor did it really come from the USO either.

[2] Forskningsprojekt med tydlig anknytning till näringslivet underlättar spridning och vidareutveckling av forskningsresultaten. Sådan anknytning kan ske för grundläggande forskning genom referensgrupper med representanter från berörd industri eller mottagare av resultat, eller genom direkta samarbeten och innovationsutveckling som syftar till framtida kommersialisering av forskningens resultat. (Energimyndigheten, 2014)

A division emerged within the observing researchers too. When they dispersed to find coffee, one senior researcher set out alone until I asked to join her, and the others said that they had stuck together in the time we were away. Her choice becomes clear once we understand her role as media liaison for the installation, as being (nearly) alone meant she could perform her role for the event, talking to the installation engineers and the media, without interruption from perhaps impatient researchers. There was also some pressure to present the researchers as a research collective rather than as a single research hero: a senior researcher who acted as some sort of representative of the research collective, for example, fielded awkward questions from some of the public.

These more senior researchers were performing functions that seemed to be furthering the interests of the research group; communicating what the research group did to the public, and informing those waiting about the progress of the day. This could be seen as the action of an individual with a specialised role (Park & Burgess 1921, 26), and an articulation of the interests expressed within the research collective (p38) in interactions with non-group members. Instead, stepping away from the main research group to perform these actions could be seen as enactments of specialised roles within the PRG: the temporary communicator role and the longer-term post-doctoral researcher role.

With the researchers travelling to be physically present at the installation and engaging with the public (and through their attempts to determine possible installation timeframes earlier in the day in the private accommodation), the research group appeared to be trying to claim their involvement in the work, to outside observers and perhaps also to each other within the research group. This associating act occurred through a more local movement too: when the device had been attached to the base prior to installation, the researchers had gathered for a photograph in front of it. The doctoral student who had worked on both the technology development and the events of this installation day joined them for the picture, flanked by two doctoral students with proud smiles and fingers pointed at her, presumably identifying her as the individual deserving of credit. This was a picture that seemed to position her, and her work, as part of the PRG.

However despite the very public representations of the research collective, the activities taking place suggested a more complicated picture than a PhD student being a member of one social group with a specialised role similar to that of others with specialised roles highlighted in this chapter. She was clearly engaged with a very different type of work during this episode (physical and dirty versus observing and inactive, for example), and when the other researchers went home she continued to work on the installation with the USO engineers. This points towards two further observations. The first is that the doctoral student was able to choose to step between the PRG and the USO and carry the interests of the research group with her: she was

able to secure the assistance of the USO engineers during the production and installation of the research device for example, and yet from her role (in that she was the only non-senior researcher who spoke to the media that day) she was still able to comment on the distinction between the research group and the USO, and define the technology as a university research object rather than a commercial prototype.

The second observation is that she was able to select which of the social groups she was a representative of at any given moment, and act appropriately for each. This meant that, in line with and slightly extending Park's (1928) comments on the migratory individual, the doctoral student was familiar with and able to choose to express the signs and interests of two social groups at the appropriate moment – in this case either to further her individual interests (earlier interviews with this researcher pointed to her primary motivation being to make the technology work) or those of the social groups of which she was a member. This action further aligns with the notion of the collective and the individual, since the social group is a collective that exists for the benefit of its individual members (Park & Burgess 1921).

Conclusion

In this episode, researchers and PhD students observed and occasionally engaged in a range of activities surrounding the first installation of a new generation of the research technology. In contrast to earlier encounters with the PRG and its relation to the USO, this narrative has highlighted that individuals can not only be members of one social group and express the interests of that group in social interaction, but that they can choose to express the interests of a number of different social groups to whom they claim membership in order to further their individual interests.

The research collective was represented throughout the day by three individuals in particular, one acting as a media liaison and the others as a source for information with regard to the installation and technology. These individuals with specialised roles thereby communicated the interests of the other individuals in the research collective to observers, and asserted the research collective's claim to the work and the technology. Other individuals in the research collective repeated this narrative when they posed for pictures with their colleague in front of the device. One obvious caveat to this observation is that under Park's concept of interests and desires, actors may not be fully aware of the underlying reasons for their conscious desires, and in this case I can certainly agree; although taken in a wider social context (considering the organisations and observers outside of the research group for example) the in-the-moment actions of the researchers can also be understood simply as friends and colleagues expressing happiness and pride in one another's' work.

The installation described here complicates the blurry picture of the relationship between the research group and the USO outlined in an earlier section by focusing more specifically on an individual researcher as she moved between the two, and provided several examples of actors' attempts to draw the boundary between the two and claim certain activities to be within one rather than the other, in this case for example claiming that the technology development was within the research group. It also further complicates the narratives offered in existing literature on academic entrepreneurship and academic capitalism by including the voices and actions of non-faculty and less senior researchers.

The next chapter continues by examining how the researchers were invited to try to structure the activities of the research group, and presents the meeting that underlined their subsequent failure to organise and that informs some of the concepts researchers appeared to refer to in their descriptions of their expectations and experiences in the earlier empirical chapters.

7. Internal (dis)organisation

In the first year of my observations for this case study, and when the USO had been in the development process for a number of years, the professor entrepreneur decided that he could no longer be as involved in the university research as he had been in the past; although he would be available to a limited degree, he was taking a short period as guest professor at a foreign university. He used the announcement of his withdrawal to encourage the university researchers to determine how they wished their group to continue with regard to research in the technology area. In this chapter, I turn to Park's notion of collective behaviour (1927) to examine a two-day meeting during which the researchers discussed the research group's future.

The chapter begins with a presentation of the meeting, the most extreme example in the empirical material of the group's efforts to self-organise, which leads up to the question of what traditional structuring forces within academic settings this attempt at organizing the PRG might be up against. This early discussion continues the exploration of research question two (*What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?)*. However, it takes a step beyond previous chapters, which more simply considered the various social groups and interests associated with them, by examining how the multiplicity of social groups to which actors belonged (or aspired to belong) complicated the group's efforts to structure their activities in response to the professor entrepreneur's anticipated departure.

Research group meeting

In 2011 the research group held a two-day meeting immediately prior to a conference many of the researchers were attending. The big announcement of the meeting was that the professor entrepreneur, also the chair of the research department, had been elected to a position of greater responsibility within the university, and would therefore be unable to have as much involvement in the research as he had had previously. Although a few of the researchers already knew about this impending change this was the first time the group had heard the news.

The professor entrepreneur introduced the meeting by stating his intent to clarify the roles of the individual researchers due to their being so many (at this time 20 researchers), their responsibilities with regard to existing research funding, and the status of current funding applications. The meeting began with a run through of the finances applied for and granted to the project, and the professor emphasised the importance of financial support:

> "Good research is never done without economy, never, that's lesson number one. Can we build that and that and that? Do we have that money?" (Professor entrepreneur, 2011)

The professor entrepreneur connected this to the legal requirements of research, and kept meticulous records of his department's funding applications in stuffed binders in his office. He quickly outlined the departmental funding application amounts:

> "Externally 2002 it was almost 5 million, 2003, 10 million, then it increased as you can see in external grants, 2010 was a bit poor actually, 2011 it's a bit more, and we have a rather good budget for 2012, 38 million. But this is not "[*this particular research area*] this is the whole division. We have to think of these as orders." (Professor entrepreneur, 2011)

The researchers posed questions, mostly concerned with how the financing worked: were these funds pre-allocated to specific projects? Is this money just for new PhD students? Where does this money come from? The professor explained, taking one or two individuals from the spreadsheet being projected onto the wall and tracing the figures next to their names. The first question related to the professor's withdrawal arrived:

> "To what extent do you expect us new seniors in the group to take over this kind of work, or if you intend for us to have a bigger understanding of what you do, or if you want us to succeed you in these tasks?" (Researcher, 2011)

The discussion turned to how people should try to cultivate relationships with funding agencies, and the professor entrepreneur explained how a portfolio of several offered a better chance of securing resources than relying on one. He then began asking the researchers questions about the status and history of the research group; who has funding from this agency, who is financed from that agency, how many PhDs have been completed in the research group, and so on, explaining how this information needed to be provided for internal university evaluations. The more senior researchers began to offer up their own stories of evaluations by actors external to the research group, mainly funding agencies, highlighting the link between research activities and securing resources. However, after divulging his take

on research communication the professor entrepreneur moved the discussion onwards without going into further depth.

The next part of the meeting was designed as smaller group discussions around some questions: What do we do, how do we divide responsibilities? Now that we are larger is communication working? Does everyone know what everyone else is doing? How do we work with journal papers? The future, recent and coming seniors what responsibilities do they see themselves taking? The professor summarised the questions on a whiteboard, and then turned to the five senior researchers, asking them what they were doing in the research group and what their areas of responsibility were. As they answered the professor divided an A3 paper into six and filled in a box with a senior researcher's answers. He invited the remaining researchers to indicate which box they felt they fit into, and then moved a few into boxes he argued were more appropriate. The group then separated into these smaller sub-groups to discuss the questions they had already outlined.

When the larger group convened after the sub-group meeting time the issues raised were discussed, with several proposals for improvements. An issue that seemed to provoke a lot of discussion was that of communication. The researchers eventually agreed that whilst individual researchers felt they could communicate well with other individuals when faced with a specific question, communication across the wider group was more difficult and often lacking.

> "Some of us who are bit older, we used to have meetings every so often, to go through and find out what are we doing, what papers are we writing, is there something we want to ask each other, something to get the group to feel like it's a united group working together." (Researcher, 2011)

One solution proposed was to hold monthly project meetings, which were to consist of a summary of events, planning and co-ordination of activities, and short presentations by researchers. Each meeting was to have a note-taker and be headed by a different senior every time. One group had also discussed whether the professor entrepreneur needed to be present at these meetings, and concluded that while it was good if he could attend, it may be easier to have "wild discussion" if the professor entrepreneur was not present.

A conflict that emerged during the meeting concerned how the researchers perceived science and the difference between that and what they were doing. For some, this discrepancy was a big problem. One of the topics discussed the effect that had on publishing, and what criteria should be used to select who gets to be named as an author in a project which utilised the work of the whole group. Some quoted CERN's policy of listing every person as an author, but raised two main points of conflict: in producing the PhD thesis, the doctoral student required articles written in a very specific publishing

format (which was not compatible with twenty or so co-authors on each article), and in terms of career advancement, individuals required a number of papers in which they were a first author in order to secure certain employment positions. One proposed solution – initially supported by those present – was to send e-mails to a newly created e-mail group to invite researchers to collaborate on articles.

This episode encouragingly seems to suggest that structuring the PRG was no impossible feat: the researchers appeared to be in agreement about what they would like, they had voiced some of their concerns regarding the group as it was before the meeting, and had identified some possible solutions to these. Unfortunately, the structure suggested in the meeting was never realised as a permanent characteristic of the group, and the question arises of how a condition apparently desired by the individuals in the group failed to be realised. The next section suggests that multiple social group memberships and conflicting interests arising through these, was a contributing factor.

Structure and the PRG

Anyone who has spent time in academic research has probably become aware, usually at an early stage, of more widespread norms governing academia – forms of institutional and cultural norms informing our experience of university life, and influencing activities within academia – including for example rules and regulations of course, but also less formal norms such as the relationship between supervisor and student, appropriate ways of acquiring research resources, and so on. Several of the concerns and conflicts that surfaced during the meeting presented here do indeed make out familiar tropes within the literature that has paid an interest in the institutional and cultural workings of academic institutions (see for example (Slaughter & Leslie 1997, and Austin 2002).

Literature on the entrepreneurial university reminds us, for instance, that the university is an institution acting within a political context under which academia is seen as one of three (macro) actors in the Triple Helix (Etzkowitz & Leydesdorff 1995). Supported by government (a second macro actor in this arrangement), the university acts as a key driver of R&D outputs and educated workers, both for the benefit of industry and for the continuation of the universities' mission. While this implies that the academic institution is fundamentally split between serving external interests (being of use, providing utility) and pursuing knowledge by means of critical-analytical inquiry (for its own sake, remaining open-ended), Slaughter and Leslie (1997) noted that the policies designed to drive the activities supposed to attain this double aim can be divided into two main types: those that are directed towards science and technology strategy; and those aimed at ensuring

the quality of the education and academic institution. The thesis now turns to examine some forms of institutional structuring to which individuals in the PRG are subjected, before looking at some further efforts by individual researchers to organise the research group, and the resistance they meet in attempting to do so.

Structuring the academic way

So what of the other side of higher education policy, described by Slaughter and Leslie (1997) as concerning education quality? Although Slaughter and Leslie were concerned with the quality of undergraduate and postgraduate education and the relationship between the assessment of these and resource allocation through university administration structures, it is measurements of quality as they pertain to doctoral students that are of interest here. The wider research community assesses doctoral students, engaged with the research activity, through such mechanisms as peer review publishing and the production of doctoral theses.

This leads to two observations. The first is that the assessment of departmental quality is not performed by specialists in the same discipline as the researchers in this research group, but rather by a wider academic community: professors in other (related, but perhaps not fully comprehending) disciplines, university administrators, and even current and prospective students. Further, such assessments can also be comparative in nature, that is, the research group is measured against other research groups, and individual applicants are measured against other applicants in considerations for research funding, a topic highlighted in the episode presented at the outset of this chapter, for example. This means that the assessment criteria must include a less specialist (research or subject-specific) measure of quality; a "good" university department is expected to produce publications such as peer review articles and completed student theses, for example.

The second observation is that some of these same indicators of a "good" research department are also applied in judgements of "good" academics when it comes to appointing individuals to faculty positions. Over the course of an academic career the individual researcher is continually assessed by their production of traditional science outputs; peer reviewed articles and, for doctoral research students in particular, the final thesis. So how does a researcher in this case study learn about these academic norms and become influenced by them? Austin described the students' entry to graduate school as a process during which graduate students are socialised "to the role of graduate student, to the academic life and the profession, and to a specific discipline or field" (2002, 4). The student makes sense of the world around them through a combination of enrolment to formalised procedures and, where these fail to provide guidance, observations of and interactions with established faculty (2002).

Doctoral students in this particular case study come from a wide range of disciplines, from natural sciences to professional Masters degrees, including some who have completed their Masters studies within the department or written a thesis in connection with its research. The first few months are often unclear, although occasionally a recently granted funding application may indicate an area in which the newcomer should be active. This means that the student may spend some time exploring the research around them in their search for a research focus. Doctoral students must take certain classes in order to fulfil the requirements for the degree, and although certain courses are compulsory for safety reasons, many practical, skills-based courses have also been taught on an informal basis as and when students decide that they need the knowledge.

> "It's been extremely free, that the people who take charge and are active, they can learn a lot and they can get a lot of, they can be educated in these things if they want to. But there's nothing structured, there's not a plan." (Researcher, 2014)

But despite several assertions from the researchers that the research group lacks structure, there are forces acting to structure the activities of the research group, some of which can be inferred from artefacts and some from observations of actors' interactions and their comments on them. For doctoral students for example the study plan and employment contract provide early clues as to the structure of both the role and academic life, both in terms of organisation and in terms of time. The student can see who their supervisor is, get an indication of the rough area in which they are to perform research, and can see from the document how many years they have to complete their doctoral studies. They also learn a little about the structure of their academic department since the chair of the department and the study director typically sign these documents. The study plan is often drafted after a discussion between the supervisors and the doctoral student, so the student may form some initial ideas about the structure of their position through hearing about demands from external funding organisations relating to their research, some discussion about how many articles their doctoral thesis should contain, or how many conferences they should attend, for example.

> "We have a formal application for their intake, all the PhD students, we know exactly which date they should do their licentiates and we know exactly which date they should do their PhD thesis." (Professor entrepreneur, 2011)

Structure can also be found in researchers' duties outside of research activities, some of which are also specified in these early documents. At Swedish universities doctoral students are often employed to teach undergraduate and Masters degree students, and it is in this aspect of the doctoral study period that some students could find structure. Doctoral students cannot be respon-

sible for courses they are engaged in teaching, so those in the PRG they often took the position of teaching assistant. This means that they worked with a senior colleague, often an associate professor or higher, to deliver the course. While doing so they were able to observe senior colleagues' behaviours and approach to responsibilities, perhaps even finding a role model, as Austin (2002) suggested, although there was no clear indication of that happening in this case study, adding another layer of structure to that offered by the discussions with the supervisor.

All of these structuring effects have been quite passive compared to the meeting described at the beginning of the chapter, in that any structure arising through these arrangements is often an artefact of a sometimes much earlier decision, probably made by actors now only distantly connected to the research group or long-forgotten. However, the meeting gave an account of deliberate acts – social acts – by the professor (in announcing his withdrawal) and by the researchers (in their discussions regarding communication and structure). The next section considers efforts made by individual researchers to organise and structure the research group and the research activity.

Efforts to organise

As the meeting described earlier in this section suggested, many efforts to structure the research activity came as a reaction to new knowledge such as the withdrawal of the professor from the research group. They could also arise as a response to an experience of frustration; one difficulty the research participants often described was the lack of knowledge transfer within the research group.

> "That's why we can do the same mistake over and over again. New ideas frequently come up with 3 years in between because people forget or don't read past work." (Professor entrepreneur, 2012)

Park and Burgess considered dis-organisation of the collective as a form of internal threat to a social group, and argued that a struggle against such a threat was a form of collective action. Further, this collective action was a defining feature of a social group on two counts; firstly it signified that the group was capable of concerted action (Park 1927), and secondly any organisation arising as a result of it could include the creation of markers of an organised collective such as specialised activities for individuals within the group. This section continues by exploring some of the attempts made to provide structure for the research group.

Tools

Some efforts to organise the research activities and counter inefficiencies came in the form of trying to establish the use of tools. An online database of documents pertaining to the research, intended to include technical drawings, descriptions of work performed, etc. seemed to undergo a somewhat regular revival attempt every few years, usually at the instigation of a researcher who had struggled to find the information they needed about past activities, components used, or experiment outcomes, from other actors in the research group. However this database, the LOG, failed quietly as an organisation tool after every effort to get the researchers to use it.

> "I heard about the LOG. It hasn't worked since I started, I think now they'll try again. It's a good idea, especially for small practical things, like what shackle is actually connected down there, but we don't have, I don't think we have structure in the group to make such a system work. It's a bit unstructured one could say. The structure is what you see in those mails, when someone says: "let's have a meeting" that's the structure we have. And whoever comes to the meeting and wants to help out can do that, otherwise it's up to each and every one to gather information." (Doctoral student, 2014)

One issue with documentation identified by the researchers was that while there were lots of ideas about what should happen, the constant movement of doctoral students into and out of the research group, the individuals often assigned to these kind of administrative tasks, meant that the documentation system changed as each person performed them in their own way, and there was never an individual who could take responsibility over a long period to stabilise the routines surrounding the documentation.

> "In the best case there should be documentation, each (*device*) should have a binder, there's a file system on the computer but it's not always complete and you can't always trust what's in them, someone did it in the beginning and then it changed and changed again so no one ever took responsibility for keeping documentation and gathering information." (Doctoral student, 2014)

For example, after the two day meeting one of the doctoral students was assigned the task of recording the activities pertaining to the construction and installation of the devices, such as what each was named, when it was installed, when it was removed, and so on. At some point during his time as the responsible individual the document changed from Swedish to English, presumably so that the increasingly international research group could read the document. However, once he departed the document was updated less regularly and, if they had referred to it in the past, the researchers stopped using it as it became out-dated.

Publishing

Another outcome of the meeting described in this chapter was a proposal to try to establish some ground rules for publishing: since the device around which the research centred used research findings from a large number of researchers without some of the individuals actually being involved in the experiments to which an article might refer, should every researcher be an author? Should only those researchers with experimental findings be named authors? How many authors should be on an article? How then should those constructing the research device but not engaging in a particular experiment be given credit for their work? Further complicating matters, should those approaching the time when publications mattered more, such as when compiling a doctoral thesis, be given the position of first author? How should such a prioritisation be made? These questions and others surrounding the issue of authorship were taken up in a series of dedicated meetings, but these meetings quickly became criticised by some researchers for not being concerned with the research.

> "I think that's P1, not to conclude who should be author for an experiment that hasn't even (…). People are discussing who is going to be authors for the (*device*) that's not even complete yet. I think it's a little bit wrong attitude to the, but that's just me." (Doctoral student, 2012)

However, as with many of the organising attempts the researchers noted that authorship meetings in particular seemed to suffer in terms of how often they happened, and how much energy the participants were willing to give to them.

> "I see the same things happening now as they did in the winter of 2009/10, … (*I*) started calling for meetings to discuss co-authorship. I didn't have the stamina to continue with that because I was getting closer to submitting the manuscript for my thesis but we also back then discussed, say, we should tell everyone that we're starting to think of a paper or starting to write a paper, we should be better at that, and then it died and then the same thing is happening again, (a doctoral student) has just called for a meeting on Tuesday where he will present thoughts on a paper, but I think, we have had, we haven't had a structured way of dealing with co-authorship and that caused some problems." (Researcher, 2011)

One reason for the perceived failure of the meetings as a tool could be that researchers saw them as more of a performance and lacking whatever was needed to get actors to do what they had agreed to do during meetings.

> "You've been to the meetings and everyone picks up their happy face and "sure I can do that" and then just nothing happens, and there are no counter effects, or nothing, there are no carrots and there are no whips." (Doctoral student, 2014)

Here it becomes clear that while there were expressions made by individuals about their desire to organise the collective, there was something else at play. Rather than act as we might expect given the formal and collectively agreed upon structures, individuals expressed notions of organisation to the others in the group through their interactions (Park & Burgess 1921) and to myself in interviews, but seemed to return to other activities when distanced from those interactions.

Resisting these efforts

We can see from this brief exploration that there were a number of structuring forces already present in the research activity, such as the formal admission documents and organisation of duties such as teaching. In addition, several actors had at different points taken it upon themselves to organise the research group, either through dedicated meetings to discuss the research activity and group's future as in the empirical example, or through the attempt to instigate the use of tools such as the online document repository.

However despite these, there was no indication throughout all of the observations made and interviews conducted with the researchers that they believed that the research group was organised effectively. Rather, they variably expressed their desire to see their ideal of the research group realised, frustration when this did not appear to happen, and resigned acceptance when they seemed to "give in" and turn their focus towards their individual task and how they might accomplish this given the research group as they experienced it. So the question naturally arises, how can these individually and collectively expressed desires to see a more structured, organised research group result in the opposite experience for the individual researchers? And secondly, how might this perceived failure to organise impact the research activity? To try to answer these questions the next section considers the different forces already outlined as sources of potential conflict, and identifies some forces arising as a result of these conflicts.

Science and technology policies act on academia by providing opportunities for research funding, a resource Slaughter and Leslie argued as coming increasingly from external funders (1997). University departments seek finance through various research funding organisations, and this research group is no exception.

> "I speak a lot of that, but I don't think the general group sees a big value because we don't succeed in doing stuff, but I think its what gets this (…) group money, we get money because we throw a lot of money (*at this technology*), that's what we're known for." (Doctoral student, 2014)

Some of the researchers in the case study perceived that the research funding acquired by their department was primarily secured based on promises of

construction of the technology and it's various iterations, and not more traditional research activities such as investigation.

> "Sometimes I'm feeling (…) that we are, for example now we have had 8 (*devices*) in the (test site) and we have only tested 3 or 4 of them or something, of the other ones, but we are still trying to produce new without testing them, without like writing this report without writing published data, (…) and then I am feeling like ok, we are only building things without doing the research about it, the most important is actually the publications and things like that, and then I feel that something is wrong and then they say ok, but we have the financiers that we need to put it in the (*test site*) and we have, but what does it matter if we just put it there and then it doesn't work and then we build another based on that one." (Researcher, 2011)

It is clear then that while the research group was influenced by research funding providers to construct research objects, there was also a reaction to that within the research group. This reaction appears to contain some negative element; the researcher understood that there was pressure on the group to construct but they also felt that research outputs were not being produced, and that this might be a sign that the research activity itself, which for this researcher was a central part of being in a research group, was not taking place.

Conflicts between interests

An indication of a potential conflict arises when we place Slaughter and Leslie's (1997) assertion that researchers direct their efforts towards activities that offer them a benefit against Park and Burgess's (1921) suggestion that a social group is a collective that exists for the benefit of the individual members. At first glance these seem easy to reconcile; that the researchers derive some individual benefit from their membership of the collective and the collective efforts made by them and the other members of the group.

However, it could also be argued that the decision as to what is beneficial to the individual could either be one in which an individual decides how to react to the social context acting upon them (Slaughter & Leslie 1997), or one in which the individual interests are mediated by those of the others in the collective, and therefore arrived at through the interaction of the individual with the collective (Park & Burgess 1921).

We can assume that there are activities that researchers perceive as more or less beneficial, either for the group (such as administration tasks that may help in structuring the group) or the individual researcher. In the context of career progression of the individual, some activities could at the extreme be perceived as risky – undertaking them may lead, through using resources which could have been allocated to activities deemed to be more beneficial for example, to the individual placing their career progression at risk. How

do researchers decide which activities are potentially rewarding and which are potentially risky for their individual interests?

Austin (2002) explained that aspiring faculty are strongly affected by their observations of academic reward structures. In these she included tenure processes and decisions – what efforts are rewarded when it comes to making promotion decisions, and who makes those decisions? Two factors are noted to be particularly important during these moments in the academic career: publishing (Clark 1989) and teaching (Harman 1989). Both of these activities are strongly encouraged through formal documents; the doctoral student is often contracted to teaching activities for 20% of their work, and the thesis in many science departments, at least here at Uppsala University, is often a collection of published articles bound with a text designed to draw them together around a central research problem.

However, the ways in which these two are factored into the reward structure are quite different. Completion of the doctoral degree is established through the assessment of the collection of published articles, and applications to senior research positions are also judged partly on the volume, and occasionally the impact factor, of publications. Every year all researchers are required to report their publishing activities to the university central administration, and these figures are used to determine part of the financing each department receives. Research on the trade-offs between teaching (including preparatory time) and research activities suggests that the two are often in conflict (Fox 1992), which becomes relevant when we consider that teaching is often less easily accounted for in academic reward structures. Whilst teaching activities are often written into employment contracts at the university, from doctoral student level and upwards, there is often little formal assessment of this; rather, the value of teaching enters when the researcher undergoes assessment for a teaching position. However, according to one member of a university recruitment committee, it is primarily the quality, and not the quantity, of the teaching that is valued. This means that while teaching activities may contribute to a positive assessment of candidate quality, a particularly skilled individual may manage to gain the required experience with less than 20% teaching duties, and a less skilled researcher may need much more time in the classroom to achieve a positive assessment.

But as Harman (1989) noted, tension was apparent during appointment procedures where practical, "hands on" work was weighed against more traditional academic experience. If researchers are assessed according to their academic experience with regard to more "traditional" academic activities in appointment procedures, and practical work must compete against activities which can lead to teaching quality and published research outputs, why do some researchers engage in these more practical tasks?

Efforts to organise construction

Constructing the technological devices around which the research group conducts research has been a contentious issue for many years, with researchers varyingly very motivated to design and build the units, extremely unwilling to invest their time and energy in construction activities, or somewhere in between.

There is clear indication that most researchers see the necessity of construction activities for example, yet only a few actively seek to engage in it. The few who do perform construction activities often reported having to persuade other researchers to help. Faced with a heavy construction task, unwilling colleagues, and a mounting pressure to satisfy their own education, research, and teaching demands, some suggested that for young doctoral researchers, construction had become almost like a rite of passage, in which the student threw themselves with gusto into the creation process, and then gradually burnt out before settling into research life a little further from the imposing artefact of the research.

Empirical observations of meetings at the research group and interview data from researchers suggested that there might be two main avenues through which resistance to construction arose in the research group. The first concerns the beliefs arising in new researchers' when they observed other actors' resisting calls to assist in construction tasks, and the second can be connected to the USO and narratives of researchers' experiences in USO engineering.

New researchers didn't just learn to understand the structure of the research group through the supervisor and colleagues they taught with; their observations included witnessing and hearing other researchers' narratives of attempts to formalise activities such as departmental meetings and the reactions to these. The two-day meeting outlined in this chapter described how one outcome was a suggestion for more regular departmental meetings. For senior researchers these monthly meetings were one way to try to establish who to engage in essential "hands on" work (Harman, 1989), but attempts to recruit people to this kind of activity often fell flat.

> "I can't really demand (…) that they do stuff, I more have to appeal to our mutual desire to do research and divide the load between us (…). It's difficult (laughs)." (Researcher, 2014)

This lack of enthusiasm for practical work displayed during the meetings was a problem firstly because the researchers observe that nobody else, present at the meetings or signified perhaps through their absence, valued this kind of activity, and so the meetings themselves could have been creating and reinforcing the belief that practical work was not of value, either to the individual or to the group as a whole. The second issue was that on the very

rare occasion that an individual volunteered during a meeting they could be assigned a large workload.

> "She's one of these, when she was new she came very optimistic to the first (…) meeting and ended up in charge of a lot of stuff. So officially she was in charge of the whole (…) project and deployments, she's supposed to be in charge of deployments, that's her PhD field, how can we make deployments better, cheaper. She's done (…) engineering. So she was very optimistic and that's what happens when you come to a group." (Doctoral student, 2014)

This has been reported as being particularly common when new doctoral students enter the research group, possibly because they simply do not know what the work entails. When faced with a large practical workload, the formal teaching requirement, and the formal doctoral studies course and publication requirements, doctoral students quickly appeared to lose the energy required to balance all of these demands.

> "We'll see how many PhD students we can burn out before we stop. It's a big system for one person to make work, and no one has the background that they're supposed to." (Doctoral student, 2014)

Burnout might be an exaggeration, but talk in that direction could indicate a wider belief that engaging in construction activities was perceived as being a risk to the individual's ability to perform their formal responsibilities. Indeed, this is reflected in Slaughter and Leslie's (1997) finding that faculty less well placed to benefit from an opportunity were less likely to commit. While Slaughter and Leslie may have been describing the likelihood of faculty to engage in commercial activities, the reverse may also be true; that unless researchers see a potential to benefit from an effort, or if they see a potential risk, they are less likely to engage in these activities.

Construction and the USO

One other way for researchers to develop a set of negative attitudes surrounding construction activities might be through the concepts they referred to surrounding the relationship between the research group and the USO, already explored in an earlier chapter, and in particular the somewhat linear nature of the movement some actors reported to believe characterised the transfer of knowledge and individuals from the research group to the USO.

Unfortunately and for numerous reasons the engineers who made the transition from the university to the USO have been seen, or have reported, to find it difficult to remain in the USO. Often they moved onwards, taking a step away from the type of technology at the centre of this case study and into other fields within industry. If they wished to remain with this technology and if they could be accommodated, they have moved back to the university research group, but some seemed to believe that this movement could be

backwards and against a supposed linear progression. Further, those that made it back to the research group invariably settled quietly into their work or, with some rather more dramatic narratives emerging around them, seemed to find their return met by treatment that some university researchers and USO engineers perceived as difficult.

Could this perception, correct or otherwise, offer an explanation for the apparent unwillingness of the researchers to engage in construction at the university? If we turn to examine the empirical data presented in this section then it could be easy to understand. Construction at the university shares a number of key activities with engineering activities at the university; they both require specialist knowledge, physical labour, engaging with commercial suppliers, and relocating at various moments to the spinout factory. It has perhaps more in common with commercial engineering than with what some believed traditional research entailed through the way knowledge is constructed and communicated: patents versus journal articles, welding rather than simulating, and CAD drawings rather than conference presentations. In a way the construction activities at the university took place in a halfway space, and any who entered this construction space risked being tempted, persuaded, or pushed, to the USO. Consequently, it follows, they would be placed in such a position as to risk the punishment they associated with earlier actors' attempts, should they wish to resist this process.

There is of course no way of finding all the possible reasons for researchers to avoid the construction activity. Certainly the two suggestions made in this section are not the only likely ones; just as some individuals joined the research group because they were impressed by the professor entrepreneur, others were driven by a desire to work on what they believed could be a world-changing technology, others simply wanted to make the technology work. This means that we could quite simply say that, in addition to the two suggestions made in this section, some researchers had no desire to build anything, and so managed to avoid doing so.

Conclusion

Some individuals within the group had attempted to structure the research activity around interest areas or activities key to research such as construction, including the professor who had initiated the two-day meeting. Other efforts included attempts to establish the use of tools such as an online documentation system and regular departmental meetings to discuss issues such as authorship of articles resulting from group activities. These efforts could fit into Park and Burgess' (1921) conceptualisation of social groups through identifying them as concerted action of the group to organise its members as a collective and to establish and assign specialised roles. Structure is one way through which social groups, Park argued, can bring permanence to a

collective (1927, 735), but this chapter suggested that such a state was challenged by social forces already prevalent within the PRG and in other social groups to which PRG members also belonged.

This chapter suggested some possible sources of resistance to efforts to structure the PRG, beginning with the observation that newcomers were socialised to the research group, an idea already suggested in literature on higher education, through observing the other research group members such as supervisors, teaching colleagues, and so on (Henkel 2005, Mendoza 2007). In doing so they discovered that researchers appeared to publicly support efforts to structure the research group, through for example calling for or volunteering individuals to maintain group documents or engaging in discussions around co-authorship, during meetings, but found later that they didn't follow through on these tasks or were critical of such discussions.

When Slaughter and Leslie's (1997) concept of academic capitalism was placed beside Park and Burgess' (1921) ideas concerning individuals' relation to the social group of which they are members it became clear that researchers' individual interests conflicted with activities which benefited the research group as a collective. Some activities, such as construction, were necessary for the group but did not necessarily lead to research outputs that directly rewarded the individual in most cases, such as published articles, and this suggested that individual researchers might then have favoured non-construction activities.

Construction was framed as a major site for tension, and this section began to try to describe two main avenues through which resistance to activities such as structuring and construction – viewed as essential for the research group's continued survival but unrewarding (or risky) for the individuals tasked with performing them – arose. The first concerned beliefs researchers appeared to form after observing other researchers' engaging in these activities, with ideas appearing to emerge which suggested that researchers were burnt out after trying to get devices built or that construction was not valued beyond its ability to draw in financial support, i.e. it was not valued in terms of more traditional research outputs such as articles, by more senior colleagues. The second relates to ideas about the USOs relation to the research group and movement between them; combined with observing or hearing rumours of the individual researcher's risks of moving to the USO, including negative consequences if the USO placement is a failure, or of past researchers quitting the venture entirely, the individual researcher might perceive more risks than potential benefits of getting too close to the technology development activities.

However, there are still some individuals who are, at least at the beginning of their time with the research group and possibly before they begin to report the research activity in terms of the concepts outlined in this chapter, highly motivated to construct devices for research. In conclusion, the concepts the researchers appeared to relate to regarding the different activities,

that structuring efforts and construction were not in line with the individuals' more pressing interests such as career advancement, were one reason why the research group failed, despite repeated expressions of intent, to organise internally.

Finally the professor entrepreneur emerged as a clear influence on the research group – it was after all his announcement around which the structure meeting was called, for example. This has been implied through literature on USO creation (Vohora *et al.* 2004) and through an earlier chapter addressing technological development in the case. However, a Parkian analysis suggests that the professor entrepreneur was instrumental in much of the PRG's activities, including the meeting described in this chapter, and frames him as a social actor complete with his own bundle of interests. This in turn leads us to question what forces might be at play through his group membership, and what other forces might be revealed through his departure. The next chapter considers the professor entrepreneur and his influence on the research group and its activities.

8. Leadership and Absence

Presenting a case study such as this would be quite difficult without addressing a central character in literature on academic entrepreneurship and entrepreneurial academia – the academic entrepreneur, in this case referred to as the professor entrepreneur for reasons explained in chapter four. The inescapable observation of earlier sections is that many of the tensions arising throughout the development work were related in some way to the actions of, including the decisions taken by, the professor entrepreneur, which is perhaps not such a surprising finding given what we might expect such a position to entail. Many of the actors interviewed mentioned him in connection to their work, and indicated in various ways how they also perceived his influence in wider circles. He was seen to be active in promoting his work:

> "(*He*) is pretty vocal so I guess they, and to, as I understood it they've, they've had a lot of contacts with the ministry of enterprise by themselves." (State agency representative, 2014)

He attracted students and employees:

> "…and (*he*) was exceptional in several ways so I got interested in (*him*), working together with (*him*), so, but mainly it was my interest in working in this field." (USO engineer, 2014)

And those working with him felt his presence both in terms of what they did and how they felt after time spent with him:

> "(…), he's a kind of genius of course, but everything should be how he says. So he has a lot of energy, but he also takes a lot of energy from other people." (USO board member, 2014)

He was, in conjunction with the academic entrepreneur at the USO, responsible for removing the technology development activities from the USO to the university research group (PRG) as described in the previous chapters, making him a particular influence over both the research and the USO activities as he moved around the organization.

This is particularly interesting because a description of such a relationship with the PRG and the USO could offer a different perspective on the individual moving between the two groups, a topic presented earlier in the the-

sis. Firstly, this chapter deals with a figure that we might expect, based on the reviewed literature, to have a strong direct influence over the activities taking place, and secondly the earlier description of the doctoral student moving between the PRG and the USO did not really consider how those remaining in a group might relate to individuals after they had moved out of the research group.

This section sets out to explore the professor entrepreneur's relationship to the PRG through direct observations and the experiences reported by other individuals participating in the efforts to develop and commercialize the technology. It begins by presenting the individual as the heroic entrepreneur, placing him at the very forefront of the PRG and USO. Following this, the professor entrepreneur is described in more Parkian terms: as an individual acting as a member of one specific social group. Finally the chapter concludes with a description of the professor entrepreneur as a figure enacted through interactions between social group members, but with himself being absent from those interactions.

The Hero Entrepreneur

Many of the interviews conducted with the university researchers and USO engineers came around to the professor entrepreneur – many had become interested in the venture after they had met him, or felt that he had personally played a large role in their everyday lives.

One of the first notable qualities of the academic entrepreneur was his seemingly impossible ability to understand how the wider world (economically and technologically) could develop. From this, he has made predictions about a certain commodity market for example, and been proven correct years later. Many around him were, even if they originally expressed scepticism, convinced of his brilliance.

> "When (*he*) had his installation lecture (…) he mentioned this, that (…) will be a very tight sector because (…) is going to be very expensive, it could even go to (…) and then at this lecture there was a lot of other people there, there were other professors (…) and they were all saying "skräckpropaganda!" (laughs) (…) And after that (he) was proven right. So I think (*he*) could see ten years ahead." (Professor, 2015)

The image of a brilliant mind entered into comments from other individuals in the research group and USO regarding their reasons for joining the venture. USO engineers described him as "exceptional in many ways", "intense", "thorough", and so on. Much of the talk about the professor entrepreneur was reminiscent of a very masculine entrepreneurial discourse: alertness, a speculative ability to see into the future (Kirzner 1999), task-oriented

(Ogbor 2000), and so on. The academic entrepreneur described for example how he was persuaded to join the venture:

> "Well, when (*he*) called and said that we are now starting up a new company (…) can't you be in the board of directors? I said of course, and then I asked what will that company do and he said (…) and I said forget about me, I don't believe in, I will never sit down in such a company (laughs) and then he said that well, can't you come next week and we show what we have done, and after 20 minutes I was in the board of directors." (Academic entrepreneur, 2014)

As professor too he was not only spoken of in terms associated with power, but he also had formal powers granted to him through more traditional academic structures. Occupying the role as the head of the university research group he held a powerful position and of course was responsible for the activities and people in his research department. For example, athough he kept careful records of the applications made in stuffed binders behind his desk to comply with the law, it was often the senior researchers who sought and applied for funding opportunities. However, whoever wrote the application, the leadership role of the professor entrepreneur was usually acknowledged as a matter of routine.

> "It's always (*the professor entrepreneur*) who decides in the end where the money goes, and I think he's the top name of all applications. Then I know that a lot of (*others*) also involved in writing applications. But how they do, whose name is on and who gets the money I'm not sure but in the end its (t*he professor entrepreneur's*) decisions I guess." (PhD student, 2014)

Outside of formal documents and structures though, things became a little less clear. At the USO he seemed to jump between roles, sometimes maintaining a distance as the owner, and at other times trying to take direct control as head of engineering. Wherever he was sitting though, he directed many of the choices made with regard to the technology development, specifying very exactly for example the output required from the technology and the materials that should be used. Once he had given his directives though, he would often disappear.

> "And we had a meeting in the beginning kind of setting up the goals, like the framework, the parameters we should reach and then (*he*) was pretty much out of the picture for 6, 7 months, (…) we were doing lots of, a lot of work for the (…) order at this time." (Researcher, 2014)

Emailing the professor entrepreneur provided an insight into the frustration of being a researcher within the venture – receiving a reply other than the "out of office" automatic response often felt like a success even if the answer to a question was in the negative. Although he always had access to his mo-

bile and suggested that researchers could send text messages, and indeed some did so, it was suggested that this was a difficult communication method, and we can imagine that at the least it is a form of communication with a number of limitations.

His return to either the USO or the PRG often heralded some dramatic event. For the technology this often meant that some work was to be repeated, but it could also mean that the researchers or engineers would be forced to re-organise completely.

> "I was never fully in charge because once every two months, it was very seldom, (*he*) came to us, looked at what I'd done and said 'no, we can't do this'." (USO engineer, 2014)

In the early days of the venture the fledgling professor entrepreneur could almost be forgiven for keeping a close eye on technology development at the USO, particularly when it was left to inexperienced, although talented, engineers. However, in repeatedly rejecting the development work he caused some of the engineers to feel that they were constantly under his shadow or that he felt that they were unable to work autonomously. Later, the control became much more direct:

> "When he came in he didn't like the directions we had taken on some parts, he didn't like some of the priorities we had made, and it led to conflicts and (…) he took over the design." (Researcher, 2014)

The comments from the researchers, engineers, and colleagues, suggest a driven, possibly even aggressively so, individual whose actions and will dictated the activities of all others in the organizations he entered.

It would appear that some of the characteristics of the entrepreneur emerged in the professor entrepreneur's own talk too; on one occasion he noted to a class of students that over years of development at the university and the USO, there had been little in the way of observable change, and he concluded that this meant that his idea had been "good from the start". Other classic concepts of the entrepreneur also appeared, such as that of discovering new opportunities (Schumpeter 1947) in his description of his understanding of the market as: "a market that nobody thinks exists in the (…) community (…) it doesn't exist on the map if you ask (*competitor*)" (Interview, 2012).

Still further comments reinforced the genius narrative outlined earlier, this time from the professor entrepreneur himself, who seemed frustrated by the inability of other actors to share his assessment that certain activities were, in his view, obviously necessary.

> "And then I discovered that nobody calculated and I asked them why no-one calculated, they (were) just using the old design. So we have to recalculate

> and really make sure. And then we have had some troubles here as well because I couldn't foresee that it was so big difference. And it's a big difference." (Professor entrepreneur, 2012)

Just part of a social group

The professor entrepreneur often distinguished, as he did in the previous excerpt, between himself as an individual and himself as part of a collective organisation. In both positions though, he expressed his blindness, both as an individual entrepreneur and as a representative of a "we" collective: "you are trying to use your intelligence, we need to see but we can't" (2012). This is in stark contrast to suggestions made earlier in this chapter by actors working closely with him, who saw him as an individual with a remarkable ability to predict the future, and in contrast to the discourses suggested in literature on future-seeing abilities (Kirzner 1999).

The need to exert control suggested by other actors earlier in this section was repeated in the professor entrepreneur's own description of his move from the research group to the USO.

> "Since November or beginning of December I am head of construction, because we needed to change that because otherwise we couldn't get this new thing into (*the USO*)." (Professor entrepreneur, 2012)

However, his use of pronouns could suggest that whilst he had an interest in exerting influence on the development activities at the USO (Park & Burgess 1921, 453), he framed the activities taking place as a result of his decisions as group actions:

> "No, no, that's not the problem. We have had, changing from the (*first material*) to (*new material*) as we are doing, has been a problem, so we have to verify that very hard. So that's why I'm, we're not releasing the design." (Professor entrepreneur, 2012)

In contrast to the entrepreneurial narrative that literature on the topic, particularly within the area of academic entrepreneurship, might suggest, the professor entrepreneur appeared to describe his influence as being limited in two key ways. The first, hinted at by the swift adjustment in his sentence from the pronoun "I" to "we", could indicate that he was limited to directions or actions that the group, in this case the USO and possibly other project actors, deemed appropriate. Park and Burgess (1921) discussed leaders' behaviour in relation to other group members, and described how a social group would only follow an individual if their actions were in line with the collective interests or the character of the social group.

The second limitation suggested by the professor entrepreneur was the position in which he acted. Sitting as the owner of the CEO, distanced from the technology development activities, he was unable, in his version of events, to ensure implantation of a significant technology change. Once he moved to become the "head of construction" at the USO[3], a move he noted was motivated by the utility company's representative as necessary for the continuation of the project, the professor entrepreneur was able to push through the design changes he had developed at the university. This is interesting from two points. The first is that we can see how the authority granted to him by certain positions was understood by the external actor as important in terms of the feasibility of the commercial project, i.e. that the professor position was limited in terms of the influence he could wield over the USO compared to that of head of construction.

From this we could understand that the professor entrepreneur was understood to only be able to exert influence through direct means, through physically returning and sitting as a USO actor himself.

Secondly it could also be suggested that concerns directly related to product development and a significant USO demonstration project, i.e. commercial concerns, motivated his temporary movement away from the PRG. Chapter seven also highlighted another instance of one of the professor entrepreneur's movements that could be interpreted as an absence, motivated instead by forces closer to the academic realm. When he was elected to a higher formal position within the university this also made demands upon his time and previous commitments. Alongside the many descriptions of the professor entrepreneur and his actions as an actor in the venture, there were also discussions observed between other actors or moments revealed in interviews during which the professor entrepreneur was interpreted by other actors as being absent, or other actors' actions within the USO or research group were suggested to be the result of their interactions with him, often without any clear indication that this was actually the case. The next section considers a number of instances in which the professor entrepreneur, as a role rather than an individual perhaps, was understood to be absent.

Professor Entrepreneur and absence

The absent professor entrepreneur appeared to take several forms: the first as a shoulder-dwelling guide, helping the group and individuals through the whispered question "what would *I* do?" This might be a gentle prod for the new arrivals, helping them to adapt to a working group under the professor

[3] I have referred elsewhere to *construction* as *engineering design*, since the actors used the terms construction and production, which are easily confused for those not familiar with the organisation, to differentiate between design and production

entrepreneur's direction when he was not around to ask directly. The second might be a shadowy figure causing stressful feelings for the more experienced researcher or engineer as they considered an action they felt might contradict the directives given to them.

Explicitly referring to the professor entrepreneur during an interaction with other researchers or observers was a tool that appeared to be used by those in the venture, either to make sense of others' actions or to absolve the speaker of responsibility.

There were numerous occasions on which the USO engineers did not agree with the academic entrepreneur, the individual at the helm of the USO from the early days of the venture. Attempts to counter directives from him were often met with angry outbursts, and as a result engineers sometimes felt the need to justify communication difficulties as possibly being a consequence of trying to interact with an incompetent manager, the professor entrepreneur having a strong influence over the academic entrepreneur, or the academic entrepreneur hiding behind an image of the professor entrepreneur to assert his own position.

> "It was so obvious he had been talking to (*the professor entrepreneur*), (…) and he was listening blindly to (*him*), so (*the academic entrepreneur*) was involved in the technical discussions but that was only for show." (USO engineer, 2014)

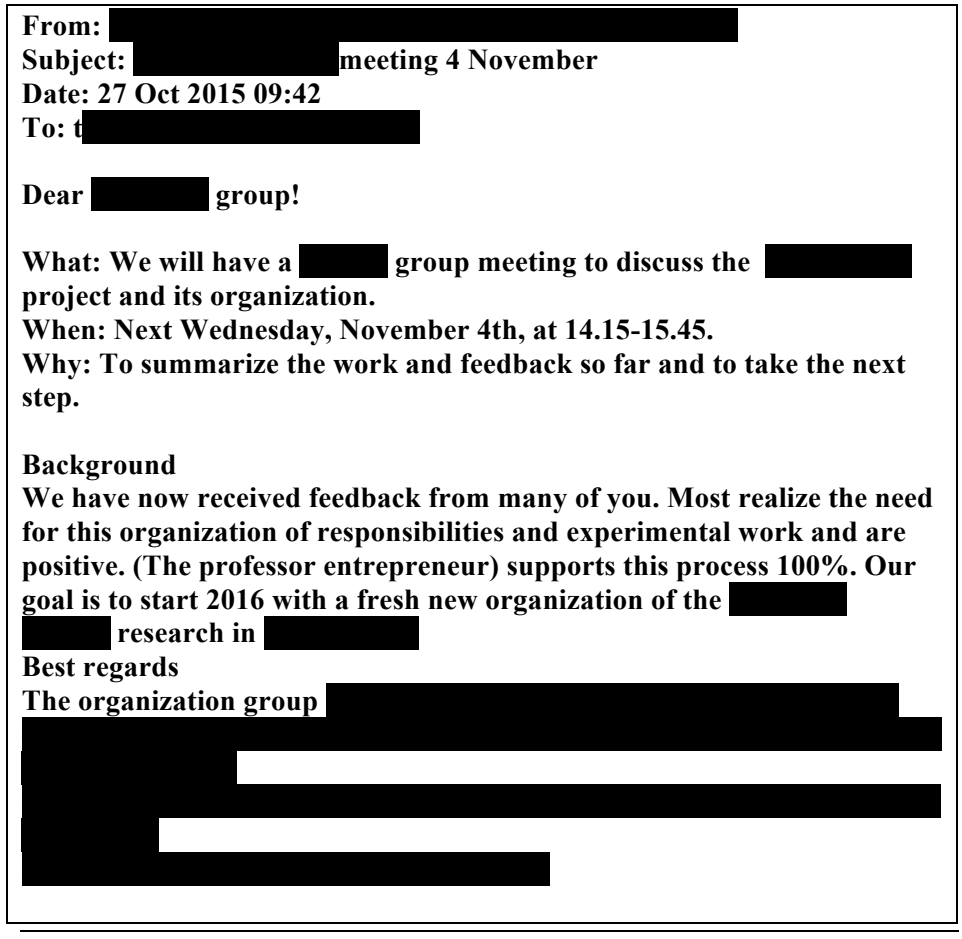
If an obstacle, in this case the academic entrepreneur, could be characterised in such a way then it would appear to change the dynamic of the academic entrepreneur-engineer relationship from the engineer's perspective; perhaps instead of simply being a discussion during which proposed solutions to technical issues were rejected before they even reached the professor entrepreneur, whom the USO engineers suggested was an excellent engineer himself, the discussion could be understood by the USO engineers as an incompetent manager failing to recognise the potential of their proposals because he was unable to understand the technicalities of the problem and the solution.

In this form the image of the professor entrepreneur is problematized, even partially blamed in the example, for problems that occurred within the development activity. In other moments though it could be used as a shield, deployed against uncomfortable questions posed by other actors, for example:

> I think a lot of people got pretty sad, or mad, (…) maybe disappointed is a better word, that why wasn't they included (…) why weren't those people chosen to build the (*device*) instead of me, stuff like that. (…) I actually think they should talk to (*the professor entrepreneur*) (…) because (*he*) is the person who gave me the order to keep quiet. (Doctoral student, 2012)

Along with the attempt to direct the interviewer to pose the question elsewhere, to the professor entrepreneur, the researcher in this case constructed a narrative in which she was a passive actor, only doing what the professor entrepreneur had instructed her to do; it absolved her of the deception she sensed that her fellow researchers thought she had performed. In this example the researcher turned to the professor entrepreneur to direct attention away from herself, perhaps to try to calm any actions from the other researchers regarding this.

In contrast, invoking the professor entrepreneur's name, even explicitly stating his support for a researcher's actions, could be seen as an example of its use as an attempt to drive activity.



From: [redacted]
Subject: [redacted] **meeting 4 November**
Date: 27 Oct 2015 09:42
To: t[redacted]

Dear [redacted] **group!**

What: We will have a [redacted] **group meeting to discuss the** [redacted] **project and its organization.**
When: Next Wednesday, November 4th, at 14.15-15.45.
Why: To summarize the work and feedback so far and to take the next step.

Background
We have now received feedback from many of you. Most realize the need for this organization of responsibilities and experimental work and are positive. (The professor entrepreneur) supports this process 100%. Our goal is to start 2016 with a fresh new organization of the [redacted] **research in** [redacted]
Best regards
The organization group [redacted]

Figure 3: " (The professor entrepreneur) supports this process 100%." (Email, associate professor, 2015)

In several instances, researchers at both junior and senior levels have referred directly to the professor in their efforts to engage others in activities

such as construction work or re-organisation of the research group, for example. Although there was usually no suggestion that the professor would be aware of researchers' engagement or otherwise, it could be argued that in calling upon his name, researchers were seeking to remind their audience of the absent authority figure. This reminder might serve to conjure up images of the professor giving the instruction himself, or remind the researchers that others have already invested a lot of energy into the research activities in the past. Of course, whether this actually led to an increased engagement from the researchers is difficult to determine.

Discussion

Bruni, Gherardi, and Poggio (2004) argued that research into entrepreneurial activity only served to reinforce masculine ideals of entrepreneurship, and attempts to rectify that by studying female or minority entrepreneurial acts reduced these to "other" or "extraordinary" cases, and so further reinforced entrepreneurship as a masculine activity. It could be suggested that the concept of the entrepreneur is so ingrained in our understanding of entrepreneurship that we are unable to imagine a situation where such an individual does not wield power, even to the detriment of the individuals, groups, or activities that we observe at a given moment. In this chapter actors' talk about the professor entrepreneur also referred to concepts often associated with the heroic entrepreneur through descriptions along the lines of him being exceptional and intense.

When a professor takes on the academic entrepreneurship role it is hardly surprising that (s)he affects other actors such as TTO representatives (Shane *et al.* 2014) or other actors in demonstrating commitment or credibility (Vohora *et al.* 2004) and so on. But in this case it would appear that the professor entrepreneur caused effects in the academic research group and the USO too – university researchers and USO engineers reacted to his presence by conducting new development work according to his new directives for example, and they reacted to his absence with expressed frustration. What is more interesting though is that some effects could be seen even when he was absent, and further still, even when he had no immediate ability to enact his authority in a given moment. What could be inferred from this?

Turning to Park and Burgess, this apparent disagreement regarding the influence the professor entrepreneur was able to wield became clearer. Considering the professor entrepreneur as a member of a social group, he was able to influence the symbols and speech that make up the interactions of the social group, and thus he was a part of the mediation of the multiple individual interests, including his own, that emerged and were adjusted in the social group setting (1921). As soon as he left a social group, whether moving his energies to the USO or to the research group, or even to another research

department or a slightly distanced role within the university, he was no longer a part of the interactions between group members.

As a formal authority though, less senior actors than him seemed to seek the professor entrepreneur's approval for their activities – though it is hardly surprising that a doctoral student might turn to formal requirements and relationships in trying to determine the best course of action at any given moment. They then turned to their own understanding of the professor entrepreneur in their interactions within the social group, and gradually this influenced the interests of the collective. Upon returning, the professor entrepreneur might have witnessed changes he was previously not aware of, a complaint he made quite often, and he appeared to try to force his own will upon the activities of the group, whether the USO or the research group. In each case the interests of the collective had possibly, mediated through interactions of cautious researchers and engineers, drifted somewhat. This meant that the professor entrepreneur's attempts to control the collective were perhaps interpreted by group members as being farther from the collective interests than they were willing to follow, as Park and Burgess might suggest (1921).

It is perhaps also interesting to view this as a remedy to the hero narrative of the entrepreneurial scientist (Bruni *et al.* 2004, Lam 2011) who leads the venture through the USO development process (Vohora *et al.* 2004). Rather than describing a single actor steadily moving the venture from the laboratory to the balance sheet, this case showed that the individual, despite being the figurehead of both USO and the research group, encountered resistance to his leadership in the form of collective interaction-derived concepts of himself. It discredits to some extent the idea that there is a single figure or team of leaders (Shane 2004) and points to a need to develop an understanding of how a group can agree upon and act upon collective interests in performing the USO development process (Vohora *et al.* 2004).

Conclusion

This section used USO engineers', management's, and university researchers' reports of their experiences and observations of communication between them to explore how the professor entrepreneur was influential in the university research and technology development activities, both through his direct interaction with these actors and during times he was absent.

The narratives offered by the actors, including the professor entrepreneur himself, suggested that while there were a number of points upon which they could agree (narratives of the genius of the professor entrepreneur and discovering new worlds were reflected here), there was a conflict in their reported perceptions of his ability to enact his will upon the venture. Although the researchers and USO engineers described his control of their activities as

one might have expected from narratives offered in literature on entrepreneurs, the professor entrepreneur described having limited control and being blinded to the activities happening in his own organisation.

Since the professor entrepreneur was not an active subject for many of the interactions described here, being for example absent (either as a guest professor elsewhere or simply busy with other responsibilities) or represented by other actors, it follows that other actors, in this case researchers and USO engineers, were doing much of the research and development activities that, we can recall, are key to a fledgling company's success (Brown & Eisenhardt, 1995, Jensen & Thursby, 2001). Further, they were also re-presenting the academic entrepreneur throughout their communications with each other, or through their acceptance of directives or norms. One way many of the actors described their activities, whether at the university or the USO, included the perception that the academic entrepreneur was absent.

With the professor entrepreneur perhaps embodying the collective purpose (Park & Burgess 1921), it would not be hard to imagine that those reliant on the professor entrepreneur, such as researchers dependent on someone in the professor entrepreneur role to give guidance, to search for a means through which to reproduce his direction. Failing to find such a guide in the environment immediately surrounding them, or being unwilling to accept a substitute guide, such as when a senior researcher tried to galvanise others into action for the group, they may turn instead to their individual representations of the professor entrepreneur to replace him until he returned.

This chapter has presented the professor entrepreneur in three different ways to try to conceptualise the way in which research group actors try to work with the absence following his movement out of the social group. In the first description, he is understood to embody the classical, perhaps outdated, heroic entrepreneur, but through the second description we see how he is also a member of a social group, embedded in interaction rather than standing alone. When he is not present in those interactions though we can see how the actors remaining in the social group turn to the concepts they used to understand his part in the group to try to continue, or stimulate, the interests of other individuals in the group. Since this is an action based in interaction between group members, Park and Burgess' concepts help us to understand how the interests expressed within a social group gradually shift through moderating effects of the various individuals, until finally the returning professor entrepreneur finds himself distanced from the social group to the extent that he struggles to fit into his old role.

So far the research group's actions concerning the movement of individuals has only considered those moving into and out of the group, one doctoral student, and the professor entrepreneur. The next chapter turns to individuals in a very different organisation, a state agency to which the research group has applied for funding, to consider how individuals who remain outside of the research group can influence the group.

9. Commercial logic and academic research

This chapter explores how some of the concepts used by external actors to relate to the research activity and its connection to the USO may complicate attempts to secure essential resources for the research activities. Park's notion of migrant individuals and their impact on communities they encounter (1928) loosely informs this section, but the empirical case allows for an extension of the theory by suggesting that an individual is not required to move from one community to cause concern in another, and by describing how such social interaction and influence might work. Further, the chapter highlights a risk not previously identified in literature on academic entrepreneurship or USOs in the entrepreneurial university, that of the dangers to which a research group may be exposed through their connection, or external actors' beliefs about such a connection, to a USO.

The professor entrepreneur had called a meeting to discuss some of the responses that one research funding organisation had made to recent research funding applications from the research group. It was prompted by an email conversation in which researchers had expressed confusion at a research funding organisation's curiosity regarding figures the researchers understood as being related to commercial concerns and the USO, and a first-hand account of this meeting is presented at the outset of this chapter. A later discussion with the professor entrepreneur suggested that this was not the first time such questions had been posed, but it is presented here because it was the only meeting on the topic that I had been able to observe. This episode problematizes some confusing beliefs that had arisen through one research funding organisation's understanding of the relationship between the research group and the USO, and the solutions researchers proposed to handle them.

Further, the empirical data revealed a number of assumptions made by this external actor about the research and development process which, despite said to be undertaken as two separate activities (academic research at the university and commercial development at a USO) as one might understand from literature on commercial development of academic research results, seemed to be understood by the research funding organisation as being more akin to popular descriptions of R&D as an *industrial* practice. Introducing popular concepts of product development and commercial interests as they related to the research group at this point helped to reveal the development logic underpinning some beliefs of both external and internal actors which suggested that some activities which might normally be associated

with development work were essential to research activities (see for example Fowler, Lindahl & Sköld 2015). Returning to the literature presented in the review chapter, this section helps to develop some of Slaughter and Leslie's (1997) discussion on the impact of more typically commercial concepts on academic research, suggesting that where Slaughter and Leslie stop at the beliefs of university actors and their capitalist approach to securing academic research resources, in fact such concepts possibly extend beyond the university actors and into the organisations on which some research depends for survival. The chapter begins, as with earlier empirically based chapters, with the empirical episode, and continues with a discussion of the forces revealed.

A crisis meeting

In the middle of March in 2015 an associate professor was managing the installation of the latest university device at the research test site. Before his departure he had applied to a research funding organisation for the funding of an upcoming university research project, and had soon afterwards received an email from the man (known as "A" in this episode) handling the case at the organisation. The email contained a request for further information and included a list of questions he wanted answering, nothing unusual when a funding application is concerned, but the researcher was surprised to see what the research funding organisation was asking about. Specifically, they wanted to see figures such as capital expenditure and expected cost reductions when compared to earlier test pieces, particularly in relation to future commercial devices. He was so surprised that he immediately emailed the entire university research group the question: "Has anybody else got these absurd questions?"

The head of the research group replied that he had not, but other seniors involved confirmed that yes, they had been asked either those exact questions or some that were very similar. Shortly, the opinion was offered that these enquiries were not at all appropriate for university research, and the chatter quietened.

A couple of days later a meeting was called for all those who had or were currently dealing with such requests from the research funding organisation, and I asked to observe. The meeting was low-key and the initiator of these discussions, still out deploying devices, was absent, leaving just six individuals. The professor entrepreneur (sitting both as head of the PRG at the university and as founder of the USO), one other professor, two post-doctoral researchers, a PhD student, and the Design Manager at the USO, who had previously been a PhD student at the USO, sat in the research head's office and mulled over the request.

So where did these questions come from? The professor entrepreneur claimed that the tables included in the email as a form to complete were

from a PhD thesis written in Denmark that concerned a similar technology research topic. He pointed to the recent state of Danish innovation policy under which inventors are required to fill out a similar form outlining the financial aspects of the future development outputs as part of an organised, and measured, attempt to innovate within designated areas.

> "They have much more of an innovation projects, like they say: - ok we would like to build a (…), how could it look like - and then they invite everybody to do that, and you have to fill out the forms here, and they will see: - ok, here you have the most material for the most (…), something like that." (Professor entrepreneur, 2015)

He continued, suggesting that some individuals involved in Programrådet (a board of representatives often involved in guiding education policy on the program level) advising on the applications received by the research funding organisation had been in contact with those in Denmark. One of the post-docs added that she had heard of these referred to as "Standardised Innovation Methods" and quiet laughter bubbled at the table.

The suggestion was made that they should speak to the man handling the application at the research funding organisation, but this was quickly dismissed by others: "He'll reply that it's Programrådet that wants it, that's what he said when I asked him" (Post-doctoral researcher, 2015). He (A) is apparently young, having recently graduated from university and relatively new to the role of application handler at the research funding organisation. The professor entrepreneur offered up that he had spoken to another contact within the organisation (hereafter known as "B"), and revealed that the information being requested had been disclosed to the innovation department at the organisation by the USO, but that it was classified. The professor entrepreneur suggested that they reply to the request by informing the application handler that the research funding organisation already had the information, albeit in a neighbouring department, and that it could be accessed once his division, the research funding department, had signed their own secrecy agreement with the USO, but he suspected that the Programrådet would not be satisfied with that response. Further complicating the matter, one of the members of the Programrådet was employed by a large utility company, a company who had had their own relationship with the USO as one of their customers; if the figures were released to the research funding organisation, there was a chance that future relations with this utility might be negatively affected.

How could the response from the research group offer a satisfactory answer to the questions in order to progress the application for research funding without breaking the secrecy agreement with the USO or risking the relationship with the company's potential future client? Perhaps they could offer up figures from a case outside of Sweden instead, the professor entrepreneur suggested. In that instance they could provide material quantities

and outputs, but would be limited to offering the retail price and not the production cost of the devices.

At this point I wanted clarification; were they discussing the price of a commercial project from the USO as supporting evidence for university research?

> "This is what is weird, we are the university and we are planning to do research not commercialisation, and we are writing that we are doing research." (Post-doctoral researcher, 2015)

> "We have PhD students, we have to investigate." (Professor entrepreneur, 2015)

The head of design at the USO then contributed to the discussion, saying that she had written applications from the USO and yet had not had these questions. If anybody wanted information on the spinout, she asserted, they should ask her. At this point one of the post-doctoral researchers interjected, pointing out that while the other researchers had received requests for figures concerning the future commercial application of the technology currently at the university, the request put to her by the same research funding organisation specifically requested figures from the USO. For her, this confirmed her belief that the relationship between the research department and the spinout was strong, but the professor entrepreneur interjected in protest.

> *Professor entrepreneur*: It's not at all strong, it's really on the contrary, it's very weak. To some extent there are strong links but in many ways there are very weak connections.
>
> *Post-doctoral researcher*: Yes but it's the spinoff company, and there's a lot of people who work in both and we have a constant discussion…
>
> *Professor entrepreneur*: I sit on the inside now (…) I know that there are a lot of things that the university has this opinion and (the USO) has the other opinion, more than you expect.
>
> *Post-doctoral researcher*: But that doesn't mean there isn't a strong connection.
>
> *Professor entrepreneur*: No, it could be, but it could be much stronger. We don't anticipate that everybody understands the spinout concept in the university, (…) not the researchers in this division.
>
> *Post-doctoral researcher*: We don't work at the university as consultants for the spinout.
>
> *Professor entrepreneur*: But they think that.
>
> (Meeting, 2015)

Others at the meeting suggested that the research funding organisation may think that the relationship was stronger than in reality, and in doing so may assume that the research at the university is intended for use by the spinout. However, the post-doctoral researcher insisted that the research performed at the university department was of interest to others outside of the company

too. For the professor entrepreneur though, dedicated university research was not unheard of. He described how he had been involved in the approval process of a case in which the intended results from a research centre, costing around 8 million GBP and spread across a number of highly rated universities in the UK, were exclusively for one company. The researchers reacted with surprise, comparing that to their own experiences in which they felt under pressure, particularly in funding applications, to show that their research was of a wider research interest.

The conversation turned to how to provide figures that would satisfy the request, since, as one postdoctoral researcher suggested, they should indicate that they were aware of similar technologies on the commercial market. One solution proposed would be to remind the research funding organisation that they were a university research department, but provide figures that the USO could offer without breaking the secrecy agreement – figures from another case perhaps. But then the university research was far behind the USO in terms of the output based on the investment, and the researchers worried that the research funding organisation would use the figures to say that the university research department was not efficient enough to be granted the financial support since the company was able to produce the device so much more cheaply.

Worse, said the group, was the idea that all of the university research groups might be facing the same questions and, without any commercial development of their own concepts, they might be forced to provide estimates of such figures that could be wildly inaccurate. If the research funding organisation was to compare this research group's figures (a research group aware of just how expensive it can be to perform this type of research) with those who underestimated their costs through inexperience, then there was a chance they may lose out in this round of funding applications. Could they report percentage figures instead? In such a case they could indicate that they would use 27% of the money on steel, 3% on concrete, and so on, which would also provide an opportunity to identify material and cost reductions from previous builds. In the real case they had managed to reduce the thickness of a major component to approximately half of its earlier value, which could look impressive. They could also offer up their calculated output of the device, which had improved by 35%.

But would the research funding organisation be satisfied with such a response? The group outlined several problems with this proposed solution. Firstly the accuracy of any description would be limited: one of the postdoctoral researchers pointed out that they wanted applicants to discuss future cost reduction activity too, and raw material prices are variable and hard to predict. Further what should they report as output figures? The output could also vary to a large degree depending on the natural environment, which varies drastically depending on where in the world the technology is used and the weather conditions that change year on year. Secondly, which design

should they take as the starting point? Depending on which device was described as the "old design" upon which the improvement figures were based, savings could vary quite considerably.

One of the key issues appeared to be that the figures the research funding organisation wanted were held in a secrecy agreement with another department within the very same funding organisation. I asked what the problem was; considering that the professor entrepreneur was on speaking terms with a senior member of staff (B) at the research funding organisation, surely a phone call could clear this up.

> "(*B)* is situated on the commercial side (…), having the responsibility for a lot of projects which have a commercially viable state, (*A*) is on the research side, they have nothing to do with each other, don't even speak with each other, they have no idea – (*A)* may have an idea who (*B)* is but they don't, totally separate." (Professor entrepreneur, 2015)

A post-doctoral researcher wondered if they could use the relative seniority of individual B at the research funding organisation to pressure individual A; would it be possible to rely on A's inexperience in the role to deny him the requested figures on the basis that they were held in a secrecy agreement with B's department?

Two of the post-doctoral researchers had contacted the application handler at the research funding organisation for further clarification, and following the replies they received had become frustrated at the response. As well as diverting responsibility for the odd request for figures to Programrådet, the research funding organisation had suggested that they tried to reduce the application in the hope of improving it by cutting away sections of the text: specifically those pertaining to the building of new devices. This, they reasoned, would allow the university to focus on the research but as one researcher wondered, what were they supposed to do research on if they didn't have the funding to build the devices?

Frustration turned to laughter as the researchers compared the different terms used in the requests for information, revealing that the research funding organisation had used a number of technical terms interchangeably despite them meaning completely different things. The group laughed again, perhaps at themselves this time, as they approached the last question, what are the operation costs, turning to the head of design at the USO to answer the query, as they didn't know the answer despite years of operating their research devices.

Convinced that the application handler was not very experienced in this area of research, the group wondered if he had sought advice elsewhere. Some time later in the meeting, after discussing the possibility of using cost information from a much earlier device, the thoughts of the professor entrepreneur turned to two of his former PhD students who were involved in con-

structing it, and who later moved to the USO. He revealed that although neither is engaged in the research or the company any longer, both sit on Programrådet advising the research funding organisation on these applications. "Whatever we tell them, we give them a hint about where (the USO) is today" (Professor entrepreneur, 2015).

Clearly there was a lot of confusion surrounding these research applications both at the research funding organisation and at the university and, as the discussions around the immediate problem of the figures request continued, talk turned to trying to make sense of the issues. The professor entrepreneur began by outlining his struggles with building a system that straddled university disciplines and extended into industry:

> "Different parts in physics have their own opinion of what's hot, and to combine several like hydrodynamics, mechanics, electromagnetics, they will always have their own idea of what's the most important, and then connecting in environment and economy, it's just a mess." (Professor entrepreneur, 2015)

When the professor entrepreneur left the room briefly to take a phone call, the head of design at the USO turned to me and asked if the odd request from the research funding organisation was likely to be an attempt from them to try to find out whether the professor entrepreneur prioritised the university research or the USO development. Sitting as both founder of the USO and chair of the university research department from which it spun out, the professor entrepreneur held a position many could find ambiguous, but the line between industry and academia is not always easy to distinguish. As in the case presented here, even research funding decisions could affect university research with regard to any associated innovation even if the application is only in regard to academic research.

> "If it's an innovation call then you can fill in things that you think can be commercial, make judgements about 'this is better than that', and you have your commercial contracts, and then you can motivate research – in some sense we are motivating research here based upon the success of (the USO), it's not the other way around. In order to be more successful we would like to have (*specialist*) research done at the university (…). There are also people who say 'now we have done too much research, we stop because it's commercialised', and that's also crazy because we continue to have research, on airliners, vessels, cars, it's just continuous because it's improving, you know." (Professor entrepreneur, 2015)

With this in mind, the group wondered if the research funding organisation had some confusion as to what university research was, particularly since a viewpoint that university research and innovation research were one and the same activity could lead to requests for commercial figures on university research. The meeting ended with an agreement by those present that those

affected by the questions posed by the research funding organisation representative should contact him to ask for further clarification on the issue.

Concepts from outside of academia

The funding organisation, having received a number of applications from the university research group to its research funding division, had responded to the research proposal with questions concerning the technology to be constructed. These questions though were focused on aspects of the construction that were related to the supposed development of the financial aspects of the technology.

The researchers in this meeting asserted that commercial questions were inappropriate because this was not an innovation project, but what is an innovation project and what is university research in this context? The researchers here claimed that they felt under pressure in for example their funding applications to demonstrate that the research they performed was not dedicated to the spinout, but of interest to a wider audience. Should this research then stop when commercialisation occurs? The professor entrepreneur appeared to think that the opinion of some outside of the university was yes, research should stop, but that this was a very linear way of thinking and did not account for continued research into long-established innovations such as aircraft or cars, an idea reflected in Vohora *et al.*'s (2004) model, where the research component remains in the final phase, sustainable returns. Here too, the lack of clarity surrounding the relation of that research activity outlined in the literature review was reflected in the different views of the researchers.

Some key concepts that seem to explain how the research funding organisation understood the research group's activities can be seen in the claim of the use of "Standardised Innovation Methods", the worries expressed that the research funding organisation did not understand the research nor the resources required to perform it, and the concern that the relationship between the research group and the spinout was seen as very close by an external authority, leading to the possible consequence that the university research could be judged according to economic standards set by a commercial organisation. It did not seem to be of consequence whether the activities were taking place at the university laboratory or within the factory, just that something was either being "built" or being "researched" (and here the use of quotation marks is to highlight the possibility that these are terms constructed to describe the activities the organisation believed should be taking place).

This is problematic firstly because, as identified by the researchers, the questions were phrased in such a way as to suggest that the answers would be used to compare the university research object to other devices. These

"other" devices might be the commercial device from the USO, or devices from other university research groups. In the first case it was a problem because the USO was producing devices according to a commercial development logic, i.e. making material and component choices according to the cheapest functioning alternative, whereas the PRG was instead seeking to gain knowledge concerning the effectiveness of new, possibly untested, material and component choices. In the second case, the research device would be assessed according to other research devices from other research groups in Sweden. The professor entrepreneur asserted that there were no research groups who had a commercial product, and therefore none who could offer more than very rough estimates of the answers to these commercial questions. This research group, with experience based on previous iterations of the technology at the university and commercially developed devices at the USO, could not hope to compete with naïve cost estimates, which could be very much underestimated, from other research groups.

It could be argued that this is simply a manifestation of Slaughter and Leslie's academic capitalism (1997), that academics are forced to compete in a market-like structure in which they, and their research proposals, are pitted against other research groups' applications in a bid for essential financial resources. This argument could hold merit, but the empirical case here suggests that the commercial questions arose as a consequence of various actors' understanding of the research group and its connection, however contested, with the USO as one in which they were closely informing each other.

This suggests a second reason for this line of thinking being problematic, in that it assumes that the university research group follows a type of development logic rather than research logic. In other words, it assumes that the research group sought to incrementally reduce the cost of constructing the technology and/or increase the output to cost ratio compared to earlier efforts, mirroring concepts of product and process development in which the earlier stages are characterised by product performance and the later stages by a focus on product standardisation and costs (Utterback & Abernathy 1975). A further extension of this reasoning might also suggest that the research funding organisation assumed the research group was part of a development organisation (whether purely within the university or as an organisation spread between the research group and the USO) working together in a SCRUM-like manner such as that proposed by Takeuchi and Nonaka (1986) with other research efforts (perhaps those belonging to researchers who did not receive these questions) to produce a financially successful product,. This was in contrast to the assumption that the university research group sought to produce knowledge concerning the technology and determine its potential for increased power efficiency, and disseminate that knowledge to a wider academic audience.

With a research funding organisation reflecting concepts associated with commercial development in their questions to applicants, this might suggest that the research groups most likely to secure funding would be those able to demonstrate progress in the commercial setting, some way along Vohora *et al.*'s (2004) model, particularly with regard to reducing uncertainty as described in the earlier stages. This might mean showing cost reduction, or providing experiment data showing that the research group was heading towards producing a technology that could potentially compete economically with other (commercially available) technologies in this area. This could be observed on a number of levels in the case. The funding program to which the researchers in the meeting just described had applied suggested that the program was intended to increase knowledge about the technology area, which included the development of cost-effective solutions and improved operation strategies[4].

"Cost effective" is a somewhat vague term, but it could be read in this context as saying that the technology should be comparable with current similar technology area costs per unit of output, a reading in line with the discussion in this chapter in which those present at the meeting spoke in these terms. For a new technology this could mean substantial cost reductions and efficiency improvements, such as those we might expect in a product / process innovation model (Utterback & Abernathy 1975), were needed and this was certainly an idea represented in the researchers' descriptions of their work in documents and interviews at other points in the case.

> "I (…) really tried to decrease the cost of the whole system." (Doctoral student, 2012)

> "Different designs (…) have been evaluated, with the main focus on increasing the (…) output and reliability of the system while decreasing the costs" (Doctoral thesis, 2014)

Figures concerning the costs and output results of the technology could also serve to reduce uncertainties surrounding the technology. Other efforts to reduce uncertainties include solving specific problems (Trott 2002), and this is a theme that emerged repeatedly throughout interview data.

> "But we also need to, we also have some problems. So I think that's the very non-scientific driver right now, to *make* it work." (Doctoral student, 2014)

> "… So it's a way to remove all the problems, so many problems, without (*adding*) more stuff, everything its like easy to remove all the components if you have so much money and so much time." (Doctoral student, 2012)

[4] Original text not included for anonymity purposes.

> "I mean at university for example, if I got a problem that I don't know, if this one will work for example, if this circuit will be the best or if this circuit will be the best, then it is we take time, and we do, and test them both, and do some analyses and things like that." (Researcher, 2011)

It would appear then that the research funding organisation was demanding that the research group relate their technology to the market of similar commercial technologies and their research to the market of research projects. The successful acquisition of research funding appeared to be, in this case, dependent upon the applicants demonstrating through the presentation of figures (some of which belonged to the USO and were tied up in confidentiality agreements with external partners) that indicated that the devices constructed at the university for research purposes were economically, and perhaps technologically, comparable to commercially available devices.

Conclusion

This chapter has raised the issue of beliefs concerning research commercialization, already outlined in earlier chapters, as enacted through a research finance organization's interactions with the university research group seeking funding for a number of research projects. A meeting to determine the direction researchers should take in pursuing their applications further was described, and some of the assessments given by the researchers were presented.

The empirical material suggested that alongside the idea that research groups engaging in research commercialization might be more attractive for external financing organizations, a notion already presented in the literature (Slaughter & Leslie, 1997, Shane, 2004), the commercial aspect of the technology, even if it is declared separate from the research activity, introduces or increases the risk for the research organization to lose out on research funding. This is due to concepts concerning the relationship between the two reflected in the questions from the research funding organisation, which could lead, as in this case, to the construction of the university research object being compared to commercial products, a comparison that many researchers believed would not have a favourable outcome.

10. Social forces at play in an entrepreneurial university setting

This chapter moves on from the series of empirically driven analyses presented in chapters four to nine, and is concerned with the forces that can be inferred as arising throughout these episodes and the case. Once these have been described, the next chapter will consider how they relate to one another, whether they align or conflict with each other for example, and how the various actors might try to balance these forces as they move within and between the social groups in the case study.

In the earlier empirical chapters the main social groups of the case study were outlined and described, and these early analyses began to identify some of the forces acting within and around the entrepreneurial university; these included the concepts actors used to understand the connection of their research activities to the USO in chapter four, and (very) public expressions of interests in the installation of a research device in chapter six. Later empirical chapters considered actors outside of these groups and some ways in which they related to the individual actors and the collectives, and began to try to describe episodes where actors had tried to negotiate changes in some characteristics of the social group. For example chapter seven described how researchers tried to determine and implement structure within the PRG with respect to activities such as construction, meeting schedules, and research topics; activities that were essential to the collective but not particularly rewarding for individuals according to notions of traditional academia. This structuring attempt was one way to establish permanence of the social group according to Park. However, it was the norms of the wider social group, traditional academia and the professor entrepreneur – one actor who appeared to be able to drive certain interests such as construction despite the challenges posed by conflicting demands on the researchers – that the group found difficult to break away from, and the attempt was reported to have failed.

Some movements of actors and more or less tangible resources were described, including migrations (Park 1928) between academia and industry and more iterative journeys into and out of the research group and the USO, as well as less tangible movements such as shifts in collective interests. Finally the empirical material was extended through a discussion of the concepts to which individual actors seemed to relate – concepts such as the val-

ue of academic research, what academic research commercialisation should look like, individuals' roles in such a group, and so on; put otherwise, the explorations so far have sought to explore the interests and (perhaps unsatisfied) desires to which the actors in these social groups aspired, and which have helped to shape these interactions (Park & Burgess 1921).

Social forces

Park's social forces were introduced in the chapter on theory, but as a short reminder, Park understood social forces to be the influence group members exerted on each other. Key to the notion of social forces is that they are enacted or revealed through the public interactions of the individuals, through the relation to concepts used in these public expressions (Park & Burgess 1921). Social forces are enacted through actors' interactions and this may be through direct interactions such as speech or written communication, examples of which we have seen in the empirical material presented in this case study, but they may also be enacted through formal organisation, administrative devices, or technology, which Park and Burgess (1921, 30) suggested were "artificial extensions of the social group". Forces arise through the desires of individuals, derived from their (sometimes unconscious) interests, when the individuals seek to realise an unrealised condition. Individuals respond to these forces to maintain their group membership, or in other words, to avoid becoming lost (1921) or partially isolated from the social group.

In other words, social forces arise when individuals transform their individually held interests into public expressions. These may be seen in quite a simple way, for example when an individual is interested in recruiting other actors to assist in writing an article and they ask who else might share their research focus at that time. They can also be understood as being more complicated, such as when an individual might analyse the market for a material, combine this with an interest in pursuing commercially relevant research to make their project attractive to current and potential research funders, and transform these together into an interest in the physical properties of a new material before expressing this interest in a research funding application.

Academic entrepreneurship

The first force to describe is perhaps the most obvious, and it emanates from the notion of academic entrepreneurship such as it is conveyed, more or less, by dominant literature on this topic. However, the case study presented in this thesis appears to suggest that concepts of academic entrepreneurship, including the models and ideals of commercialising academic research, are

reflected in the descriptions from the actors and, through some examples, in their approaches to activities described in this thesis.

In chapter five it was the actors *external* to the research group and the USO whose beliefs concerning the relationship between the two were in focus with regard to this academic entrepreneurship type force, such as when the state innovation support agency described having a positive reaction to the USO because of previous experiences with the research group. Even after the demonstration project ran into trouble, the utility company representative continued to talk of the relationship between the research group and the USO as an important element in his hopes for the future of the technology. In doing so he was arguably reflecting concepts of research knowledge application that we could associate with the entrepreneurial university, such as the idea that the USO has unhindered access to the research group's work, for example (Etzkowitz 1983). This can be understood as a reflection of approaches to the university and innovation in a wider sense: Sweden's innovation policy is translated into practical support through initiatives which support entrepreneurship programs such as KIC which span countries and universities, and more locally through the university's establishment of a TTO, for example.

It could be suggested that a connection can be made between structures reflecting desires for entrepreneurial behaviours from research actors and the emergence of a driving force for activities associated with USO creation. A somewhat clear link can be seen between the KIC initiative and researchers' understanding of the relationship between science and industry; for example, KIC Innoenergy PhD school candidates had to persuade program administrators that they had entrepreneurial intentions through the production of a business plan (KIC Innoenergy 2012), similarly a research funding application might call for the research leader to highlight possible commercial applications of some outputs of the intended research, thus stimulating them to think in these terms. Once such an intention is given voice however the researcher could be persuaded (if we choose to believe KIC's efforts) through courses or offers of future funding for research should a company be founded, to commit to such a venture and begin the USO development process (Vohora *et al.* 2004). Other "nudges" towards researchers reaching an academic entrepreneurship conceptualization of the relationship between research and USO creation include the presence of TTOs in and around the university, and the university's celebrations of researchers who begin a commercialization journey.

However, despite appearing to desire efficient transfer of knowledge from academia to practical applications, researchers also appeared to be aware of other forces at play. In the first empirical analysis chapter, chapter four, the academic entrepreneurship force was apparent in researchers descriptions of the research, in which for example they suggested that "good research" should result in some commercial application or result in the survival of the

USO, that there would be a linear transfer of knowledge produced through research activities to the USO, and that the research group and the USO would be separate organisations. These might be considered reflections of popular concepts of academic entrepreneurship, and researchers appeared to recognize that these were ways of talking about the relationship between academia and industry, rather than being exact accounts of their "true" nature. They were able to distinguish between concepts of academic entrepreneurship surfacing in these accounts and their own experiences, describing how knowledge and ideas sometimes moved the other way, from the USO to the research group, and suggesting that the university was not always ahead in developing the technology. One example of a force that may arise in resistance to forces working for USO creation is that of traditional academia; for example, Mendoza (2007) described graduate students as seeing patenting during their studies as career opportunities if they were motivated to work with industry, but for more traditionally academic students such activities might be viewed as delaying academic publications and therefore detrimental to their careers. This force will be described shortly under the title of Traditional Academic Values, and resistive forces will be addressed in the following chapter.

In conclusion, the academic entrepreneurship force comes in three main different guises, and can be seen in the ideals and beliefs held by actors internal to the two social groups, institutional structures within and around the university (immaterial as well as material) encouraging actors to behave in an entrepreneurial manner, such as TTOs, etc., and the beliefs held by external actors who control resources or otherwise hold a stake in the research and/or USO activities.

Commercial strategy

Perhaps unsurprisingly in a case containing commercialisation, the issue of markets also came into play. Specifically, commercial market forces had a very clear effect upon the research activity that in turn sparked some of the key moments described in the case. These can be divided into the commercial forces behind material purchasing decisions and the resulting research direction, and commercial forces associated with the USOs device being just one of many technologies posited to perform the same function in a specific commercial market.

A lot of the activities depicted by the different chapters could be related to the decision to change the material of a central component in the technology. Doctoral students, professors, and USO engineers reported this to be due to the material used in the older devices becoming more expensive and the cost being anticipated to increase further in years to come. In light of this the decision was made to research a new potential material. The research activity was therefore subject to forces stemming from the materials market,

which emerged in actors' estimates of the future availability of certain materials and associated price fluctuations.

The influence of commercial forces was perhaps most clear in terms of the pressure to demonstrate the suitability of the USO for the commercial realm. The commercial forces in this case were apparent from the very start of the chapter five, which described the multi-actor demonstration project: the project was initiated to demonstrate the commercial viability of a large-scale installation of the technology, and to show that the USO could deliver both the technology and the services surrounding a large-scale installation of its devices to a utility company. This kind of situation, where there is a lot at stake with respect to technical and commercial reputability, is described quite neatly in Vohora *et al.*'s (2004) juncture of credibility, since a successful demonstration would demonstrate that the venture had secured the financial resources and competencies critical to securing customers in the future. The installation itself was, if not a form of demonstration of commercial capabilities itself, an event that subjected the technology and organisations involved to a wider public scrutiny. It was performed in a relatively public domain, contrary to research activities at the university and engineering activities at the USO for example, where outputs could be selected and controlled to a somewhat greater extent. This meant that there were several direct observers, including researchers, actors from the USO, and myself, but also newspaper and radio reporters and members of the public. Through these direct observers we could also infer that there would be indirect observers as well; a wider public audience, state actors including financing agencies such as the state innovation agency supporting the demonstration project and the research funding organisation, as well as commercial actors including (both current and potential) partners and customers of the USO. Even though the device actually being installed was defined as a university research object, it had been assembled and deployed by the USO and associated suppliers. As such, there was pressure to perform a successful (without being too clear on what that might mean) installation in the lead up to the later operation of the device.

However, the pressure to demonstrate the commercial readiness of the technology and the USO also spilled over into the academic realm, as exemplified in the chapter describing the meeting to address commercial questions posed to the PRG actors, chapter nine. Taken in the context of academic entrepreneurship literature, this might not be so surprising: Shane (2004) for example suggested that investors might perceive a USO lacking commercial awareness as a risk, and that they might look to the founder, in this case the professor entrepreneur, for reassurance regarding their investment. Taking commercial concerns into account for research activities might indicate the suitability of a USO leader for taking a USO into a realm they are demonstrably familiar with: a commercial market. The questions sparking the events in chapter nine could arise from external actors' desires to see that

the professor entrepreneur had good contact with, and possibly good control of, less commercially experienced actors at the USO. This was perhaps particularly important in light of the movement of one of his recently graduated doctoral students, the beginning of which was described in chapter six, into a senior role at the USO.

Commercial forces could then be understood to be working in three main ways: raw material prices influencing key design decisions, pressures to demonstrate the commercial capacity of the USO on USO actors, and (arguably misplaced) pressures to indicate the commercial viability of the PRG's research activities.

Academic capitalism: science and technology strategy

Engaging in research and development (as R&D, not as university research) is perhaps a somewhat obvious expectation of a USO as it emerges from the realm of academia and searches for a profitable product or service and its connection to a market. As this case study shows though, it also appeared as a force in the PRG, pushing the researchers to conduct and prioritise work more associated with applied than basic research. As this section will outline, the forces associated with R&D and academia emerged under two rather different categories: the first associated with the more classical capitalist university notion of research resource acquisition, and the second linked to the university's expected role in innovation as it relates to society at large.

A first force associated with R&D is one that emanates from the increasing and, according to Slaughter and Leslie (1997), capitalist pressure within academia to acquire research resources through the demonstration of interests and capabilities such as construction, commercial aptitude, and the ability to conduct activities that reflect R&D curves.

In chapter six, which described the installation of a research device, an external actor concerned with academic research had the opportunity to observe, through the media and other direct observers' reports, the deployment and material surrounding it. This suggests that there may also have been a pressure on the researchers to demonstrate that the university had been instrumental in bringing forth the technology being deployed, and in doing so raise the profile or perceived relevance of the research activity and research group. This aligns quite neatly with the virtues heralded by the dynamics of academic capitalism, as outlined by Slaughter and Leslie (1997). The PRG actors' response to such a force could be seen for example in their apparent interest in being associated with the research device being installed.

Construction was one way through which researchers tried to demonstrate that the research was of value outside of the university, both as an activity to produce research objects upon which peer reviewed articles and student theses were based, and as a physical object through which to communicate knowledge to the USO. As such, the necessity to engage in construction

exerted a force related to the dynamics of academic capitalism, which acted to initiate construction of the various iterations of the technological artefact of the research activity. This can be seen as similar in nature to an R&D force, with the difference being that the researchers seemed to conceptualise it as non-negotiable not least for the research activities themselves, adapting the external pressure to engage in construction to one inherent to the academic knowledge generation process. In doing so they framed it as an essential activity for the continued survival of the research activity through such arguments as the need "to make it work" (doctoral student, 2014), and questioning how they were to conduct research without constructing the objects in the first place. In other words, R&D was twisted into an activity performed in the pursuit of academic knowledge, rather than in the pursuit of a commercially viable technology.

A meeting held to address the strange questions put to the PRG during a research funding application process revealed the force exerted by a single actor, namely a research funding organisation representative, on the actions of the research group. Many of these concepts appeared to be quite similar to literature on academic research commercialisation in that there was an assumption of an open communication between the USO and the research group with regard to knowledge about costs and return on investment figures, for example. While this assumption was perhaps accurate at times, and could be directly observed for example as the USO engineer participated in the meeting, there were restrictions on how far knowledge from the USO could travel as a result of its commercial relationships, such as the one that it had with the state innovation agency. However, the idea that the PRG device might be compared to the USO's product suggested that rather than viewing the USO as a recipient of knowledge gained through the PRG's experiments on research objects, the actor at the research funding organisation had expected that both versions of the technology, that of the PRG and the USO, would be comparable in commercial terms such as return on investment calculations. In other words, he understood the PRG to have developed a technology capable of competing commercially, despite the differences in logics, costs, etc. bundled into a university research project, and positioned the research as dependent upon it following (widely known) R&D curves.

Research funding cuts were suggested as one reason for academics starting new companies outside of the university for example (Slaughter & Leslie 1997), and this certainly provides one way of understanding senior researchers' entrepreneurial actions. However, resources need not be limited to financial or indeed tangible – social capital has already been described as key to commercialisation activities but reputation can also play a role for researchers pursuing academic career goals. Nascent entrepreneurs tend to associate entrepreneurship with increased reputation (Krabel *et al.* 2010), and so starting a company is one way to build such an intangible resource. Similarly it could be suggested that even researchers without entrepreneurial

aspirations or the resources to start their own companies may accept the concept of academic capitalism, and try to demonstrate their link to the industrial application of their research, as the junior researchers and PhD students did indeed appear to do during the installation episode. We can perhaps understand that when it comes to behaviour, an actor's set of concepts regarding the world around them might actually drive them to certain actions, as in the last claim by Krabel *et al.* (2010) that nascent entrepreneurs believe that acting entrepreneurially increases reputation. Even if an academic was not particularly interested in starting a company and believed in a more traditional separation of research and business they might still believe that they could obtain resources for research through demonstrating the qualities and behaviour that they believed were appropriate or rewarded within their particular research community (Henkel 2005), i.e. of being seen as an entrepreneurial academic.

Forces associated with academic capitalism with regard to science and technology strategy could be seen in three main ways concerned with research funding acquisition: in the installation episode during which researchers from the PRG tried to demonstrate their association with device and a doctoral student at the centre of the technology development (and thus the importance of the research activity), through the construction of research devices to secure research funding, and through external actors' expectations that the PRG device would follow a R&D curve to demonstrate suitability for research funding to be granted.

Innovation system

A second force related to R&D is linked to the university's expected role in innovation as it relates to society at large. Many of the actors featured in the case, and not least those external to the university, understood the academic institution as being part of the national strategic innovation system (Eklund 2007) and, often through the PRG's (presumed) relationship with the USO, conceptualised it as instrumental to the USO's development. As such, both the PRG and the USO were subject to a force associated with their presumed roles in an innovation system. For the PRG this was connected to the research activity and surrounding concepts seen in literature describing capitalist notions in academia (Slaughter & Leslie 1997), and was characterised not only by a pressure to follow R&D curves and demonstrate cost reduction as already described, but also to perform research of strategic interest to society in a wider sense. This can be seen in KIC's literature (KIC InnoEnergy 2016b), which suggests that orienting research activities towards developments with commercial potential will open up new potential streams of research funding, for example. However, in this case study the PRG actors were almost expected to "step in" to the R&D activity when required by

partners in the USO's demonstration project, and were explicitly expected to provide information (key figures etc.) for the USO demonstration project.

In turning to the documents provided by the research funding organisation in which they detailed their approach to supporting academic research it became clear that one of the ideas they focused on was that of "strategic research" and, in particular, research with a potential to develop commercialisable technologies (Swedish Energy Agency 2009). This "strategic" approach suggests that those actors assessing the incoming research funding applications would be searching for indications that the proposed research had commercial potential, and the questions posed by the representative of the research funding organisation, questions of cost reduction, etc., would suggest that those most able to demonstrate their progression towards commercialisation would be more likely to secure these resources.

However, contrary to questions of organisational development highlighted in the academic entrepreneurship literature and the lack of focus on the technology in academic capitalism literature, these questions concerned issues described in product development and strategic innovation literature, suggesting that these were the dominant concepts in this case. We can for example see expectations of actors having focused on the technological performance in earlier stages and expectations that their activities (at the time of the empirical observations) were undertaken with cost reduction and up scaling as primary concerns, concepts reminiscent of Utterback and Abernathy's (1975) dynamic model of innovation, a conceptualisation that many actors interested in technology development (such as those at the state agency and utility company) would surely recognise. Literature on organising for technology development for example contributes something quite contradictory to popular conceptions of academic research commercialisation; considering Takeuchi and Nonaka's (1986) description of a SCRUM approach to R&D introduces the notion that research actors do not pass the development activity to counterparts at the USO – an exception being descriptions of surrogate entrepreneurs – but rather work alongside the more market-centric actors throughout the product development process. Taking the parallels with classic innovation literature further, if we view the country, or industry to which this technology relates, as the "firm" and the research funding organisation as the department making strategic decisions as to which areas of R&D to fund, this description bears striking similarities to product development and R&D strategy of the firm, as outlined by Trott (2002). Under such a paradigm, the research funding organisation treats research as the R&D function of the country; continually assessing, allocating funds to those areas it sees as most promising with regard to fulfilling the strategic aim of the country.

This suggestion is also supported by the events described in the chapter discussion the multi-actor demonstration project. Returning to Vohora *et al.*'s critical junctures (2004), the professor entrepreneur's decision to remove the technology development from the USO engineers and build his

own (competing) version after he and the academic entrepreneur declared it a failure could be read in a number of ways, with both interpretations revealing the potential influence of different forces. The first reading, remaining with Vohora *et al.* (2004), would be to recognise that a failure to develop the technology would signify that the USO had failed, despite securing financial resources, to secure the needed competencies and organise these in the appropriate manner to complete a successful product development process. A failure of the organisation to pass a juncture in the USO development phases could, given the arrangement of the project in this case, lead to the withdrawal of one or both of the external partners and, along with them, their financial support. A second interpretation of the events could relate to the organisation as a social group. An organisation in which the reaction to a perceived threat, in this case the threat of failure to deliver on promises made by the USO and the risks associated with that, is a re-organisation of responsibilities is not necessarily an organisation which has failed to develop – on the contrary, the ability to re-organise according to new conditions is a competence outlined in Vohora *et al.*'s (2004) re-orientation phase, which occurs after the juncture of credibility, and appears in Park's description of internal organisation as a response to a threat to the social group (Park 1927, 734). The USO alone was not capable of such a re-orientation, since it did not have the resources (or competencies in this case) required to develop the technology, according to the professor entrepreneur. However, the USO and the research group, which the external actors already believed to be linked, together possessed the resources to successfully perform the technology development activity (in the form of the professor entrepreneur and a PhD student working overtime). If these R&D forces were even partially accommodated by the USO and the research group (rather than resisted), the USO could stand a better chance of survival.

Forces associated with the concept of the PRG and the USO as part of an innovation system can be found in the state agency's documents clarifying their approach to strategic innovation efforts, and in external actors' understandings of the organisation of the PRG and the USO and how this might relate to the spin-out process.

Traditional academic values

One clear tension in the case, identified by both doctoral students and management at the USO, concerned that which emerged as a result of doctoral students struggling with the norms of industry. Both the USO CEO and the professor entrepreneur suggested that the confidence of researchers in their ability to perform independent research did not translate well to the function of industrial engineering, and one doctoral student developing the device expressed the difficulty of dealing with industrial suppliers without what she suggested was experience one might gain through working in industry. The-

se can of course be understood as struggling with commercial forces: rather than taking time to understand their work on a deep level as they could at the PRG, researchers who moved to the USO were restricted to calculating to the extent that the resulting design would "work". Decisions within the industrial realm are arguably much more concerned with commercial issues – how much does a component cost, what are the cost benefits of improving accuracy, and so on.

It could be argued then that many of the tensions surrounding the technology development, particularly after the movement of the development activity into the university, arose as a consequence of forces we might associate with more traditional notions of academia. Academic norms, often suggested to be prevalent within the wider academic community and key to researchers' decisions to behave entrepreneurially (Becher & Trowler 2001, Colyvas 2007), are suggested here to be a contributing factor to some of the beliefs within the PRG concerning the lack of structure or the nature of other researchers for example, and these beliefs may lead to the individual perceiving that they, and their role, existed outside of the collective to some extent (Park 1928).

Some of the researchers had, despite suggesting that the USO and the research group were linked through, for example, the sharing of resources or the actions of external actors, described a necessity to maintain the appearance of them being separate organisations. This could be understood as a force stemming from an interest in maintaining the Mertonian academic ideal of being autonomous and generating knowledge that could have many different potential applications, a force deriving from an interest in drawing a line between the external world of commerce and industry, and the university world of pure and disinterested pursuit of knowledge. However, on the few occasions that the researchers did discuss the need to maintain a clear distinction between the research group and the USO, it was often linked by the speaker to research resource needs and the threat of resources being removed if the research was perceived as being only for the benefit of the USO. As such, one could understand the delineation being made here as being closely associated also to the dynamics of academic capitalism, which frames research activities as being involved in an ongoing battle for resources, and researchers as being (solely) interested in their own work being assessed favourably in this competition (Slaughter & Leslie 1997). Academic capitalism emerged for example in attempts by individuals within the research group to encourage activities – such as construction – which improved the collective's chances of such favourable evaluations in research funding decisions, but concepts of traditional academic life, including those implied or codified in formal structures of the university, appeared to underlie much of the tension surrounding construction. These traditional academia forces, revealed in actors' push to publish academic research articles for example, made non-traditional activities less attractive – a description that

both supports and extends literature on the topic; Mendoza (2007) for example found that doctoral students described academic publishing as being a high prestige activity, and one favoured by researchers for the benefits that such activities could bring in the short term such as grants and future recognition, as opposed to more entrepreneurial type activities such as patenting which they described as only bringing benefits in the long term, if at all.

This is perhaps particularly interesting to consider, since certain sciences are characterised as being somewhat closer to R&D, and thus construction should be a part of their particular research department's norms (Becher & Trowler 2001). However, relationships between the researchers and observations of more experienced researchers' behaviour, i.e. not engaging in construction activities, informed newer researchers about the interests to which an academic, as opposed to an engineer for example, should adhere. This is also suggested in literature on the entrepreneurial university, in which structures such as university policies and external networks could discourage a researcher from starting a USO. However, a social lens suggests that social groups could encourage or discourage entrepreneurship; Etzkowitz (1998) for example described how academics would commercialise their research when others in their research community acted as role models and encouraged them to follow, with role models perhaps suggesting that the pursuit of knowledge and article publication were the activities a researcher should be performing.

A particular form of interaction emerged from the symbols and traditions of traditional academia in the form of formal authority, and although this was not itself a force (not being associated with its own internally held interest), it is of note here. This is because it is a somewhat special twisting of the traditional academic forces by specific actors, usually senior researchers, to lend extra weight to their own expressions of interest. The traditional academic force can be seen for example in the professor entrepreneur's directives to the doctoral student to develop the technology in chapter five, or in the professor entrepreneur's organising of the structure meeting in chapter seven, and the influence of authority could also be observed in the removal of the development activity from the USO in chapter five.

The influence of the individual in this position of authority is perhaps not unexpected – certainly literature on USO creation and academic entrepreneurship describes the importance of the actions associated with this particular role (Vohora *et al.* 2004, Shane *et al.* 2014), and an academic entrepreneurship force has already been outlined earlier in this section. However, where this fits into traditional academia can be understood with help from Park and Burgess' (1921, 34) description of the individual as able to influence and mediate their and other individuals' interests within the social group. Once the professor entrepreneur had left the social group, although usually only temporarily, his absence revealed that actors lacking the formal authority positions tried to emphasise the professor entrepreneur's support

for many of their efforts. The individuals turning to this were not necessarily interested in expressing the will of the professor entrepreneur, but were perhaps more concerned with cajoling other researchers into assisting with construction, and needed therefore to frame their interest in traditional academic terms in order to secure actors' interest in activities that so desperately needed for the research activity, but which were not typically rewarded within the academic structures.

The traditional academic values force was characterised as primarily acting upon researchers, and emerged from university structures, traditions and symbols. It worked to separate the research activity from non-traditional research activities, seen for example in the necessity to keep the PRG and the USO separate organisations. However, it also seemed to give rise to researchers struggling to interact with industrial actors and worked contrary to some other forces, such as the academic capitalism science and technology strategy forces.

Table 1. *Summary of Social forces identified*

Force	Arises in:	Possibly emerges from:	Examples
Academic entrepreneurship	Researchers, External actors	Structures e.g. Policy, courses	Researchers suggested that good research should lead to commercial products but admitted limited experience of this, apparently desired good transfer of knowledge
		Nudges e.g. presence of TTO's, research funding applications, role models	External actors encouraged the creation of USOs through the organisation of entrepreneurially-directed education programs (e.g. KIC)
			External actors associated experience with PRG with USO's expected performance
Commercial strategy	Research focus (material)	Commodity market	Material decisions in research were determined by estimates of future material market changes
		Investment market / need for credibility	USO needed to demonstrate the ability to perform in the commercial setting
Academic Capitalism: science and technology strategy	Researchers, Research funders	Demonstrate research relevant outside university	Research should be commercially relevant in order to secure future funding, and construction is an essential part of that
		Observing others acting entrepreneurially	Researchers encouraged to demonstrate commercial aptitude to advance their academic careers
Innovation system	Research funding process; USO	Concept of university being driver of country's innovation	The PRG was expected to demonstrate cost reduction / follow R&D curves
			PRG was expected to develop a commercially viable technology by a state innovation support agency
			University framed as a performer of strategic research
Traditional academic values	Researchers	University structures, traditions, symbols	Belief that there should be a clear divide between the university and USOs
		Researchers struggling with industry norms	Academia is organised according to well-known career structures, traditions, and symbols,
			Resistance to non-traditional activities (e.g. construction) at the PRG
	Professor entrepreneur orders; Researchers' requests to others	University structures, traditions, symbols	The role of the professor is part of organising other actors to perform certain tasks
			E.g. Development moving from USO to PRG; Structure meeting organisation;
		Professor entrepreneur as individual and as traditional academic symbol	Researchers' referring to professor entrepreneur in their requests to others

Conclusion

This section has outlined a number of forces that appear to emerge throughout the empirical material in the thesis, and already a number of observations can be made. The first is that many of these forces appear to have the potential to conflict with or complicate one another, and this will be explored in the next chapter.

A second observation is that the rather clean categorisations here overlay a much messier, interacting collection of forces that appear to originate from different places and different logics, and combine in some ways to emerge in the social interactions of this case study. One example of this might be with regards to forces employed in the interest of efficient knowledge transfer out from the university to wider society (through industrial applications); under the academic entrepreneurship force researchers believed good transfer of knowledge to the USO was indicative of them doing good research (a quality linked to traditional academia), and external actors seemed to assume that such knowledge transfer was occurring simply because the USO had come from the PRG. This reflects popular conceptions of academic entrepreneurship (the star scientist, no indication of the USO breaking the umbilical cord to the PRG). On the other side, researchers also suggested that they should demonstrate the relevance of their research results outside of academia in order to secure research funding for future university research, and seemed to believe that (temporary) employment at the USO might aid in their academic career progression, reflecting concepts from academic capitalism science and technology strategy. Although these social forces appear to be quite similar, the interests underpinning them, a defining characteristic of social groups in Park's conceptualisation, differentiate them.

Finally, the forces outlined here can be divided under two umbrellas: the entrepreneurial (academic entrepreneurship and commercial strategy) and the academic capitalism (science and technology strategy, innovation systems, and traditional academic values). Somewhat understandably, these groupings arise by means of the main interest – the commercial and the academic – and mirror the division in literature on entrepreneurial academics and USOs between academic entrepreneurship and academic capitalism. However, rather than suggesting that such a division is necessary for the study of this phenomenon, this thesis and its findings demonstrate that the two are, perhaps obviously, interconnected. More so, it suggests that this interconnectedness complicates the two areas by revealing the limitations of examining one side without considering the other, and the next chapter goes on to examine this interconnectedness further by considering how these different forces might relate to each other, and how actors might turn to particular concepts as they navigate the forces of the social groups as they move within and between them.

11. Walking the plank

Despite the numerous instances throughout the case of the research group and the USO being described in terms that we might understand as meaning that they were viewed as a single organisation spanning the university-industry divide, the two were clearly separate organisations. This statement is perhaps one of the few points on which actors within the USO and PRG could agree: from doctoral students to the professor entrepreneur at the university and from engineers to the academic entrepreneur at the USO, all who were asked about the relationship were firm in their assertion that they were separate legal, financial, and organisational entities. The distinction between the two is also observable in their separate activities, relationships, and purpose. The university research group for example engaged with academic research funding organisations and other university actors, shared their research findings with other researchers through publishing articles, and had both the time and resources to try to gain a deep understanding and to contribute relevant scientific knowledge related to a specific technology area. The USO on the other hand wanted to produce and sell as much of the commercial version of the technology as they could, secured financing through state agencies supporting innovation, and partnered with relevant corporations.

At the same time though, we cannot ignore the many "things" crossing between the two, from formal purchases of laboratory time to informal chats while actors from one part stood physically in the other, complicating the divide between the two organisations and perhaps giving rise to the many different and contradictory views on the relationship between them. Neither can we ignore the effects the presence of each has on the everyday workings of the other, either through tangible boundary crossings performed by individuals and artefacts as in chapter six and by chaos-causing forces as described in chapter nine, or through imagined, and often idealised, boundary crossings as suggested in earlier discussions of expectations and beliefs of the various actors as they remained in their respective places.

How can this be conceptualised to help further this discussion? Throughout the chapters so far, Park's work on social forces has helped to outline some of the influences acting on the various actors. Additionally, his work could also be used to further our understanding of how separate organisations can maintain their standing (as academic or industrial) and yet at the same time benefit from their closeness, through engaging in informal linkag-

es for example. It also helps in offering an explanation of why various social forces arise and affect beyond the organisations we might normally expect them to relate to.

This approach helps us in two main ways; the first concerns the empirical and the second the analytical. More specifically the first brings attention to the interconnectedness of seemingly independent activities and the iterations between the two social groups as a function of their symbiotic relationship, and the second allows us to think in terms of how individual and collective interests might give rise to forces, and how such interests are furthered through the relationship between the neighbouring groups.

How close?

In chapters four and six the researchers described their movements between the research group and the USO, talking about their efforts to manage the different activities their various roles demanded. But one key activity was that of construction, and PRG researchers were often required to complete the final assembly and testing of the research device at the USO factory. They were learning how to construct the unit, and this is one example of how the doctoral student learning activity and the USO engineering activity could benefit from an alternative to the resource based view outlined as a limitation of approaches earlier in the thesis. The actors stepped across the divide between the research group and the USO, often directly ignoring the boundary between the two, and yet at the same time remained members of two very different social groups, an observation that implies that they were subject (mostly) to the forces of their respective social groups and (to some extent) those of the group they spent time with. Indeed, Slaughter and Rhoades (2004) argued that the premise of the RBV is that the organisation is clearly separate from the surrounding context, i.e. that the organisational boundary is the defining feature of such analyses, and in doing so they criticised earlier work on academic capitalism which relied on this approach. They suggested instead that the academic capitalist regime is characterised by "the development of new networks of actors who develop organisations that span and blur the boundaries between public and private sectors", an argument that would not need much of a stretch to reach what this thesis argues concerning USO creation and research activities.

The notion of boundaries and boundary crossing is particularly interesting if we consider more recent literature on the topic. Scholars paint an understanding of boundaries as temporary distinctions that are constructed to perform certain functions; they might for example aid in the constitution of identities by delineating the group from others (Mørk, Hoholm, Maaninen-Olsson, & Aanestad 2012). Gieryn (1983) for example described the demarcation of science from non-science as useful for scientists' pursuit of tradi-

tional career goals, or, in Park's terms, as useful for furthering the internally held interests of individuals within the (macro) social group known as academia, and allowing for the collective to try to realise publicly expressed interests such as more idealised scientific goals (Merton 1957). It could be argued that the organisational boundary between the USO and the PRG in this case study has the potential to variably exist and not exist according to the specific interests taking priority at a given moment. From the perspective of the actors at the state innovation support agency and the utility company, boundary crossing such as this was aligned with their interests linked to academic entrepreneurship; they wanted to see effective transfer of knowledge from the university to the USO, and in particular to the demonstration project they were supporting in this case study. When considering the PRG and the USO as dependent upon the transfer of knowledge to convince the two external organisations of their legitimacy (as recipients deserving of their support, for example), it makes sense that the boundary between the two be nuanced during its various constructions. This was revealed in the case in two main ways.

Firstly, the state agency and utility company wanted the transferred knowledge to be relevant to the USO, and so the movement of actors between the USO and the PRG was also potentially indicative of the usefulness and relevance of the knowledge making its way into the USO and demonstration project. The logic here is presumably that as actors move from the USO to the PRG they carry with them the questions and problems that require a deeper analysis, as one of the researchers suggested in chapter four, and so through conducting scientific research guided by these same questions researchers produce knowledge that is perhaps more likely to be of commercial applicability. A strong link to the PRG was therefore potentially important to the USO's attractiveness as an innovation support target for the state agency. This is described in figure 4.

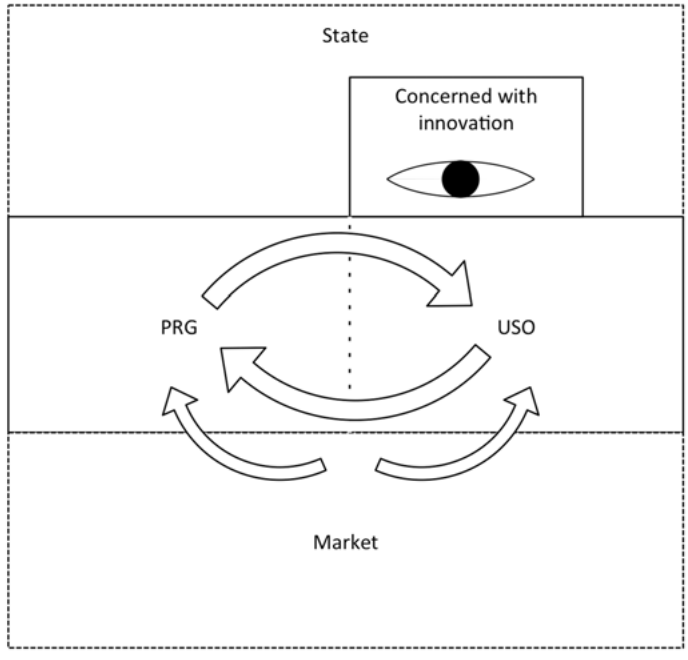


Figure 4: Suggestion for desirable interaction between academia and industry, under a system in which state agencies are concerned with innovation only

On the other side, and illustrated in figure 5, the research funding organisations didn't, and don't, want to support private businesses through public spending on university research, so direct links between the PRG and the USO could be frowned upon, and therefore a risk, for the research group. In order to secure resources for PRG activities, the research group had to establish a boundary between themselves and the USO. There was clearly a boundary in many areas: the finances of the two were separate, they appeared to refer to very different symbols and structures (articles vs. patents, single actor in an unstructured group vs. small groups in a hierarchy, academic titles vs. management titles, etc.), highlighting the presence of the academic capitalism force as it concerned traditional academia. Simultaneously though the PRG also had to demonstrate that the research they were conducting was commercially relevant and possible on a purely practical level. This meant that they produced physical artefacts and were driven to make them function as commercial devices might, and researchers faced some pressure to demonstrate their familiarity with the commercial world (through for example selecting appropriate materials, working for a period in industry, or organising the research activities in a structured manner), demonstrating appropriate behaviours for a more technology and strategy-based academic capitalism.

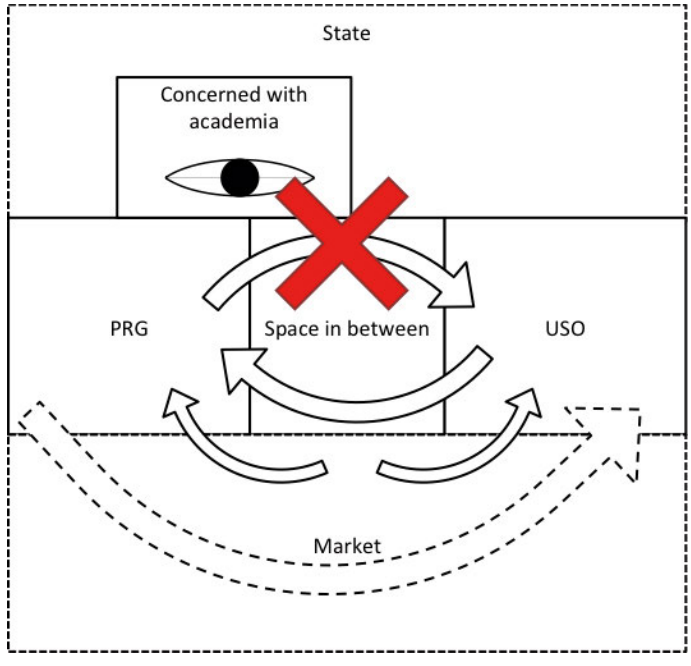


Figure 5: Suggestion for alternative desirable knowledge transfer when state agencies are concerned with the use of (for example) state resources

However, demonstrating such competencies appears to have opened up the door to other forces too, one example being that of the academic capitalism science and technology strategy force under which the research group was expected to have developed the technology to a commercially-comparable point, and where costs were reduced over succeeding generations. During the meeting to address this force the construction of the boundary between the PRG and the USO was the central task. Despite the concept of boundaries being of help in understanding the construction of the research organisation and the company for external actors, there were of course plenty of examples of this particular boundary being broken (USO engineers using software at the university, PRG doctoral students building devices at the USO factory, the professor entrepreneur trying to direct both organisations, etc.) while the actors breaking them appeared to remain in their original social group at the time. The defining, and perhaps more stable, feature of these social groups were the interests, both those that actors appeared to hold internally and those that were publicly expressed.

A key difference between the notion of boundaries and social groups can thus be understood through the concept of social forces, which appeared to cross organisational boundaries with some ease but faced resistance within the social group, and often did not make it beyond some initial actors who had direct contact with actors outside of the social group. In other words, the actors subjected to a force at the point of "first contact" did not allow it to

modify their internally held interests, and instead expressed interests within the meeting that directly contradicted them. As such, they did not take on these interests as their own, nor did they adopt them to further other interests they may have held, and therefore did not enact them in subsequent social interactions with other individuals in the research group.

Coupled to this under Park's concept of social groups were the various social forces to which the individuals were subjected. Within these social groups though it would seem that sometimes researchers were able to accept and work with some of the forces, but in chapter nine there was also a particularly clear indication that sometimes forces needed to be resisted. The section continues by seeking to understand the concepts of acceptance and resistance as they relate to social forces and the case at hand.

Acceptance and resistance of forces by researchers

In this section two key themes connected to the researchers and their relationship to the various forces at play are explored; firstly the acceptance of the forces pushing for product development and commercialisation type activities to be performed by the actors within the capitalist university (Slaughter & Leslie 1997), and secondly the resistance to these forces. The chapter continues by considering the notion of specialised roles as a form of resistance and how this might play into Park's concept of community, and raises the issue of how individuals may act to further their interests and those of the social groups to which they belong. The case study then comes full circle by returning to the entrepreneurial university and framing researchers within it as engaged in a series of iterations between the research group and the USO, allowing for both academic entrepreneurship and academic capitalism to play out through public expressions of (private) interests in the form of symbols of these concepts (Park & Burgess 1921).

Specialised roles

In the wider field of management studies there is a long tradition of works exploring the wide range of forces to which organisational members are professionals are subjected, and which appear to shape their interests and beliefs (Alvesson & Willmott, 2002, Kunda 2006). Within the field of project management a stream has emerged which concentrates on how this field of knowledge could influence the interests of the individuals making use of it in their everyday activities. This also captures the interplay between academic knowledge and practises of the entrepreneurial university with project management knowledge, which in turn seems to be particularly relevant to this case study. Hodgson (2002) for example argued that "the field can be associated with an abstract and apparently objective body of rules, with a

specific language and ontology", and that it worked on the individual as a disciplining force through the (self-)perceptions of project managers and project members. More specifically, Hodgson suggested that a project management discipline, when viewed alongside professionalism, allowed for links to be made between professional knowledge, the construction of a professional identity, and the maintenance of conduct appropriate to a professional. In other words, the discipline of project management enabled a very specific form of control through the creation of and rewarding of actions particular to a specialised role within the organisation.

We can see already that a number of parallels can be drawn between Hodgson's study of project management and this case study's suggestions regarding academic entrepreneurship; he found for example that actors compared their own activities with some "ideal model" (2002, 813), a manifestation of Park's unrealised desire perhaps, and described it as an "add-on" to employees' experience of their occupations and unthreatening to their core activities. Further, he argued that an appropriate performance of project management could be rewarded with an "increase in security, status, material rewards and social influence" (Hodgson 2002, 806). In a slightly later article Hodgson (2005) explored the notion of resistance in project management in conjunction with performance, describing for example how "professionals" agreed to perform a particular task because it would be expected of their position, and then immediately announced that they would not be doing it because it would be "too proactive" – effectively verbally performing the behaviours appropriate for their project management roles, but not actually doing the action they agreed to perform.

A recent article on project management forces entering academia and researchers' actions with regard to it, *The projectification of university research* (Fowler, Lindahl & Sköld 2015), suggested that actors engaged in a front-stage-back-stage divide between project performance and research activities. It suggested that such a split was one way in which researchers could resist the disciplining effects of project management in academia, and characterised this divide as a partial acceptance and accompanying resistance to non-research forces. Three modes of resistance to project management forces were suggested: partial embrace and isolation, establishing a separate administrative organisation specifically to deal with the forces, and the creation of increasingly project task-orientated roles for researchers. This model could help to understand how researchers respond to the commercial forces for example, since we can already see from the episodes presented earlier in the thesis that there were some instances where modes of resistance similar to these three could have emerged.

One metaphor used in the article outlines a front-stage and back-stage conceptualisation of project management in academia (Fowler *et al.* 2015). This suggests that some actors, usually early-career researchers, are presented on stage to talk the project management script and persuade research

funding organisations that they are engaged in appropriately managed practices of research, whilst the more senior scientists conduct the explorative and difficult to predict research behind the scenes.

This metaphor came from Goffman's notions of the front-stage and the back-stage (1959). Goffman followed Park in exploring social forces, although he took expressions and the management of performances as his focus, rather than interactions between actor and observer or audience. For this reason, and because I do not intend to introduce a further theoretical concept at this point, I turn to a Goffman-inspired metaphor of a theatre to help conceptualise how actors in cases such as that described in this thesis might cope with the various social forces to which they are subjected.

Theatre as an interactive metaphor

An element that Goffman barely touches upon is the notion of the audience and their relationship to the theatrical presentation. In Goffman's analysis, an audience is simply another team of performers to which a performer directs their expressions, and the interplay between the two groups is not explored. Interactions with audiences however can be carefully stage managed through, for example, the provision of props, controlled by actors on stage through specific instructions, or be fooled into believing an audience member is participating when they are in fact a "stooge" (Lawson 2014).

However, even the simple presence of a particular audience can alter a performance, through for example their natural reactions to the action on stage, or through their pre-existing social status. This leads into the suggestion that any theatre show conveys multiple stories – stories beyond those told on the front stage itself.

The first is the on-stage representation of a script, essentially repeatable and adapted depending on the director, writers, the cast, and perhaps the physical stage itself. Even in theatre within which the audience is invited to step onto the stage (or the stage is enlarged to encompass them), this story is one that is carefully managed.

Another is the story with which each audience member returns to their respective communities, and this is the story of the performance itself. This will also include details such as the individual's impressions of the activities surrounding the performance such as the ease of entering the theatre, perceived deviations from the audience member's own understanding of perhaps a classic story, the presence (or absence) of other audience members, and the reactions of other audience members to the performance or one another. The stage for these stories, again reflecting the multiple understandings of the case, is the front of house.

However, when we speak of audiences we often remain fixated on the individuals seated in the auditorium, in the orchestra seating, on a balcony, or in one of the stage boxes. We forget that others observe these stories – theatrical directors, ushers, even actors on stage who are waiting for their line.

The second story can be of greater importance to these spectators, and surely their interests attune them to particular aspects of the story. For the analysis here the reaction of the seated audience, especially those seated in the stage boxes who might have a particular importance when it comes to ensuring the future of the show, is important.

Turning this to the topic of the thesis, there were numerous examples with which parallels to this theatre metaphor could be drawn. The chapter describing researchers' discussions surrounding commercial questions regarding the research activity, chapter nine, showed that actors engaged with the front-stage performance, the "audience" in this metaphor, can not only decide how to interact with those "on stage", the PRG researchers (and the USO), to some extent, but may also be actors who funded and set the stage in the first place. The stories with which they leave the theatre, which can also include their interpretations of other actors in the audience, can lead to decisions that could threaten the future of the PRG or the USO through the refusal to grant further financial support, for example.

The actors on stage, in chapter nine the PRG researchers, are tasked with providing a narrative that meets the expectations of the audiences they are concerned with, i.e. not deviate from the "story" of doing research and doing research commercialisation. In chapter six the actors on the front stage – during the installation in the public space – performed their roles and stressed the divide between the activities of the PRG and the work of the USO. In the case study we can understand that efforts could be made to prevent the invasion of the PRG by commercial competition forces.

This concept is not too far from Gieryn's (1983) assertion that science is demarcated by spokespersons who protect it from the controls of government or industry and who preserve the interests of the research community. This is achieved, under Gieryn's model, by actors' selecting the appropriate repertoires based on the interests guiding them. Connecting this to Park's social forces concept, the actors relate to the interests that are most likely to further those of the social group to which they belong.

Returning to the theatre metaphor we can draw parallels with the development of specific plays; researchers choosing to engage with specific research activities, or particular events being highlighted to signal what the intended story is. "Scripts" might be discussed when research funding calls are announced, and reactions from the audience might spark – at least in more improvised performances or when participatory audiences might be a little more difficult to control – a short discussion during the interval to determine how to react to ensure that the on-stage story can be told (when research funding organisations ask about returns on investment figures, cost reductions, etc.). Important to note at this point is the observation by Goffman that performances are expressions of the meaning of tasks performed backstage. In other words, the discussion of "scripts" and fabrication of performances is not an activity designed to deceive outright, but rather an

activity necessary to preserve the activities happening backstage through a more nuanced performance of their meaning on the front stage. This can include the obscuring of activities audiences, often lacking the specialise knowledge of those both back stage and front stage, might not recognise as being essential to the continuation of an activity. Goffman gave the example of sailors in a kitchen leaving their rank at the door, and described how the dropping of the front stage performance was a necessary pressure-valve to ensure the performance could continue as soon as the actors returned to the stage.

However, much like the stage, many of the discussions in the entrepreneurial university are held "back stage" by more senior actors and, like the stage as presented in the projectification discussion (Fowler *et al.* 2015), some actors remain in supporting roles at times and are engaged only in providing a front-stage representation of the back stage activities of for example trying a new design, failing, and trying again. This moves us on to the next mode of resistance, and on to Park's notion of specialised roles, having pre-emptively framed it as a form of collective response.

Park and resistance of the collective

Although the first two modes of resistance presented by Fowler *et al.* (2015) could possibly be inferred from the case study, it is the third mode of resistance to which I now turn, and which in particular seemed to partially reflect the narrative of a doctoral researcher who designed the device for the demonstration project, the details of which were presented across a number of chapters earlier in the thesis. This third mode of resistance was characterised in the article by a division of labour, with researchers "drifting out of research" and becoming a "new breed of project administrators (often youngish researchers with diminishing senior support and/or funding)" (2015, 26).

With a small shift from project management to the forces already outlined in this thesis as being connected to the USO and its (perceived or actual) links to the research group, the argument can be made that this same mode of resistance can be seen reflected in the case study, as explored here. While the "projectification" process is explored in the article from the perspectives of discipline and performance, these ideas are accompanied by connotations of perhaps unwilling participants and authoritative figures, and only really explore the individual as a reactor to forces rather than as a member of a social group and a social actor. Park's work with regard to this can then help in furthering the discussion on forces entering foreign social settings, but for the purposes of this thesis his ideas concerning specialised roles can be taken with the notion of public expression of selected concepts to help us understand how individuals might end up separated from the social group as the collective attempts to resist the influence of externally-arising forces.

Park devoted much of his work on the individual to the relationship of interests to collective behaviours. However, his exploration of the structure of the social can be linked to the notion of specialised roles:

> "When the role of the individuals in the action of the group has become fixed in habit, and particularly when the role of different individuals and their special functions have become recognized in custom and tradition the social organization gains a new stability and permanence which permits it to be transmitted to succeeding generations" (Park 1927, 4).

While the research group has not been active long enough to produce succeeding generations of tenure track actors, the professor entrepreneur being of course still present at the time of writing, the university and research division have existed for much longer, and some of these traditions and customs have already been explored to an extent in an earlier chapter on academic forces. We could perhaps understand some of these academic forces mentioned earlier as they made themselves known in the attempt to divide the researchers within the group into specialised subsidiary research teams with shared specialisations, an attempt that could be argued to have failed because the researchers were driven by their individual curiosity or career needs. However, these individual interests can be seen to emerge as single researchers develop their own specialisations, a necessary part of ensuring the continuous operation of the research group (Etzkowitz 1983).

To take on a specialised role and succeed in it "depends upon concentration upon some single task" (Park & Burgess 1921, 713), and with this comes the implication that other tasks are excluded, or put another way, the individual is removed from tasks not related to their specialisation. Although true isolation is impossible according to Park and Burgess, relative isolation could be understood as a force acting to move the specialised individual (or role) towards the periphery of the social group, and perhaps even out of it entirely into a new or different profession. Such a force can also be seen in the empirical case; in the descriptions of the ideal research group, researchers appeared to reflect the notion that individuals should be sensitive to, and therefore aware of, the activities of others in the social group (1921). If an individual is made to deliberately hide some of their specialised role, they are no longer linked to the collective through the mechanisms by which group members become aware of each other's behaviours.

Key to the idea of the specialised individual and their gradual approach to a profession is the consideration of forces acting upon the individual occupying such a role. Park and Burgess had, earlier in their description of the collective and the individual, outlined the mediating effect the collective had upon individual interests and behaviours, but later in their expansion of this concept they added one more force: "the customs and code of a profession… oblige the individual to act in accordance with ends which to him are not his

own… to take account of interests superior to his own" (1921, 717). They were thus describing the mediating effect the collective had upon individual interests and behaviours. Many of the forces outlined in this thesis appear to have arisen through individuals acting with regard to interests that they themselves did not hold, for example the state agency's commercial questions of the research finance proposal in chapter nine.

The individual in the collective's resistance

This section stays with Park's work on the individual and the collective, and turns to examine how the individual and the notion of specialised roles could be understood as one way in the research group resists and accommodates the various forces to which it is subject, in particular those associated with the commercial realm and industrial product development outlined earlier in the thesis.

Individuals within the PRG viewed the group and the perceived link to the USO in a number of different ways: as a space within which they could build technologies, or as a playground in which they could learn the specific skills and norms of the discipline, for example. The PRG, and the surrounding university, was an organisation they could utilise partly to try to realise their various interests and desires (Park & Burgess 1921). However they were sometimes also aware, perhaps acutely, of the respective norms to which the research group and the USO adhered, and which of these forces were aiding and resisting their individual interests. As such, they sometimes moved around them according to the interests they wanted to express and further. Sometimes however, these desires drew researchers more towards the USO than to the research activity.

Distance between the individual and the collective has been explored earlier in the thesis in connection to the professor entrepreneur and the concepts associated with him enacted by researchers in his absence. In Park's original argument, the distance between the expressed interests of the would-be leader of a collective and those of the remainder of the social group was indicative of the propensity of the collective to follow the individual. The further the leader departed from the interests expressed by the collective, the less likely they were to be allowed to lead the group (Park & Burgess 1921). However, the individual need not be leading, or aspiring to lead, the group for this distance to have an effect, since the individual "finds in the community as a whole… an environment adapted to his needs and one which he is able to adapt himself" (1921, 26). In other words, the individual is aware, to an extent, of his or her own interests, and able firstly to find a social group and secondly to determine through interaction with and observation of other social group members how membership of a particular social group might realise those interests.

This offers two key insights into the experience of individual researchers in the relationship between the research group and the USO. The first con-

cerns the already hinted-at observation in this case study that individuals are members of or can aspire to be members of more than one social group. Literature on academic entrepreneurship suggests that individuals can be a member of one group (the research group) and aspire to join another (the new USO) (Vohora *et al.* 2004), but it can also mean for researchers that they are members of a specific research project, the research division, the university, and academia in a wider sense. Each of these different social groups may have different memberships, different collective interests, and so on.

In Park's exploration of the relationship between individual and collective interests he made the point that collective interests are produced through the interaction of group members and the mediation of their interests until those expressed in the interactions are reflective of the common interests of the group. Here he argued that through interactions with other group members, the individual's internally held interests are also modified (Park & Burgess 1921). Individuals' interests can of course be related to the identity concept, and modification of these to social identity.

Henkel (2005) for example explored academic identity and its formation as a process during which an individual's purpose is to "acquire a clearer private sense of academic identity, together with a recognised public image or reputation", describing what we might understand as the development of a set of internally held interests and a sensitivity to the appropriate interests to express publicly in a given social group. There is some discussion of scientists' decisions to commercialise their work framed as a result of social interaction with entrepreneurial colleagues (Stuart & Ding 2006). Lam (2011) described the different identities of university researchers and their identification with the entrepreneurial act, and identity theorists would argue that actors' concepts, both those held internally and those expressed publicly, are a product of identity work (Alvesson & Willmott 2002). Boundary crossing is highlighted as a particularly interesting focus in identity work, since the boundary crossing individual encounters external forces more frequently, and scholars emphasise the focus of such boundary-crossing individuals as being internal, with them engaged in a search for "inner safety and ontological security" (Lindgren & Wåhlin 2001). However, although identity theory can offer some insight into the movement of individuals between social groups, it places the identity narrative actors tell themselves and their interplay with the social context at the centre of the analytical framework. In contrast, Park's social forces concept frames the individual, the collective, and relationships between individuals and social groups as conduits of social forces, but it is the social forces themselves, and not the actors, that are the central concern.

"The same individual may be a member of different societies, communities, and social groups at the same time" (Park & Burgess 1921, 437), particularly when their doing so is a mechanism by which knowledge transfer is

assumed to happen, such as in this case. If an individual is a member of more than one social group, even temporarily, the argument can be made that they are subject to their individual interests being modified through their engagement with two or more sets of collective interests. Further, that individual may already have an inclination, through her past interests or current activities within one social group, towards interests more reflective of the other social group. In one example in the case study a doctoral student appeared to relate much more easily to interests associated with groups concerned with the technology as a physical artefact; the material suppliers, the students with short-term summer contracts, and the USO.

The second insight concerns the individual and the perceived difference they report between their individual interests and those of the collective to which they already belong or aspire to be a member of. This notion was discussed by Park in terms of the collective's response to leadership attempts and the likelihood of a positive response varying according to the difference the other individuals in the group perceived between the proclaimed leader's (or leaders') expressed interests and the interests of the collective (Park & Burgess 1921). In this section, the relationship is reversed, examining the ease or difficulty an individual experiences in reconciling their individual interests and those of the collective, and how their perception of this closeness might affect their membership of the social group.

The idea that the individual carries a collection of interests with them as they travel (or consider travelling) between different groups, coupled with the notion of individual interests being influenced by the collective interests of those groups, leads to the observation that an individual's perception of the distance between their own interests and those of the groups to which they belong, is itself a potential force acting on researchers (Park & Burgess 1921).

To try to conceptualise this in this case study, the narrative of the individual researcher could read as follows:

A doctoral student begins with a theoretical work, perhaps with some more practical tasks assigned by more senior researchers. They are new members of the research group, but also members of the wider social groups of the research division, the university, and the academic community. These are all places in which they are engaged with the collective interests of learning, educating, teaching, and so on. Within the specific research group they might also be relating to the collective interests of seeking to understand the theoretical and practical science behind a technology, sharing that knowledge with a wider peer group, and eventually also interests related to making the scientific research object work.

As part of trying to construct the research object a few researchers work together over a number of short periods. Some parts can be designed and built at the university, but much of the work requires tools or expertise found at a USO and, with the university test site located just a few kilometres from

the USO facilities, the researchers spend a little time discussing their work with USO employees as they perform the final assembly of the research object, learning construction skills, and maybe persuading USO employees to assist in producing research devices.

Eventually, the interests of a researcher might develop as they spend time in these different activities, and they begin to take one of many directions: into more academic activities or into practical development work, for example. Sometimes they may spend time in one area and decide to enter another, and sometimes other forces mean they spend more time in the same area than another researcher might – we might see granted research funding as one force encouraging researchers to engage with specific tasks, particularly if that funding is dependent upon specific outputs such as physical artefacts. At key points the researcher has to take certain decisions, and their individual interests, modified and mediated to an extent by the social groups with which they have performed their work, are important. A researcher with little less interest in writing articles may well jump at the opportunity to move into the USO, a similar movement might also be seen in researchers focused on the problem of making a technology work. On the other hand, a researcher for whom aspects of more traditional academia have been influential on their individual interests would perhaps seek to remain with, or perhaps increase their involvement in, activities more associated with the university and their research group. In this narrative it becomes quite clear to see how forces can be related to individual and collective interests, and how forces emerge and interact depending to some extent on which social groups an individual engages with.

All at sea?

The title of the thesis was inspired by a drawing made by one of the research participants during an early and somewhat experimental part of the study designed to draw out the researchers' understanding of their work in a visual format. This particular individual was the professor entrepreneur, and he described his entrepreneurial endeavours as standing on a plank balanced on the edge of a ship, telescope to one eye, and sharks circling underneath. Inspired by this sketch, the empirical case is now used to illustrate some of the movements that the earlier analysis presented, and it is important to note at this point that the description offered here is my, slightly exaggerated, interpretation of how the various interests and forces might play out in a case such as this.

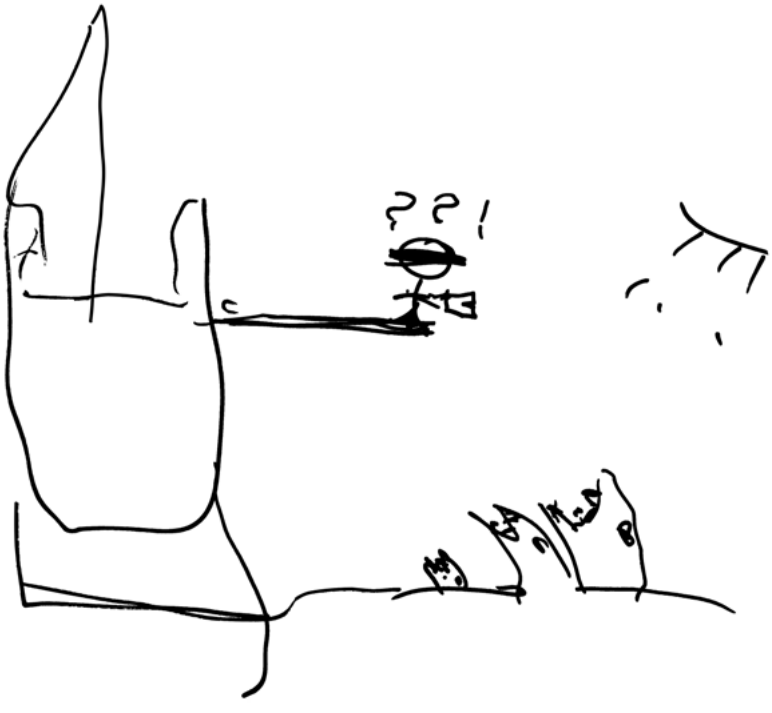


Figure 6: Sketch by an individual in the PRG, 2012

We may see the ship as the university division, home to the PRG. It represented something large, something that could weather storms and arrive at its destination under the guidance of a skilled crew. At the same time though such a vessel is constantly at risk: at risk of damage from outside (weather) forces, or at risk of being taken off course when guided by a crew with an agenda. The plank acts as a launching point, and while some individuals might leap and relish the chance to take on the sharks, others are more cautious, such as in this case.

The plank is interesting with regards to the journey along it, as perhaps a similar journey has fascinated researchers examining USOs such as Vohora *et al.* (2004) or Rasmussen (2011). While the research commercialisation journey is often painted as a path scattered with obstacles and key moments, this walk might instead be seen as steps taken towards the end of that plank, followed by some foundational move backwards, towards safety – not that this was indicated in the same sketch, but a small scribble of an easy chair and a TV in the corner of the same page hinted at the comfort and relaxation that the researcher in question suggested he dreamed of. This movement can be understood perhaps as a step backwards by the professor entrepreneur, but such movements might not be judged favourably by observers: investors, university actors, or other similarly shark-like actors.

Notably, the individual walking the plank in many popular images in film is alone – see Wendy in later adaptations of Peter Pan playing the damsel in distress, or Luke portraying the male hero in Star Wars – with the exception being cases where a male hero is mocked for failing to save the damsel he is made to walk the plank alongside. Is a professor entrepreneur a damsel that needs saving or a hero sacrificing himself to spare others under this narrative? Proponents of the male, experienced entrepreneur (Shane *et al.* 2014), or the "star scientist" (Colyvas & Powell 2007) may have some ideas about that but, as this thesis has tried to demonstrate, these images are misrepresentative of a collection of activities that demand the deep and interested involvement of many actors. Returning to the theatre metaphor discussed earlier in this chapter, we can understand that these exaggerated scenes are often used to draw the eye of the audience away from other characters who may be doing more to drive the plot forwards. For example, Wendy's walk obscured the arrival of Peter Pan and his dashing rescue attempt, and all eyes were on Luke's walk rather than on R2D2, who was waiting patiently to supply him with his weapon, and other cast members who were preparing to fight. In other words, the staging of these walks served to distract the viewer from the surrounding (social) context.

An alternative, making use of the collective this time, allows for a less obvious retreat along the plank – possibly important for actors concerned about the impression such activities could have on current or potential investors – and features instead the professor entrepreneur taking (tentative) steps along the fateful plank while actors around him and tied to the venture (PRG researchers and USO engineers, for example) alternate between drawing the plank slowly back into the university and hammering new planks on the end to lengthen the journey. This is of course a very rough analogy for the efforts of the actors in this case to maintain the USOs connection to the relatively safe university whilst at the same time not technically being in the boat. However, it hints also at an increasing fragility as the plank / journey lengthens – will they continue to source what they need to continue building, or will those around tire of their antics and push them off? Will the plank continue to hold the weight of the increasingly cumbersome venture, or will it eventually break under the strain? Considering the USO and the PRG as undergoing an iterative journey, rather than a linear or stage-based development, offers us a new conceptualisation of this phenomenon.

Iterative spinning: the case

To frame this analysis it must be observed that most of the events reported in this thesis took place between the years of 2011 to 2015, when most of the observations were made. However, some individuals in the case had been involved with the research group and, or, the USO for a much longer time, some even to the very beginning of the venture. This meant that some events, episodes that had occurred in the years prior to those that could be

directly observed, were also somewhat accessible – individuals could recall their experiences and there was also documentation in the form of patents, media, and financial records. Although these years could not be explored in as much depth as those occurring more recently, what became apparent was a movement back and forth from the research group to the USO – of individuals, ideas, the focus of individuals who had a foot in both, and so on. This seemed to be a series of iterations that could be described as commercialisation attempts, according to Vohora *et al.*'s model (2004), immediately followed by resistance to the commercialisation activities and subsequent refocus on the research group's activities.

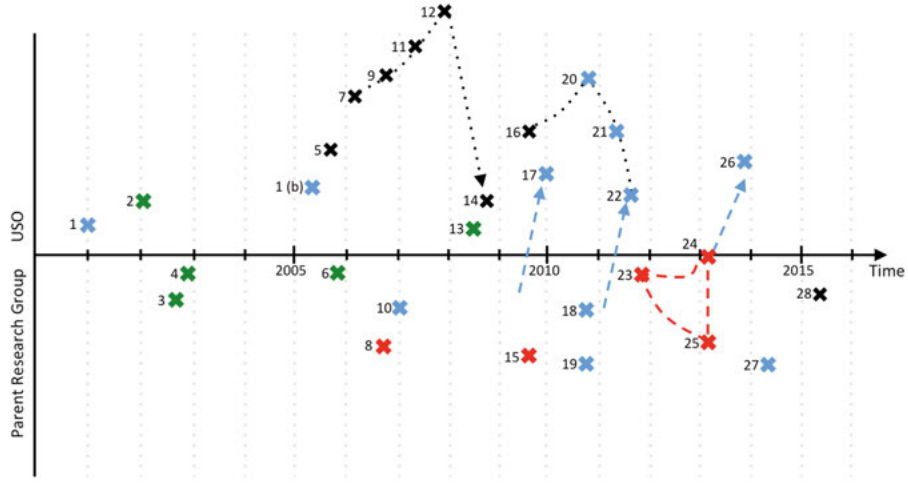


Figure 7. Timeline indicating events in the case study

Table 2. Key to Timeline

1.	**USO founded (2001 holding company, 2005 (b.) daughter production company)**
2.	**1st patents (app. Jan 2002)**
3.	**1st thesis (MSc) (June 2002)**
4.	**1st article**
5.	**Discussions with potential customers**
6.	**1st thesis (PhD)**
7.	**1st order for pre-study evaluation**
8.	**Installation of first PRG device**
9.	**Pre-study evaluation of site**
10.	**7 students**
11.	**Raise financing**
12.	**1st test device order**
13.	**Patents extended to regions**
14.	**Order failed**
15.	**Installation 2nd generation device**

16. **Multi-Actor demo project granted**
17. **Researcher to USO**
18. **Structure meeting**
19. **13 students**
20. **Specifications to USO**
21. **USO device not fit**
22. **P.E. to USO**
23. **R&D to PRG**
24. **Construction PRG device**
25. **Installation PRG device (3rd generation)**
26. **PhD to USO**
27. **Researcher tries to organise**
28. **Research funding meeting**

Green: Codified knowledge / articles / patents
Black: Financial-centric events
Blue: Organisational events
Red: Technology / physical artefact

So how might such an iterative model play out? This constructed narrative is based on the interests, forces, and movement outlined in this thesis, but we can also see how utilising Vohora *et al.*'s process model (2004) can help to illustrate the movement through increasingly commercial activities, as sketched in figure 7.

The events initially looked like a reflection of an idealised academic entrepreneurship: an inventing and driven professor teamed up with his experienced and business-savvy friend to offer the world an innovative new technology. Tools were developed at the university, everything from the software used to simulate the various designs and test conditions to the engineers hired at the USO straight from graduation. The technological concepts determined to be commercially promising were relocated to the USO headquarters and a factory close to the university test site, and commercial activities began. This reflects Vohora *et al.*'s (2004) critical junctures, *opportunity recognition* and *entrepreneurial commitment*, which could be inferred as occurring around points 5, 1 and 2 respectively.

First iteration

In the first iteration, the commercial technology development activity was pushed to the USO, hovered for a time between the university and the company until it could no longer be sustained, and eventually withdrew to the university. When a doctoral student completed their studies there could have been opportunities at the USO, particularly if they were closely involved with the design and construction of the technology at the university. They had become familiar with a number of the problems facing the development

and had both direct and indirect knowledge of some of the solutions, certainly more so than anyone who might be hired from industry.

Vohora *et al.*'s (2004) *pre-organisation* phase can be read in the timeline, following the escalation of events through points 7, 9, 11, and 12. The first USO prototype was created for installation, a small demonstration project negotiated by the business partner at the USO and with a national utility company as a customer. As the spinout was a very small organisation at the beginning, certain resources from the university were utilised. These included part-time and temporary employment of doctoral students part way through their studies, and the purchase of time using university simulation software. The USO engineers began to realise the economic pressures of spinout activities and they saw the need for, and introduced, their own investigations into production methods.

Despite problematic results from the factory tests of the resulting prototype it was installed anyway, and the project fell through (point 14). The venture had failed to progress through the critical juncture of *credibility*. Conflicting stories emerged from those involved. The relationship with the customer was difficult to re-establish, and they lost interest in the USO and the technology. By this time a number of the USO engineers had either turned to pursue doctoral studies at the university or had decided to leave the venture entirely, some citing the relationship with the academic entrepreneur and the professor entrepreneur as a factor.

The first iteration described here showed how the engineers were dependent upon resources that could not be found at the USO, and so they were forced to return to the place where the resources were located, the PRG. Faced with new issues and pressures, and commercial questions not addressed at the university, the engineers had created their own sets of knowledge. These same commercial forces located at the USO and enacted by the academic entrepreneur at the USO were blamed by some of the engineers for the pressure they felt to install the technology before they were confident that it was ready, and small but important mistakes were made. Having failed to successfully demonstrate the technology in a commercial setting the USO engineers moved away from the technology development. The environmental, administrative and business management remained in a much-reduced USO organisation, and activities at the USO continued with preparatory works such as site surveys.

Second iteration

Sometime later the USO secured financing for a huge demonstration project (point 16), supported by a state agency and co-financed by another utility company, beginning the second iteration. With a diminished technology development division at the USO, a number of engineering consultants were hired. Researchers who had completed their doctoral studies moved to the company and were this time joined by engineering consultants and business

managers. Again they were working under the business partner rather than the professor entrepreneur, and points 17 and 20 show them pushing again to get through the phase of *pre-organisation*.

Increasingly frustrated as the deadline for the first installation of the demonstration project approached, the professor entrepreneur reiterated the design specifications and removed the managers between him and the USO engineers. To keep a close eye on progress he held regular meetings with the USO engineers, which are rumoured to have been "rough". However, in parallel he selected a doctoral student at the research group for a project. They worked up to and over the summer, when the university and USO were empty for the scheduled holiday period, to design a new version of the university technology.

The student suspected that the version they were developing was intended for the USO, and just a few months later these suspicions were confirmed. The professor decided that the construction design division at the USO should be scrapped (point 21 in the timeline), and he pulled the university researchers at the USO back to the university. Thus ended the second iteration.

The third iteration was incomplete at the time of writing this thesis. It could be the same as the previous two, but the stakes were much higher; rather than being a few devices at a test site the demonstration site was in the magnitude of hundreds of devices and the cost considerably higher. The doctoral student who had invested the most time in the device built at the university during the second iteration had completed her studies and had been placed as the head of design at the USO, making her an additional doctoral student who had made this transition.

Iterations: what might they offer actors in such cases?

Commercialising research is clearly not an easy task, as we can see from the case presented throughout this thesis, and setbacks such as those highlighted could be quite common even if they are rarely described. Shifting completely out of the empirical case now, it could be argued that some of the forces described in chapter ten give rise to a need to have a stock of narratives on-hand to counter notions of failure that might, for example, arise amongst observers, and place certain interests at risk.

The iterations offer the actors, both those involved and others observing, narratives of repeated efforts to progress towards commercialisation. These narratives describe the university support and offer apparently solvable problems as the causes of the failures, failures which rely on something of a hero to bring the development activities under control again. Each iteration offers a potential resolution of the issues faced during the previous one, for example through the replacement of USO engineers with trusted university researchers.

Why is this important? There are two main issues to focus on. Firstly, such narratives present the reasons for returning to the university in ways that highlight the competence of academic researchers, since they are able to step in to change the problematic parts of the organisation underneath them when the organisation fails to deliver on the promises made to project partners. Although such an understanding could be contested by actors who have interests which give rise to forces such as traditional academia, these ideas could be supported by USO actors or actors invested in the USO's activities, who could instead relate to interests associated with the academic entrepreneurship force, for example. They also reaffirm, in other words the importance of the relationship with the university research activities, and also support notions of the university research as contributing to the on-going efforts to commercialise a potentially important technology, reflecting concepts of the innovation system force described in chapter ten. For investors such as the utility company co-financing the huge, multi-million kronor demonstration project for example, seeing that the university research they supported in the past had a link to the commercial development of a technology they were interested in was an important factor in their financing decisions.

On the other side of this, narratives of the researchers' work being realised in the commercial setting reflects the academia envisioned by such organisations as KIC InnoEnergy and other research resource providers (KIC InnoEnergy 2016b). Playing up to these ideals as a research actor returns the analysis to academic capitalism (Slaughter & Leslie 1997), particularly with regard to the academic capitalism science and technology strategy force outlined earlier. Academic capitalism helps to explain much of the forces driving activities that research funding organisations may respond more positively to, such as construction, since we can understand that researchers may present themselves in a certain light to secure essential research resources, and academic entrepreneurship may help to explain why university researchers, at least from tenure-track positions, start their own companies.

In contrast to the images provided by Vohora *et al.* (2004) of the venture moving from all-research activities to mostly-business activities, the iterative narrative presented here suggests that the movement is instead between social groups reaching out over the organisational borders of the research group and the USO. There is no single organisation moving towards a future state of "mostly business"; instead there is a gradual growth as a PRG and an associated USO benefit from the movement of things between them, the movement of things from mostly-research to mostly-business, and back again.

However, in line with discussions in literature on academic entrepreneurship and academic capitalism and in the empirical material in this thesis, the divide between the two separate groups is an important component of establishing legitimacy. A research group could not (or should not) secure fund-

ing for research activities if those same activities are performed purely with the intention of developing a commercial product for example, nor could a USO convince would-be investors and customers of their credibility as a company if they appeared to be heavily dependent upon their parent university research group (Vohora *et al.* 2004, Wright *et al.* 2006).

It could be suggested that researchers are able to play up to concepts of R&D and entrepreneurship when the possible results of such expressions are resources they need for research activities. This would reflect a partial acceptance of the forces, and could be seen for example in earlier chapters with researchers "claiming" certain activities as originating within the research group, or in applications to research financing organisations where construction was a central component of a proposed project. However, despite these instances, academic forces demand certain activities and the production of the outputs of academic science, and these must take place otherwise the research group could collapse. This would suggest that alongside the acceptance of forces from the commercial realm for example, researchers must also resist these in order to preserve the academic character of the group.

In this chapter Park's work on specialised roles within the collective was taken up in conjunction with work into resistance and accommodation of forces as they move into new contexts. A short discussion considered an actor concerned with development work as occupying a specialised role within the collective, and suggested that such a division enabled the collective to resist (commercial) social forces. Additionally, the analysis considered how such a role might expose an individual to different social forces than those normally encountered by others in a research group, and how such exposure may lead to the mediation of an individual's internally held interests and motivate their eventual trajectory through the research group and, perhaps, into a USO.

12. Conclusions

Following the exploration of the forces at play in the case study, the thesis now draws to a close. To end, a short summary of the thesis will be followed by some concluding statements regarding the main findings of the case study, personal reflections on the study in a wider context, implications for practitioners and researchers, and some ideas for future research.

Summary

The thesis took off from my own experiences as I began life as a doctoral student, quickly moving into a brief outline of policy initiatives concerning research commercialisation, and scholarly understandings of the creation of companies from university research.

A number of potential issues were outlined at this early stage, varying from expectations of research commercialisation indicated by the material briefly covered existing in conjunction with a fuzzier, and less easily defined, relationship between industry and academia that my early interviews had indicated existed, to the possible limited focus of the literature that sought to understand the topic. Turning to social forces, three research questions were proposed:

> How can a social lens help us to understand some of the social forces at play in research commercialisation (specifically through the early development of a USO from a parent research organisation)?

Following this, and in connection to observations of individuals' within the research group and the USO, a further two research questions were suggested:

> What social forces might we see in a parent university research group connected to a USO, and how might these be reflected in researchers' activities and observations of the research activity and assumed links to the USO?

> How do university researchers within the research group experience and negotiate these forces?

The literature review began with an outline of the main fields of research: academic entrepreneurship, and academic capitalism including the entrepreneurial university. In this section the argument was made that these perspectives considered the creation of companies to commercialise academic research, or USOs, as a process affected by and characterised as an acquisition and application of development stage-appropriate financial and competence based resources. Further, I argued, such approaches were limited in a number of ways.

Firstly they focused on factors and events immediately prior to and after the decision to begin moving from the academic realm to that of industry, and when a longer-term perspective was taken it only addressed the business and its development. These failed therefore to consider how on-going relationships between the USO and the parent research group after the initial commercialisation decision played into their respective activities. In particular, the knowledge function of the university and the development activity on the intellectual property created within the research sphere to translate it into a marketable product remain hidden. This is important because, as the literature review outlined, product development is an important factor in the potential success of an organisation.

Secondly there is a widespread focus on individuals or small groups of individuals as the entrepreneurs, typically identified as experienced entrepreneurs and faculty. Although actors such as university policy makers and technology transfer officers make an appearance they are characterised almost as tools of the entrepreneurial university. However, narratives in the literature exclude other individuals who inhabit other roles within the university or USO who may find themselves engaged with the entrepreneurial act, individuals such as non-tenured researchers, doctoral students, or USO employees.

The social component of the entrepreneurial university and USO creation was proposed as an interesting area of study that could complicate existing narratives in literature and in practise. Researchers in related disciplines such as the sociology of the academic disciplines, academic identity, the socialisation processes of doctoral students, and even studies into social ties with actors outside of a venture, have highlighted the importance of considering social aspects as researchers conduct their work and as entrepreneurs build new companies.

After presenting Park's notion of social forces, the methods employed to conduct the research project, and the methodology underpinning the case study, the thesis moved into the case study itself, first providing an outline of the case constructed as we might expect scholars who focus on concepts in the established literature could. Without an immediate analysis of this, the narrative was followed by an exploration of actors' experiences of the research at the centre of this case study, and of their experiences of the research group's connection to the USO. A number of contrasts were revealed

between the expectations that actors seemed to hold and the concepts they referred to in describing their experiences; the university research should be ahead of the USO according to some, but their own experiences suggested that the USO had advanced further in some areas, and the division between the two should be clear but some actors assumed they were very close, even co-dependent, at the extreme. It could be argued then that actors related to concepts in their descriptions that suggested that research could be a structured, learning, and information-rich activity within which actors were driven by individual curiosity and yet worked to reach a common goal, often across organisational boundaries. There were also suggestions of actors relating to concepts that were similar to more traditional ideals concerning research and wider society; linear movement of knowledge from academia to industry was "typical" for example. However, a more contemporary concept also emerged on this topic, that actors' movement back and forth between academia and industry was a way through which they could stimulate activities in each area.

Although these contrasting concepts emerged in actors' descriptions from within the PRG and the USO, external actors also related to understandings of research commercialisation, and chapter five began to address this. A large-scale demonstration project involving the USO, a state innovation agency, and a utility company, revealed how actors' concepts of the differences between academia and industry appeared to help them understand some of the tensions and opportunities they faced in their activities. For external actors – the utility company and the state innovation agency in particular – an assumed link between the PRG and the USO, despite the PRG's lack of involvement in the demonstration project, was a concept that appeared to drive their engagement with the project and the USO.

One concept that doesn't make an appearance in literature on USOs and the wider field of research commercialisation is that of product development, a concept that actors in this chapter seemed to relate to when describing the activities of the USO and of the PRG. However, actors involved in the demonstration project and not with the USO or PRG appeared to assume that the product development activity was in a much later, cost focused, stage, whereas actors more intimately involved with the technology (and in some cases the PRG) appeared to describe it as being in a much earlier, and perhaps even experimental, stage.

A key component of understandings of knowledge transfer between the PRG and the USO presented in the empirical material is that of individuals' migration between the two. Through the presentation of the events of a single day as understood through the concept of social forces, chapter six outlined how individuals who moved between the PRG and the USO related to these two social groups, according to the interests they wished to further at a given moment, throughout the final construction and preparations for the installation of a PRG research device. The activities of three individuals

from the research group revealed how they performed roles specific to either the PRG or the USO to, for example, publicly assert the PRG's interest in the research device being installed, and perform the activities required, using USO resources, to finalise the construction of the unit.

One interest named earlier in the thesis was that of some researchers' desire to see the research group structured, and a description was offered in chapter seven of one meeting that focused on, amongst other questions, the issue of structure within the PRG. One attempt made during the meeting was the creation of a number of sub-groups, each focused around a specific area of the technology on which the PRG concentrated their efforts. A number of other proposals that researchers appeared to react positively to included the introduction of further meetings to agree on publishing research outputs, and the re-introduction of tools to increase knowledge transfer within the PRG.

However, despite expressions at group meetings that suggested that actors were interested in these initiatives, they were often reported to have failed after initial efforts had been made. This chapter argued that interests expressed in the collective could fail due to other interests within the group countering those driving the initiatives; for example, some activities that were of benefit to the collective were not perceived as nor were they actually rewarding for the individual performing them in terms reflective of a capitalist academia, such as opportunities for publishing or career progression. Other forces that could have opposed those behind the structuring initiatives included those we could associate with socialisation to a group, with individuals perhaps observing that (more senior) actors did not appear to value certain activities, and concluding that efforts made with regard to other activities, such as publishing, might be more important for their group membership.

Park explained that social forces arise as the individual seeks to realise (internally held) interests through interaction with other group members (and to some extent with non-group members, as we might understand from chapters five and six). It follows that when an individual who is a regular part of those social interactions is no longer involved, or is involved only to a limited degree, the social forces at play within that particular collective are altered to reflect the new combination of actors expressing interests. Chapter eight explored the notion of absence through the movement of one individual, the professor entrepreneur, and suggested that although based on Park's concept of social forces and the collective we might expect that an individual ceases to influence the social forces at play in a social group during an absence from a social group, it might not be so simple as those forces being removed from the social setting and disappearing. Instead, other social forces associated with the professorial role within a traditional academic setting appeared to give rise to other actors who remained within the PRG turning to their own concepts of the professor entrepreneur and expressing interests they associated with him, sometimes explicitly. In other words, other actors

seemed to try to further the interests they associated with the professor entrepreneur, sometimes directly referring to him and his wishes, when he was not immediately present to perform those expressions himself.

Chapter nine further explored social forces with regards to individuals' expressions of interests, but this time extended the exploration beyond the movement of individuals into, out of, or between two groups, by considering how an individual may be able to cause social forces to arise within a social group of which they themselves are not, and in the example explored in this chapter have never been, a member. Here, questions posed by a research funding agency representative to researchers at the PRG referred clearly to the economic development of the research device. Researchers worried that the PRG device they had applied to the agency for funding to build was at risk of being compared, in financial investment terms, to a commercial device or to other proposed devices from other universities. The professor entrepreneur appeared to be concerned that the research funding agency representative assumed the relationship between the PRG and the USO was close when, he argued, this was not the case. The questions posed by the research funding agency representative revealed that the external actor referred in his assessment of these particular funding applications to concepts of product development, but key here was that the researchers' discussed the risks of such assessments as being related to research resource provision – in other words, they referred to concepts of academic capitalism.

Looking back at these empirically-driven chapters, the thesis moved on to conceptualise five social forces that can be inferred from the findings of each chapter: Academic entrepreneurship, Commercial strategy, Academic capitalism (science and technology strategy), Innovation system, and Traditional academic values. These were argued to arise in and around the PRG and the USO in numerous ways; in researchers' descriptions of their challenges and opportunities, in arguments they used to persuade others to perform certain tasks or grant them resources, through university structures, traditions and symbols, within innovation supporting policy initiatives, and even in decisions with regard to, for example, material changes in the technology at the centre of this case. In Park's terms, they emerged in the numerous social interactions, tacit and codified, of the social groups described here, and in the symbols and tools that characterised them.

Through revealing that these forces are in play at various moments we can understand that the linear process of resource acquisition and application presented in literature on USO creation and in popular discourse is of limited use for exploring such cases. Chapter eleven presented a reconceptualization of the activities we might see taking place, which accounts for the many – and sometimes contradictory – ideas of how university research groups and USOs relate to one another. Park's concepts of the individual and their place in the collective also helped to conceptualise how social groups resist social forces.

A somewhat key difficulty suggested by the empirical chapters was the contradiction in relationships that were seemingly expected by research funding organisations and state innovation agencies. Simply put, the interest in seeing academic research put to practical use in an industrial setting, seen in this study in the state innovation agency, can conflict with the interest in establishing and maintaining clear boundaries between the university and companies, an interest which in this case could seen in the professor entrepreneur's descriptions of the legal demands placed upon the research group. However despite the professor entrepreneur's reports of giving clear directives and despite the actors who were interviewed seemingly understanding the need to have clear organisational boundaries, some actors still crossed them. One way to understand this is to differentiate between organisations and social groups, which can be achieved through the concept of social forces; individuals may remain a member of a social group such as the PRG, and yet cross into the USO in the pursuit of technology development interests, for example.

With social forces in mind, some experiences reported by research participants can be understood in terms of their ability to work with or resist social forces, particularly if the social forces under consideration appeared to cross organisational boundaries, as suggested is chapter nine.

In seeking to conceptualise resistance to social forces, the analysis turned to a recent interpretation of Goffman's concept of front-stage and back-stage to explore the notion of research and activities surrounding it, highlighting the divide between the on-stage representation and the activity to be preserved that remains back stage. This short discussion led into the presentation of the individual in a specialised role, remaining with the notion of resistance, as one way in which the interests of the social group were presented and furthered.

Park's concept of the specialised role suggested one motivation for individuals to move through, and eventually out of in some cases, a social group. Here the image of the theatre helped in suggesting how the performance of a specialised role within a group exposes an individual actor to social forces associated with a particular audience or with the role they occupy. Park described how an individual's internally held interests were mediated by the social forces to which they were exposed, and we can understand then how the occupation of specialised roles, performing activities more closely related to product development for example, might lead to an individual to be motivated to pursue new or strengthened interests outside of academia. This speaks to existing literature on academic identity and entrepreneurialism in supporting the assertion that association with entrepreneurial individuals, particularly if they are part of the same social group, can increase the likelihood of a researcher behaving entrepreneurially (see for example Colyvas & Powell, 2007 or Obschonka *et al.* 2012). However it also expands upon Vohora *et al*.'s (2004) USO process model by suggesting that the individual

(or individuals, as this thesis has suggested) may be for a time a member of multiple social groups, both the research group and the emerging USO.

Staying with specialised roles, the analysis presented a final critique of the focus of current literature on specific, often higher-status or "star scientist" (Colyvas & Powell 2007), the individuals in focus in narratives of academic entrepreneurship and the USO development process. The plank from the thesis title was finally presented as a metaphor for such a narrow focus in order to suggest the importance of actors who are supporting, and yet often invisible, characters close to the nascent venture. Through allowing the academic entrepreneur to take centre stage (or to walk the plank from the entrepreneurial university into a USO and industry alone), surrounding actors were able to safeguard the interests of the social group by, in the example given, prolonging the USO process in an effort to motivate the support of (external, but possibly also internal) actors for both the research and the industrial activities. Such a reconceptualization shifts the rather simplified and linear process of USO creation into an iterative, back and forth effort through the explicit, rather than implied, inclusion of the research activity. The analysis concluded by suggesting that iterations, in contrast to a linear or unidirectional USO process, offer narratives of entrepreneurialism to satisfy the forces of academic entrepreneurship for example, and at the same time allow for narratives that motivate the continued necessity of the research group from which the USO had emerged, in order to satisfy forces of academic capitalism.

Concluding statements

Something else was going on beyond what the resource based literature could tell, and Park's social forces helped to explore this. Conceptualising the commercialisation of academic research in social terms helps us to understand it as the movement of artefacts of research into commercial application, combined with an emerging structure, currently consisting of literature on the topic and the organisation of actors to assist in and perform the commercialisation activity, such as university incubators, university investors, etc. However, as the recent coverage of the problematic aspects of USO involvement for researchers at a neighbouring university perhaps hinted at (Kleja 2016a), there is a distinct lack of understanding of how university research groups and their respective USOs relate to one another, how ideals of academic entrepreneurship, so ardently promoted by university administrations, are transformed into forces within academia, and how these forces are actually handled in practice when they encounter other forces already prevalent within academia.

Woven throughout the case were questions concerning the individual and their relation to the various social groups of which they were members, as

each individual could choose which of the collectives' interests they wished to express in a given interaction, and these collective interests mediated the individual interests through interaction with other group members. This gave rise to resistive forces, such as when actors in positions of *Authority* were unable to enact their will because they were too far from the collectively expressed interests.

University researchers within the research group experienced and negotiated the forces identified here through their relationship with the collective, or rather collectives, of which they were members. In many of the instances in which an individual felt forces they were able to determine whether the force was conducive to their individual interests and whether it was appropriate for the group in which they were conducting activities at the time. Sometimes they could then either move, for example from the research group to the USO or the other way around, in order to try find a place where the forces acting on them in the different group were complimentary to the force they experienced. This could be for example when they were working at the USO and were unable, due to commercial forces, to investigate a problem to the depth they would like to. They could then move back to the research group and their role as a researcher, and act under the concepts of traditional academia to really dig into the question.

Occasionally forces would enter a place where they were unexpected and inappropriate, given the other forces already prevalent there. These could carry with them serious consequences if the forces were not handled in a way the actor exerting the force was satisfied with, and so the individuals affected could turn to others in the social group to try to determine how best to resist these forces. One example given in the thesis was that of the commercial questions posed in a series of research funding proposals, an unexpected response for many at the observed meeting. These caused the researchers to organise temporarily to establish what interests were appropriate given the situation, and then to agree upon a co-ordinated response to these questions that would, hopefully, reinforce the academic norms and resist the commercial forces.

Finally, some forces combined in such a way that resisting them fully was a potentially dangerous act for the collective organisation and those with whom a strong link was assumed. In these instances a partial acceptance was required in the form of a small portion of the group gathering as a way to absorb and satisfy these invading forces, and prevent these forces from working their way further towards the remaining group members. This can be seen, again, in the meeting to deal with commercial questions in a research funding process, but also for example in students engaging in construction activities when others were more concerned with interests related to traditional academia forces. The thesis also posited actors' individual interests and their relation with forces around them in the social group as motivating their movement to other social groups. One example was a doctoral

student who was more interested in technology questions than producing artefacts associated with traditional academia, and who on graduation took the opportunity to move to the USO where they could further their interests without the (academic) forces that offered the potential to conflict with them.

Personal reflections

For my own part, I struggled at first to see what was so unusual with this case. Of course we should see scientific research leading to societal benefits – why else would we do science? In an earlier work, which did not fit into this thesis, I tried to tell the tale of Mårten Triewald and his Newcomen machine in the 18th century in Sweden. He, along with some of his contemporaries, established what we now know as the Royal Swedish Academy of Sciences, and he had argued strongly for the industrial application of scientific discoveries. By a long and winding road through the centuries, his work eventually led to NUTEK, and from this VINNOVA and the Swedish Energy Agency (Persson 2008).

After reading about these extraordinary historic figures and their connection to the organisations and paradigms surrounding academic research, it seems that pragmatism is woven throughout the modern university context. What is knowledge, if it is not useful (James 1995)? And following that, I understand my own naivety in my first descriptions of this case. This is an exciting case for me not because it is a university spinout company still coupled to its parent research group over a decade later, and not because some observers question the morality of two organisations like these (Kleja 2016a).

Rather, it is interesting because it seems that the boundary between industry and academia has always been blurred and pushed about by interested actors from the academic, industrial, and even state realms. The Mertonian ideal is just that, an ideal, and yet, since the advent of the physical sciences pushing in on the academic space previously occupied by theology and philosophy, there are few who, while considering a case such as this, might not struggle with the difference between the idealised concepts they could have of science and the experiences they have in their day to day realities. For many of the researchers I met, being involved in the research group in this case study was more than producing articles and teaching; often those within the research group in this case study were driven by a desire to see the technology work, some were driven to see it work on a commercial scale, and others were less invested in the technology itself and saw the project as an educational phase in their lives, and the technology a playground within which they could practise their craft. Many saw the blend of education, research, and technological playground as a positive, albeit occasionally difficult, place to work, and this struggle is something that I feel neither the liter-

ature nor popular conceptions of research taking place in the idealised entrepreneurial university succeed in capturing.

From outside of the research group though, questions have been raised. That of the value of the research activity, and the link between the research group and the apparently perpetually spinning out USO, is really more of a question about what we, as a society for example, want in return for our research funding investment. It seems that much of the debate about this revolves around the separation of several functions of the university – those of knowledge production and of knowledge dissemination and learning. Research is often, and in some views erroneously, idealised in this debate as being an exploration of the world, the outputs of which should be published and discussed amongst academics, and not transferred into the industrial realm without proper compensation, whatever that might mean, to the realm of academia.

Limitations of the work

One obvious limitation of my findings has been the access I was able to gain to the stories and episodes of the case. Despite repeated approaches, a number of researchers and many from the USO were not interested in taking part. It must also be considered that those who had a particular interest in telling their "side" may have been more responsive. This means of course that there is a likelihood that the episodes described here and the understandings outlined, along with the interests and forces emerging from the analysis of the data I collected, are unfortunately only a limited collection of those that could have been revealed through a more invasive study.

The nature of the descriptions gathered leads into the next limitation, which is that often they diverged from or directly conflicted one another. This is problematic for producing a cohesive, objective history of the case, and I did not therefore attempt to write one. Rather, I told the stories I could and produced a thesis that, in my view at least, utilises the breadth and variety of the different versions of events to explore the case with regard to the social forces informing them.

In terms of the social forces in this case study, an important observation and limitation is that they were only considered with regard to how interests associated with them were expressed in interactions between actors and between actors and myself. They were not examined to determine their origins beyond a (somewhat vague) note regarding the direction from which they could have entered the social groups in question. It is assumed in this thesis therefore that there are social forces that are interests that exist within the wider social context but which only arise within a social group when they meet, within individuals or within social interactions, interests to which they either offer support or resistance.

Implications of the study

Although Etzkowitz has already implied a bridge between academic entrepreneurship and academic capitalism through his description of the entrepreneurial university and academic entrepreneurs, this thesis has offered a strengthening of that link through the exploration of a case in which forces are drawn to some degree from the two areas of literature.

Theoretically then the thesis offers a complication of the academic entrepreneurship and academic capitalism / entrepreneurial university narratives, but it also provides an empirical complication of through the consideration of the voices of actors who would not normally enter into such descriptions, such as non-tenured researchers, doctoral students, and USO employees. Chapters four and five outlined concepts to which many non-tenure actors related, and chapter six highlighted the activities of three actors in particular who would not normally enter into descriptions in the literature on USO development, and how their performances in a public setting could be understood as expressions of social forces. Chapter eight complicated popular conceptions of the professor entrepreneur, a figure we might recognise from out-dated descriptions of the heroic entrepreneur, by considering the individual as a member of a social group. Here the concept of social forces helps to conceptualise the entrepreneur as just one individual from many who can express interests and exert social forces concerned with the activities of entrepreneurship.

A minor contribution is also of course that the thesis furthers Park's notion of social forces and the individual in the collective. This was achieved firstly through taking Park's understanding of how newcomers to a group can influence a collective and turning this around to consider how an individual's movement out from the collective, albeit temporarily in this case study, could alter the social forces at play and the collective. A second extension came in the form of an exploration of social forces as they entered a group, framing them not as a consequence of an actor's movement into a social group but as a way through which actors who remain external to the group could exert social forces on some group members. This leads into the next extension, which considered Park's concept of specialised roles as one way through which a group could resist social forces.

Implications for practitioners

Park and Burgess often spoken of interests as the precursor to forces, forces being the interests translated into a will exerted by an individual, and this raises a question from a sociological standpoint that some researchers in this case study expressed: what happens when the technology works? Despite the research group and the USO sitting as neighbouring social groups and con-

taining their own unique blend of collective interests, one central interest they shared was to create a commercially viable technology. This, in line with Park and Burgess' notion of interest as an unsatisfied capacity (1921, 455), leads us to question what might happen when this particular driver of forces is satisfied. This driver appeared to lie behind many of the forces apparent in the case; the researchers theorised, calculated, constructed, and tested to try to satisfy this interest, and the USO engineers designed and constructed, and these are not so crucial if we imagine that some interests might shift as the technology begins to prove itself, and the two may spin away from one another and towards other neighbours.

But for other actors, from those within the PRG to the partners in the USO's demonstration project, the drive to see a commercially viable technology was bundled with the belief in a linear progression from research to industry, and in the essential link between the academic and the entrepreneurial. Without the perceived need for such a link, would the research group secure the resources to continue doing what they did in this case study? There is no clear answer at this point, but the threat of completing the spinning out of the company and severing the need for a link between the two, even one which might only exist in the imagination of actors, can be understood as one interpretation of the removal or modification of one set of forces that held the research group and the USO in a somewhat stable state.

Such forces were not limited to the state agency and utility company described in this thesis. Returning to the EU-wide partnership with industry and university actors, KIC InnoEnergy, and the PhD school (KIC InnoEnergy 2016b) described at the outset of the thesis, we can see how such programmes might be leading to the proliferation of the forces described in this thesis within the realm of academia. Promises of funding for the research department and offering PhD students a career advantage outside of the laboratory seems like a sensible way to provide the growing number of PhD candidates with skills needed for careers outside of academia (Regeringskansliet 2007). With research departments perhaps seeing programs such as these as a way to secure resources, we can understand that these commercial ideas might be welcomed, at least in part, by research leaders. However, the ideas and concepts promoted by perhaps well-meaning initiatives demonstrate a lack of understanding of research and the education surrounding it. Courses explaining how to do innovation and entrepreneurship are not courses in scientific research, and doctoral students only have so much time available to learn to perform research in their subject area, engage in departmental duties such as teaching, and assist in research group tasks such as construction activities. This of course sits at odds with the Mertonian ideals of research many simultaneously appear to aspire to.

Further, the PhD school appeared to be designed to encourage students to focus on the commercial applicability of the research they, and others around them, were performing; this seems problematic when taken in conjunction

with an article in Ny Teknik, a popular science newspaper, which was critical of the USO creation phenomenon and identified a number of risks of engaging university personnel in commercially linked activities (Kleja 2016a). One central issue highlighted in the article was the blurring of the line between the research and the USO activities, something the article suggested amounted to excessive support of the USO by the university from which it originated, and exploitation of doctoral students, university technicians, and other researchers' research. The answer, the journalist argued and the university administration agreed, was to fairly compensate research that found its way into a USO, and to establish strict guidelines for the separation of the research group and the USO. A subsequent article announced the university's intention to investigate the extent to which academic resources were being used to support private ventures spinning out from the university (Kleja 2016b). However, this thesis demonstrates that such a view is an overly simplistic and naïve one. When a USO emerges from academia, cutting the cord is rather more complicated than applying for patents and keeping economic concerns separate – both occurred in this case, and yet still the two organisations were linked.

The linkages described in this thesis came in the form of social ties, technological ties, and individuals carrying knowledge and ideas with them despite their attempts to separate their university and industry roles, for example. It also came in the form of imagined ties that informed the concepts actors used to understand the research and USO activities, and this is perhaps of greater consequence for the research activity for example; actors with significant power over the research group through their control of essential research resources gave rise to forces, knowingly or otherwise, to drive the research group into activities which were further and further towards what some researchers worried was outside of the mandate of academic research.

Looking at a case study of an attempt to commercialise the results of university research through the creation of a USO, and seeing how those links emerge and came to affect the activities surrounding the research group, helps us to see that – perhaps naïve – assumptions are in fact a factor in this story. They turn up too in literature on the topic, particularly in Vohora *et al.'s* model of critical junctures (2004). In all of these, what is striking, and perhaps not so obvious from a policy perspective, is that USO creation and development are themselves learning processes, beginning at a point with little knowledge and progressing towards a more knowledgeable standpoint from which earlier assumptions can be reassessed.

For practitioners involved in research close to USOs this could mean that they should try to identify the social forces at play around them, an issue some in this case study seemed to actively care about and were worried about. This is not just for the professors and CEOs of research commercialisation though, but also the PhD students and other researchers. That there is a lack of explicit discussion of something that is clearly influential not only

in USO creation but also researchers' working life is not a criticism, but rather something this thesis has, through drawing attention to the individuals and groups surrounding the main characters of academic entrepreneurship and the entrepreneurial university, highlighted as perhaps necessary. Despite the knowledge of the senior actors in this case, their expressed intentions were, and are still, difficult to enact because other researchers reportedly stepped over boundaries in pursuit of (often intangible) resources to manage their work, through, for example, having USO employees help them in their construction activities.

Future research

For researchers interested in the sociology of science and research commercialisation though, this thesis has contributed a limited selection of the social forces at play in cases such as these. We might naturally anticipate that a further study of the same case could reveal more social forces and perhaps nuance and thicken the descriptions of those outlined here. As has already been mentioned, many individuals were reluctant to take part in this study. Informal discussions did however suggest that some doubts lay in individuals being unsure of how their words could be used or whether their descriptions could be of any value to social research. This thesis might therefore offer some foundation for future studies for social researchers to try to explain how empirical data might be useful and how such a case study might look.

However, this is just one case in one specific context, and that means that explorations of further contexts – USO's emerging from other universities within Sweden, non-Swedish universities, or other disciplinary domains for example – could make further findings concerning social forces as they relate to research and USO development. One obvious area to explore is that of cases where the USO, unlike in this case, works very closely with incubator organisations. Such cases might reveal for example different ways through which USOs and PRGs negotiate the social forces at play in their respective environments, and we might see the incubator acting as to resist forces which stray into inappropriate areas.

Final words

I would like to end this thesis on a positive note, and that is to suggest that drawing attention to the USO process and the relationship between the USO and parent or other connected research groups, whether through popular media or through case studies such as this, is a good step forward. Park identified conflict as one means through which societies underwent organising

activities, since the appearance of a new or changed force resulted in re-organisation to accommodate or resist it (Park & Burgess 1921). There are a multitude of forces acting to drive the idea of USO creation and forces acting to resist such a movement, and resolving the tension arising through the meeting of these forces is one way of realising the institution of knowledge transfer from academia as a societal benefit, an ideal I think many have been striving for over the past two centuries.

What the resolution of the conflicting tensions might look like is beyond the scope of this thesis, but based on Park's notion of social groups I like to imagine that universities will become places where individuals can spend some time learning where their interests lie before specialising in that particular area, whether that is basic research, technology development, or construction of artefacts. And, following this specialisation, individuals are rewarded for their efforts for the collective research group and society just as they are rewarded for publishing articles on the topic.

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