

Across the great divide: HRD, technology translation, and knowledge migration in bridging the knowledge gap between SMEs and Universities

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Abstract: Knowledge is increasingly claimed to be a key critical resource and source of competitive advantage in the modern global economy, especially with the rise of the service economy, the growth in the number of ‘knowledge workers’, the increasingly rapid flow of global information, and the growing recognition of the importance of intellectual capital and intellectual property rights. It is also increasingly claimed that all organizations will have to excel at creating, exploiting, applying, and mobilizing knowledge. The resource-based view of the firm suggests that organizations will need to be able combine distinctive, sustainable, and superior assets, including sources of knowledge and information, with complementary competencies in leadership and human resource management and development to fully realize the value of their knowledge. Issues include how organizations should be structured to promote knowledge creation and mobilization and how to develop a culture and set of HRD policies and practices that harness knowledge and leverage it to meet objectives. It is often asserted that many SMEs in particular appear to be failing to exploit the information, knowledge, and skills in the knowledge base (KB) embodied in higher education, research institutes, and large companies. Technology translators, able to act as intermediaries between the SME and the KB – in a sense, as brokers and facilitators of learning, using interpersonal, creative, and functional skills – were seen as one response to this challenge. This paper describes one project aimed at developing such ‘technology translators’, and presents a model of viable knowledge management and HRD in SMEs developed after critical reflection on this case study. A research agenda for the study of SME–HE collaboration and other kinds of partnerships, such as alliances, mergers, and joint ventures, using the knowledge-creation cycle and knowledge typology developed in the paper is also outlined.

Keywords: knowledge management, SMEs, HRD, technology translation, UK, viable systems

Introduction

Knowledge is increasingly recognized as a key organizational asset and its creation, dissemination, and application as a critical source of competitive advantage (e.g. Lester 1996; Lloyd 1996; Marshall *et al.* 1996). This process is often seen as requiring the deployment of a combination of core skills and competencies, including those in information management as well as in human resource management and development.

These include the creation and maintenance of organizational structures and cultures that facilitate organizational, team, and individual learning and the sharing of knowledge and information. Much recent work on knowledge management (KM) has come from information management (IM) perspectives, with the appointment of chief knowledge officers with IT backgrounds, but a need to integrate this work with perspectives drawn from human resource management, leadership, and organizational learning theory and research is often asserted; as Mayo says, 'it is the creation and transfer of knowledge between people that causes the other components to grow and which increases value' (1997: 33). This paper explores the creation and transfer of knowledge between SMEs and HE in a particular initiative, the technology translator project, and develops an alternative model of knowledge migration (rather than knowledge management) based on critical reflections on this project.

Underlying the technology translator project was the view, expressed both regionally and nationally, that SMEs are not adopting the most appropriate solutions to enhance business growth and competitiveness, especially in technology but also in management practice more generally, including HRD practice. Many seemed not to be making appropriate use of the skills and knowledge of universities, colleges, research institutes, and larger organizations. While many intermediaries operate in a technology or business support role, especially business link and innovation and technology counsellors, no one group seems to fully serve this market-place. A project which could allow SMEs, intermediaries, and academia to work together, share skills and experiences, and transfer and disseminate knowledge was identified as a more appropriate response, initially in 1998–9 in the North West region of England, but later taken up in 2000 in the Yorkshire and East Midlands regions. Such a project may also provide a case study in 'knowledge management', and enable a more adequate model of KM to be developed, one that is not based solely on IM perspectives but also draws on work in HRD, and seeks to overcome some of the positivist limitations of previous models of knowledge creation and management. In addition, reflection on such a project may also help overcome some of the limitations often reported in earlier work on HRD in SMEs, especially what has often been termed 'enterprise training'. After a review of the case study and the implications of KM for HRD, we go on to review HRD in SMEs in order to develop a rationale for the development of a 'technology translator' role. The focus in this article is not on the programme, nor on an evaluation of its effectiveness, but on the conceptual development of a model of the process of 'knowledge migration' (a conceptualization stimulated by critical reflection on the technology translator programme) and the development of models of viable knowledge creation that can be used to guide further research in the area of joint ventures, alliances, and mergers in particular.

Case study: the technology translator project

The initial aim of this project was to identify the skills and competency profile of a technology translator, someone able to bridge the gaps between the SMEs and the 'knowledge base' of universities, research institutes, and large companies. The project was supported by a wide range of players in the region, including the DTI Regional Innovation Unit. A regional innovation centre, MIC (Merseyside Innovation Centre),

was asked to lead the project, funded under the Objective European Social Fund, with local universities and business links as main partners. The objectives of the project were to:

- define the core competencies of translators, taking into account best practice, derived through discussions with experienced intermediaries drawn from business links, the universities and individual specialists involved in knowledge transfer.
- collate and develop appropriate training materials around these core competencies.
- strengthen networks between intermediaries.
- pilot training modules and methodology.
- enhance the skills of intermediaries working in the SME/ business support areas.

The benefits of the project were anticipated to be in establishing a set of competencies for knowledge transfer able to meet SME needs for more effective problem-solving and technology uptake, so improving their business competitiveness. The project was also seen to be of benefit to academia by expanding its understanding of SME needs and helping focus applied research activity. ‘Technology’ was defined very broadly in this project, referring not only to tools and procedures but also to organizational and managerial knowledge more broadly.

Participants were drawn from a variety of backgrounds, including innovation and technology counsellors or business counsellors; local authority investment officers; higher education advisers with business link; self-employed consultants or trainers in business advice or product development; SME proprietors; employees of the local Graduates into Employment Unit; a business director with local innovation centres; development managers or technology counsellors with business link; and programme managers with local university teaching company schemes.

In the context of the programme, the ‘knowledge-base’ (KB) referred to the home of the potential solution to the SME’s business problem. This included not only universities and research institutions but also large companies and business and professional associations. The ‘technology translator’ (TT) was not seen as a new role, to add to the existing plethora of business advice and consultancy roles, but as requiring development of additional roles for existing practitioners in business support, with an emphasis on facilitating solutions which might potentially come from the knowledge base. The focus was on identifying causes, not just symptoms of problems.

Altogether, seven one-day modules in the form of workshops were delivered in the North West by workshop leaders from local universities, the DTI Innovation Unit, a regional business link, and a local project aimed at developing higher skills for business. After piloting materials and delivery in 1998, all workshops were delivered in January and February 1999 at weekly intervals. The course was not initially intended to be accredited. Later, three module programmes were also run in 2000 in Yorkshire, and two in the East Midlands.

The first module, managing relationships, was intended to improve the skills of intermediaries in building relationships with SMEs. The second module, analysing needs, focused on understanding SME business development through the systematic use of analytical and diagnostic tools. The third module, creativity, focused on developing an understanding of the innovation and creative process. Module 4, the group project, attempted to develop a framework for operating as a technology translator, focusing

on the role of the translator, how it added value to intermediary roles, networking, identifying training needs, and exercises in practical implementation. The fifth module, innovation, focused on the application of innovation and creative skills to improving SME competitiveness. The sixth module, navigating the knowledge base, focused on understanding the processes involved in finding third party solutions. This theme of managing relationships with the KB and with third parties, such as universities, rather than with clients, was extended in Module 7, which focused on managing third-party relationships and sought to equip translators with appropriate tools and techniques to manage such third parties better.

The TT project was seen as an HRD intervention particularly concerned with knowledge transfer, from KB to SME. We therefore need to review knowledge management (KM) and its implications for HRD generally and for HRD in SMEs in particular, before developing a model of knowledge migration and creation based on critical reflection on the TT project.

What is KM?

In order to appreciate the rationale behind the TT project, and the conceptualization of the TT as a knowledge broker, it is first necessary to explore the growing importance of knowledge and knowledge management to the economy in general and the SME sector in particular. For Davenport and Prusak, knowledge is ‘a fluid mix of framed experience, values, contextual information, and expert insight’ (1998: 5). Within psychology and educational research on expertise, researchers have often distinguished declarative knowledge (knowing that), from procedural knowledge (knowing how) and conditional knowledge (knowing when and where, or under what conditions, e.g. Alexander *et al.* 1991). Further dimensions have been added to this basic knowledge dimension, such as the meta-cognitive or meta-knowledge dimension (knowing about knowing, or knowing that one knows) and the skills dimension (e.g. Boerligst *et al.* 1996). In addition, motivational aspects, self-insight, social skills, social recognition, and growth and flexibility capacities are important moderators of professional development and growth in expertise in knowledge workers.

This discussion draws attention to the social recognition of knowledge: for example, how and by whom knowledge is recognized, and the importance of reputation and credibility building in knowledge creation and transfer, not always recognized in discussions of KM. For Bassi (1997), knowledge management (KM) is the process of creating, capturing, and using knowledge to enhance organizational performance, such as documenting and codifying knowledge and disseminating it through databases and other communication channels. Often the role of IT or IM is highlighted (e.g. Lank 1997). KM is often seen as involving the recognition, documentation, and distribution of both explicit and tacit knowledge residing in organizations’ employees, customers, and other stakeholders (Rossett and Marshall 1999). It is often asserted that this also requires new ways of thinking and acting, new policies and practices, new technologies and new skills and job requirements (Stewart 1997; Davenport and Prusak 1998), and thus new roles for HRD (Nijhof 1999). However, there is less agreement over what specific changes are necessary in organizational structure, culture, and behaviour to facilitate KM, or what new roles are required for HRD. One of the purposes of this paper

is to develop a conceptual model of knowledge migration, seen as a key dimension of KM, based on a critical analysis of the TT project and drawing on perspectives drawn from both IM (information management, especially systems perspectives) and HRD. First, however, we need to explore some of the implications of KM for HRD theory, research, and practice.

The growing importance of KM and its implications for HRD

There has been much recent discussion, in the USA and UK, of knowledge workers, knowledge-intensive firms, and the critical role of organizational competencies. The demand for knowledge-intensive services is growing rapidly as companies are increasingly involved in services rather than goods (Nijhof 1999). In the USA the percentage of people who work with things or deliver non-professional services has fallen from 83 per cent of the workforce in 1900 to 41 per cent by the year 2000, while the percentage of those who work primarily with information has risen from 17 to 59 per cent (Stewart 1997). The distinction between goods and services is growing less clear as manual and craft work increasingly incorporate intellectual work and intelligent products are developed. In this sense, the growing importance of KM is often seen as a consequence of the move from an industrialized to an information-based economy and the rise of 'knowledge workers' and 'symbolic analysts' in advanced (post)industrial societies, where knowledge and expertise is focused and targeted to solve organizational problems. However, much of the agenda in KM has been set by IM and IT. Not only has insufficient attention been given to the role of HRD in KM (e.g. Scarborough *et al.* 1999) but the implications of KM for HRD have not been fully appreciated.

In the UK, Scarbrough (1999), surveying HRM and KM for the CIPD (Chartered Institute for Personnel and Development), argued that technology alone cannot fully capture and manage innovative thinking in an organization, and that HR needed greater attention in promoting information sharing. A technology-driven view, focusing on flows of information and group-ware, intranets and IT tools, was becoming dominant, losing sight of people and sidelining HR. KM, however, is a process, not a technology, linked to changes in the ways people work. A supportive culture is seen as necessary, supported by, for example, performance management systems that link rewards to individual contribution to projects, creating an internal market for knowledge. Encouraging people to sell their expertise and making specific reference in appraisal to passing on skills and knowledge to others may also be necessary. There may need to be appropriate HR mechanisms, such as good practice in selection, training, and reward, and an appropriate HR role in managing change and overcoming resistance to sharing information. However, rewarding knowledge sharing may reinforce notions of individual property, and may undermine teamwork – opportunities to work on challenging projects or be innovative may be rewards in themselves, generating professional recognition or influence on future projects. Short-term financial incentives may also undermine longer-term learning programmes. Basing KM on IT may place too much emphasis on the supply of knowledge and too little on how we use it.

Rossett and Marshall (1999) have taken this argument further by surveying KM-related practices as reported by 122 US HR professionals in 1998. Respondents considered that organizational culture and policies, access to information, developing

enabling technologies and the need to learn about KM were key issues for HR in the KM field. Knowledge markets exist, and there is a need to encourage employees to put their knowledge products on the shelves (Davenport and Prusak 1998). Employees may however be reluctant to give away that which is seen as vital to their identity and job security. People will increasingly need to be connected to data, experts, and expertise (Stewart 1997). While technology is often seen as critical for KM, it is not sufficient – changes in employee roles and behaviours may also be necessary (Davenport and Prusak 1997), but these have often been left unspecified. HR staff themselves may also need training in terms of their roles in KM. The survey indicated that KM is not generally pervasive in the perspectives of HR respondents, but some positive movement had been detected. Seventy per cent of respondents worked in organizations that captured some knowledge, such as best practices or lessons learned, mostly by paper-based formats. Only 16 per cent worked in organizations using technology-based systems to capture and access knowledge, mostly those in consultancy firms. These appeared also to be more likely to have access to formal KM systems comprised of people and technology dedicated to capturing, distributing, and maintaining knowledge (as well as being more likely to report unrestricted access to information, supportive knowledge systems, encouragement for communities of practice, being knowledge workers, and working in reduced command and control environments). HR professionals rated their units more highly (in terms of being customer focused, finding resources, linking resources to needs, and being knowledge workers who share ideas) than the larger organizations in which they resided. Problems were reported over information overload, restricted access to information, and managerial command and control systems.

Rossett (1999) argues that KM involves recognizing, documenting, and distributing knowledge to improve organizational performance. She claims that KM is of particular significance in relation to HRD in contributing to training needs analysis and to the planning of training to improve performance and deliver strategic results. KM challenges HRD over intellectual property, professional identity, and unit boundaries; KM perspectives change HRD's goal away from developing individual capacity to creating, nurturing, and renewing organizational resources and interactions. Instead of devising training courses, HRD practitioners should identify organized elements that learners can reference as needed, depending on the particular challenges faced. Diverse experiences and examples may also need to be captured, questions asked, and rich commentaries and stories provided, as well as technical data, to reflect user concerns. All these need to be embedded in the KM system, not in a classroom. Additional questions raised by KM for HRD include how to encourage information sharing, how to counter resistance to publicizing ideas, how to recognize individual contributions, how to provide security and status for individual contributors, and how to update the data. Thomson *et al.* (2000) argue that KM has significant implications for HRD in the career development area also. Since knowledge supply is likely to become as important as, or more important than, labour supply to increasingly knowledge-intensive firms, then employee contracts (both formal and psychological) are likely to change.

As interest in KM grows, HRD may become increasingly sidelined in favour of IM and IT, although it has much to offer KM. In part, this seems to be because many HRD practitioners are insufficiently informed about the implications of KM for HRD, and may not appreciate how adopting a KM perspective will transform their role away

from that of direct trainer towards a more consultant-like knowledge intermediary or knowledge broker role. Toracco (1999) outlines a model of KM and HRD that identifies three basic units: a model for codifying knowledge; the accessibility of knowledge; and methods and systems for KM. The model is presented from an HRD perspective, with a focus on individual knowledge. In terms of codifying knowledge, Toracco (1999) refers to distinctions between knowledge scope (e.g. job role vs. sectoral knowledge), type (e.g. explicit vs. tacit knowledge), level (basic vs. expert), and specificity (domain generality). In terms of accessibility, Toracco (1999) refers to the availability of knowledge in terms of its source, its half-life, and its degree of exposure. In terms of methods and systems for KM, Toracco (1999) refers to strategies and techniques for identifying knowledge and making it available to others. He distinguishes between depth (the extent to which knowledge is made explicit), time constraints, structure (e.g. methods for archiving quantitative and qualitative data), and roles (ways people are allocated to capturing and disseminating knowledge). Scarborough *et al.* (1999) also present a framework for discussing KM and HRM that identifies knowledge formation and acquisition, absorption and retention as key processes.

However, developing a robust model of KM and HRD in SMEs requires us to explore the specific features of HRD in SMEs, since most work in both KM and HRD has been based primarily on research and practice in large organizations. The above review of KM and HRD suggests that adopting a simple training solution to KM in SMEs will not be effective. A review of traditional HRD in SMEs also shows such ‘enterprise training’ approaches are unlikely to be successful. Both considerations suggest that new approaches, such as the TT project, are required, but need to be based on adequate models of KM in which HRD is not sidelined.

HRD and SMEs

Most research and theory building in HRD is associated with studies of large organizations. However, most firms in the UK employ fewer than fifty people. In order to analyse the nature and role of HRD in SMEs, it is necessary to analyse SMEs and their similarities to and differences from large organizations. Some argue that small firms do not face any particular HRD issues compared to large firms, but need HRD to help them grow. HRD is often then translated into formal ‘enterprise training’, often involving systematic instruction in business, managerial, and functional skills. This ‘official’ view sees the SME sector as not facing any specific HRD issues that differentiate it from large firms; HRD, of a formal ‘enterprise training’ kind, is seen as primarily necessary to facilitate their growth (e.g. Gray 1993). From this perspective SMEs are seen as scaled-down large firms, and SME HRD as scaled-down large-firm HRD.

However, UK government-supported enterprise training programmes have often not had the impact on performance anticipated (e.g. Storey 1994; Gray 1993, 1998; Stanworth and Gray 1991). There is little evidence that small business-owners are particularly attracted to such training, either for themselves or for their staff, and many commentators have argued that such government-supported enterprise training has often not been cost-effective, nor has it had the impacts desired. Some have argued that this is due to the lack of education, inward-looking orientation, and lack of perspective

of many owner-managers (Watkins 1983) or the individualism, stress on personal independence, and desire for control of entrepreneurs (Stanworth and Gray 1991; Storey 1994). Such factors may all contribute to the rejection of outside advice and training provision. In addition, very small 'micro-businesses' in particular may lack time, as well as sufficient clarity over diagnosing their training needs.

Others have argued that, on the contrary, SMEs, especially sole-traders and micro-firms, are very different from larger organizations, not just in being disadvantaged in relation to financial and labour markets, information, and compliance with regulation and reporting requirements, but also in terms of the cultural and personal motivations of owner-managers and their need for a wide range of skills in managing informal relationships. These are not often taught in formal training courses (e.g. Stanworth and Gray 1991). For other firms, perhaps in the 'growth corridor' of fast-growth SMEs with fifteen to twenty-four employees (Stanworth and Gray 1991; Stanworth *et al.* 1992), there may however be a need to introduce formal management and formal approaches to HRD, often perhaps because such firms are linked into complex supply-production-distribution chains and networks with larger businesses, and are often open to much more influence from large firms, including influences over HRD practices. Formal HRD may have a positive impact here, as Wang *et al.* (1997) show. Using Arthur and Hendry's (1990) schema to test the impact of the UK government's business growth training scheme, they showed both size effects and the positive impact of HRD on business performance (as well as the positive effect of a business plan) using multivariate analysis with 138 small firms.

However, few studies have looked at how SMEs actually manage their own HRD. There is some evidence that many trainers focus on the past, on critical analysis, on knowledge, on passive understanding, on detachment, on symbols, on neutral communication, and on concepts. However, entrepreneurs typically focus on the future, on insight, on creativity, on active engagement, on emotional involvement, on events, on personal communication, and on problems and opportunities (Gibb 1987). The entrepreneurs' stress on 'charisma' may contrast with the trainers' stress on order, rationality, and predictability, qualities emphasized in much formal training (Curran and Stanworth 1989). As a result, there may be a greater receptiveness among SMEs to more informal development processes and more personalized development experiences, such as those provided by consultants and mentors (Curran *et al.* 1996). SMEs do engage in HRD, but not necessarily in formal training, and such individualized, personalized, and consultant-like relationships may help owner-managers identify appropriate training and knowledge needs and develop appropriate skills (Stanworth *et al.* 1992). This implies that the cognitive gap between SMEs and academia in terms of the ways HRD is often delivered and received may be wide, and needs bridging in ways that go beyond formal enterprise training.

Thus this review of HRD in SMEs shows that, whereas SMEs are typically not, as the 'official' view suggests, large firms scaled-down needing formal enterprise training to grow, neither are they uniform and homogeneous with respect to HRD. Some very small firms, consultancies, and partnerships may be influenced by very different drivers from most large firms, often attributed to the owner-managers or partners' cultural and psychological motivations and a desire for independence, autonomy and lifestyle considerations, with a fear that growth will inhibit their development. For such micro-firms, undertaking very little formal training and not engaged in conventional enterprise

training for the reasons discussed, individual consultant-like relationships may be more effective in identifying appropriate development needs and successfully developing key skills (e.g. Stanworth *et al.* 1992). Larger SMEs, especially those in the 'growth corridor' of fast-growth SMEs with fifteen to twenty-four employees, may be more receptive to formal HRD, and indeed do appear to be more engaged in staff training (e.g. Thomson *et al.* 2000). However, since such firms will often be linked into supply-production-distribution chains and networks, their interest will often lie in building such relationships, in accessing knowledge, and in contributing to the knowledge chain as a knowledge intermediary. This suggests that consultant-like support from a knowledge broker may also be attractive to them, especially as our review of knowledge management suggests that the roles of knowledge broker, facilitator, networker, and intermediary will become increasingly important for HRD in general. This conceptualization underpinned the development of the TT role and project, designed to facilitate the development of knowledge-broking skills in business support roles.

Critical reflection on the TT project

However, reflection on the programme, and on a developing understanding of KM, suggests that, though regarded anecdotally as valuable and helpful by participants in many ways, the TT project represents only a limited break with traditional HRD approaches. It is based in part on a traditional OD approach to developing consultancy skills in facilitators of learning. Though it may indeed be the case that SME support staff will benefit from enhancement of such skills, such an approach does not address how KM may change our conception of HRD and OD. In addition, the TT project appears to rest on a rather mechanistic, linear conception of innovation as a process of diffusion, especially 'technology push' (e.g. Van de Ven 1986).

Though the technology translator project is fundamentally concerned with innovation and the adoption of innovation, the term has proved difficult to define in an agreed way. A dominant view, apparently underlying the TT project, is to see innovation as a product or outcome; an alternative view, to be developed here, sees it as an emergent process in organizations and partnerships. Innovation has been classified and operationalized in different ways (e.g. as occurring at individual, group and organizational levels; distinctions between innovation and creativity; socio-technical systems approaches; innovation characteristics approaches; and sources of innovation approaches, e.g. Anderson and King 1993). Innovation characteristics approaches might distinguish programmed vs. non-programmed, instrumental vs. ultimate, and radical vs. non-radical innovations, or see innovation dimensions in terms of magnitude, novelty, radicalness, and effectiveness. Source approaches might distinguish emergent, adopted, and imposed innovations. The focus of the TT approach seems to be primarily on imposed or adopted, rather than emergent, innovations.

Much work has focussed on facilitators and inhibitors of innovation, such as people (e.g. effective leadership behaviours associated with particular phases), structure (e.g. the impact of centralization, formalization, complexity, stratification, lateral communications, matrix structures, requisite variety, double-loop learning), and organizational size or resource availability. Though the TT project seemed to assume that larger organizations are more innovative than smaller ones (and there is some evidence of a

positive relationship, e.g. Pavitt 1991), Rogers (1983) found that smaller organizations were more inventive in the USA in producing new technological products. Size may be merely a surrogate for other variables, such as resource availability, the availability of slack resources, and complexity of structure. Other approaches have found that strategic type, organizational climate and culture, and organizational environment are also important facilitators or inhibitors of innovation. For example, Taylor *et al.* (2000), using a large-scale survey, have shown that the significance of inter-firm networking for innovation differs markedly between industry sectors, and that high-innovating organizations seek long-term, secure relationships with employers. Organizations also seem to adopt very different strategies towards staff directly involved in innovation as compared with staff in general, with less use of flexible employment policies for this group.

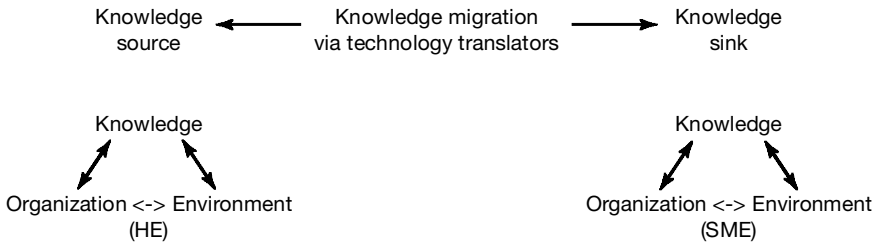
Rather than attempt to list the antecedents of innovation, another approach, developed here, is to examine the process (or series of processes, e.g. from initiation to implementation) of innovation. One unitarist approach, underlying the TT project, is to depict the process of innovation as involving a linear sequence of discrete stages; another, developed here, is to see it as more dynamic and fluid, allowing for the concept that groups, individuals, and collaborative partners may differ in their perceptions and interpretations of events, with processes developing in different, even conflicting, ways in different parts of the organization or partnership alongside the development of diverse social worlds and world-views (e.g. Anderson and King 1993). Critical reflection on the TT project's conceptualization of innovation as a product of a series of linear stages in a unitary organization leads us to propose the development of a more process-orientated, non-mechanistic, fluid approach that recognizes the existence of dynamic, conflicting, and different world-views, especially in partnerships and alliances.

It is therefore necessary to develop a more adequate conceptualization of KM, HRD, and SMEs that builds on the strengths of the TT project but responds more effectively to the challenges posed by KM. This paper goes on to develop such a framework, based on viable systems perspectives and re-conceptualizing the TT role as a knowledge broker engaged in a process of knowledge migration within a knowledge creation cycle.

Developing a model of knowledge migration in technology translation

The technology translation process could initially be considered to be a process of knowledge migration from knowledge source (the knowledge base, specifically HE in this instance) to knowledge sink (the SME) (Figure 1). Knowledge can be seen as potentially able to migrate in both directions, not only from source to sink but also from sink to source. The reasons for selecting the term 'knowledge migration' rather than the more common term 'knowledge management' are developed later in the article.

According to Steenhuis and de Boer (1999), technology transfer requires balancing between source and destination, as transfer of technology may cause potential imbalances in the destination company. In this instance, one of the roles of the technology translator may be to help monitor and correct such imbalances. Figure 1 includes



Source: adapted from Steenhuis and de Boer (1999: 86)
Figure 1 Technology translation and knowledge migration

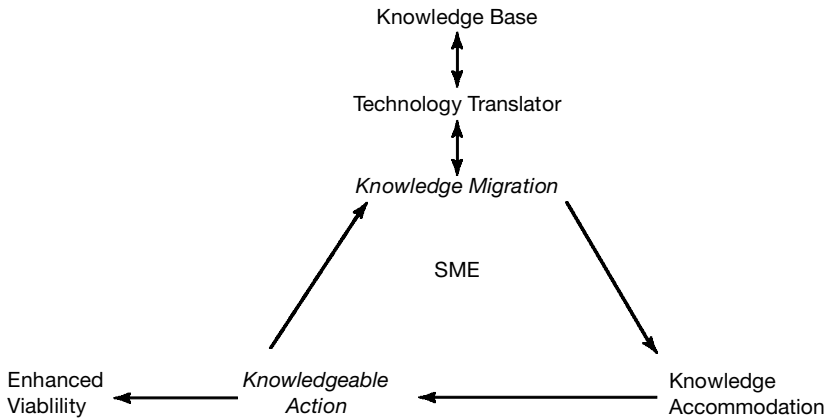


Figure 2 Three knowledge-cycle phases connected with knowledge migration

organizational and environmental characteristics as relevant factors in knowledge migration; however, most attention here will be on knowledge aspects, including the phases of knowledge accommodation and knowledgeable action that are seen as intended to follow knowledge migration (Figure 2). Again, the terms knowledge accommodation and knowledgeable action will be developed later in the article. Knowledgeable action by the SME is assumed to lead to enhanced viability, a term borrowed from viable systems perspectives, but this proposition has yet to be empirically tested.

Viable systems and knowledge management: towards a theory of viable knowledge creation

Both our review of HRD in SMEs and the implications of KM for HRD have identified the need to develop knowledge and learning intermediaries and brokers to support SMEs. The TT project focused on the role of technology translator, but, to develop such a role, a more adequate model of knowledge migration in SME–HE partnerships is needed. In understanding knowledge management and HRD in SMEs, we need a more informed model of knowledge management and transfer. One approach to

knowledge management and knowledge creation that may be sensitive in particular to partners' differences in perspectives is viable systems theory (e.g. Yolles 1999a, 1999b).

A viable system is an active, purposeful, and adaptive organization, seen as a system that can operate in complex situations and survive. Since complex situations entail variety differentiation, in surviving a viable system responds to changing situations by generating sufficient variety through self-organization to deal with the situational variety it encounters (called requisite variety). It is often said in the cybernetic literature that variety is a measure of complexity (Yolles 1999a).

A viable organization is able to support adaptability and change while maintaining stability in its behaviour. In particular, an organization is viable if it can maintain stable states of behaviour as it adapts to perturbations from its environment. Viable organizations seek ways of improving their ability to survive in complex situations. This is often coupled with the idea that they have fluid knowledge banks; organizational survival hinges upon an ability to create and manage knowledge. Knowledge creation/recognition is therefore of prime importance to organizations such as universities and SMEs and to potential partnerships between them.

The idea of knowledge creation is closely related to that of learning, and therefore HRD. Learners (individuals or organizations such as universities and SMEs in partnerships) will undertake viable learning if there is an ability to maintain stable learning behaviour. The caveat is that the learner is able to adapt to changes in a given learning environment that alters the learning situation. Whether a learner can adapt to the changes in the learning environment is a function of that learner's plastic limit. In the systems literature, when perturbations push it beyond this limit, the system either changes its form (incrementally through morphogenesis or dramatically through metamorphosis) or 'dies'. As an example of this, an SME-university partnership which is struggling for the reasons outlined earlier 'dies' in this context when one party leaves the partnership prematurely (fails?) because new learning behaviours cannot be established. If a viable organization survives, then it is able to change its form and adapt.

Knowledge creation is associated with different *world-views*. These are seen as relative to the institutions that one is attached to in a given society, and they change as institutional realities change. Thus, world-views involve views of or perspective on the perceived behavioural world that are determined by cultural and other attributes of the viewers. Through a process of socialization, views are formed within the institutions one is attached to in a given society, and they change as the institutional realities change. World-views may be shared by a group of people, though when this occurs the individuals each retain their own realities while using common models to share meaning. Further, world-views have boundaries that are generated within the belief system and cognitive space of the holders of these views, and, as a result, we can explore world-views in terms of their knowledge attributes. Clearly, our analysis of the SME-academic interface shows the two parties typically to have very different world-views.

Two types of world-views may be defined, informal (*weltanschauung*) and formal (paradigm). By formal we are referring to the expression of ideas through language. Formalization enables a set of explicit statements (propositions and their corollaries) to be made about the beliefs and other attributes that enable (more or less) everything that must be expressed to be expressed in a self-consistent way. Informal world-views

are more or less composed of a set of undeclared assumptions and propositions, while formal ones are more or less declared. Both are by their very nature bounded, and thus constrain the way in which perceived situations can be described. Now paradigms can change (Yolles 1999b), so that the nature of the constraint is subject to a degree of change – however bounded it might be. Consequently, the generation of knowledge is also constrained by the capacities and belief systems of the world-views. Specifically in this context, both SMEs and universities may have different *weltanschauungs* and different paradigms: different assumptions, propositions, and belief systems.

The idea of a world-view (Yolles 1999b) is that it:

- (a) is culture centred,
- (b) has cognitive organization (beliefs, values, and attitudes),
- (c) has normative and cognitive control of behaviour or actions that can be differentiated from each other,
- (d) has a cognitive space of concepts, knowledge, and meaning that is strongly linked to culture.

World-views interact, especially in partnerships, alliances, and joint ventures, such as the TT project, and, following the cybernetic tradition, this interaction can be placed in a cognitive domain that drives a purposeful adaptive activity system. The system has form, and thus has structure, process, and associated behaviour. This is assigned to an energetic behavioural domain. The knowledge-related cognitive domain is the ‘cognitive consciousness’ of the system that it drives. According to Yolles (1999b), the two domains are connected across a gap that we refer to as the transformational or organizing domain, and this may be subject to surprises, such as often occur in partnerships and joint projects. It is strategic in nature, and operates through information (Figure 3). The three cognitive, organizing, and behavioural domains are analytically and empirically independent. This model can be applied to any purposeful adaptive activity system by distinguishing between cognitive, strategic, and behavioural aspects of a situation, such as a partnership between SMEs and universities.

There are properties associated with each of these domains, perhaps most simply expressed in terms of Table 1 derived from Yolles (1999b). Associated with each of the

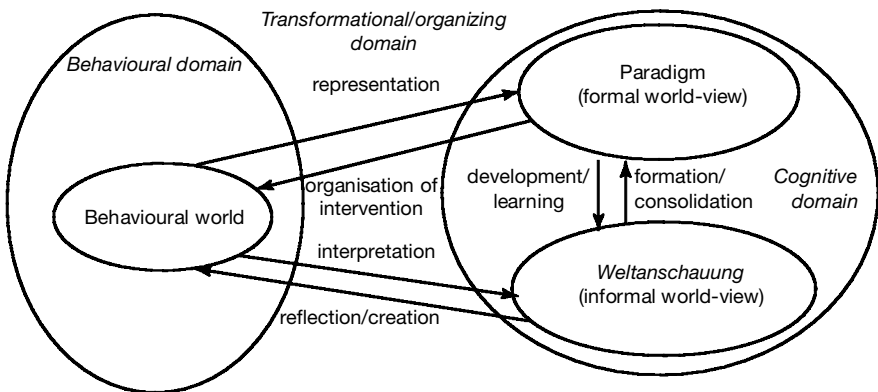


Figure 3 The relationship between the behavioural and cognitive domains in a viable system

Table 1 Relationship between human cognitive interests, purpose, and influences

<i>Technical</i>	<i>Cognitive interests of the behavioural domain (data)</i>	
	<i>Practical</i>	<i>Critical deconstraining</i>
Work. This enables people to achieve goals and generate material well-being. It involves technical ability to undertake action in the environment, and the ability to make prediction and establish control.	Interaction. This requires that people as individuals and groups in a social system gain and develop the possibilities of an understanding of each other's subjective views. It is consistent with a practical interest in mutual understanding that can address disagreements.	Degree of emancipation. For organizational viability, the realizing of individual potential is most effective when people: (i) liberate themselves from the constraints imposed by power structures (ii) learn through participation in social and political processes to control their own destinies. Autonomy and interdependence, rather than dependence result.
<i>Cybernetical</i>	<i>Cognitive purposes within the organizing domain (information)</i>	
	<i>Rational</i>	<i>Ideological</i>
Intention. This is through the creation and strategic pursuit of goals and aims that may change over time; enables people, through control and communications processes, to redirect their futures.	Logico-relational. Enables missions, goals, and aims to be defined and approached through planning. It involves logical, relational, and rational abilities to organize thought and action, and thus to define sets of possible systemic and behaviour possibilities.	Manner of thinking. An intellectual framework through which policy makers observe and interpret reality. This has an ethical and moral orientation. It provides an image of the future that enables action through 'correct' strategic policy.
<i>Social</i>	<i>Cognitive influences within the cognitive domain (knowledge)</i>	
	<i>Cultural</i>	<i>Political</i>
Formation. Enables individuals/groups to be influenced by knowledges that relate to the social environment. This has a consequence for social structures and processes that define social forms that are related to intentions and behaviours.	Belief. Influences occur from knowledges that derive from the cognitive organization (the set of beliefs, attitudes, values) of other world-views. It ultimately determines interaction and defines logico-relational understandings.	Freedom. Influences occur from knowledges that affect the polity, determined, in part, by thoughts about the constraints on group and individual freedoms, and, in connection with this, how to organize and behave. It ultimately impacts on ideology and degree of emancipation.

three domains is a cognitive property that guides organizations in the way that they function and survive. Exploration of the nature of cognitive influence associates this with the process of knowledge *migration*, that is the movement of knowledge between world-views (such as between universities and SMEs) that is subject to redefinition every time it migrates. Since cognitive influences and purpose are ultimately dependent upon such knowledge migration, then epistemology becomes an important consideration in terms of how organizations are able to survive. We are deliberately using the term 'knowledge migration' here, rather than the more conventional knowledge management, to emphasize the unplanned, emergent, and unpredictable nature of knowledge flows; knowledge is not simply a thing to be managed or mobilized in the ways often implied in the KM literature. This requires attention be given to epistemological issues.

Knowledge creation, learning, and renewal

As we have seen, the management of knowledge is becoming an important area of interest. However, the question of what constitutes knowledge and what constitutes management may be posed in different ways (Allee 1997). One approach, often associated with KM and perhaps underlying the TT project, discusses questions of ownership, control, and value, with an emphasis on planning. Another view, adopted here, is that knowledge involves organic flows and self-organizing processes and patterns. This approach explores how knowledge emerges, and how patterns change. In an organizational context, it can help analyse changes to an organization's knowledge base if a knowledgeable employee leaves, and how an organization manages to capture that knowledge. Knowledge is increasingly recognized as an important organizational asset. Its creation, dissemination, and application are often now seen as a critical source of competitive advantage (Lester 1996; Allee 1997). However, Table 1 shows that what counts as knowledge is not a neutral, but an inherently political, process, requiring attention to political and ideological issues and the ways that agendas are set and knowledge claims formulated, accepted, and legitimated. Knowledge creation is now often seen as an important consideration for organizations, but knowledge renewal is also important, including both knowledge creation and evacuation. In the former, knowledge is seen to be important for competitive advantage; in the latter, old knowledge is often seen to be of little value in changing situations. This implies the need for self-reflection by organizations and individuals on knowledge and on the learning process. Reflection on the technology translator project has led to its re-conceptualization here in terms of knowledge migration and viable knowledge creation.

A model of viable knowledge creation in SME: academic partnerships

Knowledge in the knowledge base varies: it might reside in data, information, people, tools and technologies, and it might vary in terms of type (e.g. tacit vs. explicit), scope (e.g. role, functional, sectoral knowledge), level (e.g. basic vs. expert knowledge), and specificity (e.g. its applicability to SMEs as well as to large businesses). For reasons

discussed earlier, the SME may not recognize this potential knowledge as knowledge or regard it as valid knowledge, depending on such factors as the source of the knowledge (HE may be seen as too impractical, a consultant may be seen differently), the accessibility of the knowledge (the SME may not be able to read research reports or navigate the knowledge base electronically), the credibility of the knowledge (that coming from HE may not be given credibility), and the degree of exposure of the knowledge (some knowledge may be documented or explicit, some tacit or implicit).

In developing a general framework for understanding knowledge management in academic–SME partnerships, it is tempting to use perhaps the most influential framework for knowledge creation developed by Nonaka and Takeuchi (1995). Nonaka and Takeuchi (1995: 8) distinguish between two types of knowledge, explicit and tacit (Table 2). Tacit knowledge includes cognitive and technical elements. Cognitive elements operate through mental models, working world-views that develop through the creation and manipulation of mental analogies. Mental models (like schemata, paradigms, perspectives, beliefs, and viewpoints), according to Nonaka and Takeuchi, help individuals perceive and define their world. The technical element of tacit knowledge includes concrete know-how, crafts, and skills. However, explicit knowledge is about past events or objects ‘there and then’, and is seen to be created sequentially by ‘digital’ activity that is theory progressive. An alternative perspective on the distinction between explicit and tacit knowledge, to be developed in this paper and applied to academic–SME partnerships through a review of the TT project, is also presented in Table 2.

Table 2 Typology of knowledge

<i>Expression of knowledge type</i>	<i>Explicit knowledge</i>	<i>Tacit knowledge</i>
<i>Nonaka and Takeuchi</i>	Objective Rationality (mind) Sequential (there and then) Drawn from theory (digital) Codified, formally transmittable in systematic language. Relates to past.	Subjective Experiential (body) Simultaneous (here and now) Practice related (analogue) Personal, context specific, hard to formalize and communicate. Cognitive (mental models), technical (concrete know-how), vision of the future, mobilization process.
<i>Alternative</i>	Formal and transferable, deriving in part from context-related information established into definable patterns. The context is therefore part of the patterns.	Informal, determined through contextual experience. It will be unique to the viewer having the experience. Not transferable, except through re-creating the experiences that engendered the knowledge for others, and then the knowledge gained will be different.

All knowledge is world-view and belief related. Knowledge can be redefined as patterns of meaning that can promote a theoretical or practical understanding that enables the recognition of variety in complexity. These patterns are often developed through a coalescing of information. If information is seen as a set of coded events, then consistency with Nonaka and Takeuchi (1995) occurs when they say that explicit knowledge is codified.

The creation of explicit knowledge is often seen as a process of storing and indexing information. However, these patterns can also occur mentally as tacit knowledge. Knowledge also enables context to be defined in a richer way, and this affects both data processing and the distillation of information into new knowledge by enriching existing patterns. The model leads to questions about our understanding of knowledge creation, and has consequences for the way in which we see knowledge development in organizations, such as how and through what means the patterns of meaning that enable data to be processed and information to be coalesced are formed.

Nonaka and Takeuchi's (1995: 8) SECI model of knowledge creation is illustrated in Figure 4. This offers a model of conversion between tacit and explicit knowledge that results in a cycle of knowledge creation. The conversion process involves four processes: socialization, externalization, combination, and internalization, all of which convert between tacit and/or explicit knowledge. Socialization is the process by which synthesized knowledge is created through the sharing of experiences that people have as they develop shared mental models and technical skills. Since it is fundamentally experiential, it connects people through their tacit knowledges. Externalization comes next, and occurs as tacit knowledge is made explicit. Here, the creation of conceptual knowledge occurs through knowledge articulation in a communication process that uses language in dialogue and collective reflection. The use of expressions of communication are often inadequate, inconsistent, and insufficient. They leave gaps between images and expression, while promoting reflection and interaction. This therefore triggers dialogue. The next process is combination, where explicit knowledge is transformed through its integration by adding, combining, and categorizing knowledge. This integration of knowledge is also seen as a systemizing process. Finally, in the next process explicit knowledge is made tacit by its internalization. This is a learning process,

From/To	Tacit	Explicit
Tacit	<p><i>Socialization</i></p> <p>Creates <i>synthesized</i> knowledge through the sharing of experiences, and the development of mental models and technical skills. Language unnecessary.</p>	<p><i>Externalization</i></p> <p>Creates <i>conceptual</i> knowledge through knowledge articulation using language. Dialogue and collective reflection needed.</p>
Explicit	<p><i>Internalization</i></p> <p>Creates <i>operational</i> knowledge through learning by doing. Explicit knowledge like manuals or verbal stories helpful.</p>	<p><i>Combination</i></p> <p>Creates systemic knowledge through the systemizing of ideas. May involve many media, and can lead to new knowledge through adding, combining, & categorizing.</p>

Source: Nonaka and Takeuchi (1995)
Figure 4 The SECI cycle of knowledge creation

which occurs through the behavioural development of *operational* knowledge. It uses explicit knowledge, like manuals or verbal stories, where appropriate.

Towards a critical view of knowledge management and knowledge creation

The different types of knowledge process are seen here as phases in a knowledge-creation cycle. This cycle is driven by *intention*, seen as an aspiration to a set of goals (e.g. higher performance). *Autonomy* is another requirement that enables the knowledge cycle to be driven. This increases the possibility of motivation to create new knowledge. There are three other conditioning factors. One is the need for *fluctuation and creative chaos*. This can generate signals of ambiguity and redundancy that inhibit the ‘improvement’ of knowledge. The sharing of *redundant* information promotes a sharing of tacit knowledge, when individuals (e.g. SME owners) sense what others (e.g. HE academics) are trying to articulate. Finally, *requisite variety* is needed if an actor is to deal with complexity. Thus, five factors are seen as conditioning the knowledge cycle, enabling it to maintain developmental motion.

How we see our organizations and the environments in which they exist depends upon our knowledge, understanding, and epistemological frame of reference. During the last few hundred years within the period of the industrial revolution, there was a belief in the West that science had conquered the unknown. Simple mechanistic thinking ruled, and extended into what has been called behaviourism in psychology, long decried by systemic thinkers (Koestler 1967). As the paradigm of complexity has taken hold of science, we now see the development of complex mechanistic thinking through an *engineering* view (see Fivaz 1999). The commonality between all of these views is that they all pursue a fundamentally positivist epistemology.

Those who hold positivistic views see reality as existing autonomously from any observer. Inquirers can be objective, and non-participant observers to the events that they see. The events can be represented by an observer as measurables, called data, that represent the ‘facts’ of a single objective ‘reality’. The truths set up as a pattern of propositions represent the knowledge. Through deductive reasoning, the approach usually embeds an attempt to test theory in order to improve both the understanding of a situation and the ability to make predictions about it.

In terms of complex *engineering* thinking, observers can have their own perspectives that can influence the way that they see things. Observers are seen to be endowed with consciousness, which, in an extension to simple behaviourism, can be seen to be a set of engineering processes that converts information acquired as observation from ‘outside’ into information implemented ‘inside’. A corollary of this is that different people can be better or worse at these engineering processes. In all positivist perspectives, the possibility of optimization becomes a relevant concept. Thus, to simplify, the mind is a biased machine, reality is actually out there, and knowledge can be objective.

The age of complexity has led some, particularly soft systems thinkers, away from these positivist perspectives. Alternative paradigms are described by Guba and Lincoln (1994). We adopt what they refer to as the critical paradigm, for want of a better term. Here, there are no observers, there are only viewers; their views, like their behaviours, are world-view derived. World-views also interact with each other. Following the work

of Luhmann (1995), this interaction occurs through a semantic communication process. From Habermas (1987), interaction occurs in a framework of meaning called the lifeworld.

In our critical perspective, there is no absolute real world that can be separated out, because viewers create it and interact with their creation. There is, therefore, no absolute separation between viewers and the behavioural world around them. Since what constitutes reality is determined through world-views, it changes as world-views change. In each world-view, we build our view of what we perceive to be the world through our mental models. We may believe that we share them with others, but they will be incommensurable to some degree (Yolles 1999b). This is because the models may involve different conceptual extensions, or the same conceptual extension may take on meanings that are qualitatively different. We are never aware whether these shared models are related, except by attempting to draw meaning from others' explanations provided through language, or by comparing what we expect from the behaviour of people in a situation with what we perceive that they are doing.

More generally, we may see futures to be the result of changing patterns of perception that result from new knowledge, experiences, and beliefs of viewers. As Friedan (1999) holds, prediction is local, but it requires that people are prepared constantly to modify their view of the world around them. They consistently need to realize or release the information potential inherent to the complex situations that they see around them.

In our critical perspective, there is no observer. Rather, we may propose that there is an other, who is also a potential or actual viewer. In a social context, such as a partnership, a viewer has a world-view that interacts with the world-views of others, either directly or indirectly (through some of their apparent constructions). A result of the interaction is the creation of knowledge specific to the view holder – that is, knowledge that is personal and therefore local to the viewer. Since this knowledge tells us about reality, then reality is a local phenomenon. This is also the case if one considers only a situation involving a single world-view. In this case, reality is constructed as a result of the interaction between viewers and the information around them, again seeing reality as locally generated. However, this in turn leads us to questions about what constitutes information, what constitutes knowledge, and the role of the viewer in defining them.

Knowledge, epistemology, and knowledge creation

A primary distinction often made in KM is between explicit and tacit knowledge: the former is often seen as objective, while the latter is treated as subjective. No elaboration of the nature of objectivity is provided by Nonaka and Takeuchi (1995); it appears to be consistent with positivist epistemology.

Adopting a critical epistemology, we can see that tacit knowledge is informal, determined through contextual experience, and unique to the viewer having the experience (Table 2, alternative). It is therefore not transferable, except through recreating the experiences that engendered the knowledge for others, and then the knowledge gained will be different. Tacit knowledge is therefore the result of self-learning. Explicit knowledge may be identified as formal, deriving in part from context-related

information established into definable patterns. Context formally exists as part of these patterns. Formal knowledge is transferable if the medium of transfer enables the transferral of meaning. Explicit knowledge can be a consequence of self-learning tacit knowledge or received as knowledge transfer. Examples of such transferable knowledge occur when it is provided in a book, or set out in a knowledge-base system as a pattern of meanings through a set of propositional rules, or through some other patterning process. HE-SME partnerships often attempt to transfer explicit knowledge in this way; the TT project is no different in this respect.

In the case of the SECI knowledge cycle (Figure 4), processes of knowledge creation are represented by socialization, externalization, combination, and internalization. The proposition here that the knowledge creation cycle occurs as a continuous cycle is, however, quite different from this. No structural adaptability is considered with the SECI cycle, which must therefore be considered to support a positivist epistemology. This is because each phase in the knowledge-creation process is predetermined by the prior phase, and, other than through conditioning, there is no mechanism by which any one phase can be spontaneously enabled.

As an example of this: is conceptual knowledge to be assigned to the externalization phase, developed only after socialization, or can it develop independently without socialization and be externalized? Perhaps, though, this might be through process of socializing with oneself? Our mental models centre on our conceptualizations, and these are not often made explicit. When we are unable to explain things that we believe, we create concepts that enable us to explain situations. This is a process that Cohen and Stewart (1994) call collapsing chaos, which reduces complexity. It would also seem to be the case that the process of externalization leading to new theories and generalizations offers a sound rational positivist logic. However, we are aware that such rational approaches tend to be unrepresentative of the way that patterns of belief can change the nature or relevance of knowledge. Returning to the socialization process commented on before, Nonaka and Takeuchi (1995) acknowledge that knowledge is belief based. However, beliefs may develop into knowledge without the benefit of the socialization process. In any case, socialization itself may be suspect as a way of developing models that share common meaning, as is often aspired to in HE-SME partnerships.

Ideally, we require a meta-process that enables us to show under what conditions combination (say) may follow socialization. As in the case of soft systems methodology as shown by Yolles (1999a, 1999b), this meta-process may occur through the creation of a set of control loops that explain how morphogenic and metamorphic changes can occur in a cycle of knowledge creation.

A viable approach to knowledge creation and migration in SME-HE partnerships and other alliances

The structured spiral of knowledge creation offered by Nonaka and Takeuchi (1995) appears to adopt a positivist perspective. An alternative approach is possible, linking closely with the viable system model. In addressing this, we note that each of the three domains identified in Table 1 has associated with it its own knowledge process, one connected with cognition, one with organizing, and one with behaviour. This notion

is consistent with Marshall (1995), whose interest lies in knowledge schema. Schema have four categories. They are, first, the mental organization of individuals' knowledge and experience that allows them to recognize experiences that are similar. They can then access a generic framework that contains the essential elements of all these similar experiences. They can use this framework to plan solutions. Finally, there is the ability to utilize skills and procedures to execute the solution. For this purpose, Marshall identifies three types of knowledge:

- identification knowledge – the facts and concepts making up the knowledge domain
- elaboration knowledge – the relationships between the individual knowledge components and the way they are organized
- execution knowledge – the conceptual skills and procedures required to execute an activity

Marshall himself does not attempt to address knowledge creation, though we shall do so through our own model. We consider that, in social situations, knowledge creation occurs through a process of knowledge migration from one world-view to another. This involves a process of knowledge identification. The basic knowledge-cycle model is given in Figure 5. It links to Table 1 and Figure 2, and depicts the three fundamental phases of the knowledge-creation process: knowledge migration, knowledge accommodation, and knowledgeable action. Migration is associated with the cognitive domain, accommodation with the organizing domain, and action with the behavioural domain. Each process has an input and an output. A control process also is able to condition each process through actions on the inputs or on the processes themselves. The way that knowledge migration occurs is conditioned by cognitive influence, knowledge accommodation through cognitive purpose, and knowledgeable action through cognitive intention. We shall elaborate on these shortly.

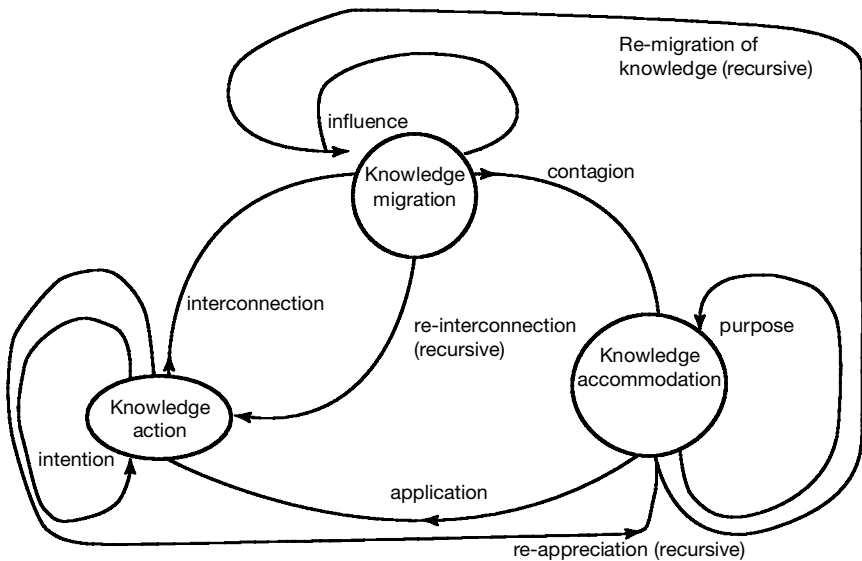


Figure 5 The knowledge cycle

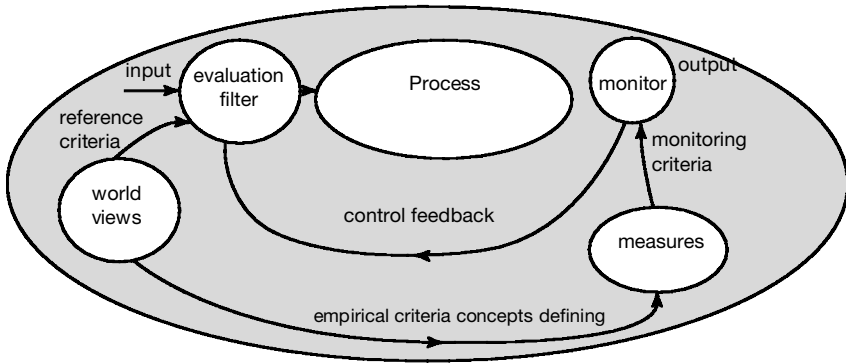


Figure 6 Basic form of the control model

The control process involved with knowledge migration (Figure 6) occurs through the development of interconnections between the world-views of the actors in a given supra-system, and is the result of semantic communication. As part of the process of knowledge migration, new knowledge is locally generated within the actor. While this may be seen as part of a socialization process, it may also be seen as actor-local and spontaneous when the process of knowledge migration operates as a knowledge-creation trigger.

Newly migrated knowledge may be shared and re-shared within the supra-system, because the new knowledge created by one actor will have a local definition that will be different for others. As a result, the originally migrated knowledge will have to be re-migrated in a feedback loop. This is fundamentally consistent with the notion of paradigm incommensurability, since every world-view will have its own distinct pattern of meaning that will be different from every other one. This does not stop the knowledge from being ‘contagious’ to relevant others within a given supra-system, such as an SME–university–TT partnership, through the continuous semantic communication process in which they participate involving recursive migration (that is re-re-migration and re-migration) of knowledge. Each recursive knowledge migration has the potential of new knowledge creation for each actor (TT, KB, SME) in the supra-system. As knowledge is migrated, it is likely to pass through a morphogenic process, and sometimes a metamorphic one that makes it new to the group.

As we have seen, knowledge management is inherently a political process. Polity, a core aspect of politics, acts as a filter on knowledge migration. It is concerned with an organized condition of social (or civil) order. Polity is connected to politics through the latter’s interest in the causal relationships relating to behaviour that enables what may be referred to as social engineering. Within the context of knowledge about the creation of order, we can talk of polity knowledge. It would seem to be connected to what Marshall (1995) refers to as elaboration knowledge (relating to the relationships between the individual knowledge components and the way they are organized within a schema). Polity knowledge can be seen to relate to the relationships between individual knowledge components as perceived by an actor to be possessed by the other actors, and the relative way that they are organized. It would thus seem to be an active recogniser of identification knowledge (*ibid.*) – i.e., the concepts and patterns of

meaning that make up knowledge. When polity knowledge is applied to other actors, it enables us to decide about them. Sometimes, such decisions involve ‘false’ assumptions that are not representative of the identification knowledge of other actors. This can inhibit the process of knowledge migration, since recognition of knowledge differences is needed before knowledge migration can occur. Partnerships between SMEs and universities offer a rich source of such potential false assumptions, frictions, and misunderstandings. For SMEs in particular, it may be difficult to identify the most appropriate source of help in HE, and it may be difficult to contact individuals (there being no recognizable ‘front door’). It may be time consuming to pursue enquiries separately within different universities, and SMEs and intermediaries may be unlikely to conduct a regional search. The quality and depth of information held by SMEs on academic expertise may be very variable, and the university may expect the SME to find it and to visit them to present its request. The university may have an external relations department or similar agency, which may be hard to contact, but which nevertheless insists that it must be the interface to the academic specialists. It may not be able to match the SME’s general management needs with a subject specialist, or vice versa. The university may expect the SME to interface separately between technical groups and business/marketing or commercial staff within a departmental structure, and it may have an intimidating charging structure, asking the SME to commit significant costs before it is sure what it is getting.

In the technology translator project described here, university–SME partnerships were seen as linkages over time, where the parties involved represent organizations seeking mutual benefits with a view to establishing common or compatible interests. There was a perceived need to establish roles, build relationships, monitor activities and progress, manage conflicts, assess mutual strengths and weaknesses, understand each other’s perspectives, and explore, respect, and value differences between parties. Such partnerships can differ over many issues, with parties having different emphases, different expertise, different perspectives, and different corporate and sectoral cultures. For example, partners are likely to have different approval processes and administrative requirements. This requires an emphasis on problem solving, the management of conflicts, and the development of a continuing partnership, with opportunities for renegotiation. Academics may seem to SMEs to be focused on problems, not solutions, with a poor reputation for delivery (e.g. Ruana 1999). They may seem to use an exclusive language, assuming pre-knowledge on the part of the SME (e.g. references back to previous research, theory, and models). They may not seem to use business language, may seem to lack business understanding, may seem to have very slow cycle times, and may seem to be focused on very small-scale issues.

Towards a research agenda for studying knowledge creation and migration in SME–HE partnerships and other alliances and joint ventures

A number of issues for further research are raised by the model outlined in Figures 5 and 6 and by reflection on the TT project. The process of knowledge accommodation may follow knowledge migration. An accommodation of how migrated knowledge can be of use to a relevant other is essential if they are to be able to harness it within

a behavioural world. Knowledge accommodation by relevant others (e.g. SMEs) is dependent upon knowledge contagion to these others. However, this is filtered through knowledge that activates *weltanschauung*-derived ideology and ethics. In addition, the evaluation reference criteria derive from knowledge about intention and logico-relational cognitive purposes. Interestingly, this connects with Marshall's (1995) idea of planning knowledge – the knowledge of which pathways to select in order to achieve a solution.

Contagion can be evaluated by examining to whom knowledge has been passed, and whether it has been retained for use (e.g. by SME from HE). Cultural and social influences can be evaluated by examining the parties' respective beliefs, values, and attitudes (cognitive organization). One way of doing this is to examine resistance to the adoption of new patterns of cognitive organization (e.g. resistance by the SME to new technologies or processes or by HE to new modes of learning). Social influences represent knowledges about the way in which social processes operate. This dimension can be measured not in terms of social meaning, but in terms of the reticence that actors have towards the introduction of new social meanings.

A consequence of the process of knowledge accommodation is its intelligent application. We say intelligent, because its obverse, rote application, may not require knowledge accommodation or even migration. This phase is termed knowledgeable action. Measurements for this control process may be qualitative, requiring an inquirer to search the local environment for ways in which knowledge has been applied (directly or indirectly) to varieties of situations. The process of knowledgeable action may be dependent upon the application of knowledge. Knowledgeable action is action that occurs with awareness of what is being done within a behavioural world. Knowledgeable action in a situation is dependent upon knowledge application to the tasks that are perceived to require to be addressed within the situation. This is filtered through knowledge that activates *weltanschauung*-derived emancipative capabilities that enable knowledgeable action to occur. The evaluation reference criteria derive from knowledge about actor interests through work and interaction. This relates to Marshall's (1995) idea of execution knowledge, seen as the computational skills and procedures required to execute a behaviour.

A consequence of the process of knowledgeable action that derives from knowledge migration is the creation of new definitions of relationships between identifiable actors. It gives meaning to work-related activities, particularly with respect to those that involve interaction, such as HE–SME partnerships.

Measures within this control loop with respect to knowledgeable action can occur by examining the environment in which that action has occurred. Work and interaction knowledge that conditions knowledgeable action can be explored by examining how work and interaction processes change with the introduction of new knowledge. Knowledge about emancipation may be determined through in-depth questioning of relevant others, such as the academics, technology translators, and SME representatives taking part in joint partnerships.

When the above control loops operate to make process changes, morphogenic changes occur in the knowledge phases of our knowledge cycle. When the control processes are complex and control action fails, knowledge process metamorphosis can occur (Yolles 1999b). As an example of a metamorphic change, a new concept may be born during the process of knowledge migration: a new way of working by the SME,

a new way of facilitating learning by HE, a new mode of consulting by the technology translator.

There are differences in the way knowledge creation is structured depending on whether one adopts a positivist or a critical epistemology. The ideas of Nonaka and Takeuchi appear influential in the development of a theory of knowledge creation. While they are constructivist in their perception of each phase within the process, they are overall structurally positivist. It is not uncommon to have this type of, usually benign, methodological schizophrenia, though it may well be more aesthetic not to. An alternative approach that does not suffer from this problem is proposed, deriving from viable systems theory. This does not see knowledge creation as a set of sequential steps, but rather as a set of phases that are constantly tested and examined through feedback. Shifts from one phase to another may occur according to the control phenomena that drive particular perspectives.

There are parallels between our proposed knowledge cycle and that of Nonaka and Takeuchi. In the former, knowledge can be created spontaneously within a migration process, and any socialization process that occurs is through communication that may be seen to act as a trigger for new knowledge. Unlike Nonaka and Takeuchi, our cycle is not required to be monotonic and continuous, relative to a conditioning process. Rather, the process of continuity is transferred to the communication process, and knowledge creation is cybernetic, passing through feedback processes that can change the very nature of the patterns of meanings that were initiated through semantic communications.

Central to this analysis of knowledge creation and a proposed research agenda on SME–HE partnerships and other alliances and joint ventures is the knowledge typology shown in Figure 7.

The typology depicted in Figure 7 derives from the knowledge-creation cycle, defined in terms of the processes of knowledge migration, knowledge accommodation and knowledgeable action. Knowledge migration occurs through the development of interconnections between the world-views of the actors in a given supra-system (such as an SME–HE partnership) and is the result of semantic communication. As part of the process of knowledge migration, new knowledge is locally generated within the actor.

Associated with each phase of knowledge creation are, it is proposed, different types of knowledge workers. Thus, those who are particularly good at migrating knowledge, whether from HE to SME or vice versa, are seen as knowledge identifiers. We can classify two cultural classes of identifiers, sensate and ideational, following Sorokin (Yolles, 1999a). Sensate culture is to do with the senses, and can be seen to be utilitarian and materialistic. Ideational culture relates to ideas, and an example might be the adherence to, say, spirituality or ideology. Sensate identifiers may be more common in SMEs, ideational identifiers in HE, though this proposition is far from clear. The acquisition phase of knowledge creation has associated with it those who might be called elaborators. It is possible to classify two polar types of elaborators, those who are responsive to new knowledge and those who are not. There may be responsive elaborators (i.e. open to new ideas and approaches) and non-responsive elaborators, closed to new approaches, in both the SME and HE sectors. Finally, closely associated with the phase of knowledgeable action are executors. Two types of executors may exist. Fundamentalists adhere to notions very strictly, while pragmatists provide for

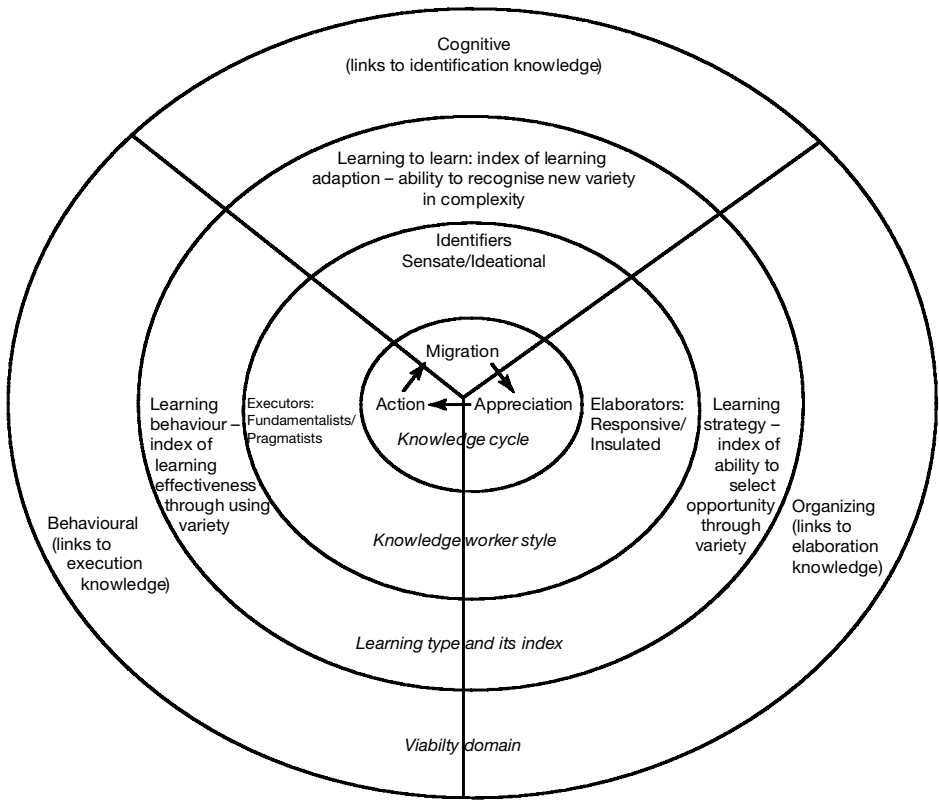


Figure 7 Typology indicating possible knowledge profiles of individuals (knowledge personalities) or coherent groups.

some degree of leeway in the way that they adhere to notions. So, there may be fundamentalist executors in both sectors (i.e. academics and entrepreneurs who implement actions only within previously defined parameters) and pragmatist executors in both sectors, willing to cross boundaries and categories. It should be pointed out at this juncture that it is not necessary to be either fundamentalist or pragmatist. There may be phases in between them, in the same way, for example, that there may be between insulated and responsive elaborators, or sensate and ideational identifiers. Thus, for instance, an identifier may be able to mix sensate and ideational perspectives, in a condition referred to as idealistic. Clearly, these ideas and propositions need testing through further empirical research. However, certain research questions can be formulated and propositions developed.

The role of the technology translator might be seen as a supportive intermediary and knowledge broker, facilitating the SME's ability to identify, recognize, and validate knowledge in the KB and access it in a process of knowledge *migration*. In addition, his or her role may be to help the SME accommodate knowledge, perhaps by recruiting permanent staff or staff associated with the KB (e.g. as consultants or applied researchers through teaching company schemes), perhaps by helping the SME establish its mission and purpose and how the KB can help in this process, and perhaps by appropriating tools, technologies, and procedures from the KB. The technology translator may

then help the SME build on that knowledge by a process of knowledge *accommodation*, perhaps by elaborating on the SME's mission and purpose, perhaps by inducting the SME into the culture of the KB, or perhaps by helping the SME adapt tools, technologies, and knowledge from the KB. Supplementing the SME's existing knowledge profile by connecting it with relevant expertise in the KB as an additional resource or complementing the SME's profile by enabling staff from the KB to fill a gap in its knowledge profile are also possibilities. Enabling the SME to enhance differentiation of roles, such as encouraging the owner-manager to delegate and allow other managers to take more responsibility, and helping the SME to reorganize its roles or build a new set of managerial roles and responsibilities are also possibilities. The translator may also help the SME *share* newly built knowledge throughout the organization by helping it develop databases, information channels, support systems, coaching, mentoring and modelling initiatives, and perhaps by encouraging a climate of dialogue, teamwork, and communities of practice throughout the SME (e.g. Wickham 1999).

The translator may also help the SME *apply* knowledge throughout the SME and help set up a process of *knowledgeable action* through mechanisms that may include systems for monitoring, management, and control, with the assistance of the KB. New tasks may be executed, or old tasks executed more expertly. The TT and KB may even play a role in knowledge *renewal* and reconstruction of the SME knowledge base, helping the SME retain useful knowledge, accumulate more knowledge, delete old or inappropriate knowledge through knowledge evacuations, and assist in processes of organizational change and learning, perhaps leading to the recognition of new knowledge and enhanced skills in knowledge self-management and enhanced ability to recognize, identify, and access relevant knowledge. This may initiate new processes of knowledge migration. Such migration is not solely one-way, from KB to TT to SME. As pointed out earlier, knowledge flows and migrates in all directions, and the KB may be able to derive significant benefits and enhanced knowledge from its interaction with the SME.

As a result, both partners may derive complementary benefits. The organization may find its focus enhanced by theory and research, or its research capabilities and evaluation skills enhanced. It may be able to access the latest research and trends in the area of interest, leading to enhanced professional development. As an active partner in a successful partnership, it may provide placements and research opportunities and help the university develop, on site, customized programmes that are focused on real problems. The organization is then also able to demonstrate its commitment to professional development, and can develop relevant models. The business may then find that such partnerships help it avoid fads, help it question its mental models and assumptions, help it develop reflection and thinking, and provide it with supporting evidence for internal arguments and external funding bids, as well as helping develop a shared model and language with the university (e.g. Jacobs 1997, 1999).

The university may also find then that its development of theory and research is enhanced by contacts with practice (thus developing its knowledgeable action), its ability to undertake field research improved, and its academic development enhanced. Through active involvement in practice, it may gain access to the latest tools and practices, and obtain recruitment opportunities for students. It may also find its consultancy skills enhanced, and its ability to customize its programmes improved.

It is predicted that such KM processes, assisted by the TT, will generate greater

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viability for the SME in the form of, for example, greater teamwork capabilities, enhanced innovation, reduced customer responsiveness, and flatter learning curves for the SME. This aspect of the model has yet to be empirically tested. Nor has the effectiveness of the TT training programme yet been formally evaluated. The knowledge-creation cycle and knowledge typology developed here in relation to the TT project and SME–HE partnerships may have more generalized usefulness in guiding research on other kinds of partnerships, such as mergers, alliances, and joint ventures.

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