A new model of knowledge and innovative capability development for small born-global bio-tech firms: evidence from the East Midlands, UK

Amon Simba

Division of Management,
Nottingham Business School,
Nottingham Trent University,
NG1 4BU, Nottingham, UK
Email: amon.simba02@ntu.ac.uk

Abstract: In the last two decades, the rapid transformation in information and communication technologies together with the adoption of more liberal structures governing trade as well as the modularisation of production and services has resulted in the proliferation of small born-global bio-tech firms. The firms have an international flair and they rapidly globalise their operations. Their strategic intent is to develop unique innovative capabilities through networking. In science-based industries such as the biotechnology sector the ability to innovate can only occur if a firm is able to both generate and integrate knowledge from inside and outside its boundaries. In that respect, this article employs a multi-case approach to construct a frame of reference for developing innovative capabilities that complement firm-based competences. The main focus is on small born-global bio-tech firms in the East Midlands region of the UK. The newly developed framework is invaluable to researchers, small born-global bio-tech and large bio-pharmaceutical firms. More so, it contributes to the concepts of dynamic capabilities and networking.

Keywords: born-global; networks; knowledge; internationalisation; absorptive capacity; inter-organisational collaborations; innovation 'ecosystems'; UK.

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Biographical notes: Amon Simba is a Lecturer of Strategic Management and International Business in the Division of Management within Nottingham Business School at Nottingham Trent University (NTU). He recently completed his PhD in Business Management at NTU. His research interests cover international entrepreneurship, business enterprise, innovation and strategic management.

1 Introduction

Born-global bio-tech firms are entrepreneurial enterprises which develop complex international resource configurations (Karra et al., 2008). Scholars universally agree that when a firm ventures beyond its immediate vicinity, it is exposed to unique resource

combinations (Schumpeter, 1950; Oviatt and McDougall, 1994; Cooke, 2001; Owen-Smith and Powell, 2004; Johnson and Vahlne, 2009). Born-global bio-tech firms exhibit characteristics of traditional entrepreneurial firms. For example, they are proactive and, innovative and they take risks but in an exceedingly complex fashion involving significant degrees of uncertainty synonymous with global markets (Burns, 2012). As we strive to understand how these new types of international ventures complement their firm-based competences fresh and more nuanced theories are needed. From that perspective, the article proposes a theoretical framework for born-global bio-tech firms illustrating the complex processes and mechanisms in their knowledge supply-chain. Empirical evidence from multiple cases of bio-tech firms, in the East Midlands region of the UK, is used to construct a new model of 'knowledge and innovative capability development'.

The model is anchored on the ideas of Freeman et al. (2010). An understanding of how born-global bio-tech firms view their social world helps us to interpret and comprehend the meanings they attach to their lived world (Pittaway, 2000; Saunders et al., 2007).

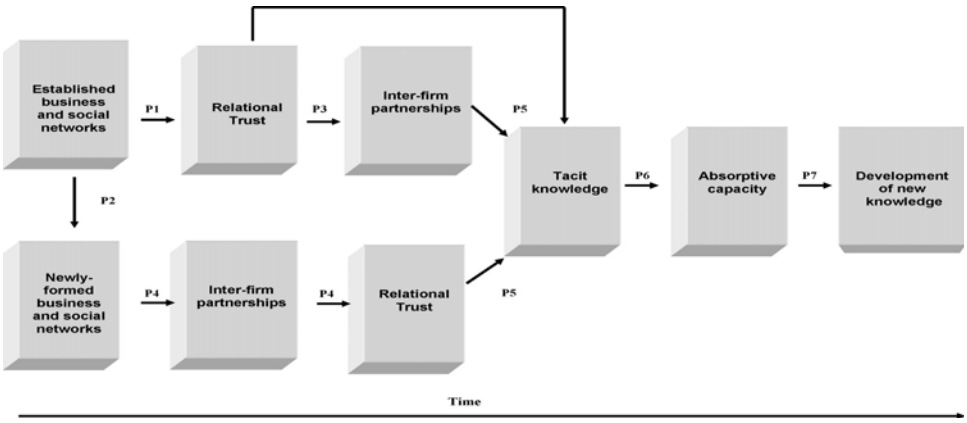
1.1 A definition of born-global bio-tech firms

Born-globals are defined in a number of different ways. For example, Oviatt and McDougall (1994) define them as international ventures that seek to derive competitive advantage from the use of resources and the sale of outputs in multiple countries. Other scholars (see Knight and Cavusgil, 1996; Knight, 2001) use a variety of measures as criteria for defining these international ventures such as: the vision and strategy to become global, time of internationalisation and overseas sales volumes. Considering the different labels used to define born-globals a distinguishing feature in all their definitions is that, they adopt a global strategy evidenced by their structural dimension which encompasses various actors in multiple countries (Oviatt and McDougall, 1994). Regardless, of this distinctive feature there still is no universal agreement to a single definition of born-globals. In all the confusion and misconceptions regarding the definition of born-global firms, the author is of the view that researchers should base their definitions on observable traits. Particularly, behaviours that are embedded in the design of the ventures should form the basis of how we define them. For example, they should be based on three prominent multi-dimensional constructs of social capital identified in the literature as structural, relational and cognitive dimensions. Structural dimension is related to global network ties and their overall configuration (Burt, 2002; Ahuja, 2000). Relational dimension focuses on trust, trustworthiness, norms and obligations in a global network (Fukuyama, 1995; Putnam, 1993). Cognitive dimension refers to those resources providing 'shared representations, interpretations, and systems of meaning among parties' [Nahapiet and Ghoshal, (1998), p.244]. From that perspective, it suffices to define born-globals as small bio-tech firms which have an international flair and rapidly globalise their operations without any preceding long-term domestic or internationalisation period.

2 Theoretical background

Scholarship on the internationalisation of small firms is littered with various models aimed at explaining their internationalisation processes. From early on Johnson and Vahlne (1977) developed the inspirational Uppsala internationalisation model (U-model) and it became a widely used model in business management. The model was based on the assumption that an enterprise develops in foreign markets by adopting a process which evolves incrementally in stages 'progressing like rings in the water' Bhowmick (2004, p.760). Put in a different way, the enterprise passes from one stage to another as it acquires more and more international experience as well as deepening its resource commitments. Other management scholars (e.g., Rogers, 1962) have developed the innovation diffusion model (I-model) which focuses on internationalisation as innovation for the firms. These two models (U and I) became the bedrock of stages theory that explained the incremental internationalisation process of small firms. According to Andersen (1993, p.212) 'both the U and I models can be properly regarded as behaviourally oriented'. Arguably, the gradual process of internationalisation, as denoted on the U and I models, can be seen as a risk-averse strategy adopted by firms as an entry mode into foreign markets. Moving forward in 1997, Teece et al. proposed the dynamic capabilities theory, they defined the theory as "the ability to integrate, build, and reconfigure internal and external competences to address rapidly-changing environments".

Figure 1 A model of rapid knowledge development: the smaller born-global firm



Source: Freeman et al. (2010, p.76)

The dynamic capabilities view is based on the notion that externally acquired dynamic capabilities attempt to bridge a firm's capability gaps by adopting a process approach: and by acting as a buffer between firm resources and the changing business environment (Teece et al., 1997). According to Helfat and Peteraf (2003) dynamic resources help a firm to adjust its resource mix thereby enhancing its innovative capabilities which underpins its ability to make new innovations. More recently, Freeman et al. (2010) proposed an inspirational model for rapid knowledge development for smaller

born-global firms. Their model, similar to the dynamic capabilities concept extends the resource-based view (RBV) and network theory specifying the level of interaction required for the development of the new knowledge process to occur in rapidly internationalising smaller born-global firms. Freeman and others instrumental model is illustrated in Figure 1.

Building on the ideas by Freeman et al. (2010) the new theory of 'knowledge and innovative capability development' for small born-global bio-tech firms is developed as a result of inference from new empirical evidence and secondary data. The new model is anchored on the model of rapid knowledge development for the smaller born-global firm. Adjustments to Freeman et al. inspirational model are made so that the new framework adequately explains the process of acquiring innovative capabilities specific to small born-global bio-tech firms. The intention is not to undermine the categorisation of the concepts contained in the model of rapid knowledge development for smaller born-global firms but rather, to adapt it so that it suites the emerging phenomenon in the bio-tech sector. Learning from Gerring's (2001), Turnbull's (1987), Andersen's (1983) and Bhowmick's (2004) critical analyses of the stages models it is a plausible thing to adjust a theory to meet the specific needs of the research phenomenon. The scholars suggest that contextual range, i.e., the scope, reach and stretch of a concept determines whether it needs to be adjusted to accommodate and to maximise its performance. Indeed, when examining specific units of a phenomenon e.g. born-global bio-tech firms being examined for this study, their contextual range can be a decisive factor in terms of the extent to which the new conceptual framework can be generalised (Gerring, 2001; Sartori, 1970). This is consistent with the views of Yin (2003, 2009) who argues for analytical generalisation of case-oriented research strategy.

Yin (2009) suggests that analytical generalisation denotes a process where generalisation takes place from data to theory rather than to population.

3 Approach

To inform the process of theory-building the author uses a multi-case approach (Yin, 2009). The main focus is on small born-global bio-tech firms in the East Midlands region of the UK. Yin (2003) and Stake (1995) advise that to avoid pursuing a study that has too many objectives, it is necessary to determine your case(s). From that perspective, the author uses a technique known as case-binding which includes: using time and place (Creswell, 2003); time and activity (Stake, 1995); and by definition and context (Huberman and Miles, 1994). Baxter and Susan (2008, p.546) support the use of a case-binding technique claiming that, 'binding the case will ensure that your study remains reasonable in scope'. Data is collected from a systematically selected sample of five biotechnology firms identified as having an international flair. Expert opinion is also sought from three key science research institutions in the East Midlands region of the UK that were identified as 'champions of innovation'. The main reason for using the multi-case research approach for this study is to allow the author to examine the research subject(s) more closely so that rich data is collected. This ensures the validity and the reliability of the new conceptual framework (Bellamy and Perri, 2009). More so, it demonstrates that the new concepts on the model of knowledge and innovative capability

development are grounded within and across cases of small born-global bio-tech firms. Results achieved in this way can be taken to be reliable (see Gerring, 2005; Huberman and Miles, 1994; Yin, 2009). Baxter and Susan (2008) affirm that a multiple case-study (Yin, 2003) or a collective case-study (Stake, 1995) allows a researcher to analyse data within and across settings. Crucially, the author preferred this method of research in particular because the evidence it generates is considered to be robust and reliable (see Huberman and Miles, 1994).

4 Methodology

Cases used in this study have been carefully chosen primarily for the following reasons:

1 to understand the world of small born-global bio-tech firms

2 to contribute to theoretical concepts of dynamic capabilities and networking.

The seemingly dated but still influential work by Eckstein (1975) identified five ways in which case material can be useful as follows: configurative idiographic studies, descriptive configurative studies, heuristics case studies, plausible probes and critical case studies. In light of this, the author is mainly interested in heuristic case-study types because choosing cases using this way enabled him to develop some theoretical concepts which are useful in explaining the capability development process of small born-global bio-tech firms.

4.1 Data collection

The author interviewed senior managers who were responsible for spearheading their firm's operational strategies. In the majority of cases the founders were also the CEOs/science directors of the visited firms and had vast experience in the biotechnology sector either from their previous posts or through years of operating as key players in the sector. For a period of about six to eight months commencing from November 2011 to June 2012, a total of about 11 face-to-face qualitative discussions were conducted ranging from 35 minutes to 45 minutes in length with an average duration of about 40 mins. Table 1 on p.5 provides an array of data describing the small born-global bio-tech firms that were visited during the data collection stage.

To achieve internal validity the author adhered to an interview guide. In cases where interesting lines of enquiry emerged follow-up questions were asked to explore the subject further. The interview guide included questions about the influence of various factors within the knowledge supply-chain of small born-global bio-tech firms identified as: business and social networks, inter-organisational collaborations, competence and goodwill trust, tacit and explicit knowledge, prior learning and absorptive capacity. The questions also focused on their personal experiences in business and social networks and how they developed trust in those relationships. The schedule guide also included questions that were aimed at getting the interviewees to explain the perceived risks of their operational strategies.

Table 1 Description of small born-global firms comprising the sample

Firms	*Origins*	*Bio-tech activity*	*Year founded*	*No. of interviews*
Critical Pharmaceuticals	UK-based biotechnology spinout company from the University of Nottingham	Involved in drug delivery technologies for the sustained release and nasal delivery of proteins and peptides and labile or insoluble small molecules. delivers advanced therapeutics	2002	1
XenoGesis Ltd.	UK based founded after the closure of AstraZeneca	Specialises in pre-clinical drug metabolism and pharmacokinetics (DMPK), quantitative bioanalysis and expert interpretation	2012	3
Haemostatix Ltd.	Spin-out firm from the University of Leicester – UK based	Develops a pipeline of haemostats based on its new class of active ingredients that replace thrombin. The firm also commercialises its new technology platform based upon a specific peptide sequence that binds to fibrinogen – a protein essential to the formation of clots.	2003	2
Sygnature Discoveries	Founded in BioCity Nottingham	Provides integrated drug discovery services. The company is also involved in a wide spectrum of drug discovery programmes and the outsourcing of discovery projects to contract research organisations (CROs)	2004	2
BAST Incl.	Spin-off business launched after the announcement of the closure of the AstraZeneca	The pharmaceutical company is involved in a new drug development process known as model-based drug development (MBDD) where investment decisions are supported by a simulation of the probability of success. The company is part of a collaborative network of 24 other organisations with the East Midlands and internationally.	2010	3

Table 2 The outcomes of the global activities of small born-global firms

		Building blocks essential for developing innovative capabilities					*Innovative capabilities*
		Business and social networks	*Competence and goodwill trust*	*Inter-organisational collaborations*	*Tacit and explicit knowledge*	*Prior learning and absorptive capacity*	
Small born-global firms	Critical Pharmaceuticals	Strong academic, personal and institutional networks. VC are also part of the network	Trust is build based on the reputation of the partner	Engages in collaborative projects with other firms in the East Midlands and overseas. Work with universities and scientists on specific projects.	The firm sponsors biochemistry students to work on projects and to study at university. Data from projects is stored on a database. Students are also bonded.	Experience is seen as essential in order to understand what knowledge should be acquired	Nano-enabled intranasal formulation of teriparatide for the treatment of osteoporosis as a result of result of working with an academic institution
	XenoGesis Ltd.	Same as BAST Inc.	Trust is built in escalating series but in cases of a partner whose cognitive distance is big that is seen as the basis for trust	The firm work with scientist from their clients to bridge the knowledge gap.	Same as critical pharmaceuticals	Same as critical pharmaceuticals	Data interpretation techniques necessary for new drug testing as a result of working with other firm
	Haemostatix Ltd.	Same as Critical Pharmaceuticals and XenoGesis	Trust is portrayed as key to knowledge exchange	Same as XenoGesis	Most of the board members have experience in product development and commercialisation	Board members have vast experience in drug discoveries which helps to understand the needs of the firm	Haemostats technology used by surgeons to manage problematic bleeding. Funding was key to the development of the technology
	Sygnature Discovery	Same as XenoGesis and Critical Pharmaceuticals	Trust is built in escalating series with partners	Same as all the other participants	Same as	Same as above	Gold standard' techniques in pain, metabolic and CNS disorders, inflammatory disease and in vivo pharmacokinetics
	BAST Inc.	The firm has a strong network of 24 other firms. The CEO has personal connections with expert scientists and connections developed from his previous employment	Same as Critical Pharmaceuticals	Collaborations are seen as the route to new drug discoveries	Same as XenoGesis	Same as with all the other firms	New statistical tools in parameter estimation and optimal design, e.g., risk and utility assessment through mechanistic modelling

4.2 Analysis

The study follows an inductive analysis style with elements of deduction. The cases chosen for analysis consist of CEOs/founders who are former employees of AstraZeneca or have vast experience in the bio-tech industry accumulated over years of operating in the sector. The next step in the analytical process was to investigate the sampled cases in order to identify patterns and trends in relation to how they generate knowledge in each case (Bellamy and Perri, 2009; Huberman and Miles, 1994). Yin (2009) suggests that using pattern-matching logic in case-oriented studies is the most appropriate technique for case analysis. Similar cases with identical features seen as typical born-globals were closely scrutinised. Taking into perspective the emerging themes, regarding the processes of generating scientific knowledge for small born-global firms, a causal link between various factors including networking, collaborating, trust, knowledge sharing, prior learning and absorptive capacity was formed. This way of analysing data is consistent with other scholars'.

For example, Miller (1983) suggests that the process of analytic induction starts with a tentative hypothesis to explain something. Data collected from each firm was sorted and transformed into a chronological order and using thematic analysis in each case history (see Table 2). Thematic analysis is multi-discipline; it is used in education research (Cohen et al., 2007), by research clinicians (see Newfield et al., 1991; William, 1992), and in political science (Easterby-Smith et al., 2012). Identifiable themes for this study are related to business and social networks, inter-organisational collaborations, competence and goodwill trust, tacit and explicit knowledge, prior learning and absorptive capacity. The study takes the stance that these concepts are the building blocks to the process of developing the innovative capabilities of small born-global bio-tech firms operating in a hypercompetitive environment driven, among other things; by the wealth of information a firm can have access to Schilling (2008). The emerging themes from qualitative conversations enabled the author to piece together and form a comprehensive picture of small born-global bio-tech firm's collective experience of business and social networks, inter-organisational collaborations, trust building, knowledge sharing, prior learning and absorptive capacity in networks. This is in line with Taylor and Bogdan (1984, p.131) who define themes/concepts as units derived from patterns such as 'conversation topics, vocabulary, recurring activities, meanings or feelings'.

5 Findings

5.1 Innovative capabilities' knowledge supply-chain

This part explains the impact of the building blocks, including: business and social networks, competence and goodwill trust, inter-organisational collaborations, tacit and explicit knowledge, prior learning and absorptive capacity, on the abilities of small born-global bio-tech firms to build their innovative capabilities. It draws upon results from within and cross case analysis using the various factors, which mitigate the knowledge supply-chain of born-global firms, as the main themes. It also outlines the

authors' propositions based on the information obtained from within and across cases. Secondary data analysis is also used to provide some insight and to support empirical evidence. This leads to the development of a model of 'knowledge and innovative capability development' for small born-global bio-tech firms.

5.2 Business and social networks

For small born-global bio-tech firms business and social networks are essential to their success. The interaction between individuals, firms or organisations with varied skills, experience and knowledge provides synergy for small firms with limited resources. They provide them with access to a wide range of economic effects (Ho and Wilson, 2006) including: access to specialised input and labour, novel information inflows and knowledge as well as access to research institutions and government R&D support services (Martin and Breschi, 2011). Breschi & Malebra (2005, p.47) suggest that, "resource pooling, risk sharing and the formation of critical masses provide incentives to create a group of inter-linked agents". Powell et al. (1996, p.46) affirms that, 'when the sources of expertise are disparate, collaborative R&D opens an organisation's eyes to the need for accessing ideas and information from a variety of sources'. This was evident when the author conducted a case by case examination of their networking activities. He found that small born-global firms link up with other firms, scientists, research and academic institutions within and outside their vicinity to jointly develop new drugs and share technical know-how. This was reflected in the response given by the President at Sygnature Discovery when asked about whether his company engages in networking. He commented that:

> Our scientists work with other scientists from other businesses, research institutions and strategic alliances to jointly test and develop drugs. We work in a highly collaborative way e.g. in our molecule synthesising process. We have secure data bases that we use to share data with our partners and clients from wherever they might be either in San Francisco or Santiago. We have realised that we do not have all the capabilities and we feel that it is important to collaborate with other companies for example, we collaborate with Cyprotex Discovery. They have better knowledge about how the drug dissolves in the body. What is important is we share capabilities.
>
> We feel that we have modelled our business in a 'hub and spoke' model i.e. we are in the middle and we are networking with other companies.

In light of this evidence, indicating that bio-tech firms in the East Midlands region in the UK are forging global networks to enhance their capability development, the author can confidently conclude that the business and social networks in the knowledge supply-chain of small born-global bio-tech firms significantly influence how they acquire scientific knowledge and technical know-how. Accordingly, Nahapiet and Ghoshal (1998), and Tsai and Ghoshal (1998) suggest that social capital embedded in a firm saves as a conduit that facilitates and enables positive conditions for the exchange of knowledge and the combination of resources to occur. When discussing with an expert working in a knowledge 'hub' the author was fully convinced that the business and social networks of small born-global bio-tech firms play a decisive role in how they develop their innovative capabilities. The innovation advisor, Rosamund Graves, commented that:

> We help firms and industry sectors access information, opportunities and partners on a global scale through specialist networks and business intelligence. On behalf of national government agencies, we deliver programmes to stimulate international inward investment, technology transfer, partnering and access to high growth global markets for UK companies. We provide business intelligence and contacts to help UK firms identify and realise international opportunities.

Her statement endorses that forging networks within and outside a firm's local industry *milieu* plays a key role in the process of acquiring knowledge and technical know-how. In that regard, it is plausible to claim that business and social networks are part of the jigsaw puzzle needed to complete the process of generating novel information for small born-global bio-tech firms.

Proposition 1 Business and social networks act as a catalyst for small born-global bio-tech firms in their process of developing innovative capabilities

Social capital and network ties have a positive impact on international start-ups, new ventures and SMEs' performance (Johnson and Vahlne, 2003; Oviatt and McDougall, 1994, 2005). Furthermore, Hughes and O'Regan (2009) stress that for a firm to gain access to knowledge and technical know-how it is essential to collaborate in networks and engage with a range of advisors that include: scientists, academia and agencies. This was echoed in the conversations with the CEO at XenoGesis Ltd., and the Science Director at BAST Inc. Ltd. When discussing about how wide-spread their networks are the CEO, and the Science Director of the firms mentioned above explained that:

> I have a good network of ex-colleagues that I used to work with at AstraZeneca and such connections are vital for sharing scientific knowledge and technical know-how. I think collaborating with other businesses and academia is essential in the bio-tech industry and it is important that businesses join to work on new discoveries. That is the way things are heading towards nowadays given the nature of the markets. Apart from using my business or social connections as conduits of scientific knowledge I also publish papers. CEO at XenoGesis Ltd;

And,

> I engage in networking activities both locally and internationally with firms and organisations in the USA, Asia for example. I personally have some contacts in America where my business started way back in 1998 as a model based on a drug development firm. Science director at BAST Inc. Ltd

Their responses boldly underline the essence of business and social networks. Indeed, the evidence is strong and this indicates that in the globalised markets of the biotechnology sector, going it alone is no longer the best option because it is so difficult for small firms to possess all the necessary capabilities. Lasserre (2012) argues that firms can benefit in globalised networks by accessing and taking advantage of geographical clusters of knowledge creation and development. In that sense, business and social networks of small born-global firms can be seen as channels through which they can access scientific knowledge and technical know-how. Considering the suggestions from the CEO of XenoGesis, and the Science Director at BAST Inc. Ltd quoted above it is plausible to conclude that small born-global bio-tech firms use networks to generate knowledge so as to leverage their internal science capabilities with a view to discovering new drugs. Thus,

giving them greater flexibility needed to survive in a hypercompetitive business environment (Schilling, 2008; Lasserre, 2012; Hisrich, 2012). Schilling (2008, p.158) further affirms that 'as firms forge collective relationships they weave a network path between them that act as a conduit for information and other resources'.

Funding institutions are also a key player in the networks of small born-global firms. Mobius Life Sciences – an investment arm of BioCity Nottingham (BCN) work alongside Nottingham City Council (NCC) to provide financial support 'seed investments' in high potential life science businesses. Crocker (2010) explains that the investment arm has a highly experienced and well networked team. This gives the author strong belief that financial support for bio-tech firms significantly boosts their limited resources and it adds value to their businesses which ultimately enhances their capacity to innovate. The CEO at Haemostatix said this:

> While business networks facilitate the flow of novel information, financial investments are a 'shot in the arm' in that they also provide a company with the opportunity to develop innovative technology. In our case we were presented with the opportunity to develop an innovative haemostat technology.

This shows that business links that include funding institutions are the bedrock for small firms seeking to make crucial innovations. What is happening in the East Midlands has striking resemblance to networking activities documented elsewhere, e.g., in the Golden Triangle of Cambridge, London and Oxford, the Silicon Valley and the Boston metropolitan area. The Cambridge Cluster Report of 2004 reports that over the last decade the cluster has acted as a magnet attracting supportive infrastructure comprising of number of key players such as: venture capitalists firms, banks, marketing experts and patent agents.

5.3 Competence and goodwill trust

Strong relationships that allow the free flow of information to occur were found to exist between parties involved in a well-established network and trust was the most important component of that process. Results from within and across cases show that small bio-tech firms trust their collaborating partners based on their technical prowess (competence trust) and good intentions (goodwill trust) within the life science sector. In this study, the author uses Blomqvist's (1997, p.3) definition of trust expressed as an 'actor's expectation of the other party's competence, goodwill and behaviour'. Consistent with Blomqvist's definition, Gubbins and MacCurtain (2008) claim that to trust an individual's ability is to trust in his or her skill and competencies to do the job. Evidently, all the participants in this study indicated that trust is established when they know that their collaborating partner is skilled and very capable. Especially, in a specific area of science which complements their knowledge gaps.

In a discussion with the CEO at XenoGesis about how trust is developed in networks he expressed that:

> We build trust by first conducting due diligence (i.e. we do a search on their level of technical capabilities, their reputation which we get from people who have worked with them before). In other words we look for partners who have higher skills and are well established/known in the industry. This is all done in a trial and error method.

The interpretation from this statement, which is supported in the literature (see Blomqvist, 1997; Sengun, 2009), demonstrates the relevance of competence (technical capabilities, skills and know-how) in the biotechnology sector and it shows that it is a necessary antecedent and basis for trust in professional relationships within a business context. Networking with organisations that have better skills levels is an important factor in building trust in the bio-tech sector particularly, in instances where potential partners are assumed to have technological knowledge and competences (Blomqvist, 1997). Furthermore, the statement highlights that the reputation of a partner, including: moral responsibility and positive intentions towards the other, was an important factor that influenced his firms' decision to accept a potentially vulnerable position (risk inherent by partnering). Welter (2012, p.194) claims that 'trust is seen to assist in lowering the transaction costs of commercial actions and the risks inherent in entrepreneurship'. In the majority of the firms in the sample, trust was built in escalating series using a 'trial and error' method. This discovery contributes to the social exchange theory (Pretty and Ward, 2001; Inkpen and Tsang, 2005; Whitner et al., 1998) which suggests that information, advice, social support and recognition are important means of building trust created through repeated interactions and reciprocity. In addition to the main meaning of the social exchange theory, when asked about how trust was builtin his firm the President at Sygnature Discoveries stressed that:

> Our partners I guess they also do a due diligence to assess whether we fit into what they are looking for. With our alliances we are well connected actually, before establishing this connection we first test the partners trustworthiness through engaging in small projects and we take it step by step until we are fully convinced that a stronger partnership can be established. Competence and reputation play a key role in building new networks.

This is further evidence suggesting that in order to build trust a wide scope of information is necessary for small born-global bio-tech firms because different types of information including relational-emotional, socio-economic and tacit-explicit significantly impact on the trust experienced. With all the firms in the sample, trust was naturally developed within their business community at BCN but with organisations and institutions outside their locality there was more of 'trial and error' requiring a lot of information search. The process of due diligence was done mainly to test the trustworthiness of a potential business partner in particular, their intentions which is related to the goodwill dimension of trust. The process of testing a partners' trustworthiness through small projects was targeted at identifying positive or negative signs and signals which Blomqvist (1997) claims are visible and easier to evaluate when the relationship is developing. This was found to be a vital activity for small born-global firms and it was critical to how they developed innovative capabilities in newly established networks. Responding to the same question on trust building in newly formed networks which they develop in a global context, the CEO at XenoGesis stressed that: 'it is very important to try different combinations to ensure that we end up working with people who share the same values as us'. In this case it was the CEO's envisaged strategy that his organisation should develop trust with its partners based on the soundness of their strategy and vision.

In the relevant literature (Mishra, 1996; Sydow, 1998), the competences of an organisation are seen as a basic and profound source of trust in asymmetric technological partnerships. Blomqvist (1997) suggests that competence trust may be born out of a firm's technical capabilities, financial resource-base and partnering competences. Thus, the author proposes that:

Proposition 2 For small born-global firms competence and goodwill trust are major factors that reduce friction and perceived risks allowing the free flow of fluid scientific knowledge and technical know-how through established or newly developed business partners.

The most common form of trust that was evident in the research sample was the sense of benevolence; meaning that scientific knowledge and technical know-how developed with partners were protected within the trusted group/network (Hoy and Tschannen-Moran, 1999). The firms relied on the goodwill of their partners to act in the best interest of both parties. In on-going relationships future behaviour was not specified but there was a mutual attitude of goodwill. As illustrated in the 'knowledge and innovative capability development model' on p.17, trust was the basis on which inter-organisational collaborations stemmed from in the capability development process of small born-global bio-tech firms. More importantly, trust was a pre-requisite to knowledge sharing and the exchange of technical know-how.

5.4 Inter-organisational collaborations

Data collected from sampled firms demonstrates that there was a strong relationship between collaboration and innovation. Through conducting a detailed case by case analysis it was found that the main reason why small born-global bio-tech firms collaborate with other firms/research institutions was to learn from them in order to enhance their innovative capabilities. Zucker et al. (1998) posit that learning underpins organisational innovation and according to Basile (2010, p.3) innovation 'is a complex and interactive process that involves a variety of actors'. In the biotechnology sector where scientific knowledge is both complex and ever-expanding in search of new discoveries the sources of expertise are widely dispersed. In such sectors, Powell et al. (1996) postulates that the locus of innovation is usually found in networks of learning as opposed to going it alone. The CEO at Critical Pharmaceuticals revealed that:

> In the bio-tech industry you need various skills and knowledge, in addition to our in-house knowledge we collaborate with other institutions such as universities, other companies – large or small both locally and internationally and along with that we have different levels of collaboration. We collaborate with companies in the USA, EU. We also have intense collaborations with companies near to us who have expertise in areas of interest we therefore work with them to access the expertise that we do not have.

This evidence powerfully demonstrates that small born-global bio-tech firms maintain a broad scope of interactions with a wide range of actors in the bio-technology sector with a view to complement their knowledge bases. Scholarship on inter-organisational networks argues that firms should look further than their own boundaries to acquire strategic resources (Subramanian and Soh, 2010; Feldman et al., 2002). The traditional model of large pharmaceutical companies where all research activities were done in-house is slowly fading into the horizon. The managing director at BioCity Nottingham (BCN) observed that: 'The large Pharma used to employ a large number of scientists under one roof and that structure is fragmenting giving rise to the formation of smaller research-based organisations'. The re-structuring exercise happening at AstraZeneca and Boots in the East Midlands and at Lund in Sweden typifies this. The pharmaceutical

giants are undergoing a strategic shift towards outsourcing their R&D activities to small bio-tech firms.

This heralds a significant move towards more collaboration between organisations in the biotechnology sector where smaller firms such as those investigated for this study are taking the centre stage. Large pharmaceuticals continue to provide marketing, commercial capabilities and financial resources. Similar studies (see Stuart et al., 2007; Zucker et al., 1998) have reported a growing trend, in the biotechnology, sector where small firms are being contracted to do the research for large pharmaceutical companies. More recently, Kang and Park (2012, p.70) reported that 'while the new biotechnology firm specialises in specific types of knowledge, products and applications large established firms have expertise in the commercialisation of new inventions that involve large scale production, marketing and distribution, and regulatory processes'. The CEO at Critical Pharmaceuticals expressed that:

> We acquire financial support to back up our products, expertise, marketing, PR, scientific knowledge and these are things that we do not have in house and they are needed to achieve our goals. The only way to achieve this is through linking up with people who have been there and done it and are well established in the market.

This highlights the significance of inter-organisational collaborations in terms of:

1 bridging the knowledge gap of small born-global bio-tech firms

2 enabling them access to markets

3 providing them with financial back-up

4 getting help from science experts who have vast experience in life science.

In support of these findings, Schilling (2008) makes similar observations and she postulates that, small biotechnology firms form partnerships with large pharmaceutical firms for their mutual benefit: pharmaceutical firms gain access to the drug discoveries of the biotechnology companies and likewise small bio-tech firms gain access to the capital resources, manufacturing and distribution capabilities of these large pharmaceutical firms. The author discovered a growing trend of these mergers and consolidations. For example, Critical Pharmaceuticals worked closely with academia to develop a highly innovative formulation of *teriparatide*. The University of Leicester (UoL) played a crucial role in supporting Haemostatix Ltd during its early stages of development. The firm received support in the form of clinical laboratories as well as opening up links with other institutions and organisations. As a result of Haemostatix Ltd's links with the UoL, it received start-up funding of £250,000 from The Lachesis University Challenge Fund and an initial investment from NESTA. The founder of Haemostatix expressed her profound gratitude in 2006 when her organisation received support from Quester, 'Quester has worked with us (Haemostatix Ltd.) since 2002 and we are pleased to have their financial support and strategic input to take the business forward'.

Proposition 3 Inter-organisational collaborations are an important step in the knowledge supply-chain of small born-global firms and they influence their process of developing innovative capabilities

However much seemingly important inter-organisational collaborations are; the study discovered that trust played a significant role in allowing the exchange and transfer of knowledge between collaborating partners to occur. It was found that for small born-global bio-tech firms with global foci; their inter-organisational collaborations were based on competence and goodwill trust. Şegun and Önder (2011, p.796) claim that, 'trust in competence refers to the perceptions of the trust or concerning the trustee's technical, cognitive and communicative competences'. At the inter-organisational exchange level small born-global firms collaborated with organisations they believed to have expertise and experience. This enabled them to successfully develop or test drug combinations.

When the president at Sygnature Discovery was asked about the importance of firm-based competencies and goodwill in trust building this is what he had to say:

> We build trust with potential partners based on their science and technical capabilities. We also receive advice from BioCity, Medilink and UKTI about potential partners and I guess it is part of due diligence.

The above statement also brings to light the fact that firms intending to enter into partnerships with other firms can use a third party to gather information about their scientific capabilities and technical know-how, more so, for those which are geographically distant. In all the firms that took part in the interviews this was important as their intentions were to work with global partners. When seeking global partners these firms relied on the advice they received from BCN, Medilink East Midlands, UK Trade and Investment (UKTI), and from their established connections. The innovations manager at Medilink explained this more fully when asked about the role her organisation plays in facilitating inter-organisational collaborations. She stated that:

> We would facilitate for companies that intend to relocate to the East Midlands by providing them with the necessary information. We support both domestic and international organisations and recently we had a company that came from India intending to establish in the East Midlands. In that case we supported them by providing them with information to enable them to achieve their goal.

Bachmann and Inkpen (2011) agree that in cases where face-to-face interactions with a potential partner are not possible a third party may operate as a guarantor. The managing director at BCN echoed these sentiments explaining that for their tenants they 'guarantee a certain level of competence and quality of a potential partner but after that they take a step back and let people work and learn on their own'. A strong bond was gradually developed between collaborating firms, whether local or foreign, over a period of time through a 'trial and error' method. When the relationship got stronger the level of trust was increased accordingly thereby allowing the free flow and exchange of scientific capabilities as well as technical know-how. In the literature regarding trust, high levels of trust are associated with a decrease in perceived risk and they are cast as being fundamental to the formation of strong relationships. Thus, strong relationships are a precursor to trusting that a business partner will act in the best interest of both parties (Şegun and Önder, 2011). Evidently, some form of connection existed between firms which used a pre-existing business network such as BCN as their base but for partners outside their locality a 'trial and error' method taking the form of smaller projects was the main method of assessing the trustworthiness of prospective partners. As such the author's fourth proposition is that:

Proposition 4 Small born-global bio-tech firms build trust with their prospective partners in escalating series basing it on their partner observations from inter-organisational collaborative projects.

5.5 Tacit and explicit knowledge

The process of acquiring knowledge is a very complex process which involves participating in generating and disseminating it in a way that benefits all the people involved (Powell and Grodal, 2005). There was cogent evidence indicating that small born-global bio-tech firms aim to develop stronger ties with local and international partners in order to ensure that they continue to receive crucial scientific knowledge. Ideas and knowledge generated from science-related projects involving sampled firms were codified and retained in the firm for future developments. This was reflected in the discussion with the CEO at Critical Pharmaceuticals regarding how his firm managed data accumulated from collaborative projects.

To this end, he explained that:

> From a scientific perspective for a lot of the key projects we trap the knowledge that people have used in a project and we have project management systems to make sure that we capture all the knowledge e.g. by monitoring projects, gantt charts and project reports.

Managing scientific information this way was not only unique to Critical Pharmaceuticals. All the firms echoed the same sentiments. They also revealed that knowledge management was a crucial part of their drug discovery process. The findings are consistent with a number of scholars (see Daud and Yusoff, 2010; Hughes and O'Regan, 2009; Nonaka et al., 2000) who discuss the concept of knowledge externalisation. They postulate that externalisation allows knowledge that exists in the head of the knower to be codified into rules, specifications and formulas that can be used and become the basis of new knowledge. All the firms that participated in the discussions regarding developing innovative capabilities in the biotechnology sector placed great value on both tacit and explicit knowledge they acquired from their trusted partners. The firms went beyond their immediate environment in search of a new context and a new world-view. Todtling et al. (2009) suggest that sector-based innovations are not bound by geographical location; they often have international or even global reach. Global networking in search of new insights was a dominant characteristic in the majority of the firms that took part in the survey. Nonaka et al. (2000) point out that the process of creating knowledge is a continuous one and it transcends beyond one's immediate environment. In a discussion with the CEO at Critical Pharmaceuticals he acknowledged that since his firm started to operate 15 years ago he has witnessed a significant transformation in the way his business now generates new knowledge. He emphasised that:

> The way we do business in the bio-tech industry has changed; when I started at Critical Pharmaceuticals most of the knowledge was only in-house. We now have access to a lot of external resources and nowadays there is a huge push towards accessing knowledge from outside for non-core areas. I would say the industry has changed somewhat it is now more open and there are a lot of collaborations with academics and research institutions and I think that has been good for the industry.

From that perspective, the interaction between individuals or a group of firms is vital in terms of facilitating knowledge transfer. As tacit knowledge exists in the head of the knower (Hughes and O'Regan, 2009), small born-global bio-tech firms work in collaborative projects with scientists, research institutions and other firms with a view to stimulate its transfer. Porter et al. (2005) point to the amalgamation of intellectual capital of clinical researchers and research academics as key to the success of the commercial world of biotechnology in the Boston metropolitan area. Similarly, Todtling et al. (2009, p.67) claim that, 'universities are regarded as key knowledge sources of firms for more advanced innovations'. This bears striking resemblance with the patterns of knowledge development emerging from the East Midlands region in the UK. There is cogent evidence of the existence of strong ties and relational-like trust in the sampled firms that are located at BCN, the region's science 'hub'.

Based on their shared values and common beliefs invested at BCN the firms naturally formed business connections and the intentions of all the firms were predictable. Boschma (2005), and Asheim and Gertler (2005) make similar observations and they highlight that interactions that occur in an institutional context facilitate the transfer of tacit and explicit knowledge. Through strong ties and relational-like trust, knowledge was freely exchanged. Discussions with the participants yielded two main forms of knowledge-sharing in the biotechnology sector. One form of knowledge-sharing that was clear was the idea of complementing each other's core competences. The strategy was evident across all the sampled cases. The collaboration between Critical Pharmaceuticals and PolyTherics is an example of complementary knowledge assets.

Critical Pharmaceuticals specialises in injectable products and PolyTherics Limited is an innovator in precision improvement of proteins and peptides. In that sense, the company's expertise and knowledge capabilities complements Critical Pharmaceuticals' technology of human injectable drugs. The second form of knowledge-sharing was in the mould process re-configuration. It is, however, important to note that in both forms of knowledge-sharing the process of transferring knowledge occurred after the establishment of the intentions of the partnering firm(s) or institution(s). BAST Ltd. as a contract research organisation (CRO) exchanged knowledge with its collaborating partners by re-arranging science apparatus in such a way that it enhances new drug discoveries. When responding to the question about how his firm's collaborative partners utilise the knowledge acquired in collaborative drug discovery projects the science director at BAST Ltd explained that:

> We use the information that we share with them to enhance their innovations and to accelerate their business processes. Basically, our ideas would change the next developments that they have which helps them to reduce costs and even sharpen their innovations and the way they put their resources together e.g. their operations and product development strategies.

With the first form of knowledge-sharing where both parties provide valuable input to the project, there was high commitment to generate both tacit and explicit knowledge. The firms developed relational capacities pooling together the skills of specialised participants who ultimately played an important role in the overall flow of information and resources in the network. The exchange and transfer of specialised scientific knowledge and skills between the firms engaged in collaborative projects or in the wider network at BCN had a significant impact on how they build their innovative capabilities. This brings to light the fact that both tacit and explicit knowledge are important factors that have an impact on

the knowledge supply-chain of small born-global bio-tech firms. Nonaka and Takeuchi (1995) suggest that the creation of new knowledge is predominantly characterised by the interaction between two main forms of knowledge, i.e., tacit and explicit knowledge. Thus, the author proposes that:

Proposition 5 Tacit and explicit knowledge generated in the collaborative projects of small born-global bio-tech firms influence how they develop their innovative capabilities.

5.6 Prior learning and absorptive capacity

Building on earlier studies by Cohen and Levinthal (1990), Jansen et al. (2005) on prior learning and absorptive capacity evidence from qualitative conversations with the founders/science directors of small born-global bio-tech firms suggests that their experience in science was crucial in the process of assimilating useful scientific knowledge. Small born-global bio-tech firms gather science-related information from a wide range of sources and the science knowledge levels of their management teams played a crucial role during the process of acquiring information which was specific to their needs. The CEO at XenoGesis explained this more fully when asked about the importance of prior learning in terms of understanding the specific knowledge that is useful for their science in business and social networks that span beyond their proximity. This is how he put it:

> One has to understand the relevance of the acquired knowledge to science and experience in that respect plays an important role. Given the experience our team of experts have in bio-tech we are in a better position to acquire the science that is necessary for our service.

The same sentiments were echoed by the CEO at Haemostatix he explained that:

> Experience in science plays an important role when it comes to selecting the right type of knowledge that is needed to develop new technology.

This demonstrates that their ability to recognise and assimilate external knowledge was crucial to their process of developing innovative capabilities. Cohen and Levinthal (1990) argue that a firm's ability to evaluate and utilise information is heavily influenced by prior related knowledge. Within case analysis revealed that for all the sampled firms, their management structure was composed of individuals who had vast experience in science and had worked for large bio-pharmaceutical firms. As such, their wealth of experience was vital in terms of understanding the knowledge gap in their firms. To get a different perspective on this the topic about prior learning and absorptive capacity was presented to an innovation expert at Medilink East Midlands as a point of discussion and she commented that:

> Working with other organisations to share knowledge and ideas is great, but what is important is that one has to have some understanding about the knowledge that will help his/her business to take that one step forward.

In all of the above statements, made by the participants, there is clear evidence that experience and prior learning have a significant impact on how a firm selects useful knowledge to complement its knowledge gap. Evidently, working with other firms or science institutions whose complementary foci is at some cognitive distance results in the

accumulation of vast amounts of information but recognising what a firm needs significantly increases its capacity to innovative. Indeed, working in collaboration accelerates the firm's process and product improvements. Schilling (2008) suggests that a firm's prior related experience shapes its ability to recognise the value of new information and its ability to utilise that information effectively. Thus the author proposes that:

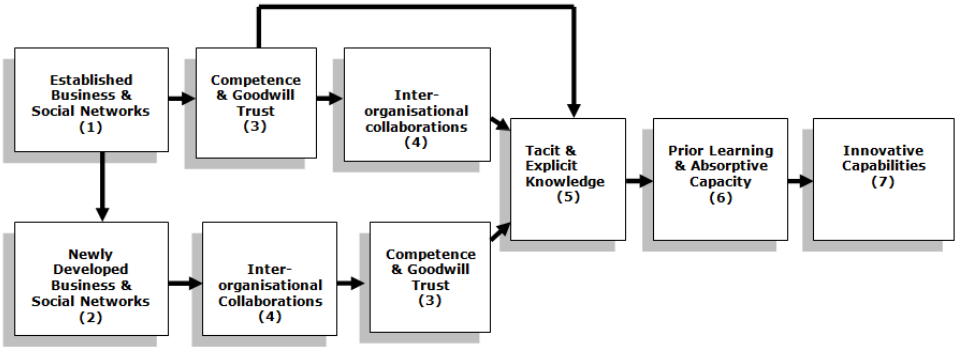
Proposition 6 The experiences of small born-global bio-tech firms are essential to their ability to recognise, assimilate and apply knowledge from their business and social relationships in a way that enhances their capacity to innovate.

It is also important to inform the reader that the concept of learning has not been fully explored here because it is beyond the remit of this study. Although the concept has been discussed in a limited fashion it has been an important part of the process of understanding its role in the development process of innovative capabilities small born-global bio-tech firms. Following an in-depth account of various factors within the knowledge supply-chain of these entrepreneurial ventures the author proposes a refined conceptual framework of knowledge and innovative capability development.

6 A model of knowledge and innovative capability development

The formation of theories in social science is fundamental to how we explain what we are trying to talk about (Gerring, 2005). Precisely, theories are instrumental in social science as they help us to make connections between the world people live in and how they interpret it (Gerring, 2001). Bellamy and Perri (2009, p.90) point out that regardless of one's research philosophy developing an adequate conceptual framework provides a roadmap that guides how the researcher explores the social world and for those working with variables and correlations they are able to 'establish valid measures and apply them reliably'. Building on the inspirational work of Freeman et al. (2010) regarding how smaller firms rapidly develop new knowledge in their internationalisation process; this study proposes a new improved framework for small born-global bio-tech firms.

Figure 2 Knowledge and innovative capability development model



Source: Modified from Freeman et al. (2010) and author's ideas

Using existing literature, empirical evidence from within and across cases the study proposes the 'knowledge and innovative capability development model'. Siggelkow (2007) affirms that using rich data acquired through closely examining instances of occurrences in cases can inspire new ideas in theory construction. In the same vein, Eisenhardt and Graebner (2007) express that the output of case-oriented research designs take various forms including: a new concept, theoretical construct, conceptual framework, propositions, and in other cases a mid-range theory. Similarly, Ridder et al. (2009) agree that case studies have the potential to uncover unusual phenomena and of repeating or countering the replication of findings of other cases which eliminates alternative explanations and elaborates the emerging theory. From these perspectives the author presents Figure 2 which neatly illustrates the proposed conceptual framework as a result of new evidence.

Small born-global bio-tech firms operate in a very complex and sophisticated business sector which is exceedingly dynamic. Therefore, it is imperative that they formulate strategies to enable them to continue to produce innovative life-saving products. The primary aim should be to enhance their innovative capabilities which enable them to make crucial innovations (Powell and Grodal, 2005). The firms used in this sample were all resident at BCN implying that they exist in a network which is already established where they have developed strong business and social ties. They demonstrated an entrepreneurial flair by venturing into the global markets in search of global partners. As denoted in Figure 2, the establishment of business and social networks, described as innovation networks by Powell and Grodal (2005), is the key building block within the knowledge supply-chain of small born-global bio-tech firms. Elfring and Hulsink (2003) make an important observation about entrepreneurial firms by suggesting that networks (business and social) contribute significantly to the venturing process of entrepreneurial small firms by presenting them with access to knowledge and unique capabilities. In their local network at BCN and the wider East Midlands region the firms were aware of the competences and the intentions of their potential collaborative partners thus, trust was built at a very early stage. This quickened the process of knowledge transfer as well as the exchange of technical know-how. So, established networks are credited with building trust which leads to inter-organisational collaborations. Established networks also led to newly-formed business and social networks (see Davis, 1970; Wall, 2009). In newly developed networks, trust was quite superficial and in some cases non-existent.

Therefore, for R&D institutions, firms or scientists located in foreign markets inter-organisational collaborations in the form of smaller projects were used as 'trial and error' conduits to test the trustworthiness of the prospective partner. Indeed, in their process of developing innovative capabilities small born-global bio-tech firms embarked on a number of different, often unsuccessful, configurations and techniques before finding the right combination that worked well for them (Lichtenthaler and Lichtenthaler, 2009). Schilling (2008) explains this process of experimentation and learning more clearly asserting that this stage in the knowledge supply-chain is vital in the sense that it allows the firm to build a base of knowledge about how key components behave, what alternatives are more likely to be successful than others, and what types of projects the firm is most successful in. Small bio-tech firms were forced to adopt the experimentation approach because of the dynamic nature of the biotechnology sector i.e. its heavy reliance on highly fluid scientific knowledge and technology to make new drug discoveries and

the speed with which these types of firms form and disintegrate required high levels of trust (Maxwell and Levesque, 2011; Welter, 2012). This strongly suggests that trust is ever-more critical for the transient and the high speed environment of the small born-global bio-tech firms as the basis for knowledge sharing (Freeman et al., 2010).As such, trust was built in escalating series because of the risks associated with developing new partnerships. Sitkin and Pablo (1992) discuss risk perception by referring to the assessment of the risk inherent to a situation. In all of the five small born-global firms the assessment of the risks associated with knowledge-sharing with new partners was done in a carefully orchestrated logical step-by-step approach. Once trust was built, whether in established or newly developed business and social networks, it paved the way for effective knowledge-sharing. Similarly, Hill (1990) claims that, it is highly likely that a firm will engage in knowledge transfer with partners who have demonstrated their trustworthiness and co-operative abilities in their other relations.

The process of knowledge-sharing is embedded in pre-existing business and social connections. Hutchings and Michailova (2006) suggest that sharing knowledge depends on the pre-existence of insider relationships and a disposition towards cooperative interdependence. Scholarship on entrepreneurship generally agree that small firms with limited resources have a tendency to soak as much information as is possible with the hope that something magical will materialise. The proposed model suggests that for small born-global firms prior understanding of the complementary resources needed for the firm to develop new life-saving drugs or technical products is essential otherwise engaging in collaborative projects will count to nothing in the way of innovations. The underlying assumptions of the model are that, by acquiring new scientific knowledge and technical know-how the firm enhances its innovative capabilities that underpin the development of new products and services in the life science industry. Furthermore, the process of generating innovative capabilities is directly anchored on the greater connectivity and enhanced collaborations in the life science's innovation 'ecosystems' described by Booth (2009, p.705) as a 'brave new world'. Indeed, the connectivity and collaboration between various actors within the East Midlands network performed a key part in the process of ensuring continued development of scientific knowledge and technical know-how by providing financial support and infrastructure. BCN provided the firms specialised premises with state of the art lab equipment while NCC and Mobius provided seed funding to promising ventures. A similar observation was made by Laine et al. (2008), the scholars maintain that, at the core of innovation 'ecosystems' are firms and enterprises which are involved in innovative collaborations with academic institutions and investors. A convincing argument regarding the logic behind facilitating the development of innovation 'ecosystems' similar to those appearing in the East Midlands region, was made by Hautamaki (2007). Hautamaki argues that the 'ecosystems' approach places great emphasis on close cooperation and a culture of creativity which refers to adventurism, entrepreneurship and innovativeness. The evidence is clear in the East Midlands region suggesting that born-global bio-tech firms are involved in local innovation 'ecosystems' that considerably influence the movement of knowledge within their knowledge supply-chain. Adner (2006) insists that an innovation 'ecosystem' facilitates integration risks of having the solution adopted across the value-chain. This is consistent with Bramwell et al. (2012) conceptualisation of an innovation 'ecosystem' approach. The scholars see it as a sophisticated way of

holistically looking at mechanisms that interact within an economic system. Crucially, for policy makers such innovation systems will 'enable them to pay close attention to the collaborative, inter-dependent nature of the innovation processes and to identify the best means of stimulating productive networks and relationships within and across disciplines and sectors of comparative advantage' [Bramwell et al., (2012), p.49]. Additionally, Wolfe et al. (2011) describes the regional knowledge 'ecosystem' approach insisting that it leverages regional infrastructures with a view to stimulate/support regional innovation processes through the collaborations of multiple partners that include: research and academic institutions, investors, other firms and investors. Wolfe et al. description of regional knowledge 'ecosystems' has a striking resemblance with the innovation 'ecosystems' within the East Midlands region that are supporting the process of generating innovative capabilities denoted on Figure 2.

7 Discussions

7.1 Rationale for stretching the model

Freeman et al. (2010) invite other scholars to carry out more research to develop further their model of rapid knowledge development for smaller born-global firms. This stretches its reach. In particular, they recommend the need for further studies to refine their conceptual framework and its applicability to the internationalisation processes of smaller born-global firms, and the network perspectives. As such, the advent of bio-tech firms with an international flair necessitates the modification of their model to accurately capture the specific world of this new phenomenon. The firms build their innovative capabilities by participating in evolving global R&D networks (Simba, 2012) hence; the need to develop a conceptual framework that adequately captures the changing terrain. As Swain (2012, p.12) noted, 'The Big Pharma model is undergoing a painful evolution, moving from competition to collaboration, from one-size-fits-all to more tailored approaches, and a longer-term view of basic research'. During the restructuring phase occurring in Europe and America (Rafols et al., 2012); scientists are taking centre stage in global R&D activities. They are forming science-based firms (small born-global bio-tech firms) which are exceedingly productive (Simba, 2012). Evidence in the literature, from within and cross cases demonstrates that the business and social connections of the scientists which were developed during their previous employment have become part of the structural dimension of their new ventures. According to Munos (2009), the business and social connections of these scientists are used as channels for scientific knowledge, technical know-how and market-related intelligence. Their cognitive dimension consists of experienced scientists implying that they have vast knowledge in science. As such, Freeman's et al. (2010) model was stretched to accommodate this new empirical evidence. By doing so, the newly constructed model of knowledge and innovative capability development significantly contributes to the understanding of the concepts of dynamic capabilities and networking theories that already exist (e.g., Rogers, 1962; Johnson and Vahlne, 1977; Teece et al., 1997; Freeman et al., 2010).

8 Conclusions

The new propositions and a revised model presented in this paper increase the performance of Freeman's et al. (2010) model of rapid knowledge development for smaller born-global firms. The new model develops new and alternative understanding of the new types of bio-tech firms developing in the biotechnology industry which are conceived with global foci. The study reveals the importance of horizontal networks and the interplay between firms, research institutions and academics that have complementary technologies and science within the knowledge supply-chain of small born-global bio-tech firms (Schilling, 2008). The author believes that the newly formulated theory of innovative capability development contributes to the understanding of the network approach which focuses on specific, well-selected relationships in the innovation process with specific actors within the same innovation milieu and beyond (Cooke, 2003; Breschi and Malerba, 2005). The study also demonstrates that for small born-global firms to receive and share tacit and explicit knowledge some form of trust between the collaborating parties has to be established. In that sense, competence trust, i.e., trust which is based on the scientific and technical capabilities of the prospective partner and goodwill trust referring to the intentions of the prospective partner were identified as critical to inter-organisational collaborations that occur in the biotechnology sector.

The study also brings to light that trust, in the collaborative projects of bio-tech firms, is built in escalating series. In established science centres relational-like trust naturally exist among resident firms. But, in newly developed networks trust exists casually or does not exist at all. With newly developed relationships the study found that the 'trial and error' method was evoked. The process was observed as starting with firms engaging in smaller projects aimed at testing the trustworthiness of a prospective partner. This potentially led to more collaboration(s). This observation is consistent with Schilling (2008) who claims that experimenting by linking up with different partners during the stage of establishing a partnership is necessary for high-tech firms as collaborating is not without risks. Within the knowledge supply-chain of small born-global bio-tech firms the previous learning and sector-based experiences of the CEOs, bio-entrepreneurs or science directors are crucial in terms of absorbing specific capabilities or choosing the right partner with specific skills or knowledge that complements their firm's internal capabilities. As much as the research approach adopted for this study is presumed appropriate the author is aware of its inherent limits. For example, using computer software SPSS which generates quantitative data would add to the validity of the proposed concepts. The study is limited to five participants from the East Midlands region in the UK. Nonetheless, the output which is 'knowledge and innovative capability development model' illuminates the salient mechanisms and process that mitigate the knowledge supply-chain of small born-global bio-tech firms.

Finally, the author makes two important recommendations. He recommends studies that test the extent to which independent variables such as: business, social networks, competence, goodwill trust, prior learning and absorptive capacity influence the innovative capability development process of small born-global bio-tech firms. The traditionally held view that large bio-pharmaceuticals are the most dominant force in global markets might well be evolving. The advent of small born-global bio-tech firms on the global stage in substantial numbers, worldwide, reflects an emerging business model with the potential to perhaps become the most dominant in the harsh economic times in which large organisations are feeling the strain.

In that regard, the born-global phenomenon requires great attention because it heralds the emergence of a new phase in international exchange systems whereby regardless of the size of a business, it can play an important role in global markets. From that perspective, he also recommends future studies that investigate how small born-global bio-tech firms learn to cope with the complexity of global markets given their cultural diverse nature. This will help us to deepen our understanding of how born-global firms organise the exchange of ideas, technologies, people and information in global networks.

References

Adner, R. (2006) 'Match your innovation strategy to your innovation ecosystem', *Harvard Business Review*, Vol. 84, No. 4, pp.98–107.

Ahuja, G. (2000) 'Collaboration networks, structural holes, and innovation: a longitudinal study', *Administrative Science Quarterly*, Vol. 45, No. 3, pp.425–455.

Andersen, O. (1993) 'On the internationalisation process of firms: a critical analysis', *Journal of International Business Studies*, Vol. 24, No. 2, pp.209–232.

Asheim, B. and Gertler, M. (2005) 'The geography of innovation', in Fagerberg, J., Mowery, D. and Nelson, R. (Eds.): *The Oxford Hand book of Innovation*, pp.291–317, Oxford University Press, Oxford.

Bachmann, R. and Inkpen, A.C. (2011) 'Understanding institutional-based trust building processes in inter-organisational relationships', *Organisation Studies*, Vol. 32, No. 2, pp.281–301.

Basile, A. (2010) 'Networking system and innovation outputs: the role of science and technology parks', *International Journal of Business and Management*, Vol. 6, No. 5, pp.2–15.

Baxter, P. and Susan, J. (2008) 'Qualitative case-study methodology: study design and implementation for novice researchers', *The Qualitative Report*, Vol. 13, No. 4, pp.544–559 [online] http://www.nova.edu/ssss/QR/QR13-4/baxter.pdf (accessed 1 July 2012).

Bellamy, C. and Perri, G. (2009) *Principles of Research Design: A Guide to Methodology in Social Science*, Sage Publications Inc., London.

Bhowmick, S. (2004) 'Towards understanding small firm internationalisation – technology based SME focus', *Frontiers of E-Business Research*, pp.758–770, University of Auckland.

Blomqvist, K. (1997) 'The many faces of trust', *Scandinavian Journal of Management*, Vol. 13, No. 3, pp.271–286.

Booth, B.L. (2009) 'Beyond the biotech IPO: a brave new world', *Nature Biotechnology*, Vol. 27, No. 8, pp.702–709.

Boschma, R. (2005) 'Proximity and innovation: a critical assessment', *Regional Studies*, Vol. 39, No. 1, pp.61–74.

Bramwell, A., Hepburn, N. and Wolfe, D.A. (2012) 'Growing innovation ecosystems: university-industry knowledge transfer and regional economic development in Canada', *Social Sciences and Humanities Research Council of Canada*, pp.1–62.

Breschi, S. and Malebra, F. (2005) *Clusters, Networks and Innovation*, Oxford University Press Inc., New York.

Burns, P. (2012) *Entrepreneurship and Small Business: Start-up and Growth*, 3rd ed., Palgrave Macmillan, Basingstoke.

Burt, R.S. (2002) 'Structural holes and good ideas', *American Journal of Sociology*, Vol. 110, No. 2, pp.349–399.

Cohen, L., Manion, L. and Morrison, K. (2007) *Research Methods in Education*, 6th ed., Routledge, London.

Cohen, W.M. and Levinthal, D.A. (1990) 'Absorptive capacity: a new perspective on learning and innovation', *Administrative Science Quarterly*, Special issue, Vol. 35, No. 1, pp.128–152.

Cooke, P. (2001) 'Regional innovation systems, clusters and the knowledge economy', *Industrial and Corporate Change*, Vol. 10, No. 4, pp.945–974.

Cooke, P. (2003) 'The evolution of biotechnology in three continents: Schumpeterian or Penrosian', *European Planning Studies*, Special Issue on Biotechnology Clusters and Beyond, October, Vol. 11, No. 7, pp.757–763.

Crocker, G. (2010) *Opportunity: UK Life Science Start-up Report 2010*, Mobius Life Sciences Fund, Nottingham.

Daud, S. and Yussof, W.F.W. (2010) 'Knowledge management and firm performance in SMEs: the role of social capital as a mediating variable', *Asian Academy of Management Journal*, Vol. 15, No. 2, pp.135–155.

Davis, J.A. (1970) 'Clustering and hierarchy in interpersonal relations: testing two graph theoretical models on 742 sociograms', *American Sociological Review*, Vol. 35, No. 5, pp.843–852.

Easterby-Smith, M., Thorpe, R. and Jackson, P. (2012) *Management Research*, 4th ed., Sage Publication, London.

Eckstein, H. (1975) 'Case study and theory in political science', in Greenstein, F.I. and Polsby, N.W. (Eds.): *Handbook of Political Science*, Addison-Wesley, Reading, Mass.

Eisenhardt, K. and Graebner, M. (2007) 'Theory building from cases: opportunities and challenges', *Academy of Management Journal*, Vol. 50, No. 1, pp.50–57.

Elfring, T. and Hulsink, W. (2003) 'Networks in entrepreneurship: the case of high-technology firms', *Small Business Economics*, Vol. 21, No. 4, pp.409–422.

Feldman, M., Feller, I., Bercovitz, J. and Burton, R. (2002) 'Equity and the technology transfer strategies of American Research Universities', *Management Science*, Vol. 48, No. 1, pp.105–121.

Freeman, S., Hutchings, K., Lazaris, M. and Zyngier, S. (2010) 'A model of rapid knowledge development: the smaller born-global firm', *International Business Review*, Vol. 19, No. 1, pp.70–84.

Fukuyama, F. (1995) *Trust: The Social Virtues and the Creation of Prosperity*, Hamish Hamilton, London.

Gerring, J. (2001) *Social Science Methodology: A Critical Framework*, Cambridge University Press, NY [online] http://www.bu.edu/polisci/JGERRING/Causation%20(JTP).pdf (accessed 23 September 2012).

Gerring, J. (2005) 'Causation: a unified framework for the social science', *Journal of Theoretical Politics*, Vol. 17, No. 2, pp.163–198, Sage Publications.

Gubbins, C. and MacCurtain, S. (2008) 'Understanding the dynamics of collective learning: the role of trust and social capital', *Advances in Developing Human Resources*, Vol. 10 [online] http://adh.sagepub.com/content/10/4/578 (accessed 10 August 2012).

Hautamaki, A. (2007) *Kestävä innovointi. Innovaatiopolitiikka uusien haasteiden edessä*, Sitran raportteja 76. Sitr,. Helsinki.

Helfat, C.E. and Peteraf, M.A. (2003) 'The dynamic resource-based view: capability life cycles', *Strategic Management Journal*, Vol. 24, No. 10, pp.997–1010.

Hill, C.W.L. (1990) 'Cooperation, opportunism, and the invisible hand: implications for transaction cost theory', *Academy of Management Review*, Vol. 15, No. 3, pp.500–513.

Hisrich, R.D. (2012) *International Entrepreneurship: Starting and Developing and Managing a Global Venture*, 2nd ed., Sage Publications, Thousand Oaks, CA.

Ho, M.W.Y. and Wilson, M. (2006) 'Knowledge resources for university spinouts: the role of the academic entrepreneur', *Academic of Management Proceedings*, Auckland University of Technology, Auckland, New Zealand.

Hoy, W.K. and Tschannen-Moran, M. (1999) 'Five forces of trust: an empirical confirmation in urban elementary schools', *Journal of School Leadership*, Vol. 9, No. 3, pp.184–208.

Huberman, M.A. and Miles, M.B. (1994) *The Qualitative Researcher's Companion*, Sage Thousand Oaks, NY.

Hughes, T. and O'Regan, N. (2009) 'The effectiveness of knowledge networks: an investigation of manufacturing SMEs', *Education +Training*, Vol. 51, Nos. 8/9, pp.665–681.

Hutchings, K. and Michailova, S. (2006) 'Impacts of culture and institutions on knowledge sharing in Russia and China', *International Journal of Emerging Markets*, Vol. 1, No. 1, pp.21–34.

Inkpen, A.C. and Tsang, E. (2005) 'Social capital, networks, and knowledge transfer', *Academy of Management Review*, Vol. 30, No. 1, pp.146–165.

Jansen, J.J.P., van den Bosch, F.A.J. and Volberda, H.W. (2005) 'Managing potential and realised absorptive capacity: how do organisational antecedents matter?', *Academy of Management Journal*, Vol. 48, No. 6, pp.999–1015.

Johnson, J. and Vahlne, J-E. (1977) 'The internationalisation process of the firm', *Journal of International Business Studies*, Vol. 8, No. 1, pp.23–32.

Johnson, J. and Vahlne, J-E. (2003) 'Business relationship learning and commitment in the internationalisation process', *Journal of International Entrepreneurship*, Vol. 1, No. 1, pp.83–101.

Johnson, J. and Vahlne, J-E. (2009) 'The Uppsala internationalisation process model revisited: from liability of foreignness to liability of outsidership', *Journal of International Business Studies*, Vol. 40, No. 9, pp.1411–1431.

Kang, K-N. and Park, H. (2012) 'Influence of government R&D support and inter-firm collaborations on innovation in Korean biotechnology SMEs', *Technovation*, January, Vol. 32, No. 1, pp.68–78 [online] http://www.elsevier.com/locate/technovation (accessed 13 July 2012).

Karra, N., Phillips, N. and Tracey, P. (2008) 'Building the born-global firm developing entrepreneurial capabilities for international new venture success', *Long Range Planning*, Vol. 41, No. 4, pp.440–458 [online] http://www.elsevier.com/locate/lrp (accessed 22 December 2012).

Knight, G.A. (2001) 'Entrepreneurship and strategy in the international SME', *Journal of International Management*, Vol. 7, No. 3, p.155–171.

Knight, G.A. and Cavusgil, T.S. (1996) 'The born global firm: a challenge to traditional internationalization theory', in Cavusgil, S.T. and Madsen, T.K. (Eds.): *Export Internationalizing Research – Enrichment and Challenges, Advances in International Marketing*, Vol. 8, pp.11–26, JAI Press, New York, NY.

Laine, K., Vander Sijde, P., Lahdeniemi, M. and Tarkkanen, J. (2008) 'Higher education institutions and innovation in the knowledge society', *The Rectors' Conference of Finnish University of Applied Science*, ARENE.

Lasserre, P. (2012) *Global Strategic Management*, 3rd ed., Palgrave MacMillan, NY.

Lichtenthaler, U. and Lichtenthaler, E. (2009) 'A capability-based framework for open innovation: complementing absorptive capacity', *Journal of Management Studies*, Vol. 46, No. 8, p.8.

Martin, R. and Sunley, P. (2011) 'Regional competitiveness: clusters or dynamic comparative advantage', in Huggins, R. and Izushi, H. (Eds.): *Competition, Competitive Advantage, and Clusters: The Ideas of Michael Porter*, pp.211–238, in press, Oxford University Press, Oxford, GB.

Maxwell, A.L. and Levesque, M. (2011) 'Trustworthiness: a critical ingredient for entrepreneurs seeking investors', *Entrepreneurship Theory and Practice*, DOI: 10.1111/j.1540-6520.2011.00475.x.

Miller, S.I. (1983) 'Some comments on the logic of triangulation', *International Journal of Experimental Research in Education*, Vol. 20, No. 2, pp.200–212.

Mishra, A.K. (1996) 'Organizational responses to crisis: the centrality of trust', in Kramer, R.M. and Tyler, T.R. (Eds.): *Trust in Organizations: Frontiers of Theory and Research*, pp.261–287, Sage, Thousand Oaks, CA.

Munos, B.H. (2009) 'Lessons from 60 years of pharmaceutical innovation', *Reviews Drug Discovery*, December, Vol. 8, pp.959–968, doi:10.1038/nrd2961.

Nahapiet, J. and Ghoshal, S. (1998) 'Social capital, intellectual capital, and the organisational advantage', *Academy of Management Review*, Vol. 23, No. 2, pp.242–266.

Newfield, N.A., Kuehl, B.P., Joanning, H. and Quinn, W.H. (1991) 'We can tell you about psychos and shrinks: an ethnography of the family therapy of adolescent substance abuse', in Todd, T.C. and Selekman, M.D. (Eds.): *Family Therapy Approaches with Adolescent Substance Abusers*, pp.277–310, Allyn and Bacon, Boston.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company*, Oxford University Press, New York.

Nonaka, I., Toyama, R. and Konno, N. (2000) 'SECI, 'Ba' and leadership: a unified model of dynamic knowledge creation', *Long Range Planning*, Vol. 33, No. 1, pp.5–34.

Oviatt, B.M. and McDougall, P.P. (1994) 'Towards a theory of international new venture', *Journal of International Business Studies*, Vol. 25, No. 1, pp.45–64.

Oviatt, B.M. and McDougall, P.P. (2005) 'Defining international entrepreneurship and modelling the speed of internationalisation', *Entrepreneurship Theory and Practice*, Vol. 29, No. 5, pp.537–553.

Owen-Smith, J. and Powell, W.W. (2004) 'Knowledge networks as channels and conduits: the effects of spillovers in the boston biotechnology community', *Organisation Science Journal*, Vol. 15, No. 1, pp.5–21.

Pittaway, L. (2000) *The Social Construction of Entrepreneurial Behaviour*, Thesis, Newcastle University Library.

Porter, K., Whittinghton, K.B. and Powell, W.W. (2005) 'The Institutional embeddedness of high-tech regions: relational foundations of the Boston biotechnology community: chapter 10 in Breschi and Malerba, *Clusters, Networks and Innovation*, p.261.

Powell, W. and Grodal, S. (2005) 'Networks of innovators', in Fagerberg, J., Mowery, D. and Nelson, R. (Eds.): *The Oxford Handbook of Innovation*, p.56, Oxford University Press, Oxford.

Powell, W.W., Koput, K.W. and Smith-Doerr, L. (1996) 'Inter-organisational collaboration and the locus of innovation: networks of learning in biotechnology', *Administrative Science Quarterly*, Vol. 41, No. 1, pp.116–145.

Pretty, J. and Ward, H. (2001) 'Social capital and the environment', *World Development*, Vol. 29, No. 2, pp.209–227.

Putnam, R.D. (1993) 'The prosperous community: social capital and public life', *The American Prospect*, Vol. 13, No. 1, pp.35–42.

Rafols, I., Hopkins, M.M., Hoekman, J., Siepel, J., O'Hare, A., Perianes-Rodriguez, A. and Nightingale, P. (2012) 'Big pharma, little science? A bibliometric perspective on big pharma's R&D decline', *Technological Forecasting & Social Change*, pp.1–17, DOI: 10.1016/j.techfore.2012.06.007, SciVerse [online] http://www.ScienceDirect.com (accessed 7 August 2012).

Ridder, H., Hoon, C. and McCandless, A. (2009) 'The theoretical contribution of case study research to the field of strategy and management', in, Bergh, D.D. and Ketchen, D.J. (Eds.): *Research Methodology in Strategy and Management*, Vol. 5, pp.137–175, Elsevier, Oxford.

Rogers, E.M. (1962) *Diffusion of Innovation*, The Free Press, New York, NY.

Sartori, G. (1970) 'Concept misinformation in comparative politics', *American Political Science Review*, Vol. 64, No. 4, pp.1033–1053.

Saunders, M., Lewis, P. and Thornhill, A. (2007) *Research Methods for Business Students*, 4th ed., Prentice Hall, Essex, London.

Schilling, M.A. (2008) *Strategic Management of Technological Innovation*, 2nd ed., McGraw-Hill Companies, New York, NY.

Schumpeter, J.A. (1950) *History of Economic Analysis*, Allen and Anwin, London.

Şegun, A.F. and Önder, C. (2011) 'The conditional impact of competence trust on inter-firm learning in a collectivist SME context', *Industry and Innovation*, Vol. 18, No. 8, pp.791–812. Available at: http://dx.doi.org/10.1080/13662716.2011.621746

Sengun, A.E. (2009) 'Which type of trust for inter-firm learning? Paper to be presented at the *Summer Conference 2009, DRUID*, Copenhagen Business School, Denmark.

Siggelkow, N. (2007) 'Persuasion with case-study', *Academy of Management Journal*, Vol. 50, No. 1, pp.20–24.

Simba, A. (2012) *Investigating How Small Born-global Biotech Firms in the East Midlands, UK Develop their Innovative Capabilities: A Multi-case Approach*, Doctoral thesis, Nottingham Trent University Library.

Sitkin, S.B. and Pablo, A.L. (1992) 'Reconceptualising the determinants of risk behaviour', *Academy of Management Review*, Vol. 17, No. 1, pp.9–38.

Stake, R. (1995) *The Art of Case-study Research*, Sage Publications, Thousand Oaks, CA.

Stuart, T.E., Ozdemir, S.Z. and Ding, W.W. (2007) 'Vertical alliance networks: The case of university-biotechnology-pharmaceutical alliance chains', *Research Policy*, Vol. 36, pp.477–498.

Subramanian, A.M. and Soh, P-H. (2010) 'An empirical examination of the science–technology relationship in the biotechnology industry', *Journal of Engineering and Technology Management*, Vol. 27, No. 3, pp.160–171.

Swain, C. (2012) *Big Pharma in Crisis?, Business Management*, Cambridge MedChem Consulting, [online] http://www.samedanltd.com (accessed 28 November 2012).

Sydow, J. (1998) 'Understanding the constitution of interorganisational trust in trust within and between organisations', in Lane, C. and Bachman, R. (Eds.): *Conceptual Issues and Empirical Applications*, Oxford University Press.

Taylor, S.J. and Bogdan, R. (1984) *Introduction to Qualitative Research Methods: The Search for Meanings*, John Wiley & Sons, New York.

Teece, D., Pisano, G. and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal*, Vol. 18, No. 7, pp.509–533.

Todtling, F., Lehner, P. and Kaufmann, A. (2009) 'Do different types of innovation rely on specific kinds of knowledge interactions?', *Technovation*, Vol. 29, No. 1, pp.59–71 [online] http://www.elsevier.com/locate/technovation (accessed 15 September 2012).

Tsai, W. and Ghoshal, S. (1998) 'Social capital and value creation: the role of intra-firm networks', *Academy of Management Journal*, Vol. 41, No. 4, pp.464–476.

Turnbull, P.W. (1987) 'A challenge to the stages theory of the internationalisation process', in Reid, S.D. and Rosson, P.J. (Eds.): *Managing Export Entry and Expansion*, Praeger, New York.

Wall, R.S. (2009) *NETSCAPE: Cities and Global Corporate Networks, Erasmus Research Institute of Management (ERIM)*, Doctoral thesis, Erasmus Universiteit Rotterdam.

Welter, F. (2012) 'All you need is trust? A critical review of the trust and entrepreneurship literature', *International Small Business Journal*, Vol. 30, No. 3, pp.193–212.

Whitner, E.M., Brodt, S.E., Korsgaard, M.A. and Werner, J.M. (1998) 'Managers as initiator of trust: an exchange relationship framework for understanding managerial trustworthy behaviour', *Academy of Management Review*, Vol. 23, No. 3, pp.513–530.

William, J.L. (1992) 'Don't discuss it: reconciling illness, dying, and death in a medical school anatomy laboratory', *Family Systems Medicine*, Vol. 10, No. 1, pp.65–78.

Wolfe, D., Bramwell, A. and Munro, A. (2011) 'Clusters, collaboration and networking: review of international best practice and implications for innovation in Canada', Final report prepared for the Strategy and Development Branch, National Research Council, PROGRIS, Munk School of Global Affairs, Toronto.

Yin, R.K. (2003) *Case-study Research: Design and Methods*, 3rd ed., Sage Publications, Thousand Oaks, CA.

Yin, R.K. (2009) *Case-study Research: Design and Methods*, 4th ed., Sage Publications, Thousand Oaks, CA.

Zucker, L., Darby, M. and Amstrong, J. (1998) 'Geographically localised knowledge: spillovers or markets?', *Economics Enquiry*, Vol. 36, No. 1, pp.65–86.