Subtheme

6.1. Start-ups, spin-offs, science parks, business incubators, technology transfer offices, joint research projects, in-firm (company) universities, business acceleration centres, corporate incubation, university proof-of-concept centres, etc.

Title

The Influence of Academic Entrepreneurs' Human Capital on developing Social Capital

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Keywords: Academic Entrepreneurs, Human and Social Capital, technology-transfer, university-industry collaboration, bio-entrepreneurs

1. INTRODUCTION

The broad area of this study is entrepreneurship, with specific emphasis on academic entrepreneurship. Entrepreneurship is gaining increasing attention in because of its impact on economic growth and job creation. Entrepreneurship, defined by Fisscher *et al*. (2005, p.107) as "… *the process of discovering and developing opportunities in order to create value*". These discoveries and opportunities are created by an individual normally known as 'entrepreneur'. The other feature of current study focuses on biotechnology sector within the UK.

Creating an enterprise is a complex phenomenon (Wright *et al*., 2004). In particular, when academic founder attempts to commercialize the created research outside the academic environment. The complexities, typically, pertain to the characteristics of an entrepreneurs who lacks resources; lacks knowledge of recognizing opportunities (Lockett *et al*., 2003); and lacks business experience to commercialize an idea within industrial (business) environment (Mosey and Wright, 2007).

Academic researchers are experts in their fields of research while they make discoveries within laboratory settings. They, however, are quite uncertain when they take their discoveries from laboratory to industry for economical returns (Lockett *et al*., 2003). There can be several reasons for this lack of certainty. The most establish cause, as evident within literature is lack of information and market knowledge to identify and exploit opportunities (Ucbasaran *et al*., 2008). They lack in network resources to acquire commercial knowledge and novel information (Wright *et al*., 2004).

The work of Stinchcombe (1965), suggest that small businesses, especially in high technology sector, are exposed to the problems of 'liability of newness'. Moreover, the author is of view that small firms are more vulnerable at initial stages of their inception because founder lack legitimacy and resources at early stages (Rashdi *et al*., 2011). In order to encounter the problem of liability of newness, the founders are required to develop networks to gain legitimacy and secure resources (Elfring and Hulsink, 2004). This is especially challenging for academic founder because, unlike corporate entrepreneurs, they lack networks with resource providers and not sure how to develop those (Mosey and Wright, 2007).

This study is an attempt to investigate potential obstacles that academic entrepreneurs (AEs) encounter at early stage within knowledge and capital intensive sector, such biotechnology. It is, however, less well studied regarding the different resource needs at different stages of venture development, for an academic spinoff within biotechnology sector. This research, therefore, explains the resources required at earlier stages. The idea is to forge a framework which explains and make readers understand the requirement of biotechnology ventures, from academic environment, at different stages. Moreover, the findings of this study underscore the need for different resources at different stages of venture development. In addition to that the utility of networks at different stages is also highlighted within this research.

The next section underlines the literary evidence regarding the academic entrepreneurship, and the resources needed to establish a new entity. Section 3 states the research framework, which underpins

the issues regarding the stage based literature. The discussion terminates with key research questions that are explored within empirical research. Methodology follows in the next section. The rationale is given to justify the chosen methodology. Section 5 analyses the data and results are formulated based on the analyses. Findings of the study are furnished in section 6, and propositions are developed based on the findings. Lastly, study conclusions are given in section 7.

2. LITERATURE AND CONCEPTUAL FRAMEWORK

2.1 Literature

The purpose of this section is to discuss the technology transfer from academia to industry. Technology is information which is utilized to accomplish a certain task, whereas; transfer is the movement of information (technology) via specific channel (Rogers *et al*., 2001): either organization or individual, for instance. Within the context of this study, the functional categorization of transfer is further decomposed into 'how' (mechanism) and 'who' (tool) parts. Technology may be seen to utilize the creation of company from university, such as university spin-off (USO), which covers how part. While transfer, however, is made by an individual who transmits particular technology from university to private sector (industry); in order to create value. This individual is named as academic entrepreneur (AE) for this study.

University spinoff defined by Shane (2004, p. 4) as a new company founded to exploit piece of IP created by faculty member or staff in academic institution. Smilor *et al*. (1990) defined USO in more detail as: (a)The founder as faculty member, staff member, or student who either left the university to start a company or remains affiliated with university; and (b) The technology or technology-based idea developed within a university was used to start a company.

It is mentioned above that AEs lack resources for the development of USOs. These resources are further divided into further categories: financial capital (tangible), human and social (intangible). The major portion of these resources, according to Kolfsten (2005), is possessed via the help external rather than internal sources. It is evident from the literature that some universities support new firms. The kind of support that these new firms receive from parent organizations (e.g., universities), however, is not sufficient at the development stages, and specifically for those firms which are highly knowledge intensive and operate within capital intensive sectors; such as biotechnology.

2.2 Conceptual Framework

2.2.1 Research Field

Biotechnology is well known as a high-risk industry but having potential for large rewards (Vanderbyl and Kobelak, 2007). The biotechnology sector has increasing significance based on two accounts. Firstly, the actions of biotechnology firms can have a profound effect on both society and our everyday lives. Secondly, the sector is emerging quite rapidly, especially in the developed countries[1]. This rapid diffusion is caused as the result of the creation of immense wealth and employment through this sector.

[1] See Ernst and Young (2008) Report: Beyond the borders

While biotechnology are superior at producing spinoffs because research produces more discrete inventions than other industries, there may be more barriers in commercializing life sciences discoveries than in other sectors (Shane, 2004). A specific characteristic for many biotechnology ventures is that they burn huge amounts of money before they generate revenues.

In addition to the issues regarding finance, it, however, has been recognized the industry is further hindered by the fact that biotechnology is globally lacking in managers with appropriate entrepreneurial and commercial skills (Rashdi *et al*., 2011). Therefore, it could be argued that the two main drivers of failure of academic spinoffs are undercapitalization and inappropriate human capital (Brett *et al*., 1990). If an entrepreneur, however, attains sufficient management techniques, the funding deficiencies can be surmounted (Cowling *et al.,* 2007).

In order to address the issues highlighted above, a conceptual framework is developed, which focuses on the gaps that AEs encounter within biotechnology sector at earlier stages of development. It also, guides researchers to adopt certain methods to get to a certain point.

2.2.2 Research Framework

It is generally agreed that a new venture goes through predictable stages of evolution (Sequeira and Rasheed, 2006). Once ideas emerge from idea sources or creative problem solving, they need further development and refinement, before the best idea is chosen to be commercialized. Since, this study deals with the initial stages of venture development, hence this refining process, is divided into four major stages: idea/concept stage, proof of concept stage, product development stage, and test marketing stage (figure 1).

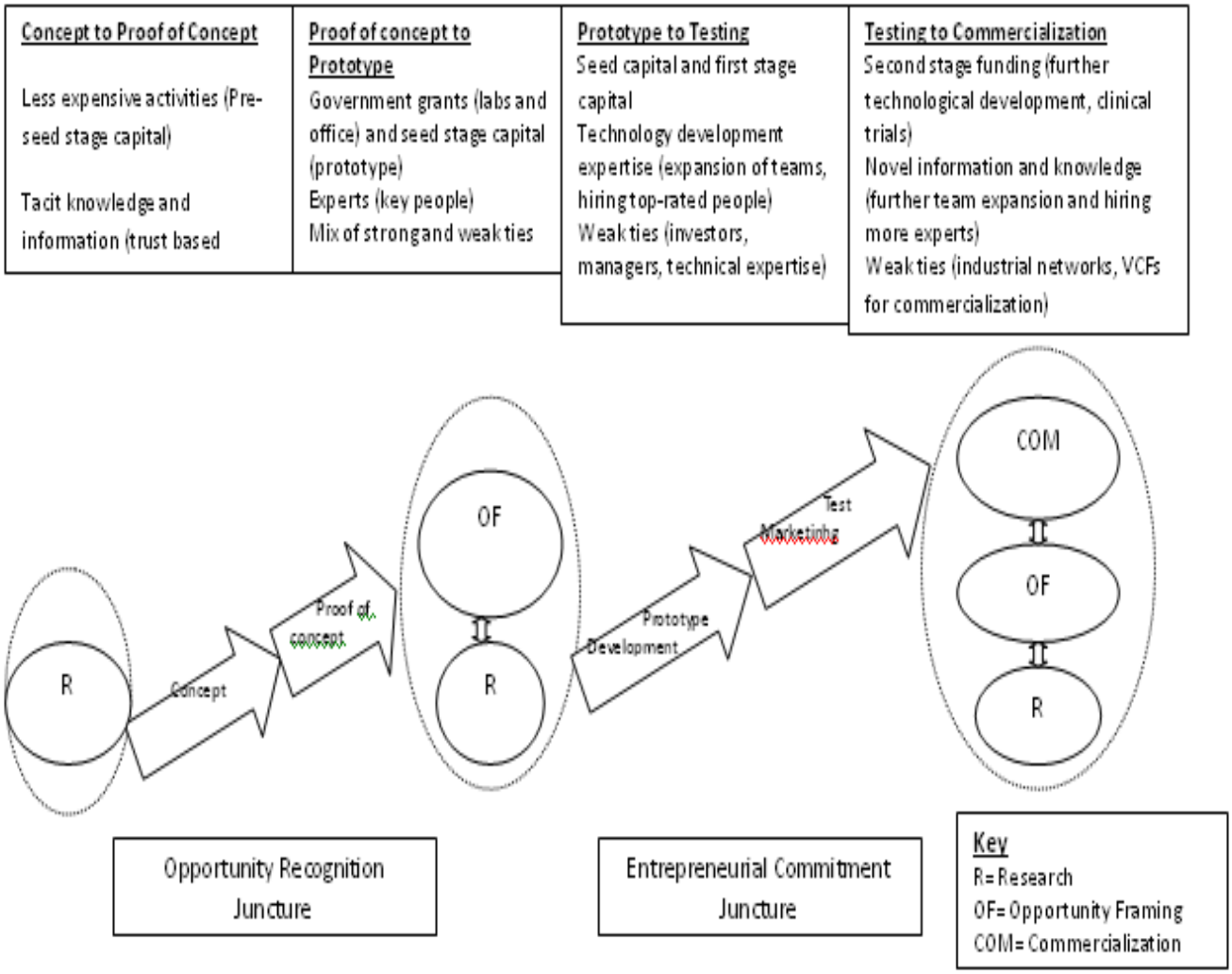
2.2.2.1 Developmental stages

For many spinoffs, the first step in the process is the generation of a novel idea through some form of basic research. This process usually occurs at a university or research organization. The next step is to apply this research to some form of practical use. This involves proof-of-concept stage. Completing the proof-of-concept demonstrates some form of utility, and if the concept is novel then a patent can be filed to protect the discovery. Following this, the concept will enter into technology development stage where further optimization takes place. This may involve the development of a product that is based on the concept.

Once the product is optimized and quality controlled through verification and validation processes, a working prototype is developed. The prototype is tested or trialed in a clinical setting to ensure it performs as required. Once clinical testing is completed, and no further modification is required, the product is ready for commercialization.

Having discussed the various stages, the next section discusses resource gaps for new ventures. The barriers need to be encountered to move towards next stages. In addition to that, these barriers require different set of resources, depending on the stage of progression.

Figure 1 Stage based resource needs of USOs
Critical Resource needs at different stages



2.2.2.2 Resource gaps

The process of entrepreneurship begins with a business concept (or opportunity discovery) envisioned by an individual, and proceeds to the point where it is necessary to exploit it. For this it is necessary that different resources are acquired (Timmons, 1994). AEs specifically encounter two broad challenges that of opportunity recognition and entrepreneurial commitment, as shown in figure 1.

The critical juncture of opportunity recognition lies at the interface of the research stage and opportunity framing stage (fig 1). Only a small subset of the population, who benefit from Kirznerian disequilibrium[2], discovers those opportunities. The reason for this competitive advantage is their ability to connect specific

[2] More experienced entrepreneurs discover more opportunities than less experienced counter parts, this distributes opportunities unevenly.

knowledge to discover opportunity (Wright *et al*., 2004). Specific knowledge, generally, is acquired via experience; therefore more experienced individual recognize more and better opportunities.

The critical juncture of opportunity recognition lies at the interface of opportunity framing to commercialization (fig. 2). In order to acquire fruition of the recognized or perceived opportunity, it is necessary that it should be exploited (Shane and Venkatraman, 2000).

2.2.2.4 Resource needs at critical stages

Vohora *et al.* (2004) emphasized the importance of the exchange of tangible and intangible assets such as information and knowledge for development of technology based ventures. From idea/concept stage the ventures are required some pre-seed capital, e.g., to show to the host industry that the idea is actually going to be success and may be tested to form prototype. This stage involves less expensive activities such as library search, contact with key customers and focus groups. Similarly the seed capital is needed to form a prototype and to write a business plan to attract various investors.

After the development of prototype, the founders look for significant amount of finance (e.g. venture capital) for further technological development, i.e., to test the product or service, e.g., clinical trials. Clinical trials normally require huge amount of finance, therefore new ventures typically raise money from investors in a series of stages, rather than all at once.

Within the entrepreneurship literature, scholars recognize that social structures are gaining increasing importance for the formation and growth of business (Hoang and Antoncic, 2003). For instance, for product development and test marketing the value of novel information increases significantly (Hine and Kapeleris, 2007). In particular, the networks ties are closely and widely considered to be crucial for gaining both tangible and, more specifically, intangible resources. These ties are particularly valuable if the venture operate in a high-technology sector from academic environments (Mosey and Wright, 2007).

There are, nevertheless, certain ambiguities regarding the level of entrepreneurs' experience, the extent and diversity of ties and the nature of resources that are gained by entrepreneurs. Therefore, the following research questions are posed which focus on the entrepreneurs' human and social capital, particularly prior experience and network ties, respectively.

2.2.3 Research Questions

The significance of three critical resources; financial, human and social capital, for development of venture from one stage to another within extant literature is highlighted. All the resources were reported to have a defining impact on the emergence and growth of the venture. The significance of human and social capital, however, has a distinctive position at the emergence and growth stages. Ireland *et al*. (2003), though, argue that relative to human capital and social capital, financial capital often can be duplicated by competitors and may be substituted by other resources. In a similar vein, human capital is often enhanced through the firm's social capital (Burt, 1992). Thus, human capital and social capital, combined, are the basis for obtaining and developing other important resources necessary for exploiting opportunities (Ireland *et al*., 2003). This results in need for developing social ties for AEs to tap resources for their new ventures.

At early stages, strong ties are more important because these kinds of ties help in exchanging tacit knowledge; and exchange of information quickly and at lower costs. These ties are less influential as ventures moves to more mature stages. However, as venture moves ahead, it depends more on acquisition of higher level of sophisticated knowledge and diversity of networks. That is, weak ties are more useful than strong at later developmental stages.

The literature predominantly portrays that entrepreneur incorporates venture only once, as mentioned in the introduction. The human capital literature, however, suggests that entrepreneurs may incorporate subsequent ventures, suggesting that entrepreneurship is not a single-event action (Ucbasaran et al., 2009). Furthermore, the author suggests that during previous venture experience, the experienced entrepreneurs essentially develop ties which are either strong and/or weak in nature. In contrast, the 'first time' entrepreneurs may or may not have prior strong or weak ties at the venture incorporation.

Starr & Bygrave (1991) have suggested that prior business ownership experience may bring a variety of assets. These assets may be skills and expertise, for instance, to identify and serve markets for venture development and growth (Ucbasaran et al., 2008). In contrast, novice and less experienced entrepreneurs will be in a weaker position, because they use simplified decision models which guide their search capacity (ibid). Also, within a university environment, regardless of their scientific achievements, these entrepreneurs lack commercial experience of exploiting scientific discoveries (Mosey and Wright, 2007).

There is sufficient literature which stresses the importance of both the mix of strong weak ties for opportunity recognition and exploitation (Elfring and Hulsink, 2004). Moreover, the ownership experience is quite vital for the development and success for new venture. However, there is scarcity of literature regarding the extent and nature of strong and weak ties. There is, also, scarcity of literature which addresses the importance of diversity of experience and its influence on venture development. At present little is known about those relationships (Mosey and Wright, 2007). This creates a gap within a literature; therefore the following research question is posed.

RQ1: What is the extent of existing strong and weak ties at the start of new venture development for academic entrepreneurs with different levels of prior experience, within the biotechnology sector?

To gain insight on the potential barriers faced by nascent entrepreneurs, the literature on how the diversity of ties influences at different phases of development, is drawn. For example, it was reported that entrepreneurs require strong ties at the emergence stage, whereas, in the growth stages the significance of weak ties is increased. Also, it was argued that human capital shapes social capital: as through experience entrepreneurs enhance credibility and reputation. Thus, experienced entrepreneurs expand their network (weak ties). In contrast, the less experienced entrepreneurs lack credibility and reputation at the earlier stages (Hite and Hesterly, 2001). They develop different new weak ties. Hence:

RQ2: What is the extent of new weak ties developed at the early stage of venture development by academic entrepreneurs with different levels of prior experience, within biotechnology sector?

It was reported earlier that more experienced entrepreneurs are likely to get access to more resources in comparison with novice entrepreneurs due to breadth of social capital from their prior experience (Mosey and Wright, 2007). Thus, the quality, breadth, and depth of a venture's human capital and social capital influence the gaining of resources (Ireland *et al*. 2003). Hence the following research questions are drawn:

RQ3: What is the nature of resources gained at the early stage of venture development by academic entrepreneurs, with different levels of experience, through existing strong and weak ties within biotechnology spinoffs?

RQ4: What is the nature of resources gained at the early stage of venture development by academic entrepreneurs, with different levels of experience, through new ties developed, within biotechnology spinoffs?

4. METHODOLOGY

This is an exploratory study which aims to generate theory pertain to the influence of experience of an AE on developing new relationships with industry actors (see appendix), within biotechnology sector. The results of this empirical study will develop new propositions. Research questions; extent of control over behavior environment; and degree of focus on contemporary events, consistent with Yin (1994), guides the research strategy as case study research. In addition to that, research questions and research framework proved instrumental in collection of data and analysis (Elfring and Hulsink, 2004).

Several steps are followed to carry this research project. First of all constructs are specified. AEs are divided in three categories (table 1):

(a) Entrepreneur with No Experience (ENEs): *ENEs* have no prior experience before they incorporated their present venture.

(b) Entrepreneur with Some Experience (ESEs): *ESEs* have either industrial, fund-raising or both the experiences prior to starting their current venture.

(c) Entrepreneur with All experience (EAEs): *EAEs* have prior ownership experience, i.e., they previously have at least one venture creation experience before they incorporated their present venture.

Secondly, the data source -that matches the categories- to be accessed is identified. BioYES (Biotechnology Young Entrepreneurs' Scheme), UK, is one of the reputable source where relevant valuable data for this study could be found. The sampling procedure, therefore, based on theoretical rather than random sampling (Eisenhardt, 1989).

Thirdly, multiple data evidences are collected. Primarily respondents are observed at different field locations (table 1). In case of missing data, further face-to-face and e-mail interviews are conducted. In order to enhance the quality of research, face-to-face interviews are conducted with industrial experts (appendix 1b). This increases validity of research. In addition to that, company websites, news reports,

search engines, etc., are used as secondary source of evidence. These multiple sources of evidence were used to examine the validity of the data and constructs.

Finally, the data is analyzed within and across the groups. The replication logic technique is used, again, to increase the validity of the relationship between constructs. The findings generate theory, both in case of supporting or disconfirming a relationship. Especially rejection of relationship provides an opportunity for theory refinement and extension.

Table 1 Cases Selected

Firm/Year of Incorporation	Company Location	Fund-raising Experience (Y/N)	Industry Experience (Y/N)	Ownership Experience (Yes/No)	Category
Axordia 2001	Sheffield	No	No	No	**ENE1**
Celltran Ltd 2000	Sheffield	No	No	No	**ENE2**
Nanoco Technologies Ltd. 2001	Manchester	No	No	No	**ENE3**
Gentronix Ltd 1999	Manchester	No	No	No	**ENE4**
Neotherix 2007	Manchester	No	Yes	No	**ESE1**
DxS Ltd 2001	York	No	Yes	No	**ESE2**
Renovo 2000	Manchester	Yes	Yes	No	**ESE3**
Malvern Cosmeceutics Ltd 2005	Worcestershire	Yes	Yes	Yes	**EAE1**
InhibOx Ltd. 2001	Oxford	Yes	Yes	Yes	**EAE2**

5. DISCUSSIONS AND RESULTS

5.1 Prior Ties and new weak ties by the Sample Entrepreneurs

Consistent differences were observed, within (table 2) and between sample entrepreneurs (table 3), in the extent of prior ties. Entrepreneurs have heterogeneity in terms of prior ties, before they incorporate their respective ventures. The most common ties are with parent department and research colleagues.

ENEs found to have limited networks, and are mainly from their parent departments. For ESEs the picture is somewhat different. Although the majority of prior ties are limited to a parent department, they apparently have fewer ties outside their parent department (table 2). The diversity of experience appears to have positive influence on the extent and nature of prior ties. ESE1 had both industrial and commercial experience before the start; this resulted in a diversity of ties. In contrast, ESE2 and ESE3 had only industrial experience and that too during previous employment. EAEs, apparently, have more network ties than either ENEs or ESEs. Their prior ties, unlike ENEs and even ESEs, are not limited to host organizations. On the contrary, they are broadened to a variety of networks actors, both internal and external in nature. One reason for having a different number of prior ties, at the start, appears to be due to their prior ownership experience. For example, when asked from IE2, what is the nature of ties academic entrepreneurs usually posses prior to starting a venture, IE2 responded:

"It varies. Lots of [academic entrepreneurs] go to technology transfer companies, who already have associated networks with investors, IP managers, [etc.], even contacts with banks, which can be very important. Then, there is a gap –where there are some advisors who introduce academics to different networks…."

Table 2 Sample Entrepreneur's Prior Ties

	Network ties	ENE1	ENE2	ENE3	ENE4	ESE1	ESE2	ESE3	EAE1	EAE2
	Venture Capital Firms					●				●
	Business Angels									●
	Surrogate Entrepreneurs (Interim Managers)									●
	Professional Venture Management Firms									●
	Business Link (Or Regional Equivalent)									
	Regional Development Agencies						●		●	
	Management Consultants									●
	IP/ Legal Firms					●			●	●
	Other Universities								●	●
	Private Laboratories									●
	SMEs									●
	Large Firms/ Industry					●	●	●		●
	Science Parks									
	Business Incubators									
	University Technology Transfer Office	●	●						●	●
	Government Grant Agencies/ Charitable Organizations								●	●
	University Challenge/ Proof Concept funds					●				
	Research Colleagues	●	●	●		●	●	●	●	●
	Other			●	●	●	●	●	●	●
N		**2**	**2**	**2**	**1**	**6**	**4**	**3**	**7**	**14**

EAEs apparently have well developed network in comparison to either ESEs or ENEs. Similarly, ESEs have variety of network ties in comparison to ENEs. The quality and richness of experience appears to influence the abilities of entrepreneurs to possess both internal and external network ties.

Differences within ESEs in terms of developing new ties were observed (table 3). Prior extent and nature of experience and abundance of resources, as in case of ESE1, appear to have a negative influence on developing new ties. In contrast, ESE2 and ESE3 have lesser resources at the start and they appear to develop more ties to encounter the scarcity of human resources.

Table 3 Sample Entrepreneur's New Ties

Network ties	ENE1	ENE2	ENE3	ENE4	ESE1	ESE2	ESE3	EAE1	EAE2
1. Venture Capital Firms	■	■	■	■	■	■	■		
2. Business Angels	■	■		■		■		■	■
3. Surrogate Entrepreneurs (Interim Managers)	■	■	■	■					■
4. Professional Venture Management Firms		■	■	■		■	■		
5. Business Link (Or Regional Equivalent)						■			
6. Regional Development Agencies				■		■			
7. Management Consultants									
8. IP/ Legal Firms		■	■	■	■		■	■	■
9. Other Universities	■	■			■	■	■	■	■
10. Private Laboratories	■	■		■	■	■	■	■	■
11. SMEs	■	■	■	■	■	■	■		
12. Large Firms/ Industry	■	■	■	■	■	■	■		
13. Science Parks								■	
14. Business Incubators									
15. University Technology Transfer Office									
16. Government Grant Agencies/ Charitable Organizations	■	■		■	■	■		■	
17. University Challenge/ Proof Concept funds	■	■	■	■					
18. Research Colleagues									
19. Other	■	■	■	■	■	■	■	■	■
N	**10**	**12**	**8**	**12**	**8**	**11**	**8**	**7**	**6**

Within ESEs, there appears some heterogeneity in terms of developing new ties. This heterogeneity observed to be as a result of a different set of experiences, as more experienced entrepreneurs identified more useful ties in comparison with less experienced entrepreneurs. Also, these entrepreneurs do not appear keen on developing many ties at the start; rather their focus seems to be on gaining industrial and market knowledge. They, therefore, focus on diversity of ties than volume of ties. IE4 (who also has

ownership experience) endorsed the value of ownership experience. When asked what is influence of prior experience on new venture? He responded as:

"[Firstly] I will be able to do it much better. … Secondly, if we could do it now, we could have done it properly. Also, the time between one activity and another becomes shorter."

From the above discussion, it is could be observed that for ENEs, the real challenge, initially, was to develop ties with the funding agencies. Through these contacts they developed new contacts, largely, for follow-on funding. On the other hand, more experienced ESEs approach both internal and external actors to access initial resources. The mechanism for developing new ties differed in case of EAEs. They have lesser focus on gaining finance, and their main focus appears to take advantage of bridging structural holes between successive stages. For this purpose, they develop new contacts with commercial and industrial actors who possess necessary knowledge and information. It was found here that the extent and diversity of experience has a negative influence on development of new ties.

5.3 Resources Gained from Prior Ties

The gaining of resources from prior ties varies from group to group, however; within groups, the nature of resources gained is more or less similar. The most common resources, however, that each group of entrepreneurs have gained appear to be new network contacts and advice on technology and business development. ENEs apparently gained resources mainly from parent organizations. Evidently, they utilized university networks to extend their relationships beyond the university departments. ENE3 realised the value of university support:

"[the university] have 5 to 6 million (£s) worth of equipment, which we couldn't buy ourselves as an individual company."

ESEs, on the other hand, have gained resources which are more focused on attaining advice on various aspects of business development, building relations outside their research networks and also, to gain funding. Within ESEs, there were consistent differences regarding the gaining of resources from prior ties. It was found that the variety of experience is beneficial in terms of gaining resources such as social, human or financial capital, as observed in the case of ESE1.

Within the EAEs there were more similarities than differences, regarding their business development approaches. EAEs are more inclined either to gain advice or building networks for their new businesses, than accessing finance. They seem to have prior ties to secure investment. For example EAE2 have prior ties with a charity organization and received funding immediately for the new company. In his own words:

"Much of my own research is financed by a US cancer charity."

Funding is one critical resource that all the entrepreneurs are looking for, at the early stage. If they acquire a significant amount of funding, such as venture funding, this provides a stamp of approval. When asked about the key resource required by nascent entrepreneurs at early stage, IE3 responded as:

"Fund-raising is the main issue for the entrepreneurs who start their venture, at the early stage. They rely on equity side –banks, business grants, angels and also from large VCs. Mostly they look for bigger size capital, rather than small size investments."

The EAEs are more inclined towards building new relationships and gaining investment through VC firms. IE3, when asked about the nature of previous ownership impact on new venture, he responded as:

"... I think, if an investor knows you already run a business it is one of the risks that he wants to take [by investing in your company]. His attitude is: they can technically be very good, academically very good, but can they manage and run the business commercially?"

It appears that the extent and diversity of experience positively influences on the acquisition of resources from prior ties. One reason appears that EAEs already have the experience of setting up a company. It could, therefore, be argued that these types of individuals probably possess capabilities to gain required resources at different stages of venture development. In contrast, the ENEs have a lower level of experience prior to the start, therefore, they not only lack in identifying resource needs, but they also lack ties to access those. Similarly, ESEs appear to have diversity of ties, but they lack prior ownership experience to identify resource needs at different stages. Hence, the ownership experience gives a psychological edge (Mathew effect), in addition to credibility, within the commercial environment.

5.4 Resources Gained from New Ties

The most common resources that are gained by entrepreneurs via new ties, initially, was to secure finance and then to develop venture team. In addition to funding and developing teams, the other resources gained are advisory in nature. There are also many other resources that are gained by the entrepreneurs which are strategic in nature, for instance: know-how (novel information), technology and business development, etc. Entrepreneurs with more experience have better capacity to gain resources than entrepreneurs with lesser experience.

5.4.1 Resources gained by ENEs

For proof of concept funding, ENEs assisted by their parent organizations and later by university challenge as initial funding options. The later stage funding comprised of local and regional funding agencies, business angels and VCFs. In terms of developing teams, all the ENEs hired CEOs initially. ENE2 commented about the CEO of the CellTran:

"Mal [Jarmolowicz] had her own business, she had sold two businesses. She also worked in a big pharmaceutical company and she had a good track record. …She has raised money, done it successfully and made profits on business they sold. She has a good network because she owns her consultancy business."

ENEs have secured finance by various rounds of funding. Through prior networks, new relationships are developed with key actors which give a competitive edge to the new venture. ENE3 stated:

"You need not only money, but you need networks as well. You can't do everything yourself."

In addition to that, ENEs developed various collaborations which enabled access to many useful resources as discussed by ENE2:

"Collaborations are great. It allows you to access other people's skills that you may not necessarily have. It also allows you to have much larger pots of money that you couldn't access on your own. Also, it allows

you to do things quicker which is critical. If the collaboration is an effective one, you can reduce your development time line from."

5.4.2 Resources gained by ESEs

Similarity was observed within ESEs to gain financial resources; however, they differed when it comes to developing human and social capital via new ties. Finance, initially, is gained via prior experience and developing relationships with local and regional grant agencies, before approaching VC firms.

The ESEs appears to have gained funding as well as new ties from investors and investment companies. Once these kinds of ties are developed, it becomes easy to interact with people within that environment, in comparison with individuals who do not have that kind of experience. As commented by ESE2:

"Business Link is a useful resource: there are a number of potential investors, who are interested in your technology ...but you need someone to be introduced to VC companies, where one introduction leads to another introduction."

Consistent differences were observed within ESEs in developing human capital via new ties. For example, in the case of ESE1 the company evidently increased the staff at a very rapid pace. ESE1 suggested that the people are a very important aspect of any business. ESE1 remarked:

"We [co-founders] have a lot of experience working with pharmaceutical companies. But it is very important to surround yourself with experienced people, who really know the industry and they really know about certain essential aspects."

Not only increasing the number of staff, but planning in advance, as to what sort of team is required at the start, is essential, and add value to the business as remarked by ESE3:

"If you thought about who will be on your Scientific Advisory Board and why, who might be on a non-executive level, will add weight and benefit to that."

5.4.3 Resources gained by EAEs

For EAEs, their initial funding sources found to be local, followed by grant funding from charitable organizations. EAE1, evidently, has been able to access the funding because of the prior ownership experience. With reference to the value of having ownership experience, he said:

"This is essential because it's through this network that you build the next business and so on."

EAEs have not developed their teams rapidly at the start. This appears to be due to the nature of the technology they were trying to develop, where team expansion was not required at the initial stage of venture development. Regarding the human capital development, these entrepreneurs have turned their focus on gaining industry knowledge and market information via prior and new ties. EAEs, however, realised the value of human capital or management team, and EAE1 remarked:

"You need a staff with a business background. You need to find business partner. Don't be on your own; you need somebody with MBA or a legal background."

It was found that the diversity experience and ties positively influences the exchange of knowledge and information to bridge structural holes. It was observed that entrepreneurs with more experience and

resources develop less number of ties, and vice versa. Prior ownership experience enables EAEs to optimise their prior human capital and to develop social capital which is focused on developing businesses. They preferred to adopt business strategies which assume less risk, while developing through initial stages. In that manner, EAEs develop social networks which provide effective bridges to gain market knowledge and information. ENEs, although, developed more network ties than ESEs, yet the extent of ties appears to have little effect on gaining resources. It was observed that, ENEs have gained, comparatively, smaller amount of finance, formed smaller teams, and the pace of business development observed slower than in the case of ESEs and EAEs. ESEs gain more resources, yet via the help of fewer ties than in the case of ENEs. ESEs initially have secured higher finance, followed by forming bigger management teams and development of relationships to gain intangible assets such as market information and tacit knowledge.

6. PROPOSITION DEVELOPMENT

6.1 The Influence of Diversity and Extent of Prior Ties

Prior venture experience develops and enhances mental models (cognitive frameworks) to identify resources through which entrepreneurs organize their venture development process (Baron and Ensley, 2006). Prior to starting their ventures, the EAEs have ties with several network actors; ESEs have fewer ties; and ENEs have limited internal ties. This relationship is supported for this study.

The significance of prior ties is highlighted in the literature, and scholars (e.g., Shane, 2000) are of the view that for a process from idea to actual start of a venture, prior knowledge and information are important. This is significant, because prior network gives access to relevant information, ways to serve markets and ways to deal with customers (Bhagavatula *et al*., 2008). The sociological literature suggests that an individual with prior employment history possesses different networks (Zhang *et al*., 2008). Also, prior attainment of networks is dependent upon the general and specific human capital (Wilkund and Shepherd, 2008). The entrepreneur with fund-raising experience develops ties with industrial actors and financiers. Fund-raising experience increases credibility in the business environment and certification for extent of ties (Manuela *et al*., 2009). In this way, entrepreneurs expand their network of strong and weak ties.

ENEs and ESEs, because of their lack of venture creation experience, have restricted mental models to identify the resources or access to those resources. In contrast, EAEs have well developed mental models to identify and access resources. Therefore, prior experience influences the extent of strong and weak ties. These ties are critical sources to set off the building of new ties and gaining of resources, as observed in this study. Therefore it is proposed that:

P1: AEs with diversity and extent of experience positively influence on extent and diversity of strong ties external to the academia within biotechnology sector.

6.2 The Influence of Diversity and Extent of New Ties

The significance of prior ties is highlighted in the literature (e.g., Shane, 2000). However, the development of many ties has an adverse effect on the venture which lacks finance at the start, because developing and maintaining ties are costly (e.g., Sequeira and Rasheed, 2007). Finally, the other point that is discussed in the literature is regarding the quality of ties rather than the quantity, i.e., gaining more resources from fewer ties (Koka and Prescott, 2002).

There was no influence of ownership, fundraising and industrial experience on developing new ties, as observed in the case of EAEs, ESEs. EAEs have developed fewer ties than any of the entrepreneurs in this sample (table 2), similarly ESEs with both fundraising and industrial experience developed fewer ties than ESEs with only industrial experience. Also, ESEs have developed fewer ties than ENEs.

It was found that EAEs are more tactical in developing the quality of ties rather than quantity. Prior ownership experience of EAEs enabled them to access resources from lesser number of ties. This is consistent with the study of Koka and Prescott (2002) who argued that experienced entrepreneurs are more intent on developing ties with actors where they expect information richness: this emphasizes the quality and nature of information that is accessed through ties. Also, EAEs have prior extent and diversity of ties, therefore quality of information is given more emphasis. A more developed network, however, particularly in terms of quality of ties, is more beneficial to a new business (Elfring and Hulsink, 2004). Hence, the number of ties *per se* is neither necessary nor desirable. It is quality not quantity of ties which is desirable at the early stage of business development. Therefore, it is not the extent but the nature of ties to bridge structural hole is of significance. Hence it is proposed that:

P2a Entrepreneurs with ownership experience are more likely to develop smaller number of specific ties than entrepreneurs without ownership experience, at the early stage within the biotechnology sector

Entrepreneurs differ in their capacities to access useful information through their networks, and these differences are a key source of variation in entrepreneur's competitive abilities (McEvily and Zaheer, 1999). Individuals with fund-raising experience have important resource acquisition capabilities (Wright *et al*., 1998) that give them a competitive advantage over individuals who do not have that kind of experience. Fund-raising experience does not influence positively, but on the contrary, this gives a negative influence on gaining more ties at the start. It was found that ESE1 has developed fewer ties than either of the entrepreneurs in this category. The diversity and extent of prior ties results in more support. Diversity of experience results in developing mental models which leads entrepreneurs to be more alert in developing further relationships (Ucbasaran *et al*., 2009). Based on the findings and evidence from the literature, it is now proposed that:

P2b: Entrepreneurs with fund-raising experience are more likely to develop ties which are more diverse in nature than entrepreneurs without fund-raising experience, at the early stage within the biotechnology sector.

Industrial experience has significant influence on the performance of a venture as posed by Mosey and Wright (2007). Through industrial experience, individuals attain knowledge and decision making

experiences which help them identify the kind of resources they need at different stages of the life-cycle process. Cooper *et al*. (1994) argue that through industrial experience, individuals attain tacit knowledge which is acquired by investing time in the industry and also during a decision-making exercise within industrial environment. Therefore, it can be implied that gaining industrial experience, typically, enables entrepreneurs to enhance learning capacity, by being part of the environment where venture is created and then developed.

It was found that ESEs during their prior industrial experience work within different projects, strategic collaborations, etc., where parties free up resources to solve complex problems (Koka and Prescott, 2002). The entrepreneurs with less diverse experience have a lower level of cognitive frameworks which creates a gap to identify the kinds of resources that cater for venture needs. This results in developing ties with different network actors who may or may not have been valuable at the stage, as evident in the case of ENEs. Thus, prior industrial experience not only enriches tacit knowledge and learning, but it also has a positive influence on making decisions to develop ties with actors who have diverse information. Therefore proposition is developed:

P2c: Entrepreneurs with industrial experience develop ties which are more diverse in nature than entrepreneurs without industrial experience, at the early stage within the biotechnology sector

6.3 The Influence of Diversity and Extent of Prior Ties on Gaining Resources

Wilkund and Shepherd (2008) referring to human capital theory posits that individuals with more or higher quality human capital achieve higher performance in executing relevant tasks. The ownership experience of EAEs influences on gaining resources from their prior ties. For example, it was found that EAEs have gained funding and intangible resources from their prior ties. The use of networks is an important business strategy because it allows founders cheaper access to resources that may not, otherwise, be available through normal market transactions (Ireland *et al*., 2003). The other valuable aspect of networks is the providers of information and tacit knowledge: which is difficult to exchange in the absence of embedded networks.

EAEs have both strong and weak ties, prior to venture incorporation. EAE2, however, has more ties than EAE1; largely thanks to the extent and the diversity of experience. Through embedded (strong) ties, they gained tangible and intangible resources, such as finance and information and tacit knowledge about different aspects of business development. On the other hand, information and tacit knowledge help these individuals in developing proof of the concept. Through non-redundant (weak) ties, EAEs have gained much of the resources, which were intangible in nature. The entrepreneurs have gained more novel information, once they have received a market signal about the viability of their technology. These resources are gained via prior weak ties, initially.

Due to their prior strong and weak ties, EAEs have lowered their costs, as information becomes easy to exchange between partners (Sequeira and Rasheed, 2007). Elfring and Hulsink (2004) argue that, while strong ties provide resources, particularly financial and human capital, and hence provide stability to the

firm, weak ties facilitate the search for critical resources providers (investors, technology providers, key customers, etc.). In the above discussion, although the relationship is supported, it still lacks specificity. For example it was endorsed that prior ties have a positive influence on resources, however, it was not clear about which kind of resources. Based on the findings and in the light of literature, it is proposed that:
P3a: Entrepreneurs with ownership experience are more likely to gain more intangible than tangible resources than entrepreneurs without ownership experience, at the start within the biotechnology sector

Individuals with fund-raising experience have important resource acquisition capabilities (Wright *et al*., 1998) that give them a competitive edge over individuals who do not have that kind of experience. In addition to that, industry experience has significant influence on the performance of a venture as proposed by Mosey and Wright (2007). Fund-raising and industrial experience has a negative influence on gaining several ties at the start.

Less experienced entrepreneurs initially have lower degrees of legitimacy and reputation than more experienced entrepreneurs (Katz and Gartner, 1988). Thus, they need to gain access to external resources and expertise that cannot be produced internally. It was found that industrial experience also contributes to human capital and enables access to social networks for the identification and exploitation of opportunities.

ESEs, as a result of their prior industrial experience in general and fund-raising experience in particular, gain access to financial and human capital at the start. Initially, they have gained resources from their internal networks. Soon, however, they start to utilize their prior social capital to gain critical resources, such as finance and novel information. In addition to that, they developed human capital soon as they gain financial capital. In this way they increased their social capital, which helped their businesses to develop. They also have prior labor market experience; therefore they have developed fewer ties than ENEs. Moreover, within ESEs, who have a diversity of experience (e.g. ESE1), have developed even fewer ties.

It was found that ESEs during their prior industrial experience, increased understanding and knowledge via industrial partners (Koka and Prescott, 2002). The ENEs, on the other hand, have lower level of cognitive frameworks which creates a gap to identify the kinds of resources that cater for venture needs. This results in developing ties with different network actors who may or may not have been valuable at the particular stage. ESE1 has experience which gave skill-set to raise funds for her new venture, which other entrepreneurs in the same group lack. ESE2, because of his prior industrial experience, has utilized the local and regional contacts for advice gaining finance and so on. Similarly, ESE3 has used his prior industrial relationships to persuade industry to attract R&D funding for development of technology. Therefore previous industrial or fund-raising experience provide entrepreneurs with the skill set to gain resources, which results in a competitive advantage. ESEs have gained more tangible resources than intangible resources, hence specifically:

P3c. Entrepreneurs with industrial and fund-raising experience are more likely to gain tangible than intangible resources than entrepreneurs without industrial and fund-raising experience at the start, within the biotechnology sector

6.4 The Influence of Diversity and Extent of New Ties on Gaining Resources

Securing resources is one of the crucial tasks of the entrepreneur(s) in new ventures. EAEs are particularly looking at bridging structural holes, because it allows a new venture to control resources which provide access to novel information (Wright *et al*., 2005) particularly at the later stages.

It was found that EAEs have developed ties which are rich in information. Because of their ownership experience, EAEs have been more calculative in developing ties with actors where they can control the information resources. For example, during the strategic alliances, they position themselves from where they can control the information benefits. Because when organizations solve a particular problem they free up resources, (Koka and Prescott, 2002), as hinted earlier. Hence:

P4a: Entrepreneurs with ownership experience are more likely to develop more calculative ties with actors to bridge structural holes than entrepreneurs without ownership experience, at an early stage within the biotechnology sector.

Wright *et al*. (2005) argue that structural holes can be bridged by hiring people with expertise external to the organization. It was found that the entrepreneurs who have prior fund-raising/industrial experience gain more resources than entrepreneurs who only have industrial experience. ESE1 has secured significant financial and human capital resources from new ties. The aim was to gain novel information to gain advantage of structural hole. Therefore it was required to develop more human capital which possesses the capability to act as boundary spanners for developing novel information. The strategy that ESE1 adopted in order to encounter the deficiency of experience and expertise is to develop bigger teams. Hence

P4d. Entrepreneurs with fund-raising are more likely to develop bigger teams than entrepreneurs without fund-raising experience at early stage, within biotechnology sector.

It was found that prior industrial experience has a positive influence on gaining resources from new ties. Reiterating the argument in previous proposition, the extent of initial finance has been influential in shaping the strategy of novice entrepreneurs. ESEs develop their venture based on the extent of finance. Moreover, since ESE2 and ESE3 secure less funding than ESE1, they developed smaller teams than ESE1 and consequently less human capital development for their venture.

One interesting aspect that was found, however, that within this group the entrepreneurs who secure less funding develop more new ties. Ireland *et al*. (2003) are of the view that quantity as well as quality of human capital and social capital influence the amount of financial resources that a firm can expect to obtain. Also, weak ties are beneficial to a new venture (Hite and Hesterly, 2001), because weak ties form connections between actors, which in turn develop social capital. Unlike EAEs, the ESEs lack ownership

experience to take advantage of structural holes. They, therefore, develop bigger teams and more network ties than EAEs. Hence:

P4f: Entrepreneurs with industrial experience are more likely to develop bigger teams than entrepreneurs without industrial experience, at early stage within biotechnology sector.

7. CONCLUSIONS

7.1 Research Contributions

On a broader level, firstly, and most importantly for this research, few people have considered the way in which the influence of variation of experience has on developing different relationships. Secondly, this is one of the pioneering studies to consider industrial, fund-raising and entrepreneurial experience altogether to gauge the influence of prior ties and new ties, at earlier stages of new venture development within Biotechnology sector. The findings in this area indicate strong support for researchers, practitioners and policy makers, who are linked with entrepreneurship and commercialisation of academic ideas into commercial reality.

The main contribution of this thesis is the depth of studying the relationships between the varieties of entrepreneurs' experience before incorporating ventures. More specifically, this study looks more detail the fund-raising and industrial experience of an entrepreneur. There is a great deal of literature regarding the issues of funding and fund-raising. The literature focuses on the issues of how important finance is and what mechanisms are adopted to raise it. For this study, however, we have delved deep into the issue of the fund-raising experiences of novice entrepreneurs, and its influence on the gaining of resources: not only finance, but also human and social capital. Similarly, there is neglect in the entrepreneurship literature regarding prior labor market experience, in terms of its influence on developing new ties and gaining of resources. This neglect persists, even though there is a wealth of literature which highlights the influence of general and specific human capital on the venture performance (e.g., Wilkund and Shepherd, 2008). Hence, we have made a fine grained analysis of both the fund-raising and industrial experience. This resulted in some useful findings in the previous chapter.

One of the interesting aspects that we have drawn out is the fact that experienced people have ties with financial actors which is lacking within nascent entrepreneurs. With no track record or credibility, this becomes a challenge. The experienced entrepreneurs have relationships with funding firms, which could result in attaining financial resources. Despite prior ties, however, experienced entrepreneurs developed IPs which does not require a significant amount of funding. Other researchers have not looked in more depth, i.e., the subtleties of the kinds of relationships which we considered are very important, despite the fact that there is not much literature available. Thus, it contributes to the existing literature.

7.2 Research Limitations and Suggestions for Further Research

This study is conducted within a UK setting and targets the biotechnology sector. The empirical findings provide a picture of entrepreneurial intentions and efforts in the UK biotechnology sector. Care should be

taken over generalizing the findings from a single industry and location, and future research could investigate the extent to which framework of this study holds in other industries and countries.

Another limitation of the present research is that all the data collected are retrospective in nature. Cognitive scientists have found that memory is subject to considerable distortion and change over time (Baron and Ensley, 2006). To minimize such effects, we have carefully compared the descriptions of respondents with secondary data, which include company information, press releases, etc. Therefore we expect that this would minimize the recall bias. Because all retrospective data are subject to potential sources of distortion, however, only additional research can eliminate them as potential contributors to the present findings.

Finally, this research exposes the results of relationships of entrepreneurs with different levels of experience. The individual characteristics of entrepreneurs are, however, not considered. For example, Hite and Hesterly (2001) proposed that entrepreneurs may differ in their individual propensity and capability to form networks. This could be an important topic for future study.

7.3 Implications for Policy-Makers and Practitioners

This study reveals that novice entrepreneurs lack internal capabilities to develop through different stages. The lack of internal capabilities is the result of the deficiency of human capital. Many authors are critical of the way entrepreneurship education is delivered in traditional business schools (Gibb, 2002). This criticism is largely on its relevance to the needs of different types of individuals (entrepreneurial needs). Traditionally, entrepreneurship education curriculum is designed to serve the theoretical understanding of the individuals (Gibb, 2005). There, however, is a lack of policies where the majority of academic founders fail to develop their ventures further towards the stage of sustainability.

The essence of this study is to concentrate on how-to (human capital) and who-with (network ties) of an academic entrepreneur. This deals with two of the most significant issues for the transfer of technology from university to industry. The first issue relates to the role of business schools in delivering the education which is aimed to stimulate and promote entrepreneurship culture within academic environment. This could best be done if the practitioners such as: experienced entrepreneurs, venture capitalists, and individuals from corporate environment, are involved in designing the entrepreneurship curriculum, rather than designing the curriculum by set of academics with predominantly theoretical understanding of entrepreneurship (traditional model).

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Appendix

List of Network Actor

Network Actors
1. Venture Capital Firms
2. Business Angels
3. Surrogate Entrepreneurs (Interim Managers)
4. Professional Venture Management Firms
5. Business Link (Or Regional Equivalent)
6. Regional Development Agencies
7. Management Consultants
8. IP/ Legal Firms
9. Other Universities
10. Private Laboratories
11. SMEs
12. Large Firms/ Industry
13. Science Parks
14. Business Incubators
15. University Technology Transfer Office
16. Government Grant Agencies/ Charitable Organizations
17. University Challenge/ Proof Concept funds
18. Research Colleagues
19. Other

Industrial Experts

Industrial Expert	Position	Interview Location
Glenn Crocker	Chief Executive, BioCity, Nottingham	BioCity, Nottingham
Martino Picardo	MD, UMIC Manchester	Old Trafford, Manchester
David Parkinson	Professor, Sheffield Hallam University	Kenwood Hall, Sheffield
Rick Schoeman	Manager, Corporate Finance, Baker Tilly	Kenwood Hall, Sheffield