Supporting learning in advanced supply systems in the automotive and aerospace industries

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1. Introduction

Small and medium sized enterprises (SMEs) in most sectors face intense pressures related to evolution in the strategies, tactics and operational methods of the large companies that dominate their markets. Among these pressures are those linked to 'supply chain restructuring'. Many SMEs are caught up in this process, whether as suppliers to large companies, or as their competitors. Stresses on SMEs also emanate from the extending roles of e-commerce. Yet their survival imperatives generally emphasise extremely limited time horizons. Operational demands force them to deal continually with immediate tasks and problems, leaving them with few opportunities to develop an overall strategic approach to their business.

This paper analyses the attempts made within the KLASS project to support the learning of individuals and organisations in advanced supply systems in the automotive and aerospace industries. The project was principally funded through the European Union's ADAPT programme, and KLASS has sought to support SMEs through inter-company, computer mediated, learning networks that have a strong focus on both immediate performance improvements and longer term objectives. We contend that this approach improves the prospects for productive collaboration between SMEs and institutions in the broad educational sector. It also supports the development of new capabilities in SMEs, including those related to exploitation of the Internet and e-commerce, and fosters a shift from the immediate, short term focus of SMEs to a more strategic perspective.

The strategic and operational contexts of SMEs have been influenced by the changing patterns of innovation within supply systems for complex products in the automotive and aerospace industries in the last decade. Current forms of product system integration now differ markedly from those of the past, which were based on single ownership of multiple stages of production and distribution. The newer forms have developed around the process of 'de-integration' in large companies, and are currently viewed in terms of the 'supply chain'. They are generally founded on large firm control over market access at strategic points in the total product system – for instance, retailer control over access to consumers. This control is facilitated by intensive use of information and communications technologies (ICTs), and is used to achieve tight co-ordination over all stages of production.

The KLASS project has been concerned principally with the automotive component sector, where the conditions for improving production and sustaining supply chain participation among smaller companies are being investigated. However, the project has also involved companies in aerospace component supply and the project approach has the potential for transfer to other sectors. For reasons of space, however, only the contextual background of the automotive supply chain will be given, although the subsequent commentary upon learning in networks will range across examples drawn from both sectors.

2. The automotive supply chain

The automotive supply chain involves the total sequence of production from raw materials extraction and processing, through intermediate stages of component production and manufacture of sub-assemblies, into end product manufacture. In the automotive industries, the supply chain is increasingly being managed in a broader way - closer to what we view as a total product system. This recognises the broader resource and environmental impacts of car production and use. It takes a 'cradle to grave' view of the product life cycle which extends through the phases of 'aftermarket' use, including the end-of-life reprocessing of motor vehicles. Within the product system, the KLASS project was concerned with the levels below that of the vehicle manufacturers (VMs) – that is, in what is generically referred to as automotive component supply.

Automotive product systems are organised hierarchically, with the VM at the top, controlling level. The characteristics of suppliers in the different tiers vary greatly, but some generalisations are useful. Those in tier one are mostly large or very large companies in terms of employee numbers and capitalisation. Many have a sophisticated technological base - for instance, those producing specialised electronic, electro-mechanical and mechatronic systems or subsystems. The capacities of the leading tier one suppliers include significant research and development, product design and other advanced innovative capabilities. These companies are pressed to develop these capabilities further by VMs that are increasingly 'outsourcing' elements of product development and manufacturing (Abreu et al, 2000). The tier one suppliers have an expanding role in vehicle specification - for example, in safety and in functionality. However, this is accompanied by closer scrutiny on the part of VMs – through 'supplier assessment' – of the functioning and practice within tier one companies.

By contrast, the numerous companies in tiers two to four are mostly SMEs, including many micro enterprises. Some of these provide specialist functions, but a large proportion have very limited technological capabilities. The KLASS project was primarily concerned with companies in these tiers although, as will be seen, VMs and tier one companies can have a central, motivating, role in stimulating these smaller companies to participate in learning networks. These SMEs have been faced not only with changing patterns of supply, but also with significant restructuring within the industry as a whole, adding an extra dimension to the uncertainty they face.

3. Structural change in the automotive sector

Throughout the 1990s, growth in vehicle ownership was exceeded by the rate of growth in manufacturing capacity. Estimates of surplus capacity are generally in the region of 20 million units world-wide, including 6 million in Europe. In this highly competitive context, the sector is experiencing a fundamental restructuring – as has been evident in recent changes in the UK-based automotive sector. Among the VMs, there have been some major changes in the structure of ownership. These include mergers - most notably of Daimler-Benz and Chrysler, and acquisitions of smaller VMs, such as Saab and Volvo, by larger companies. Other companies have become linked through share ownership - such as Renault's 38% of Nissan and General

Motors' 20% of Fiat. These developments are viewed as a transition towards dominance by five or six global car producers.

Restructuring has involved a major shift from internal production to outsourcing. bringing new opportunities for suppliers, particularly at the tier one level. Their roles are expanding as they take on the design and production of major systems and modules. However, this is accompanied by closer scrutiny of tier one capabilities by the VMs. VM selection of preferred suppliers, together with the 'de-listing' of many other suppliers, is contributing to a concentration among tier one companies. Mergers and joint ventures have increased, and the approximately 800 tier ones in the world automotive industry in the late 1990s is forecast to fall to about 30 during the current decade. There is a parallel reduction in the number of suppliers in the lower tiers.

This change follows from several factors, among which are attempts to shift towards variants of the 'lean manufacturing' methods associated with leading Japanese VMs. The approach emphasises tight co-ordination between the companies within a VM's supplier base. Continual improvement in supplier performance is required to meet VM requirements for 'cost-downs' – that is, annual or more frequent reductions in the prices paid to suppliers throughout the production life of a car model. These have become a standard requirement in VM contracts with suppliers. As the share of total added value accounted for by suppliers rises, supplier efficiencies become increasingly critical to VMs competitiveness - not only in product cost but also for consistent high quality and for manufacturing flexibility. Responding to this changed environment presents all suppliers with major challenges to their financial, human and physical resources. The challenges are particularly daunting for SMEs in tiers two to four since their financial resources and management expertise are generally limited.

SME's capacities for response are also shaped by a fundamental divide in the emerging supplier hierarchies – that between the suppliers of more specialised components or services and those who supply commodity parts and components. The former generally depend on high levels of skills that can be hard to replicate – as is reflected in product development capacities, in relative product complexity, and in manufacturing capabilities. These capabilities yield relatively high returns, while VM or large tier one customers are often keen to retain these companies as suppliers, for instance because of their contribution to product distinctiveness and to levels of value added in the end product. On the other hand, commodity items are increasingly sourced by VMs and tier one companies by electronic means, using the equivalent of a 'reverse auction' in which potential suppliers bid on price alone for supply contracts. This extends supply opportunities for suppliers in low labour cost locations, and puts pressure on commodity suppliers elsewhere. However, some commodity suppliers in EU based locations have retained advantages through their proximity to major VM sites and their established abilities to comply with the total quality and kanban delivery requirements that are embedded in supply contracts.

However, many UK based SMEs – such as some of those participating in our learning networks – are poorly placed in relation to commodity supply. The underlying problems often relate to very poor standards of management and inefficiencies in their pattern of work organisation. These are reflected in low productivity levels, as is illustrated by Toyota's work with UK suppliers which improved productivity by some 500% over a five year period (EMTA, 2000). Poor performance is also evident in

quality shortfalls and in failures to meet customers' delivery schedules. These shortcomings are also related to inadequate workforce skills. Further problems for these SMEs often include poor development of e-commerce capabilities (excluding them from many sales and purchasing channels), and limited capacities for moving from reliance on commodity products towards activities that yield more added value.

Competitive pressures are thus particularly acute for the approximately 7,000 companies in the UK automotive sector – even before such issues as exchange rates are taken into account. Many companies are poorly equipped to respond, often because they lack training oriented management cultures. In many cases, the management culture is ill suited either to recognising the scale of change that is needed for business survival, or to initiating the types of response that are required for survival. The scale of the challenge can be indicated by the main capabilities now increasingly sought in suppliers by the VMs and tier one companies. These are:

- consistent output quality – increasingly at the zero defect standard (workplaces where this capability has not been valued rely on high cost 'inspecting out' of non-conforming items);
- the manufacturing flexibility required to meet customer requirements of small batch deliveries of varied parts;
- continuous improvements in production methods to meet regular customer 'cost-down' requirements;
- the inter-organisational capabilities that are required to meet increasing VM pressure for tight integration and co-ordination of production, product design and development and other functions between all players in the automotive supply chain;
- team capabilities which depend on multi-skilled team members who can exercise high levels of autonomy in determining work priorities;
- capabilities for using e-commerce across a broad span of business to business interactions and transactions in the supply chain;
- the development of new management capabilities that are attuned to these conditions.

4. The KLASS project: ideas and implementation

The previous sections establish the context of the KLASS project. The project focused on learning and knowledge development to facilitate collaborative functioning and improved performance between companies. Project partners included manufacturing and distribution companies, research institutions, training organisations, an FE college and several universities. The Open University, with expertise in the support of distance learning, lead the project. Transnationality was provided by partners in Denmark, France and Spain. Four key project objectives were to:

- Clarify and meet organisational and inter-organisational learning needs where co-ordination and integration of design, production and other processes extends across multi-company, multi-stage product supply systems.

- Identify and utilise the mix of distance learning technologies that is best suited to the combination of individual learners, SMEs and the project's SME centred learning networks.

- Support SMEs in adapting to demands for increasing knowledge content as a foundation for supply chain relationships, and in extending their adaptive and innovative capabilities.

- Investigate ways in which information and communication technologies (ICTs) can be used to support distance learning in the team-focused inter-company contexts with which the project is concerned.

The project aimed to stimulate economic innovation in SMEs through innovative learning. The approach centred on the development of two types of learning networks. One is process oriented, and aimed at workplace teams that include a mix of operators and managers (Type 1 networks). These networks link up to eight suppliers to a main, tier one, customer. They function through learning about the core tools and skills that are needed to improve the capabilities outlined above. Teams undertake 'hands-on' learning by doing, which involves problem identification, and the development and testing of solutions. The second type of network (Type 2 network) is aimed at senior managers in SMEs in tiers two to four, which are linked as buyers or suppliers. The focus is on developing awareness of the scale of the threats that they face, and on the skills needed to respond to them. Emphasis is placed upon establishing the measurement and improvement tools that are required to meet the increasingly demanding quality, cost and delivery standards of customers. Another aim of these networks is to foster the cultural adaptations needed in the current competitive environment.

In both cases, KLASS is building on prior, pioneering work by members of the partnership. A web-centred learning approach also supports both the development of e-commerce capabilities among the participants, and network group learning undertaken between multiple, linked workplaces. Learning support is provided, face to face and via project ICT facilities, by a team of experienced professional engineers, trainers, learning support specialists and mentors.

In the Type 1 networks, tier one companies have persuaded their suppliers to identify key individuals with central responsibility for shopfloor innovation in supply management. These people, nominated as 'Change Agents', become project participants, and Open University (OU) students, and follow T020 Stimulating Competitiveness in Supply Chains, a pilot course for the KLASS project. They are invited to a series of one week, intensive workshops at the tier one company, led by an engineering tutor (employed by one of the partner organisations: Industry Forum) together with a learning support tutor. In the four week intervals between these workshops, the Change Agents apply what they are learning in a practical context in their own companies. They keep in touch with other students via a computer conferencing system and undertake assignments designed to encourage them to reflect on their learning and the implications of applying it. The learning support tutor has a role akin to that of an OU tutor counsellor, offering educational counselling, mediating the multi-media course materials and marking the students' assignments, but on a more intensive basis than on conventional OU courses.

As the course progresses, the computer-based activities move their focus from work in individual companies to collaborative learning across the network of which all the students' companies form a part. There are obvious advantages of such a programme

for the tier one companies who see rapid benefits in terms of the cost, quality and delivery performance of suppliers. There are also competitive advantages for all the companies in the network. Students also gain as individual learners. Overall, the expectation is that the competitiveness of the SMEs will be enhanced in the future, whether they are working with this particular tier one customer or with a different one.

In the Type 2 networks, groups of senior managers from SMEs are brought together at the site of one of the project partners for a diagnostic workshop which aims to help them to identify the learning needs of their companies. They then participate in a series of half day workshops that match those identified needs and, again, use computer based conferencing and activities to keep in touch and to facilitate the application of what they are learning within their own commercial environments.

The forerunner of the Type 2 networks was funded from the DTI initiative 'Learning from Japan'. A Tier 2 supplier, realised that the key to supply chain performance rested with SMEs rather than large companies, so they reorganised themselves and their suppliers into a network of companies that, together, focused upon enhancing performance through focusing upon quality, cost and delivery. They used IF engineers to work on production improvements, but they also set up a learning centre where employees, suppliers and customers could learn away from immediate pressures of work. The network has grown steadily and there is even collaboration with competitors. For example, three competitor tool-makers have adopted a common costing structure and now tender for contracts as a group. This has helped iron out peaks and troughs in work and all three companies have grown. Staff employed in the open learning centre offer training and development, but will also get involved in exercises to adapt 'best practice' to different settings. The key driver of change has been the quality of sharing of information, knowledge and experience among suppliers across the supply chain.

Mersey Automotive Group act as the key intermediary group in another network. This time there is a very strong pull from the top of the supply chain, but once again the group has been well-resourced with the DTI offering support to the establishment of an Automotive College. With impressive facilities and underpinning funding it has been possible for those from education and training to work hard at building relationships with companies. Even SMEs will work with trusted intermediaries once a relationship has been established, although it is important not to raise company expectations too quickly. The strategy is part of a sectoral approach to business improvement that includes the establishment of an e-business community and a programme of support for continuous improvement.

The development of the Type 1 and Type 2 Networks involved developing partnerships and forging strong links with a number of organisations. The networks were more difficult to establish than was originally expected, because of the sharply deteriorating economic conditions experienced by many players in the automotive sector (particularly as two of networks were to be linked to Rover in Birmingham and Ford at Dagenham). There were knock-on effects to many suppliers and a number of companies found it difficult to focus upon anything other than crisis management and a fight for survival. Indeed one company remarked that they were looking to diversify

out of the automotive sector rather than become more locked into supply chains of the sector.

The Type 1 networks were built around Society for Motor Manufacturers and Traders (SMMT) Industry Forum work and the comprehensive learning programmes focused upon improvements to manufacturing processes. The Type 2 networks drew on the work of BOLDU (British Open Learning Development Unit) and focused upon trying to generate support for supply chain network developments from SMEs. Once they were launched, however, the networks exhibited a high degree of collaboration and knowledge sharing among the project partners.

5. The KLASS project: supporting innovation and learning

It was too early to identify any cultural shifts, but that achieving that was one of the long-term goals of the work with the change agents in the companies. The way of working on materials production in which much emphasis is given to the production of meaning within the networks was for the OU indicative of the shift towards a more decentralised view of the processes of knowledge creation. The commitment to working with and through networks also meant that the project materials were tested in a variety of contexts. It is worth emphasising, however, that the focus upon SME skill needs in supply chains was the vehicle for a bold experiment in trying to accomplish organisational and inter-organisational learning and knowledge management across supply chains, as well as supporting individual learning. This implies a reshaping of the boundary between HE, continuing education and training and organisational development. The underlying pedagogical idea is that there is considerable value in attempting to link processes of knowledge creation with approaches to tackling the core problems of manufacturing practice as a means of engaging learners (in SMEs) that have traditionally been difficult for formal education and training institutions to reach.

Perhaps as important as the development of innovative products was the recognition by the project team that innovation is a social process. Hence particular attention was given to building relationships to support innovation not just between the partners but also with the companies in the Networks. The support for change agents was itself designed so that they would be able to support process innovations within their companies. This means that the Networks offer not only a mechanism for technology and process transfer and exchange of ideas about development and practice, but also a means of supporting those interested in acting as change agents in support of development and innovation. The Networks have the potential to grow as a general means of innovation transfer in supply chains. The project sought to give people not only access to innovative ideas, but also because of the way the project was structured it also gave learners opportunities to shape these ideas in ways that were directly useful to them in their work. This applied particularly to the work with company change agents.

A major concern with the development of learning networks to support practice is that the knowledge generated is often decontextualised. This may then mean it is of relatively little use to employees in coping with many of the problems they face in practice. One way the KLASS project addressed this concern was through focusing closely upon what the Industry Forum (IF) engineers see as key problems of

manufacturing practice in the workplace itself. This ensured attention is given to problems and dilemmas that are central to manufacturing practice. These problems and dilemmas have significance both for individual and organisational performance. The problems are likely to contain combinations of practical concerns, organisational issues and socio-cultural problems. The IF approach to process improvement was underpinned with an inter-locking series of products: MasterClass; Supply Chain Group; Team Leader Training; and Value Stream Mapping. Details of this approach, together with case studies of their implementation are given in the DTI (1999) publication 'Quality, Cost, Delivery: seven measures for improved competitiveness in manufacturing industry'. This approach also means that employees are directly involved in processes of active knowledge creation.

The project developed mechanisms for effective learner support and offered support too for work-based learning as a process. The KLASS project offered effective learner support not only through its system of tutors and assessors, but also through peer support through the network organisation. The focus within the project upon offering substantive support for learning and development of change agents within the companies also resulted in an increase in the capacity of those companies to support other forms of work-based learning. As some of the learning was grounded in improving manufacturing processes and practice there was little doubt that this contributed to improvements in efficiency. The competitiveness of SMEs may also have been improved insofar as a consequence of the project they were able to operate more effectively within supply chains. This is particularly important as in the automotive industry manufacturers and Tier 1 suppliers are expecting greater independence in ways of working with suppliers and are expressing an increasing commitment to processes of quality training (Abreu et al, 2000).

This paper is presented at a workshop on 'Context, power and perspective: confronting the challenges to improving attainment in learning at work'. For this workshop we have been asked to make clear the extent to which our findings can address four key issues:

- **Conceptualisation of learning at work**
- **Conceptualisation of attainment in learning at work and how to measure it**
- **The contextual factors that make learning at work problematic**
- **Factors that contribute to improving commitment to learning at work.**

Perhaps the best way to utilise the findings from this interesting, but very specific, project is to outline some of the ways project ideas, processes and outcomes could make a contribution to addressing these issues.

6. Conceptualisation of learning at work

Eraut et al (1998) highlight the importance of organised learning support for learning at work and draws attention to its relative rarity. So the KLASS project is an example of a highly structured approach to the provision of organised learning support. On the one hand, the case may be thought to have limited generalisability because of the amount of time and other resources poured into the development and implementation of a structured system of learner support. On the other hand, it could be regarded as illustrative of the scale of the effort required if companies and individuals are serious

about the implementation of significant change based upon a transformation of the relationship between working and learning. The more specific contributions to this issue are as follows:

- The involvement of Industry Forum (IF) engineers and their established processes designed to embed performance improvements in Quality, Cost and Delivery (with consequent promised effects on the bottom-line) acted as a **strong catalyst** to galvanise the interest of companies. Once the initially narrowly focused learning approach was underway it was often (though not always) possible to **broaden the interest** of companies and participants in learning.

- It is relatively easy to have an immediate impact on quality, cost and delivery in companies that have been primarily concerned with immediate operational issues. In contrast the process of embedding **sustained continuing improvement** is much more challenging and could take years to achieve. This is not to decry the value of the process outlined here, rather just to acknowledge that in organisational terms it is the ideally **beginning of a longer-term process**.

- The focus of the IF engineers and the group of learners upon making real improvements in manufacturing practice and process at one level could fit with ideas about the collaborative creation of new knowledge. However, at another level their understanding of learning was formulaic: improvements were achieved by following a very particular approach to improvement based upon what they had learned from Japanese 'master engineers'. Hence within the project the engineering experts had themselves to **learn more about learning**. Involvement in the project resulted in a learning process for the IF engineers in how to link what they had been doing in terms of performance improvement to broader learning and assessment processes in the Type 1 networks. Their involvement in the Type 2 networks represented a further role enhancement for them and contributed to their own learning and development.

- The approach to learning through networking could be seen as an example of active model of learning whereby learners are engaged in the creation of 'new' ('contextualised') knowledge, not recipients of a largely passive process of knowledge transmission. This is in line with the theoretical framework developed to explain processes of organisational knowledge creation (Nonaka & Takeuchi, 1995; Nonaka & Konno, 1998). This approach makes use of a social model of knowledge creation and transformation. The key process for genuine knowledge transformation to occur is that knowledge has to move from the individual level into wider communities of interaction that cross organisational boundaries as happens in the KLASS networks. It is worth expanding upon the link between KLASS networks and organisational knowledge creation in more detail.

Nonaka & Konno (1998) use the idea of *ba* as shared spaces for emerging relationships that provide a platform for advancing individual and/or collective knowledge and of generating collaborative processes that enable the transformation of that knowledge to other contexts. This again fits with the KLASS approach, as does the idea that active involvement and collaboration in the networks allows participants to transcend their particular (traditional) perspectives. In supporting people in their attempt to bring about change in manufacturing processes opportunities have to be

given for practitioners to transform information from written or broadcast material into practical individual and collective knowledge. It may also be that the analytically rational world represented in learning materials may be too 'cold' for many people: they may need a richer form of engagement. Nonaka & Takeuchi's (1995) SECI model (of socialisation, externalisation, combination and internalisation) of dynamic knowledge conversions gives insight into why this lack of engagement may occur.

Socialisation (through originating *ba*):
Nonaka & Konno (1998) point to the need for an originating *ba* (or space for socialisation) where individuals can share feelings, emotions, experiences and mental models. This is necessary not only to generate initial commitment (the value of which has long been recognised), but also because genuine knowledge transformation also requires a "magic synthesis" of rationality and intuition that requires a greater depth of human engagement than just thinking. Within the KLASS approach the originating *ba* occurs during the initial face to face network meetings.

Externalisation (through interacting *ba*):
The creation of space for active reflection by groups can be seen in the way in subsequent Network meetings groups would jointly examine a range of problems commonly associated with manufacturing practice. The groups would comprise individuals with a mix of backgrounds, knowledge and capabilities. Individuals could share their own ideas and understandings (although in the Type 1 networks this phase was led by an IF engineer), and through processes of reflection and analysis, seek to generate some common understandings of how to improve manufacturing practice.

Combination (through cyber *ba*)
This stage involves creating space for combining the ideas generated in the previous stage with existing information about how work is organised in a particular workplace. Network groups would jointly examine problems in a particular workplace. The groups would comprise individuals with a mix of backgrounds, knowledge and capabilities. Individuals could share their own ideas and understandings (although in the Type 1 networks this phase was led by an IF engineer), and through processes of reflection and analysis, seek to generate some common understandings of how to improve the manufacturing process in that particular workplace. This involves the generation of new forms of explicit (contextualised) knowledge.

Internalisation (through exercising *ba*)
The exercising *ba* is a shared space to facilitate the conversion of the (newly generated) explicit knowledge into the tacit knowledge of individuals and groups. This will involve active consideration of how to apply that knowledge in different contexts and the use of strategies to support the knowledge conversion process. This was the task of the change agent, trying to embed new ways of thinking about manufacturing processes and practices.

This approach involves the spiralling of knowledge creation and transformation through continuing SECI cycles. The structure of KLASS project support was designed to allow material and ideas to be fed into the change processes over time. The essence of the *ba* of the learning community as a whole is that it does not involve

a static accumulation of different materials, documents and information, but rather when it works well it possesses the dynamism to continually create new knowledge.

This approach to the development of practice is reflective, forward-looking and dynamic and works best within a culture that acknowledges the importance of developing practice, expertise and analytical capabilities in an inter-related way so as to be able to support the generation of new forms of knowledge. Practitioners need to have a continuing commitment to explore, reflect upon and improve their practice (Schön, 1987). The initial key to going beyond competent practice lies in the ability to transfer skills, knowledge and understanding from one context to another (Eraut, 1994), and increasingly practitioners are expected to perform effectively when they work with colleagues and in groups with different kinds of expertise (Engeström, 1994). The KLASS approach is predicated upon the idea that practitioners have a key role to play in how new knowledge is generated and applied in practice (Engeström, 1994).

An individual's knowledge of practice can itself regarded as a personal synthesis of received occupational knowledge and situational understandings, derived from experimental learning, which are capable of being further transformed through a process of critical reflection. As expertise develops, and new contexts are utilised in the performance of practice, so the processes of analysis, review and reflection can lead to the creation of new forms of knowledge (Engeström, 1994). Additionally Eraut (2000) points to how practitioners also have to deal with contextual variables, such as the time available and the crowdedness of the situation in terms of the volume of information to be processed, that mean they have to produce appropriate responses in situations where the conditions for 'best practice' are not present.

7. Contributions to the conceptualisation of attainment in learning at work and how to measure it

- That the OU was able to pursue a dual track towards recognising achievement, where individuals could accumulate credit towards in the form of either or both NVQ units or CATS points, was **an interesting approach to bridging between different types of qualifications**. The use of assignments that involved critical reflection, adaptability and forward thinking was a powerful developmental supplement that overcame many of the problems traditionally associated with the relatively narrow focus of National Vocational Qualifications. [The Type1 network students work towards an Award in Change Management of up to three units at NVQ level 3 or 4, validated by the Open University Assessment Service. Amongst the on-line activities in the programme is support for the development of an APEL portfolio, which may enable some students to gain further accreditation.]

- There were clear benefits to change agents and some other participants of access to recognised qualifications, accreditation of some existing skills and knowledge and opportunities for further learning and development. They also had opportunities to experience new approaches to learning based upon collaboration and active reflection, with the consequence that participants were more likely to recognise that many of their skills were transferable and could be used in a variety of contexts. Indeed **attainments in learning could be formally recognised** if they were written up in a learner's portfolio.

- The work of the OU assessment service in coming up with accredited qualifications for change agents in a few months is amazing to those who know the **speed** at which either NVQ qualifications development or OU recognition procedures operate normally. That individuals could progress within either a CATS and/or an NVQ framework also showed flexibility from those designing the assessment system.

- There were 40 change agent candidates for NVQ 'mini' awards (3 units, two of which were compulsory, at NVQ level 3 or 4) supported by 10 OU NVQ assessors. The task of the assessors was to help students assemble evidence against standards, and offer advice on portfolio development and personal action plans as how to achieve and demonstrate the necessary competences (detailed support with the process of preparing the assessment materials was then available from the Learning Support tutor).

- The assignments helped students pull their learning together: for example, they could reflect upon how they might transfer what they had learned in the IF real-time workshops about improvements to practice and process to other contexts. The assignments also provided NVQ evidence as well as opportunities for learners to reflect upon their own learning, and were a valuable part of the personal development associated with working on the programme as a whole. The assignments were sometimes used by learners to support the case they were making as part of company employee appraisal processes. The assignments therefore helped **learning become more portable or transferable**. [The downside to this process is that some employees were not enamoured of having to write up what they had learned in assignments. For them the spectre was not one of lifelong learning, but of **lifelong homework**!]

- Assignments give clear evidence of the effect on the organisation of individual learning, but a question is raised whether there is a **need to recognise the efforts of a team.** One argument is that this is especially necessary as the team is the key link if there is to be a continuing commitment to learning in the form of attempts to sustain continuing improvement and support the creation of new knowledge. The team can also be a vehicle for innovation and the development of adaptability, evidenced by the ability to perform effectively in a range of contexts. The goal is to get the team as a whole to be forward looking and proactive.

- Unusually those involved in this programme can demonstrate improvements in aspects of company performance and improvements in their own individual learning. The latter are evidenced through reflections upon work and learning in assignments and portfolios and in the increasing quality of the assignments themselves, as evidenced by the ability to communicate effectively in writing, to be self-reflective and so on.

- There is value in portfolio building being coupled with active reflection upon what has been achieved with tutor and other students. Also because the portfolio building involved reflection upon processes it did not become mainly an exercise in photocopying: cf Grugulis (2000) about the dispiriting effects of just documenting what you already know.

8. The contextual factors that make learning at work problematic

- As always one challenge for this type of programme is to maintain momentum: for example, there is a need for more systematic knowledge gathering about the effects of participation in the programme, impact on companies and so on. (One problem concerns representation: nearly all such programmes are presented as successful – even Open Tech!).

- Note the level of provision of organised learning support required (assessors and tutors offering considerable individual as well as group support) was not sustainable except in a programme that was underpinned by considerable financial support (DTI; ADAPT and other European funding). There is little doubt that a reduced level of learning support would result in far fewer employees being committed learners.

- There is a paradox in that some of the initial enthusiasm for learning comes precisely because the learning does not seem like learning ('something hard that involves you in doing things you would not do if left to your own devices'). That is, there is the step change involved in building upon the learning attained from well-defined Industry Forum (IF) processes that focus upon improving organisational performance. That is, learning is initially limited in terms of its scope and more in-depth learning is by its very nature more challenging.

- As with other projects working with small companies in development projects some innovative ideas of the project team were circumscribed by problems arising from SMEs limited understanding of, and capacity for, ICT-based learning opportunities (GHK, 2001; Gray and Lawless, 2000).

- It will be apparent that there could hardly have been a more adverse time for undertaking an innovative project in the automotive sector than the period 1999-2001. Restructuring and closures at VMs – for example, Ford at Dagenham, BMW/Rover in the West Midlands and Vauxhall at Luton, have seriously demoralised all the companies in the total product supply system and have emphasised short term concerns rather than longer term issues of competitive improvement. The task of persuading them to participate in any kind of training/education initiative has not been easy. In some cases these companies were 'too busy' in an immediate struggle for survival to focus upon anything longer-term.

- Another factor that has exacerbated the situation is that, in some regions, so much public policy support has been directed to small businesses, including some initiatives that are inappropriate or of poor quality, that SMEs are now particularly unresponsive to new projects knocking at their doors. In this respect, the KLASS project was fortunate in being able to exploit the excellent contacts that some of the partners had with SMEs in their regions.

- Perhaps the major problem faced in trying to generate interest of SMEs in learning and development (and in generating small business growth) lies with the career motivations and personal expectations of individual owners and managers (Gray

and Lawless, 2000). Many small firm managers adopt practices that are antithetical to efficiency and growth (Gray, 1993). Indeed the most common small business ambition is for independence and autonomy rather than profits and growth (Gray, 1998).

9. Factors that contribute to improving commitment to learning at work

- Importance of rapport and a good working relationships between (IF) engineer and Learning Support tutor.

- Learners greatly appreciated support and encouragement of Learning Support tutors. (In retrospect this conjures up a vision of what Open Tech might have been like if the OU had been regarded as a positive model rather than a comparative failure, according to monetarist economists, because it represented a 'continuing drain on the public purse'. Much better just to waste forty million pounds in a one-off exercise - not - still we digress!).

- Both Type 1 and Type 2 networks have a demonstrable value in getting companies thinking collaboratively and strategically about supply chain issues. The type 1 networks involving change agents from different companies working together meant that they could get a 'feel' for the capabilities of the other companies and this opened up possibilities for greater collaboration (for example, in joint bidding for contracts). The Type 2 networks engaged senior staff from companies directly thinking collaboratively and strategically about supply chain issues.

- In Type 1 networks there was value in learning as a member of a group, including from others with a variety of backgrounds. (Those involved in the Aerospace supply chain: participants were wary about this at first, but became increasingly enthusiastic over time.)

- The use of a wide range of learning methods helped improve commitment towards learning. These methods included: participation in production process improvement reviews and implementation; Master Engineer workshops; group discussions; assignments; portfolio-building; discussions with tutor; use of computer-mediated communications for discussions, document transfer and tutor feedback.

- There was a key role for the Learning Support tutor in helping learners build and then sustain commitment towards their learning goals. The tutor role involved providing advice, guidance and information and supporting all aspects of learning (tutors had previous experience tutoring Implementing New Technology and similar OU courses); making links between IF engineer's programme; OU assignments and NVQ evidence. (The level of resources was such that, during the project lifetime, tutors could participate in the IF engineer workshop programmes.) The tutors had responsibility for supporting study, writing and learning skills as well as supporting the development of their change agent skills.

- That many of the change agents recognised the value (and potential transferability) of the skills they were developing contributed to their commitment

towards learning. For example, the skills required in coping with the challenges of trying to implement change involved compromise and dialogue, resulting in the development of advanced communication skills that have a clear labour market value (Green, 1998).

- The type 2 networks comprise mainly senior managers from SMEs from Tiers 2 and below, individuals who were often quite difficult to get to attend training, so getting them to share and build upon best practice was a major step forward. [The commitment of the Vehicle Manufacturer though provided a very significant encouragement for the managers to attend initially.]

- Many ADAPT projects reported difficulties in engaging with SMEs directly (GHK, 2001). The KLASS project had a significant advantage in this respect, because of the support of large companies as lead organisations in supply systems. Thus, for example, SMEs supplying Jaguar would be much readier to take part in an initiative that had the explicit approbation of Jaguar than if they were approached directly by providers of education and training. The participation of major manufacturers and Tier 1 suppliers in networks was therefore crucial in securing the commitment of SMEs to engage with the project aims and objectives. The initial 'hooks' to engage SMEs in learning activities were therefore particularly powerful.

- The project gave people support to help them engage in patterns of thought conducive to learning. The project gave learners generally, but especially the change agents, the time and space to engage in critical thought, self-reflection and personal development. This included opportunities for both collaborative and self-directed learning. [The corollary of this was that where the change agent role was imposed by companies upon individuals with no relaxation of other time-intensive duties these individuals took a much more jaundiced view of the learning opportunities the project presented.]

10. Conclusions

The model of learning used in the KLASS project with its emphasis upon networking, knowledge creation, linking an initial focus upon performance with a progressive broadening of ideas about learning and development was particularly well suited to its context: supporting learning and development in advanced supply systems. However, the scale of the effort and resources required to make the project successful should leave no-one in any doubt about the challenges that remain if the model were to be successfully implemented in a range of other contexts.

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