ACTION LEARNING AS AN ENABLER FOR TECHNOLOGY TRANSFER

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Abstract. There is an increasing demand for construction companies to adopt and use new technologies. This paper contributes to this developing area by providing a literature review of technology transfer and proposing a holistic system required for success. Building upon this review it assesses the potential use of action learning as a means of providing this holistic solution. The assessment is made through a literature review of action learning in construction and an analysis of results from the national Construction Knowledge Exchange (CKE) initiative which uses an action learning methodology to assist Higher Education Institutions in supporting local construction small and medium-sized enterprises (SMEs). Based on this initial policy recommendations are made for the promotion of technology transfer using action learning.

1 INTRODUCTION

Improving the performance of the UK construction industry continues to be on the UK policy agenda. As part of this agenda companies are encouraged to make more and better use of new technologies. Technology transfer is a key element of any policy to encourage adoption of new technologies. Whilst it is recognised that Higher Education Institutions (HEIs) have a central role to play in promoting technology transfer¹, and some mechanisms exist for this, it is widely accepted in the construction sector that more could be done in this regard².

There is a growing appreciation, that the new technologies being advocated must meet the needs of all sections of the industry, particularly the 95% or more of the companies that employ less than 25 staff³. Furthermore policies to encourage the adoption of new technology must be coupled with appropriate mechanisms to develop awareness of the new technologies available, and to encourage and facilitate their appropriate exploitation.

Having acknowledged the consensus that current mechanisms used by HEIs to assist in this process leave room for improvement, innovative approaches to industry engagement should be explored. Given the required emphasis on knowledge conversion and creation for
successful technology transfer, action learning\textsuperscript{4} is proposed as one mechanism through which HEIs could assist with technology transfer. Action learning is a well-used and well-documented approach to management education and development\textsuperscript{5,6}. The core idea behind action learning is to create small, mutually supportive groups (known as SETs) of people who band together to solve real problems or difficulties which are not solved in current best practice.

The aim of this paper is therefore to identify those characteristics required for a successful technology transfer system and to compare an action learning approach against these characteristics in order to make an assessment as to whether the practice of action learning matches the theoretical requirements for successful technology transfer. This comparison is then complemented with lessons drawn from previous examples of the use of action learning in construction and the initial results from the Construction Knowledge Exchange (CKE, www.cke.org.uk). Finally, conclusions and recommendations for the future use of action learning to promote technology transfer are made.

2 TECHNOLOGY TRANSFER

This section of the paper provides a brief review of existing literature on technology transfer and proposes a holistic technology transfer mechanism that requires a wide range of factors beyond technology to be taken into account to enable successful transfer to take place. These factors must all be taken account of if broker organisations such as HEIs are to meet the needs of construction SMEs needs for technology transfer. The following section will therefore examine the characteristics of action learning to determine whether it takes into account these factors and so may be a suitable method of supporting technology transfer.

There is no doubt that performance improvement can result from innovation absorbed into companies through technology transfer\textsuperscript{7}. For the construction industry the assumption is that ‘new’ technology means new to the company rather than new per se\textsuperscript{8,9}. However, in order to create effective mechanisms to aid technology transfer requires a proper understanding of technology transfer processes. These processes are complex, varying with company capabilities and processes, and the knowledge characteristics of the particular technologies. This paper therefore, takes a wide view of technology transfer understanding it to be the “movement of know-how, technical knowledge, or technology from one organizational setting to another”\textsuperscript{10}. Further, it takes a similarly broad view of technology, defining it as the know-how about the transformation\textsuperscript{11} of operational technologies and processes; material technologies; and knowledge technologies\textsuperscript{12}. To be effective the transfer itself must be both appropriate to user needs\textsuperscript{13} and associated tacit knowledge\textsuperscript{14,15}. Further, the emphasis on the embodied knowledge associated with a technology is changing the perspective from that of technology transfer to a wider view of knowledge transfer\textsuperscript{16}. This is a perspective that is very much in line with current thinking that economic growth and productivity is driven by knowledge\textsuperscript{17,3}, and that exploitation of knowledge will increasingly be the key source of
competitiveness and client satisfaction in the future.

The design and operation of a technology transfer system should be dependent upon its intended audience – what is suitable for technology transfer with large construction companies may be unsuitable for small construction companies. Large and small construction companies vary considerably and so does the work they do\textsuperscript{17,8}. The 95% of construction organisations employing less than 25 people will certainly have a much reduced managerial capability in comparison to the few big and sophisticated organisations. Solutions for one side of this divide are unlikely to work successfully for the other side. In addition current approaches to technology transfer suffer from the following failings\textsuperscript{18}:

Technology transfer mechanisms often have a linear push approach – identifying new technologies, and pushing them in their existing form into construction companies regardless of need.\textsuperscript{19}

Current technology transfer mechanisms do not fully take account of company organisational capabilities and processes necessary to enable them to successfully absorb and apply technologies. Experience from the manufacturing sector has shown that this is an important requirement.\textsuperscript{20}

There is too much of a focus on technology in current technology transfer mechanisms. Such an approach does not fully take account of the associated knowledge characteristics of the technology in question.\textsuperscript{21} ‘Hard’ technologies which are characterised by explicit knowledge require very different diffusion mechanisms and organisational capabilities and processes than those required for ‘soft’ technologies which are tacit in nature.

Successful technology transfer is therefore likely to be dependent on all of the above and so an effective ‘technology transfer system’ will be dynamic, working with inter-organisational networks, taking into account organisational direction and capability, and the knowledge characteristics of the particular technology. This view of technology transfer is consistent with the move away from sequential models of innovation and technology transfer\textsuperscript{22}. Such an approach views technology transfer not as a simple sequence of phases, rather as a multiple progression of divergent, parallel and convergent paths, some of which are related and cumulative, and others not. Viewed in this light technology transfer will only be effective if all three elements are appropriately focussed and integrated to achieve a specific aim.

3 ACTION LEARNING

The paper so far proposes a holistic view of technology transfer. This section outlines the principles of action learning as one mechanism that can assist in this process. Results from the Construction Knowledge Exchange (CKE) initiative which has successfully used an action learning methodology to broker engagement between HEIs and construction SMEs to assist
them to develop their capacity for innovation are used to compare practical results with the literature and hence draw conclusions and make recommendations for the use of action learning to promote successful technology transfer. Action learning is a method of problem solving and learning in order to bring about change for individuals and their organisations. It was developed by Reg Revans⁴, who described it as:

“a means of development, intellectual, emotional or physical, that requires its subject, through responsible involvement in some real, complex and stressful problem, to achieve intended change sufficient to improve his observable behaviour henceforth in the problem field. ‘Learning- by-Doing’ may be, perhaps, a simpler description of this process.”

The theoretical foundation for action learning is located within the learning field, combining individual learning and team-based learning²⁴. The action learning perspective is distinct from, but complementary to technology transfer – in that it offers an approach which allows individuals and teams to develop the prerequisite context-specific confidence and capability to absorb and use new technologies. Action learning can be viewed as a powerful triangulation of three distinguishable learning experiences, which lend themselves to critical monitoring and evaluation. These three angles of learning in action learning were described by Botham and Morris as Work, Set and Information. At the centre of all this was the constant need for monitoring and evaluation.

Figure 2. Botham & Morris Learning Triangle

The first angle is a focus on the learning experience from *work*. It is recognised and sustained as the individual observes and records his or her own actions and experiences gained from the actions of others engaged in a work setting. The second angle focuses on the learning experienced from participating in an action learning *set*. Again, the experience is carefully monitored by observation and recording. As the set challenges and questions the learning experience gained from work and the set, the focus is increased. The third angle is a focus on learning gained from *information* such as books, papers, courses, seminars, workshops, or whatever the individual believes is informing his or her mind which is different from the experience gained from the first and second angle is relevant for the third angle of learning.

The precise activity involved in action learning can vary with the context. However, the key features that comprise the activity involved in action learning are shown in a recent study conducted within the higher education sector as being:

- Sets of about 6 people
- Action on real tasks or problems at work
- Learning is from reflection on actions taken
- Tasks/problems are individual rather than collective
- Tasks/problems are chosen independently by individuals
- Questioning as the main way to help participants proceed with their tasks/problems
- Part of an existing programme
- Facilitators are used

The following section compares these characteristics with the theoretical characteristics identified as being necessary for successful technology transfer.

4 A COMPARISON BETWEEN ACTION LEARNING AND TECHNOLOGY TRANSFER

In order to predict if action learning can be a useful approach for technology transfer it is useful to compare the theoretical requirements that have been identified in Section 2 of this paper as necessary for successful technology transfer with the characteristics of action learning. The requirements for technology transfer have been characterised as taking account of:

- Organisational direction
- Inter-organisational networks
- Knowledge characteristics of the technology

Whereas action learning is characterised in the Botham-Morris learning triangle as a combination of:
There is clearly a strong resemblance between these characteristics. The table below takes this comparison further.

### Table 1. A comparison between technology transfer and action learning

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<thead>
<tr>
<th>Technology Transfer</th>
<th>Action Learning</th>
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<tr>
<td><strong>Organisational Direction.</strong> The motivation and ability of small companies to absorb and innovate from new technologies come from within the company and are dependent on business strategies and organisational capabilities.</td>
<td><strong>Work.</strong> Actions taken from the set are always placed in an organizational context through their application in a work setting. The organizational context is recognised and sustained as the individual observes and records his or her own actions and experiences gained from the actions in the work setting.</td>
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<td><strong>Inter-organisational networks</strong> assist the development and exchange of knowledge and resources needed to encourage learning and innovation in participating companies.</td>
<td><strong>The Set.</strong> The Action Learning set provides its own network, so that the learning experience is enhanced through participation in the set. The composition of the set is therefore very important. The set could be drawn from an organisations business network, its institutional network or consist of organisations that are initially from outside of either.</td>
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<td><strong>Knowledge Characteristics of Technology.</strong> The extent to which new technology can be effectively absorbed is therefore substantially influenced by the knowledge required to use and adopt the technology being transferred.</td>
<td><strong>Information.</strong> The third angle of action learning is a focus on learning gained from information such as books, papers, courses, seminars, workshops, etc. This angle has a clear relationship with the knowledge characteristics of a particular technology.</td>
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The above table would seem to indicate a striking relationship between the requirements of a successful technology transfer strategy and the support offered by action learning. Just as the balance between organizational direction, inter-organisational networks and knowledge characteristics would vary dependent on the nature of the technology so too could the balance between work, set and information in an action learning setting. In order to further test this proposition the next section of this paper, examines the workings and characteristics of a group of action learning sets created and facilitated by the University of Salford in the

5 LESSONS FROM THE CONSTRUCTION KNOWLEDGE EXCHANGE

The University of Salford was successful in its bid for a Construction Knowledge Exchange in August 2004. This is one of 22 national knowledge exchanges that have been created by the UK Higher Education Funding Council across a range of disciplines. The project has the aim of promoting knowledge exchange between industry and universities in the UK construction industry and aims to promote and enhance engagement in activities that establish industry needs, capture and share knowledge and build capacity and resource through enabled networks and links that reach out to all levels of business and higher education. In order to achieve this aim working with existing networks and linking them to the activities of regional universities is a priority. A primary mechanism for the CKE is the Action Learning through a mechanism titled Innovation Circles:

5.1 Summary of results

Flexibility has been an essential element in helping businesses come together in Innovation Circles. This has meant that the university has accommodated network partners’ needs by offering additional support to existing members. For individual group members “time is money” so it has been important to accommodate both location and suitable meeting times to ensure maximum attendance at meetings. Project evaluation reports thus far, the concept and principles of Innovation Circles has been well received throughout the North West and has provided a means for all partners involved in the construction sector to work together in small groups in a more focused way. Action learning has provided an excellent means by which these groups are run and ensures that action is taken on issues and problems raised by set members and continuous learning becomes a natural part of professional development and business improvement. In working this way the university sector has been able to begin to work in response to a pull from industry rather than the traditional push mode and this would seem to enable the flow of ideas up and down the knowledge supply chain.

5.2 Lessons for technology transfer

In drawing lessons for how the method could be used to encourage technology transfer it is useful to reflect on the types of groups that evaluations have shown have proved particularly successful. The first categories of group are those that have come together with each individual having already decided to take a common action. These groups therefore are concerned with effective implementation of a chosen solution rather than determining the appropriate solution. Group members share their experiences on what has and has not been successful which proves to be invaluable. Furthermore the group provides a mutually supportive environment, a concept referred to as ‘partners in adversity’, which provides the encouragement and support to see a task through to the end. In technology terms there would
seem to be many opportunities where this approach could prove useful primarily where there is a low complexity of required knowledge but a large degree of benefit that could come from socialisation and internalisation of tacit knowledge. Or, in Botham and Moriss’s terms an emphasis on the work and set sides of the learning triangle rather than the information side. Suggested examples of this include ‘effective electronic communication’, ‘making the most of a website’, ‘improving onsite efficiency’.

The second type of successful group is that where the individual members share a common bond or interest whilst not necessarily solving a common problem. If that common interest is of a technical or functional nature (e.g. responsibility for IT within an organisation) then the group is likely to be able to work in areas that require a higher complexity of knowledge drawing upon externalisation and combination and making more use of the information side of the learning triangle. Here issues relating to the introduction of new technologies into an organisation could usefully be tackled. Suggested topics that individuals within a group could tackle include adoption of wireless communication, IP telephony, onsite communications.

The third group where there has been success is that which is dealing with project specific issues. The Modern Methods of Construction group for example came together in this way. This group differs from the previous two in that it is led by one partner who has involved different members of its supply chain at different phases of the project. Here there is a strong incentive for participation by supply chain members to ensure future work and by employees of the lead company as the project is around a key future development for the organisation of the company. This has proven to be a highly effective group at generating a large number of innovations. When complex knowledge and information has been required external ‘experts’ have been brought into the group to determine action and retained within the group during implementation. This has proved a good means at developing an external knowledge supply chain for a company that has had little internal experience of the technologies in question. Here it is important to repeat that this is a company led initiative within which the university has become involved as one of the external experts. Such a group is unlikely to be formed as a result of a university push rather the university side has had to be able to respond to company need. Further it is worth noting that this has only been possible because of the HEIF funding through the CKE and would have been very hard to achieve through conventional teaching or research funding.

6 CONCLUSIONS

In summary the action learning approach has proven to be an effective mechanism for brokering engagement between university and industry. It has been successful in particular aspects that are required for successful technology transfer. It supports the need for inter-organisational networks and is also successful in responding to the organisational direction and capability of the participating companies. The action learning sets themselves have to be flexible enough to respond to these needs. For the future it is likely that different types of action learning sets would be appropriate to different types of technology transfer. Of
particular importance in this regard is the complexity of associated knowledge required for successful implementation

This paper began by reviewing literature to set out a holistic, integrated approach to technology transfer. This theoretical approach has been used to assess the usefulness of an action learning approach to promote technology transfer. The findings from the use of action learning sets through the CKE supports the view that action provides a potentially powerful approach to bringing about successful technology transfer by developing the necessary individual and team-based learning to adopt and use new technologies in specific organizational settings. This paper provides initial results, and further research in the use of action learning sets in the technology transfer process would be useful in two respects. First, to further investigate the proposition set out in Section 4 that action learning and technology transfer processes share similar characteristics. Second, this deepening of understanding would potentially assist in the better design and implementation of technology transfer strategies and programmes between HEIs and industry.

REFERENCES


