STIMULATING LEARNING AND INNOVATION TO CONFRONT SUSTAINABILITY ISSUES

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ABSTRACT

Confronting environmental sustainability issues requires firms to both enhance traditional operational practices and introduce new, innovative ones. There are opportunities to enter emergent markets for products and services supporting the sustainability agenda. It is anticipated that these circumstances will more frequently involve innovative firms in collaborations with other organizations and stakeholders. In 2009 three Dutch, one Australian and one Swedish University conceived a project to work with about twenty industry partners to facilitate learning about collaborative environmental innovation practices that may be new to these partners. In this paper we consider a number of tools to be used in stimulating learning about such practices and embedding that learning in ongoing enterprise activities.

Keywords: innovation, collaboration, sustainability

1. INTRODUCTION

Concerns about the global impact of climate change and the need to focus on renewable resources are causing firms to modify current practices and products, and to consider opportunities presented to offer new products and services. Jonker and Foster (2009) observe: 'Corporations nowadays tend to make more and more promises, not only about financial matters, but also regarding the way they are being managed (corporate governance), their use of natural resources (ecological) or their contribution to societal issues in general (safety, risk, health). This, in turn, has led to a transformation of public expectations about the role and responsibility of corporations within society. Commonly this is called the quest for 'corporate social responsibility' (CSR). Following this line of thinking, we began to consider significant changes in market and political frontiers related to environmental sustainability, and how the practice of innovation might or might not be impacted by these changes. Bessant et al (2005:1374) observe that " *discontinuity arises from shifts along technological, market, political and other frontiers and requires new or at least significantly adapted approaches to their effective management.* And ---- *successful firms can run into difficulties in trying to deal with this challenge underlining the need for active learning around a new model. This learning involves not only developing new capabilities within the enterprise but increasingly it raises questions about system level innovation. Interactions with other firms, with courses of knowledge and specialist expertise, with users and those who influence users and with many other players are becoming a key focus in the emerging discontinuous innovation picture."*

1.1 INNOVATION, SUSTAINABILITY AND ENTERPRISE PROCESSES

In 2007, a group of Europe's most experienced R&D innovation managers observed: "Innovation is changing rapidly, in response to globalisation, external pressures such as climate change, the increasing complexity of goods and services, and the recognition

that new ideas are one of the best ways for business to create new value." (EIRMA, 2007:3). A recent European Commission review observed the need to broaden the concept of innovation – "Business innovates mainly for return on investment, society must innovate for social return and transformation. Europe faces unprecedented challenges. This calls for collaborative, crosscutting responses reaching out to business, public policy communities, researchers, educators, public service providers, financiers and NGOs" (EC, 2009). For customer-oriented SMEs in particular, the benefits from investing in environmental sustainability and working collaboratively may not be evident (Cambra-Fierro, Hart and Polo-Redondo, 2008). Until recently, most companies have more or less defensive in implementing CSR strategies (Schick et al, 2002) and try to avoid special attention from local residents, environmental activists or the general public (Belz and Strannegård, 1997).

These circumstances have stimulated us to explore ways of fostering SME capabilities for developing successful and sustainable innovations in inter-organizational collaborative settings. In 2009 three Dutch Universities joined with an Australian and Swedish University to establish an action research project in conjunction with a funding body (RAAK) to address potential barriers and opportunities. Two thematic innovation opportunities are being explored in conjunction with several industry partners in each country using the action research approach:

- One theme is related to opportunities for internal enterprise process improvement that reduces energy consumption and effluent emissions
- The other is related to opportunities to develop technologies and products that provide local area energy generation from waste feedstock

Three different levels of joint endeavour integration are involved:

1. Coordinated networking between the University partners, with an emphasis on knowledge creation relating to innovation practice

2. Cooperation between the University researchers and their industry partners, with an emphasis on management practice knowledge flows, and

3. Collaboration within and between industry partner firms with an emphasis on technological knowledge flows.

1.2 RESEARCH OBJECTIVES

In this paper our research objective is to identify tools and practices that stimulate learning and innovation in support of the RAAK international collaborative sustainability project.

Our first subsidiary objective is to identify a diagnostic tool to determine the current product innovation performance of the SME's involved in the project. We propose to use a tool (IPAC) derived from the CIMA toolkit (Continuous Improvement in global Product Innovation Management), which was developed in the 4th Framework ESPRIT program (1997-1999). The focus of the latter project was the learning and improvement practices in product innovation processes. During the RAAK-project we will extend this model with our knowledge on product innovation in collaboration projects between two or more individual organizations.

Our second subsidiary objective is to identify tools and methods to increase the effectiveness of innovation management within individual organisations, considering potential failure points in the innovation process (e.g. Rothwell, 1994; Markham, 2002; Moore, 1999) requisite skills and competences (e.g Roberts, 1988) and the role of agents who can be used to facilitate the transition between stages (Bessant and Rush, 1995; Hyland and Beckett, 2009).

Our third subsidiary objective is to identify tools and methods to foster effective collaboration in multi-level innovation projects having different requirements at the enterprise, network and system levels. This will involve creating an open environment between the industry partners, leveraging accessible expertise and linking knowledge bases. This objective will be pursued in further detail in a separate paper.

2. SOME OBSERVATIONS FROM THE LITERATURE

2.1 SUSTAINABILITY, INNOVATION AND LEARNING

Christensen and Overdorf (2000) observe that enterprises that have traditionally focused on operational efficiency and incremental innovation may have to adapt their resource base, their internal practices and their underlying values to cope with more disruptive conditions. Drawing on our own research (e.g. Beckett, 2009) and literature on a number of related topics, we observe market and political factors converging as consumers become more interested in 'green' products and industrial clients seek to work with firms that have an internal environmental management system, for example based on ISO 14000. Some researchers studying ISO 14000 implementations have observed that the environmental management system is often integrated with other management systems such as quality, OH&S and risk management (Karapetrovic and Casadesus, 2009; Zutshi and Sohal, 2005). The ISO 14000: 2004 standard requires the establishment of a method to communicate with external parties about significant environmental aspects. Corbett and Kirsch (2001) considered ISO 14000 implementations in different countries and found that exports, environmental attitudes and ISO 9000 certification were recurring associated factors. One thing these standards have in common is that they encourage some form of risk assessment and learning (they are generally based on a plan-do-check-act learning cycle) (Epstein and Roy, 1997). This leads us to explore the use of instruments having a similar underlying logic and familiar feel, in the belief that they may be better understood by industry participants in our planned project. We have drawn on research into instruments that can be applied in intra- and inter-organizational settings (e.g. Beckett and Murray, 2000; Berendsen, 2009) and how the intensity of application varies over types of companies.

2.2 CRITICAL JUNCTURES IN THE INNOVATION PROCESS

A particular innovation may not proceed as anticipated for a number of reasons: there may not be a good fit with a firms internal or external environment causing it to be abandoned (Christensen, 2002) or there may be some problem with negotiating transitions between evolutionary stages/cycles (Markham, 2002, Moore, 1999). Vohara et al (2004) studied the evolution of nine university spinout companies. They observed (p147) that "*First, USOs go though a number of distinct phases of activity in their development. Each venture must pass through the previous phase in order to progress to the next one, but each phase involves an iterative, non-linear process of development in which there may be a need to revisit some of the earlier decisions or activities.*

Second, at the interstices between different phases of development we found that ventures face "critical junctures" in terms of the resources and capabilities they need to acquire to progress to the next stage". The identification and management of "critical junctures" is area of interest for us, and we note that there are some differences in the dominant thinking processes, knowledge domains and development processes appropriate at each stage (Hickman and Raia, 2002). Innovative ideas may emerge from a number of sources: from access to new technology, from new customer needs or from opportunities to do something better based on field experience. The nature of transitions to be managed will depend on both the source of innovation and the approach taken to its implementation, for example building on an established technology platform or creating a new one. This leads us to an approach that involves identifying where a particular innovation sits in the bigger picture, illustrated in Figure 1, and then what kinds of critical junctures might be experienced, for example in technology development or in new product development or in utilization of the innovation in the marketplace.

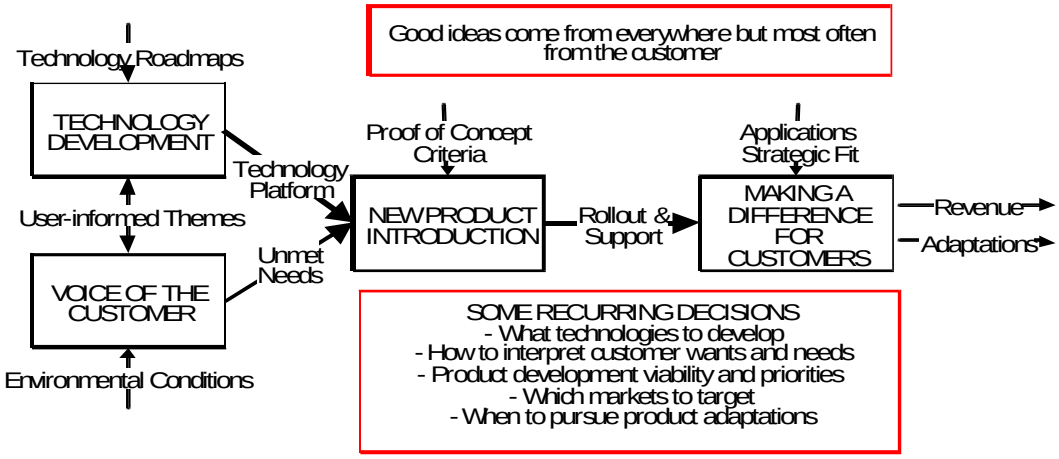

Figure 1. Mapping the Innovation Domain

2.3 COLLABORATION AND INNOVATION

One potential benefit of engaging in alliances is the prospect of spreading risks among two or more participants (Alter and Hage, 1993). Apart from organizations seeking complementary competences, sharing the costs of product development and marketing are other driving forces for collaborating. This enables organizations to take up product development more frequently and to a certain extent also concurrently. This has become more important since a large number of product innovations tend to fail (Sivadas and Dwyer, 2000). Despite the increasing importance of strategic alliances many of these alliances fail to accomplish the intended goals. Failure rates ranging from 60 to 80% percent are registered in studies (Spekman et.al., 1996; Dacin et.al., 1997; Das and Teng, 1999; Duysters et.al., 1999; Dyer et.al., 2001; De Man, 2007). Recent research (Berendsen 2009; Alders, 2009) shows that many organizations involved in strategic alliances or networks are lacking required management competences to be successful in strategic collaboration initiatives (compare Cagliano et al., 2005; Middel et al., 2005). Jaruzelsky and others (2005) found in 1000 publicly held companies worldwide, that there was no relationship between R&D spending and the primary measures of corporate success, such as growth, enterprise profitability and stakeholder return. The study pointed instead to the quality of the innovation process as a determinant of superior results. Prajogo and Ahmed (2007) found similar results in Australian firms. A

combination of appropriate inter-organizational processes and work practices, technically competent partners and capabilities in collaboration, learning and innovation is needed.

3. SOME METHODOLOGY CONSIDERATIONS

There are two aspects of methodology considered in this paper - the methodology being adopted to integrate our three objectives, the outcome of which will be a methodology we apply to the subsequent RAAK international collaborative project.

3.1 DATA AND ANALYSIS APPROACH FOR THIS PAPER

The research reported in this paper drew on literature searches and prior case studies. We re-visited twelve Australian cases of collaborative innovation, and fourteen Dutch cases. Our observations are broadly similar to those of Faermann et al (2001) who suggest that the interaction of four factors determine the success or failure of cooperation in complex settings with different kinds of actors involved. These factors are :

- The initial disposition of the participants towards cooperation.
- The extant issues and incentives driving cooperation are clear
- Leadership that supports collaboration, and
- The number and variety of actors involved (fewer is better)

Matters of motivation and collaboration led us to seek out a framework we could use in a variety of circumstances in our project.

3.2 FOLLOW-ON PROJECT METHODOLOGY CONSIDERATIONS

Interaction between academic and industrial participants in the RAAK international project is to be based on action research (Reason and Bradbury, 2001; Rossman and Rallis, 2003) and the use of instruments to help identify current and desired future practice via critical questioning and stimulating reflection. The project participants have a variety of motivations and roles, the project sponsors have some expectations regarding the outcome, and working in the environmental sustainability space may involve engagement with community actors. Both tasks and relationships that are more complex than in-house innovation activities have to be managed. The diffusion of learning has to be attended to. We propose the adoption of Activity Theory as a foundation for planning and learning from this project. Activity Theory (Vygotsky, 1978; Engestrom, 1987) derives from studies of how people think in the context of undertaking an activity, and it is argued that their environment influences the way they think and act. In undertaking broad activities driven by some motivation [Object], people decide to take an action [Subject] to achieve a goal requiring operations [Community] to be implemented through a series of tasks. How this is enacted is influenced by [Tools], [Rules] and the [Division of Labour]. Such an interlinked, socially distributed activity system is illustrated in Figure 1. Originally associated with education, Activity Theory is now being used to help study a wide range of circumstances where social and technological tools and rules are important (Hasan, Gould, Larkin and Vrazalic, 2001; Beckett, 2004). Researchers at the University of Helsinki and others are using Activity Theory as a framework to better understand the

complexities to be dealt with by innovative enterprises (UOH, 2010; Jones and Holt, 2008), and a number of researchers have used Activity Theory to explore research and design activities (e.g. Miettinen, Lehenkari, & Tuunainen, 2008).

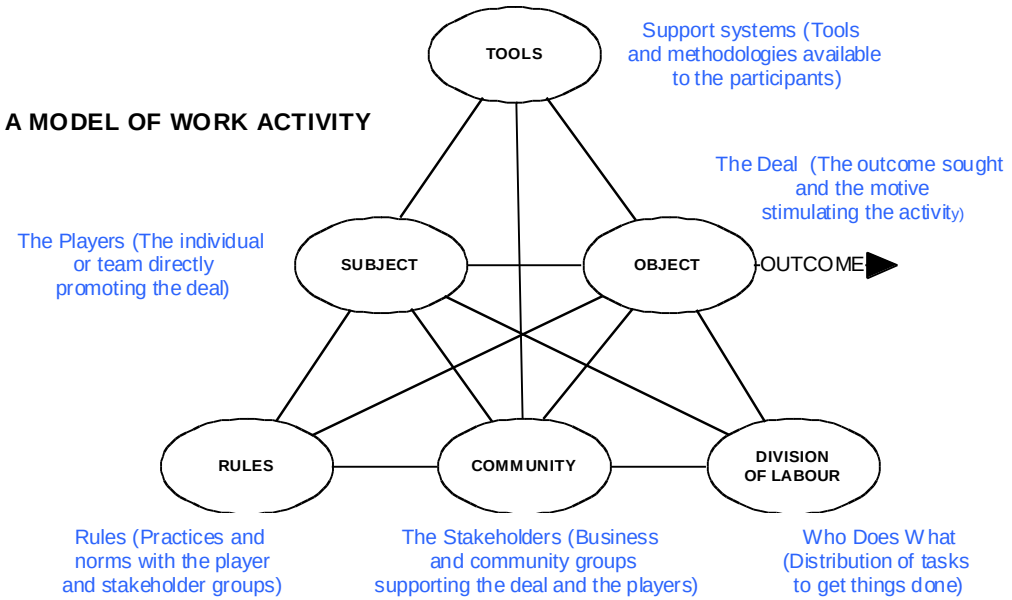

Figure 2. An adapted view of an Activity Theory project perspective

4. FOLLOW-ON PROJECT PLANNING, IMPLEMENTATION AND ANALYSIS TOOLS

Potential barriers to cooperation identified by Schartinger et al (2001) in relation to industry / academia collaborations – lack of resources; cultural differences, lack of information and spatial distance between partners need to be addressed in the RAAK project. The project will use different means of knowledge exchange between the project participants to address these issues:

For communication purposes, a project peer network (community of practice - CoP) between the participating SME's will be established. This will be organized in sub-groups and common interest domains according to the country of origin by the project managers. The prime function of this peer network will be exchange of experience between participating SME's with respect to innovation practice. This will address current processes, organization and control, the pitfalls and best practices. By exchanging experience, the CoP will directly foster learning among SME's and fostering innovation performance. This is in accordance with the standard characteristics associated with CoP's (Lesser and Storck, 2001, p. 836)

The peer network will also be used to report and discuss the implementation of new tools and methods in innovation processes between SME's, researchers and consultants plus the relevant knowledge and training to implement them.

Students will play an active role in organising the CoP within the country of origin and in exchanging economical relevant and innovative solutions within peer groups. SME's and students will participate in global network-sessions to present their plans, progress and results. During these sessions the focus is also on content and method. The participants work actively and interactively, guided by the variety of their assignments.

Students will be placed in couples; each couple is made up of a student with a technical background and a student with an economical background. Students are in the last phase of their study; they are working on their final assignment, and the consortium partners will integrate their complementary knowledge and expertise into one integral research framework

The consortium partners will use an ICT portal to exchange working documents, research data, and case study material and will meet on regular intervals to discuss progress in development of tools and instruments and the experience with implementation in SME's.

An overview of the interactive, action research approach planned is shown in Figure 3.

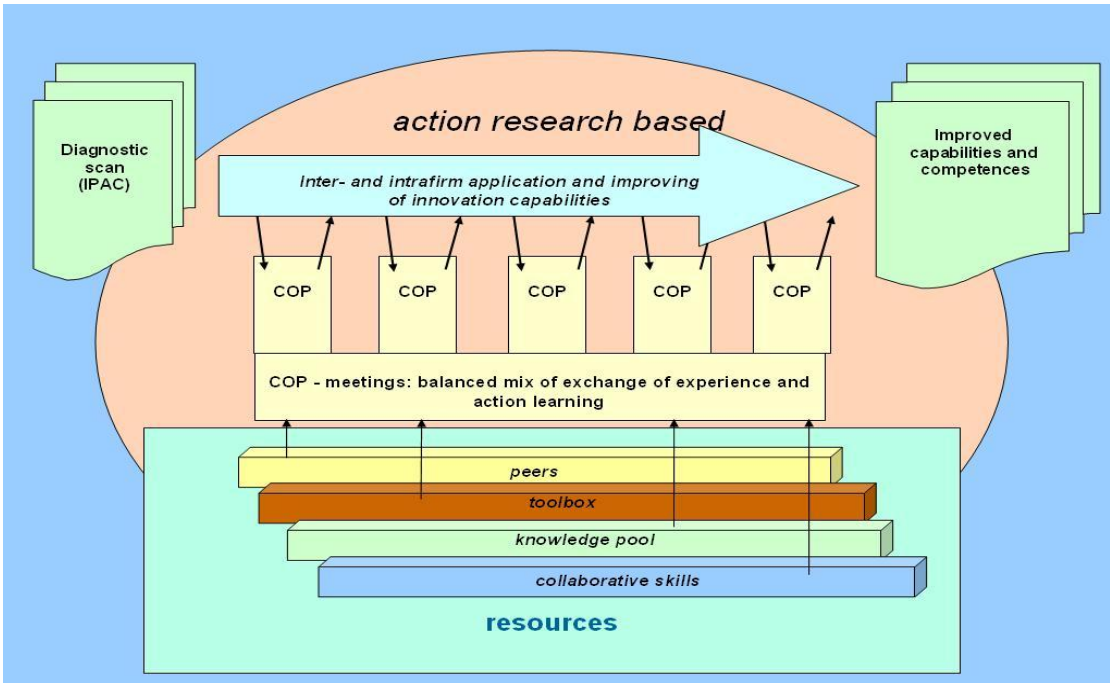

Figure 3. A proposed Action Research Approach

We propose an approach to planning and analysis based on Activity Theory as a means of considering complex interactions associated with collaborative innovation and to compare different industry cases. This theory has not been extensively used in the context of innovation, and we intend to test the practicality of its application. When we have used this theory in the context of multi-partner collaboration in an industry setting, we have found that whilst the concept was readily accepted by industry participants, the academic language was not, so some adaptations were required. For example the 'object' in Figure 2 became 'the deal'. An overview of how our project can incorporate such ideas is shown in Table 1. This kind of table can be used in a variety of ways at the research planning stage. For example if an associated activity is the development of new methodologies, this becomes a Table (activity network) in it own right. Tasks within the project such as establishing a Community of Practice portal can have their own tables. Exploring the linkages between the elements is also interesting, for example does a community associated with a particular activity have a preference for certain tools to be used?

Activity Theory Element Descriptor	Project Stakeholder		
	Sponsor perspective	**University perspective**	**Industry perspective**
The Deal (The outcome sought and the motive stimulating the activity)	-Aims to improve knowledge exchange between SME's and Universities of Applied sciences, increasing the number of linkages from about 10,000 to 20,000	-Seek to stimulate new industry and international linkages. -Create new knowledge related to the management of innovation	-Seek concrete outcomes that address some aspects of Corporate Social Responsibility whilst reducing cost and/or developing new business opportunities
The Players (The individual or team directly promoting the deal)	-RAAK (Regional Attention and Action for Knowledge circulation)	-Five Universities in three countries, their associated research centres, researchers and students	-Five or more industry participants in each country (including both focal and support enterprises) linked to their local University
The Stakeholders (Business and community groups supporting the deal and the players)	-The RAAK scheme is managed by the Foundation Innovation Alliance (SIA – Stichting Innovatie Alliantie) with funding from the ministry of Education, Culture and Science (OCW).	-The universities, their regional governments, industry and communities all provide support in-principle, and in some cases provide additional resources	-Regional and National communities want to see firms exercising Corporate Social Responsibility - Suppliers and customers prefer to work with innovative firms with "green" credentials
Support systems (Tools and methodologies available to the participants)	-Subsidies can be awarded to regional innovation programmes that are aimed at the exchange of knowledge, and are executed by a consortium of one or more education institutes and one or more businesses.	-Collaboration tools (ICT and social networks) supporting action research. - CIMA model plus Agent and Peer assist strategies for capacity-building -Student engagement mechanisms -Community-of-Practice knowledge base	-Peer assist strategies for capacity-building - In-house innovation methodologies and resources - Engagement with existing and new supply chains - Market and community communication tools
Rules (Practices and norms with the player and stakeholder groups)	- Milestone reporting requirements - Participation, exchange reporting and review requirements - Deliverable and dissemination requirements	- Cooperation agreements including rules about confidentiality and IP and cost-sharing - In-house operational rules	-Cooperation agreements including rules about confidentiality and IP and cost-sharing - In-house operational rules
Who Does What (Distribution of tasks to get things done)	- Provision of funding - Project reviews - Final project buyoff	- Allocation of resources -HAN is the lead university, and has a project management role -Each university (including HAN) assigned research and toolbox development tasks	-Industry partners undertake collaborative innovation projects to use / generate renewable energy and reduce emissions in a built environment context

Table 1. An overview of the RAAK project using an Activity Theory framework.

5. DISCUSSION AND CONCLUDING REMARKS

Our ultimate aim is to enhance the capability profile of our industry partners in a number of ways: by improving their internal practices in relation to the implementation of sustainability – oriented innovations, by enhancing their collaboration capabilities, and by building bridges for industry-university interaction. Tools to look at competence and the internal process, a COP portal and student interaction to share knowledge, a focus on critical junctures, activity theory mapping to establish a common language for collaboration management are all meant to establish a fruitful environment for innovation in a collaborative setting, which should evolve into working business models.

In working with the industry partners, we will explore the following questions

- What is the nature of the innovation activities to be undertaken? Reference to an activity overview (e.g. Table 1) and Strategic Innovation Map (Figure 1) is

intended to draw out the nature of potential risks to be managed and what has to be learned in an application sense

- What do we see as critical issues, critical junctures? Here we wish to establish key milestones and transitions to be managed in a strategic sense
- How well prepared are we to manage these activities? Here we use the CIMA/IPAC instrument to assess current innovation practice and suggest opportunities for improvement
- What opportunities to improve our resources/processes/values can be identified from our review of innovation project requirements and current capabilities?
- How can we introduce change and consolidate what we collectively learn utilizing the Community of Practice portal and university engagement?
- How can we embed this learning in enterprise norms, for example by adapting ISO 9000 / ISO 14000 arrangements (see Beckett, 2008 for an example of radical innovation development founded on ISO 9000 principles)

This approach is rather complex, but even so, there are additional topics to address. One of these topics is how to measure the impact of the different factors on the innovation process. Berg et al. (2009) propose an interesting model. They introduce a framework for measuring the front-end innovation activities from three assessment viewpoints: process, social environment and physical environment. This has similarities with Christensen's resources/process/values perspective on innovative organizations. According to Berg et al (2009) this social environment refers to people - their interaction, activity and capabilities. Process models, physical space and ICT-solutions facilitate innovation activities, but the social environment is where the ideas are born and developed. Anderson and West (1998) have developed a model of group climate for innovation stating that four factors – vision, participative safety, task orientation, and support of innovation – are predictive of innovativeness in a work group.

To be able to work with these features, we have to deconstruct them to a less abstract level. This is where an activity-theory oriented perspective may be helpful, as in some activity-theory applications, for example, 'tools' include soft technologies such as language, and rules include social norms. And the overview of 'soft' and 'hard' tools mentioned by Berendsen et al (2009) may also contribute. According to Chapman and Corso (2005) sound theory, practical knowledge and effective technologies are needed to assist firms in implementing continuous innovation methodologies within inter-company collaborative networks, where these networks are essential for competitive success. Bessant et al (2009) observe three techniques for building SME absorptive capacity. We see that the first, *Broadcast*, is facilitated by our proposed Communities of Practice portal, that the second, *Agent assist*, is facilitated by our industry – academia interaction using the tools described here and involves social interaction, and the third, *Peer assist*, is facilitated by the collaborative industry projects where different specialists must work together.

The most important factors for innovation are the availability of highly-skilled (science and engineering) personnel, international accessibility, the quality of knowledge institutions, the value added of foreign firms, the stock of private R&D capital and the cooperation between firms and knowledge institutes. Improving performance on such co-operation would strengthen innovation (Erken et al, 2005). This is even more in

effect for SME's. Therefore De Jong et al. (2007) recommend building strong alliances between public research institutes and SME's. They state that collaboration between companies and research organizations is highest in innovative sectors as chemistry, laboratories and technological industry. They also observe that innovativeness is an essential requirement for SME's to be capable of collaborating with knowledge institutes. We see this as a significant challenge, as innovative SMEs may collaborate frequently, but mainly with their traditional supply chain partners.

In summary, the environmental sustainability international project we wish to support is concentrating on organizations working in the field of building infrastructure, recycling and environmental technology and consultancy. These organizations have to focus on a broader community involvement in the new business development process, because the success of the new products and business is very dependent on the willingness of the customer to embrace new technologies demanding changes in their own behaviour related to waste handling and energy consumption. Therefore our research is contributing to new practical knowledge by developing a methodology including a toolkit, comprehensible for the SME industry partners collaborating in an environmental innovative setting.

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