

Knowledge Networks for Innovation: from Theory into Practice, the case for SMEs

Dr John Bradford, Senior Knowledge Exchange Adviser, University of the West of England, Bristol

Frenchay Campus, Coldharbour Lane, Bristol, BS16 1QY

0117 3286695, john.bradford@uwe.ac.uk, www.uwe.ac.uk

Prof Mohammed Saad, Dr Terry Winnington, Dr Surya Mahdi, University of the West of England, Bristol

Innovation, Network, SME, Absorptive Capacity

Abstract

Objectives

This paper is part of an externally funded three year Network for Innovation (iNET), whose main goal is to improve the innovative capacities of small and medium enterprises (SMEs) in Aerospace and Advanced Engineering (AAE) across the South West of England. This paper investigates the sourcing and managing of knowledge exchange as a basis for developing innovation, through the case of the AAE iNET. This is based upon the strong relationship between learning and innovation, and the theories of resource-based value and dynamic capabilities. It is also based upon the assumption that innovation is significantly influenced by the formation of networks. This view is supported by the literature on triple helix systems which draw the attention to the point of effective institutional relationships between university, industry and government as being crucial for knowledge exchange and sustainable innovation and competitiveness.

The firm's capacity for knowledge exchange can be conceptualised through knowledge acquisition, assimilation, transformation and exploitation. Together they determine the organisation's ability to evaluate and utilise external knowledge known as the 'relative absorptive capacity'. The process of knowledge exchange depends on 'innovative routines' or 'dynamic routines'. To this model of dynamic capacity we introduce the precursor capacity of awareness, and discuss how innovation networks also need to develop this within themselves and their membership.

Approach

The authors will be adopting a Participatory Action Research framework to reflect on and address the difficulties encountered by SMEs in their efforts to engage in learning and innovation development.

This framework will involve (1) proactively identifying new SMEs to the network; (2) assessing the learning needs & types of knowledge exchange mechanisms; (3) checking & monitoring their assimilation of knowledge through its exploitation; and (4) checking and monitoring its impact on SME performance. The research process will iteratively feed-back meta-learning about each stage.

This paper will provide a theoretical discussion underpinning this research. It will also examine and discuss the initial findings of stages (1) and (2) of our research process.

Results

We will be reporting the operationalisation of stages (1) and (2) of the research model.

Implications

We will attempt to provide a better understanding of how to strengthen the links between HEI & SMEs and other Institutions to inform policy. We will also attempt to provide an insight into the operationalisation of absorptive capacity.

Value

This will provide evidence for researchers working with SMEs on recognising the value of networking & learning with HEI and other Institutions. This recognition of value will be critical in a future of reduced funding.

1. Introduction

This paper is part of an externally funded three year Network for Innovation (iNET), whose main goal is to improve the innovative capacities of small and medium enterprises (SMEs) in Aerospace and Advanced Engineering (AAE) across the South West of England. This paper investigates the sourcing and managing of knowledge exchange as a basis for developing innovation, through the case of the AAE iNET. This is based upon the strong relationship between learning and innovation, and the theories of resource-based value and dynamic capabilities. It is also based upon the assumption that innovation is significantly influenced by the formation of networks. This view is supported by the literature on triple helix systems which draw the attention

to the point of effective institutional relationships between university, industry and government as being crucial for knowledge exchange and sustainable innovation and competitiveness.

The process of knowledge exchange can be conceptualised through knowledge acquisition, assimilation, exploitation and recreation. Their effectiveness is dependent upon the organisation's ability to evaluate and utilise external knowledge known as the 'relative absorptive capacity', and highlights the importance of 'innovative routines' or 'dynamic routines'.

The authors will be adopting a Participatory Action Research framework to reflect on and address the difficulties encountered by SMEs in their efforts to engage in learning and innovation development.

This framework will involve (1) proactively identifying new SMEs to the network; (2) assessing the learning needs & types of knowledge exchange mechanisms; (3) checking & monitoring their assimilation of knowledge through its exploitation; and (4) checking and monitoring its impact on SME performance. The research process will iteratively feed-back meta-learning about each stage.

This paper will provide a theoretical discussion underpinning this research. It will also examine and discuss the initial findings of stages (1) and (2) of our research process.

2. Literature Review

This is not intended to be a systematic literature review but brings together several key themes in exploring the role of absorptive capacity in the functioning of an innovation network supporting SME businesses. In order to put the network in the context of a theoretical tradition we present the underlying literature here.

Characteristics of the SME

In a further attempt to understand the differences between SMEs and larger organisations, we may consider the work carried out by Penrose (Penrose 1995, Penrose 1959) where three central issues are developed in which small firms are different to large ones; innovation, uncertainty and firm evolution.

Large and small firms have been identified as being fundamentally different by Penrose (Penrose 1995). She uses the analogy that while caterpillars and butterflies are manifestations of the same creature they cannot be meaningfully compared with each other as the differences are too great. In considering the implementation of Total Quality Management (TQM), Ghobadian and Gallear (Ghobadian 1997) conduct a comprehensive review of literature regarding the implications of organisational size. In particular they suggest that there are '*...significant structural differences between SMEs and large organizations,...*' ((Ghobadian 1997), pp127).

Ghobadian and Gallear identify 'resource paucity' as the most serious disadvantage faced by the SME considering implementation of TQM. The term 'resource' is used in its widest sense to cover not only financial resources but those of knowledge, technical expertise and management time (Welsh 1981, Yusof 2000). This would suggest that for an approach to be successful with SMEs, it should have an explicit concern for resource sensitivity.

Innovation & Uncertainty

Storey sees the role that innovation plays in small firms as stemming from their position in 'niche' markets (Storey 1994) where smaller firms are able to provide a marginally different product or service to that offered by larger businesses (Dodgson 1985). Joyce *et al* (Joyce, Woods *et al.* 1990) identify a concept of 'niche hopping' whereby small businesses will take a moderate set of skills and apply them to different niche markets as they arise. This allows for rapid innovation without massive investment. Storey further identifies a relative lack of basic research and development as being a feature of small businesses (Storey 1994), however, small businesses are seen as being more likely to introduce fundamentally new innovations than large firms (Pavitt 1987). This innovativeness may stem from the ease with which face-to-face communications throughout the organisation may be maintained as suggested by Lee *et al* (Lee 2000).

Storey (Storey 1994) goes to argue that small firms are subject to greater external uncertainty and greater internal consistency of motivation and action than large firms. The external uncertainty stems largely from the relatively large size of many customers of small firms, which gives the small firms little bargaining power with their customers (Westhead, Storey 1996). Joyce *et al* (Joyce, Woods *et al.* 1990) suggest that one coping mechanism to deal with external uncertainty is the phenomenon of '*niche hopping*'. While each niche may only provide temporary respite, the ability to keep 'hopping' ensures the survival of the company.

Processes & Mechanisms for KE in SMEs

This paper does not seek to provide an in-depth review of government policy in the United Kingdom towards innovation, knowledge exchange and the various roles of the higher education sector, for examples see (Smith 2010, CLIFTON 2010). It is sufficient here to note that innovation and the knowledge economy are

seen as vital to the future of economic growth. It is recognised that not all innovation originates within the firm and thus Knowledge Exchange becomes a critical part of that policy landscape.

In considering the mechanisms for knowledge exchange most authors refer to Nonaka (Nonaka 1991) at some point. Nonaka critically recognised that innovation stemmed from new knowledge that originates with an individual and is transformed into organisational knowledge valuable to the company as a whole. These mechanisms for transforming individual knowledge into organisational knowledge, as distinct from data or information repositories, require both individual and organisational learning. In this field the concept of double-loop learning (Argyris 1995) has become widely accepted. Double-loop learning is particularly relevant to this study as it explicitly links individual learning, organisational learning and the development of learning capacity within the organisation.

The field of organisational learning is well developed and it is not the intention of this paper to conduct an extensive meta-analysis of the key themes as this has already been conducted by Thomas and Allen (Thomas 2006). It has also been identified that the majority of theory around the learning organisation may be at odds with the characteristics of small businesses (Wyer 2000). The work presented here is focused on the SME (Small to Medium sized Business as defined by the European Union (ENTERPRISE AND INDUSTRY PUBLICATIONS 2005)).

Any mechanism for successfully knowledge exchange should, therefore, take into account both the accepted models for organisational learning and the specific resource constraints of the SME. There is a further need to differentiate between literature on innovation that examines the ability of the firm to develop new innovative processes & capacities (Humphreys 2005, McAdam 2005, McAdam 2010), and on the wider socially constructed perception of a grand innovation arising from multiple trivial developments (Pinch 1984). Our concern here is principally with the development of the network as the unit of analysis rather than the product/service or wider social construct.

Absorptive Capacity

Since the introduction of the concepts of absorptive capacity (Cohen 1990), the framework has been extended (Zahra 2002) and is now widely used in the knowledge exchange domain (Petra Jung-Ereczeg 2007, Kodama 2008, Sparrow 2009, Bishop 2011). Very little research has been found on the measurement of absorptive capacity of the firm. A notable exception is the work of Jimenez-Barrionuevo, Garcia-Morales & Molina (Jiménez-Barrionuevo 2011). In developing their measure, 18 items were identified that contributed to a firm's absorptive capacity.

- Acquisition (Potential)
 - Interaction – degree of personal interaction between organisation
 - Trust – degree of mutual trust between organisations
 - Respect – degree of mutual respect between organisations
 - Friendship – degree of personal friendship between individuals of different organisations
 - Reciprocity – degree to which the relationship between organisations is highly reciprocal
- Assimilation (Potential)
 - Common Language – degree to which members of two organisations share their own common language / jargon / phrases
 - Complementarity – degree to which the resources and capabilities of two organisations are complementary
 - Similarity – degree to which the main capabilities of two organisations are similar or overlap
 - Compatibility 1 – degree to which the organisational culture of two organisations are compatible
 - Compatibility 2 – degree to which the operating and management styles of two organisations are compatible
- Transformation (Realised)
 - Communication – degree of informal conversations about the commercial activities of the organisation
 - Meetings – degree of interdepartmental meetings addressing the development and tendencies of the organisation
 - Documents – degree to which business units publish internal documents
 - Transmission – regularity with which important business information is transmitted to all business units
 - Time – how quickly all units are informed of important business developments
 - Flows – ability of the organisation to share knowledge within and between units
- Exploitation (Realised)
 - Responsibility – degree to which functions have clarity of responsibility regarding the use of information and knowledge obtained externally

- Application – degree of capability and ability to exploit information and knowledge

For the purposes of this paper, we concentrate on the first two capacities, those of Acquisition and Absorption. Over the life of the project, and potentially beyond if resources allow, we will be engaged in numerous action research cycles exploring all capacities described. We have already begun to feed back finding on the capacity to acquire and assimilate new knowledge at both the firm and network levels.

Awareness

We introduce this capacity as a precursor to the main capacities usually described in the literature. In their seminal paper introducing Absorptive Capacity, Cohen & Levinthal describe the need for “*awareness of where useful complementary expertise resides within and outside the organization.*” (Cohen 1990) However, this awareness is not usually captured as a component of subsequent literature on absorptive capacity, where it is taken as an assumed (Zahra 2002, Jiménez-Barrionuevo 2011, Todorova 2007). We feel that this is an omission and thus re-introduce it to our framework to explicitly challenge both the firm and the network to develop a capacity for self-awareness of both their own capacities and the value of innovation in economic sustainability.

Innovation Networks

The concept of a network of individuals providing a key learning function within a business has a long pedigree (CLIFTON 2010, Allen 1969, Tushman 1977, Swan 1999, Pittaway 2004, Suvinen 2010). More recently this has been extended to the role of the knowledge broker or intermediary organisations (CLIFTON 2010, Suvinen 2010). However, it is useful to note that the role of the socio-economic network has been important in research on knowledge creation since the work by Allen & Cohen (Allen 1969). Their model, of highly connected boundary individuals is further validated in the work of Tushman (Tushman 1977) examining the role of gatekeepers in the innovation process. The concept continues to be noted and refined, e.g with the characterisation of ‘weak-ties’ by Hansen (Hansen 1999).

The role of the network in encouraging company innovation and in particular the links between the knowledge base and the economic base have been highly significant in recent government initiatives (Jones 2001). Studies have found (Pittaway 2004, Mohannak 2007) that even in highly active R&D companies (in the ICT sector) clients and customers were the source of information almost as frequently as through internal sources. Other significant sources of information included competitors and suppliers (Mohannak 2007). This may be indicative of a knowledge sub-network (Cheng 2004) functioning around a particular technology cluster, as well as a geographical cluster.

These networks are important as they represent the knowledge domain for the Acquisition (Cohen 1990) of new knowledge into a firm. It is only by having widely networked individual in those Boundary Spanning roles (Tushman 1977, Bergenholtz 2011) that will allow new knowledge to effectively permeate the membrane of the firm. Swan et al (Swan 1999) further note the need to ‘convince others within...organization(sic) of the potential advantages’. This role of convincing others was previously noted within larger organisations where opinion leaders were able to perform this function (Allen 1969).

The role of intermediaries in the functioning of an innovation network has also received attention in the literature (Kodama 2008, Suvinen 2010, Lee 2010, Saad 2008, Etzkowitz 2000). This is an extension of the boundary spanning role described by Tushman, Hansen and others (Cohen 1990, Allen 1969, Tushman 1977, Hansen 1999) by introducing a third party to deliver the cross-boundary matching of knowledge and need. The role of the Knowledge Exchange Unit or Business Engagement Unit now to be found in many Universities (Smith 2010) is an example of this provision of third party services often funded by Government sources (Pittaway 2004).

3. Research Method

The authors have adopted a Participatory Action Research framework (Ozanne, VA Polytechnic Institute & State, U. 2008, Elden 1993) to reflect on and address the difficulties encountered by SMEs in their efforts to engage in learning and innovation development. In adopting this research method we are explicitly acknowledging that an innovation network is fundamentally a social system rather than a technology or information system.

Action Research as a methodology is widely accepted and utilised in situations where the researchers are embedded in the problem domain and there is a clear action-outcome orientation required. As the key purpose of the iNET is to improve the economic performance of SMEs rather than to explicitly improve understanding about those SMEs, Action Research seems an appropriate approach. In conducting the research we have a plan that places the research questions in context and that we have broadly understood the research environment (French 2009). We are gathering data from multiple sources (semi-structured interviews, quantitative financial reports, self-reported surveys) and collecting this in a central repository,

where it can be analysed and future data capture planned (Coughlan 2002). Finally we are reflecting on those findings at the meta-level of the original theories into innovation networks and absorptive capacity to integrate the findings with current theory and where necessary new emergent theory (Elden 1993).

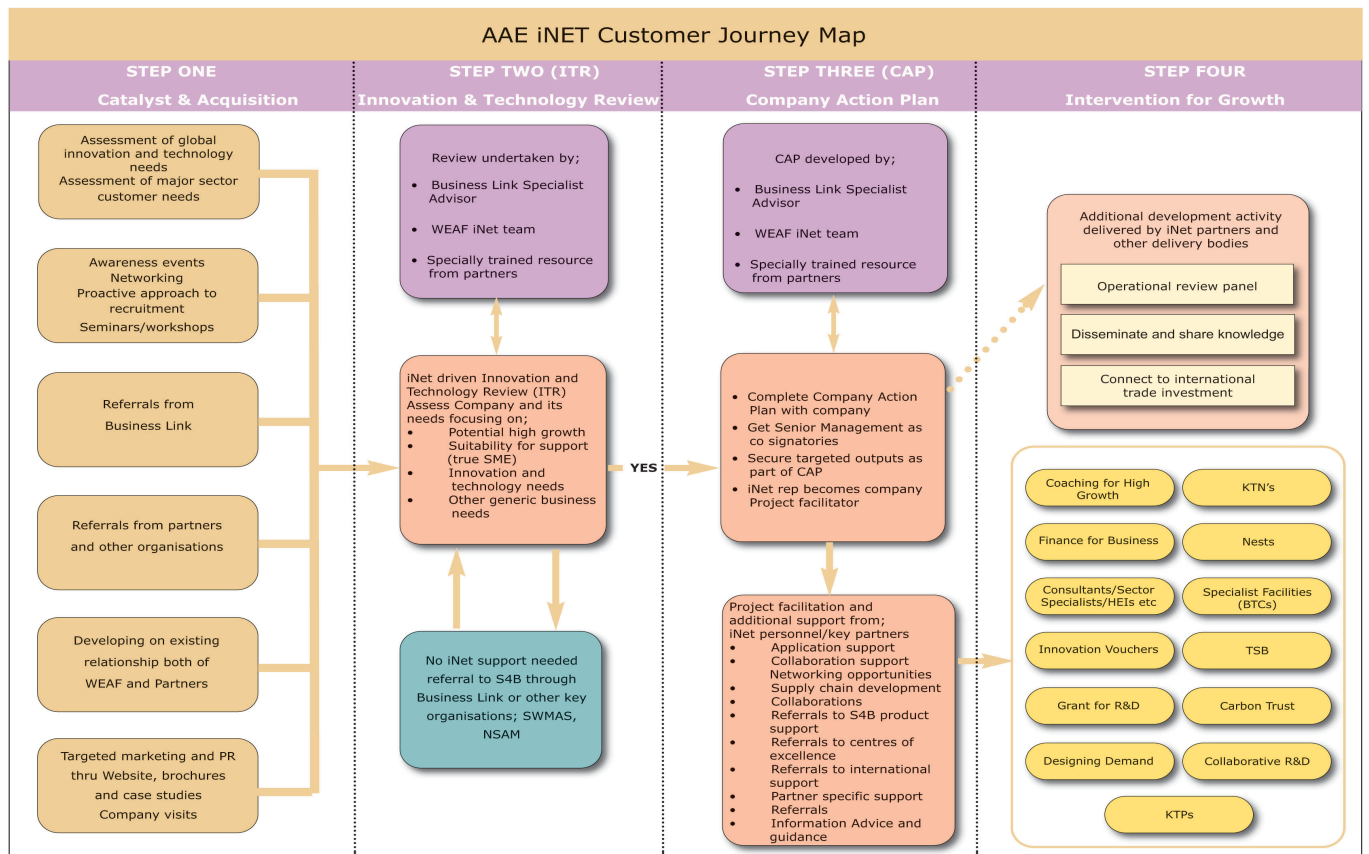
The selection of Action Research as the principle method is justified against Elden's broad review of action research (Elden 1993). This purpose of this study is to enhance the capacity of the network to study and change itself. The purpose of the network is to enhance the capacity of companies within the region to become more economically active through innovation. This highlights the contextual focus within which the network operates, that is one largely set by Government policy on economic development and regional assistance. In this context economic growth and innovation are seen as a 'good thing' and that innovation critically enables increased economic performance. Whilst at an early phase of the network, the collection of data has begun against both funding criteria (a feature of funded projects) and wider economic context criteria as described in the network's business plan. Over the life of the network funding (initially 3 years) evidence will be collected objectively (e.g. financial information) and subjectively from semi-structured interviews and self-reported questionnaires. The evidence is being analysed against both the econometric perspectives of the funding criteria and the theoretical models of absorptive capacity and networks of innovation.

The unit of analysis, and the focus of this paper, is not any individual or subset of companies within the network but the innovation network itself. The principle investigators are active participants in the network and work with the companies and partners engaged in innovation activities. The innovation network that is the vehicle for this research is funded to develop the innovative capacity of businesses within the region. The network itself will be described in more detail later in this paper.

4. Case Study

The innovation networks were proposed in response to a call from the South West Regional Development Agency (SWRDA) in England. They form part of a wider package of Government funded support for business known as "Solutions for Business" (Department for Business, Innovation and Skill 2011). The call was for support that would focus around five sectors that had previously been identified as critical to the region (South West of England Regional Development Agency 2006). Following the tendering process the iNETs were launch over the summer of 2010. Each was formed from a collaboration of regional organisations and each was tailored to the perceived needs of the sector.

This paper concentrates on one specific iNET, that of the Aerospace and Advanced Engineering iNET (AAE iNET). This network is led by an industry membership forum (WEAF), with strong University involvement (the University of the West of England, Bristol) and the Manufacturing Advisory Service in the South West (MAS-SW). Additionally there is support from the Engineering Employers Federation, and the Business Link network of innovation brokers. The final business plan for each iNET was developed in partnership with SWRDA and thus there is a degree of commonality between them. Below is a representation of the core customer journey map.



The business plan and Customer Journey Map was developed from heuristics and experience rather than explicit theory. This framework will involve (1) proactively identifying new SMEs to the network; (2) assessing the learning needs & types of knowledge exchange mechanisms; (3) checking & monitoring their assimilation of knowledge through its exploitation; and (4) checking and monitoring its impact on SME performance.

The role of the network was to provide a knowledge brokering service between the science base and industry through informal-personal network ties (Pittaway 2004, Hansen 1999, Bergenholtz 2011). To this extend the individual actors within the iNET are critical, there is no formal knowledge management system or IT system to match expertise with need. To this extent, the research question considered the degree to which such a network was supported by theory and how it could contribute to literature and benefit from an iterative innovation process itself.

Overlaid on the process flow explicit within business plan is an implicit realisation that knowledge exchange is not a linear process (Taylor 2004). This is behind the use of individual knowledge brokers rather than a mechanistic IT solution. Part of the knowledge broker's role is to ensure that they remain aware of new knowledge and thus that their own absorptive capacity is maintained and developed.

A key challenge for the iNETs is customer acquisition and the business plans explicitly reference the other business support services within S4B as contributing to new company acquisition. By hosting events and awareness activities it is expected that these will act as innovation triggers for companies to begin considering their options (Zahra 2002, Porter 2011, WU, DUFFY 2004).

Awareness

A key innovation and knowledge exchange role is identified for the specialist staff within the partner organisations. A facet of the iNET is to introduce companies to innovations outside their normal sphere of operation. These are the 'boundary spanning' individuals (Cohen 1990, Tushman 1977) that are able to analyse the business and innovation potential of companies and to develop action plans utilising the regional knowledge base.

In addition to being boundary-spanners, these advisers are also specialists in the intervention mechanisms provided by their organisation (Higher Education, Solutions for Business, etc). One activity of the network is to ensure that these individuals are kept apprised of specific initiatives, mechanisms and good practice to share with member companies. In this manner, the key actors in the network are self-aware of the need to actively acquire new information and knowledge that will prove useful in assisting client companies.

Acquisition

The network has a common review framework that represents the field procedures for engaging with companies to increase their innovative capacity through external knowledge (Zahra 2002, Lane 1998). Within this acquisition capacity from a network perspective, the actors have developed those elements identified by Jimenez-Barrionuevo: Interaction, Trust, Respect, Friendship, and Reciprocity (Jiménez-Barrionuevo 2011).

Frequent meetings are held formally and informally to assess specific options. Monthly operations meetings ensure that formal knowledge is disseminated through the network in a controlled manner. Interim meetings are held between smaller groups of advisers to discuss specific intervention mechanism, e.g. Knowledge Transfer Partnerships, and to test these against companies that are working within the network. Following a meeting with a company, it is also usual for an adviser to quickly call another to discuss specific conditions of an intervention that might be applicable.

The high degree of reciprocity in information sharing has contributed to building respect between the advisers as experts in their field. This necessarily develops over time and has been a focus over the initial 9 months of the network's operation.

This knowledge sharing has been achieved through a multi-modal approach. For the purposes of presentations to member companies, simple lists and graphical representations have helped share broad information such as target market, providers, intervention mechanism, costs, time scale, etc. More detailed information sheets have been shared between iNET advisers and these ensure a common level of knowledge about the key intervention mechanisms so that members can be knowledgeably advised on the best options for their particular innovation requirements.

Assimilation

These meetings have introduced a significant amount of new knowledge into the network. All this new knowledge needs to be analysed, classified, interpreted, and ultimately internalised to the network (Cohen 1990). The key process for doing this is identifying areas of complementarity and then from that those areas where new service offerings might be developed as part of the network's transformative capacity.

Identifying these complementary areas of knowledge is aided by considerable cultural compatibility within the adviser group. All the advisers are engineers from either mechanical or electrical backgrounds. They also have significant industrial experience as well as with publicly funded programmes. This provides an operationally common language for both business development and project management methods. Part of the project specification provided a common set of operating guidelines, augmented by European project management guidelines that ensure a degree of operational compatibility (Jiménez-Barrionuevo 2011).

Company example

Whilst the focus of this paper is on the network as the unit of analysis, the key focus of the network is improving the absorptive capacity of SMEs. It is therefore appropriate to consider how the network can use the principles of absorptive capacity internally to deliver benefit to the businesses. A short example is presented here, not to demonstrate the specific efficacy of the network or provision therein, but to show how the same principles that made the iNET innovative were cascaded down into supporting the companies that formed the network membership.

In the first month of formal operations of the AAE iNET an SME made contact following a referral from an enterprise network. The company (TDS) were broadly representative of many within the aerospace and advanced engineering sector. A doctorate-qualified founder had developed some unique intellectual property and was building a company around it. Some specialist components were sourced from overseas and some procured locally. Their product was sold to other companies (B2B) that were all substantially larger than they were. A recent addition to the business was a General Manager to 'run the business' leaving the founder to develop the technology.

Awareness

At the launch of the AAE iNET, the lead partner contacted everyone in their extended membership forum and informed them of the network's launch. Information was also placed on the website and in email newsletters. Broader launch events were planned in the second month of operation and continued for the first six-months of the project. This has introduced over 200 businesses to the network in the first six months. This is an important component in establishing awareness of the project, and triggering the awareness in the participating companies of the need for innovation.

In addition to conventional marketing via newsletters, strong reliance has been placed on informal personal networks (Nonaka 1991, Hansen 1999). These personal networks have been maintained by boundary-spanners (Tushman 1977) within the network with a specific remit to ensure that the iNET is connected to the other business and enterprise networks in the region. They also play a role in bringing companies that are not part of those networks into the iNET.

It was one of those informal networks that introduced the case example company into the iNET. The company had recently appointed a Non-Executive Director (NED) who had close links with SWRDA and knew of the iNETs launch, but no details of project focus or delivery mechanisms. The NED also knew the Senior Knowledge Exchange Adviser of the AAE iNET. Part of the role of the NED was to raise awareness within the company of different innovation opportunities and so this was a natural realisation of the informal personal network.

The initial contact was as vague as “*obtaining more information and getting involved in the iNets program*” (29 Oct 2010, from the email correspondence). This was swiftly followed up with a face to face meeting at the company premises within 5 working days. This was to a relatively short (circa 2 hours) meeting to discuss what the iNET had to offer and why the company might be interested in participating in some additional innovation activities. The meeting was also the first opportunity for the research team to understand the business requirements and planned growth strategy.

While the business was broadly aware of Universities and some of what they could offer (the founder had a PhD and the General Manager an MBA), they did not know about the specific local initiatives. They were also not fully aware of how an innovation network could assist them to select the most appropriate portfolio for them at that specific point in their business cycle.

This initial meeting followed a semi-structured interview using 5 key themes (derived from the National Aerospace Technology Strategy (Parker 2010)) to drive 5 SWOT (Strengths, Weakness, Opportunities, Threats) reviews of their business. What quickly emerged was a significant external opportunity that aligned with a significant internal weakness that also featured as a key theme nationally. This suggested an easy first engagement or “low hanging fruit”.

From this initial meeting a couple of key points were identified to explore specific areas of knowledge exchange in support of a strategic business plan. This plan was circulated to the company the following day and the process of building the team to support the acquisition process began.

Acquisition

The project structure of the AAE iNET allows for academic experts to be brought into companies to assist with scoping the innovation requirements and specifying the knowledge exchange mechanisms that might be most appropriate.

The acquisition phase began with a half-day session that involved the senior management team at TDS (founder, general manager, part-time financial director, and senior sales manager) and two additional academics from the University of the West of England with an operations and strategic business background. This session picked up from the awareness activities to fully address the knowledge that the company needed to realise their innovative potential to deliver the business plan.

A series of standard tools were used (SWOT, PESTLE, etc) to map out the business requirements. Even though much of the process was already known to the senior management, the activity of discussing it highlighted several areas for further exploration and development. The second half-day reviewed the previous notes and developed a clear action plan with linkages internally to the Higher Education sector and to specific industry and private sector connections.

In determining the most appropriate knowledge exchange mechanism to assist the company’s acquisition of new knowledge particular attention was paid to their resource constraints (Ghobadian 1997, Welsh 1981). In addition to financial constraints, the managerial maturity of the business was also a consideration. The knowledge exchange advisers knew the most likely individuals within the academic sphere that would be involved in proposed projects. This was critical in managing the relationship elements of the acquisition capacity.

A key output was the agreement from the business that they needed to acquire new knowledge in a particular area of international business development where they had an identified weakness. They were not in a position to engage a large consultancy but recognised the value that a team of MBA students might bring. This then formed the mechanism for the acquisition of new knowledge within TDS.

The consultancy module of the Bristol Business School at UWE requires students to work with a real company and to a live brief. The team met with the company and exchanged ideas on the scope and nature of the market review and business model development needed. Subsequent meetings ensured that the methods employed would be familiar to the company after the final report was delivered.

Assimilation

The company is progressing with assimilation following the delivery of the final MBA Consultancy report. It is beyond the scope of this paper to detail this phase but it should be noted that it is taking place and demonstrating the elements identified by Jiménez-Barrionuevo (Jiménez-Barrionuevo 2011). As part of

developing the capability of the business for acquiring new knowledge, they are exploring additional opportunities in parallel to assimilating the new knowledge acquired through the first iteration.

5. Discussion

This paper is reporting on the early part of a longitudinal, iterative action research study that has yet to conclude. It also presents a single, limited case study from which some generalisation may be drawn to theory but with caution.

The innovation network that has been put in place, builds on previous industry networks that existed in the region and prior collaborative working between the lead partners. From a theoretical perspective, the capacity for those prior networks and partners to absorb the new innovation of the iNET was high. There were interactions between the partners at all levels (operational and strategic) and over the previous 5 years a good degree of trust and respect had developed. The main actors within the partner organisations were engineers by first degree and subsequent careers, and this helped toward the friendship and reciprocity between the actors.

Awareness

The new network has high awareness of innovation, networking and the economic environment of the sector within the region. This is borne out by the consortia's success in securing funding for the project. The network is also highly self-aware of the need to maintain the currency and expertise of the advisers through constant review and knowledge exchange between themselves.

The practice of frequent interaction including meetings, phone dialogue, and email channels, has ensured a good degree of awareness amongst the advisers of each others' offerings and specialisms. This supports the proposition that awareness is important before initiating the acquisition of new knowledge.

Additionally, a major activity in the first 9 months of the network has been raising the awareness of the need for, and benefits of, innovation in the industrial base. This has been achieved in part through email newsletter, but largely through small events promoted through the partner organisations and directly by the specialist advisers' informal personal networks.

The awareness of the benefits of and need for innovation in the target companies is generally high, as demonstrated by the case example company, but this may be an outlier as they made early contact with the network via informal personal connections. It is expected that future companies will be less aware of innovation and their own capacities, and this is being borne out anecdotally but requires more evidence before being reported as a finding.

Acquisition

Having raised the awareness of available knowledge, and through reporting back on business reviews, the needs in the market for specific services and knowledge domains, the iNET has been successful at acquiring new knowledge. This has been supported by those elements identified by Jiménez-Barrionuevo (Jiménez-Barrionuevo 2011). The period of time between the iNET projects being proposed and initiated (roughly early-2009 to late-2010), has been a very turbulent one in a policy context. From an adviser's perspective, part of their key resource is their own knowledge about that policy framework. New developments in the assistance available to SME's have sometimes appeared on a daily basis. This presents quite a challenge to a network that is not designed to cope with highly uncertain environments. The iNET has a flexible operational model that allows the knowledge exchange advisers within it to act in their role as boundary spanners to learn about these changes through their informal personal networks (supported by their interactions with other networks and support providers) and facilitated through the respect and trust with which they are held. These are key facets of a highly developed capacity for acquiring new knowledge.

This policy turbulence has the potential to disengage businesses from knowledge exchange and considering the external environment as a source of innovation in. There has been a significant effort expended at targeting those companies within the geographical and industrial sectors that are the focus of the iNET. The aim was not to convince them of the benefits of innovation; that might be too great a step. The aim has been to facilitate the engagement with a knowledge exchange adviser who can then be going to review their absorptive capacity. This review, in conjunction with a broad based technology and business review, provides sufficient information to develop an action plan that the company can then execute to develop their internal capacities.

It is a feature of the iNET, possibly arising through funding constraints, that the processes of knowledge exchange are framed in quite a linear model. By adopting a resource-capacity perspective, the advisers within the iNET are able take a broader view on the knowledge exchange activity (Zahra 2002, Lane 1998). This provides for better alignment with both the theoretical construct of absorptive capacity (that it is a number of capacities rather than processes) and with the practical non-linear nature of innovation.

6. Conclusions

The conceptual framework of absorptive capacity has been widely discussed in the context of innovation within organisations. We have shown that two of these capabilities are transferrable to a network of organisations. We have not examined the other two capabilities within the accepted 4 capability model. As the action research cycles extend and iterate, those capabilities will be covered in the future. However, this is one study and we have also noted that there is no single optimal configuration for innovation networks, and thus, we would encourage different network configurations to also consider absorptive capacity as a theoretical framework.

We have also shown that, prior to initiating an innovation cycle, there is a need to develop an awareness capability, that is a capacity for self-awareness of both the need for innovation and the current capacities for absorbing new knowledge. Recognising this need may help others to identify mechanisms to engage with individuals within potentially innovative companies in preparation for acquiring new knowledge.

While there may not be an optimal configuration for innovation networks (Pittaway 2004), or for intervention mechanisms in assisting companies to become more economically productive through innovation, the concept of absorptive capacity may be a valuable conceptual framework in designing such networks. We have shown here that the resource constraints of SME's can be understood in the context of absorptive capacity and appropriate strategies developed. This same framework may be adopted by the network itself to ensure that it is open to, and actively acquiring new knowledge so that it may be more effectively exchanged within the network.

Much of the research and literature into innovation and absorptive capacity begins with an *a priori* assumption that companies are aware of the benefits of innovation and collaborations. Our experience suggests that this is not widely the case, however, further research is needed to better understand the underlying reasons for this lack of awareness. We do not expect a single root cause and thus another research direction might also investigate alternative marketing directed at these multiple causes.

We also suggest that researchers consider the awareness of the firm to both their own absorptive capacity, but also the economic business benefits arising from innovation. While there is no evidence that firms consciously choose not to be innovative, there is still much work to be done in raising awareness in the value of innovation as part of sustainable economic activity.

7. References

ALLEN, T.J., 1969. Information Flow in Research and Development Laboratories. *Administrative Science Quarterly*, **14**(1), pp. 12-19.

ARGYRIS, C., 1995. Action science and organizational learning. *Journal of Managerial Psychology*, **10**(6), pp. 20.

BERGENHOLTZ, C., 2011. Knowledge brokering: spanning technological and network boundaries. *European Journal of Innovation Management*, **14**(1),.

BISHOP, K., 2011. Gaining from interactions with universities: Multiple methods for nurturing absorptive capacity. *Research Policy*, **40**(1), pp. 30-40.

CHENG, P., 2004. Knowledge repositories in knowledge cities: institutions, conventions and knowledge subnetworks. *Journal of Knowledge Management*, **8**(5),.

CLIFTON, N., 2010. Network Structure, Knowledge Governance, and Firm Performance: Evidence from Innovation Networks and SMEs in the UK. *Growth & Change*, **41**(3), pp. 337-373.

COHEN, W.M., 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, **35**(1), pp. 128-152.

COUGHLAN, P., 2002. Action research for operations management. *International Journal of Operations & Production Management*, **22**(2), pp. 220.

DEPARTMENT FOR BUSINESS, INNOVATION AND SKILL, 2011. *Solutions for Business - Government Funded Business Support: A Guide for Business*. London: Crown Copyright.

- DODGSON, M., 1985. *Advanced Manufacturing Technology in the Small Firm*. London: The Technology Change Centre.
- ELDEN, M., 1993. Emerging Varieties of Action Research: Introduction to the Special Issue. *Human Relations*, **46**(2), pp. 121-142.
- ENTERPRISE AND INDUSTRY PUBLICATIONS, 2005. *The new SME definition: User guide and model declaration*. European Commission Publications Office.
- ETZKOWITZ, H., 2000. The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university.. *Research Policy*, **29**(2), pp. 109.
- FRENCH, S., 2009. Action research for practising managers. *Journal of Management Development*, **28**(3), pp. 187-204
- GHOBIAN, A., 1997. TQM and organization size. *International Journal of Operations & Production Management*, **17**(2), pp. 121-163.
- HANSEN, M.T., 1999. The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge across Organization Subunits. *Administrative Science Quarterly*, **44**(1), pp. 82-111.
- HUMPHREYS, P., 2005. Longitudinal evaluation of innovation implementation in SMEs. *European Journal of Innovation Management*, **8**(3),.
- JIMÉNEZ-BARRIONUEVO, M.M., 2011. Validation of an instrument to measure absorptive capacity. *Technovation*, **ISSU**.
- JONES, O., 2001. Expanding Capabilities in a Mature Manufacturing Firm: Absorptive Capacity and the TCS. *International Small Business Journal*, **19**(3), pp. 39.
- JOYCE, P., WOODS, A., MCNULTY, T. and CORRIGAN, P., 1990. Barriers to Change in Small Businesses: Some Cases from an Inner City Area. *International Small Business Journal*, **8**(4), pp. 49-58.
- KODAMA, T., 2008. The role of intermediation and absorptive capacity in facilitating university-industry linkages--An empirical study of TAMA in Japan. *Research Policy*, **37**(8), pp. 1224-1240.
- LANE, P.J., 1998. Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, **19**(5), pp. 461.
- LEE, G., 2000. Technological and organisational change in small- to medium-sized manufacturing companies. *International Journal of Operations & Production Management*, **20**(5), pp. 549-572.
- LEE, S., 2010. Open innovation in SMEs--An intermediated network model. *Research Policy*, **39**(2), pp. 290-300.
- MCADAM, R., 2010. Developing a model of innovation implementation for UK SMEs: A path analysis and explanatory case analysis. *International Small Business Journal*, **28**(3), pp. 195-214.
- MCADAM, R., 2005. A multi-level theory of innovation implementation: Normative evaluation, legitimisation and conflict. *European Journal of Innovation Management*, **8**(3),.
- MOHANNAK, K., 2007. Innovation networks and capability building in the Australian high-technology SMEs. *European Journal of Innovation Management*, **10**(2),.
- NONAKA, I., 1991. The Knowledge-Creating Company. *Harvard business review*, **69**(6), pp. 96-104.
- OZANNE, J.L. and VA POLYTECHNIC INSTITUTE & STATE,U., 2008. Participatory Action Research. *Journal of Consumer Research*, **35**(3), pp. 423-39.

- PARKER, R., PROF., 2010. *UK National Aerospace Technology Strategy*. Aerospace Technology Steering Group.
- PAVITT, K., 1987. THE SIZE DISTRIBUTION OF INNOVATING FIRMS IN THE UK: 1945-1983. *Journal of Industrial Economics*, **35**(3), pp. 297-316.
- PENROSE, E.T., 1995. *The Theory of Growth of the Firm*. Third Edition edn. London: Basil Blackwell.
- PENROSE, E.T., 1959. *The Theory of Growth of the Firm*. London: Basil Blackwell.
- PETRA JUNG-ERCEG, 2007. Absorptive capacity in European manufacturing: a Delphi study. *Industrial Management & Data Systems*, **107**(1), pp. 37-51.
- PINCH, T.J., 1984. The Social Construction of Facts and Artefacts: or How the Sociology of Science and the Sociology of Technology might Benefit Each Other. *Social Studies of Science (Sage)*, **14**(3), pp. 399-441.
- PITTAWAY, L., 2004. Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews*, **5/6**(3), pp. 137-168.
- PORTER, M.E., 2011. CREATING SHARED VALUE. *Harvard business review*, **89**(1), pp. 62-77.
- SAAD, M., 2008. Triple helix in developing countries - issues and challenges*. *Technology Analysis & Strategic Management*, **20**(6), pp. 649-652.
- SMITH, S., 2010. The story of a university knowledge exchange actor-network told through the sociology of translation: A case study. *International Journal of Entrepreneurial Behaviour & Research*, **16**(6),.
- SOUTH WEST OF ENGLAND REGIONAL DEVELOPMENT AGENCY, 2006. *REGIONAL ECONOMIC STRATEGY FOR SOUTH WEST ENGLAND 2006 - 2015*. Exeter: South West of England Regional Development Agency.
- SPARROW, J., 2009. Evolving knowledge integration and absorptive capacity perspectives upon university-industry interaction within a university. *Education + Training*, **51**(8), pp. 648-664.
- STOREY, D.J., 1994. *Understanding the Small Business Sector*. London: Routledge.
- SUVINEN, N., 2010. How Necessary are Intermediary Organizations in the Commercialization of Research? *European Planning Studies*, **18**(9), pp. 1365-1389.
- SWAN, J., 1999. Knowledge management and innovation: networks and networking. *Journal of Knowledge Management*, **3**(4),.
- TAYLOR, M., 2004. SMEs and e-business. *Journal of Small Business and Enterprise Development*, **11**(3),.
- THOMAS, K., 2006. The learning organisation: a meta-analysis of themes in literature. *Learning Organization, The*, **13**(2),.
- TODOROVA, G., 2007. ABSORPTIVE CAPACITY: VALUING A RECONCEPTUALIZATION. *Academy of Management Review*, **32**(3), pp. 774-786.
- TUSHMAN, M.L., 1977. Special Boundary Roles in the Innovation Process. *Administrative Science Quarterly*, **22**(4), pp. 587-605.
- WELSH, J.A., 1981. A small business is not a little big business. *Harvard business review*, **59**(4), pp. 18-27.
- WESTHEAD, P. and STOREY, D., 1996. Management Training and Small Firm Performance: Why is the Link So Weak? *International Small Business Journal*, **14**(4), pp. 13-24.

WU, Z. and DUFFY, A.H.B., 2004. Modeling collective learning in design. **18**(04), pp. 289-313.

WYER, P., 2000. Small business development and the "learning organisation". *International Journal of Entrepreneurial Behaviour & Research*, **6**(4),.

YUSOF, S.M., 2000. TQM implementation issues: review and case study. *International Journal of Operations & Production Management*, **20**(6), pp. 634-655.

ZAHRA, S.A., 2002. ABSORPTIVE CAPACITY: A REVIEW, RECONCEPTUALIZATION, AND EXTENSION. *Academy of Management Review*, **27**(2), pp. 185-203.