A NEW SPIDER ON THE WEB

Modelling the Adoption of Web-based Training

Arthur Tatnall[1] and Bill Davey[2]

[1] *Victoria Graduate School of Business, Victoria University, Australia,* [2] *School of Information Technology, RMIT University, Australia*

Abstract: The introduction of a new e-training technology is all very well, but the important question is: will it be successfully adopted and used? Conventional approaches to innovation suggest that adoption decisions are related mostly to the characteristics of the technology, but we will argue that the process is much more complex than this and that these approaches are too simplistic. In this paper we propose an ecological model of technological innovation, and show how it can be applied to considerations of the adoption of e-training products and methods.

Key words: Industry training, innovation, technology adoption, ecological model.

1. INTRODUCTION

Just because a new product, technique or technology becomes available in education does not mean that educators, trainers or students will adopt and use it. Even if its developer can show that this innovation will greatly improve the learning process, there is still no guarantee that it will be used, as many curriculum designers and educational technologists have discovered.

Rogers' (1995) Innovation Diffusion Theory suggests that the acceptance of a new product or process is mostly due to the characteristics of this product or process. In Nature, releasing 1000 baby spiders—all the same product—will result in only a few successes as the complex environment interacts with each potential spider. In this paper we will show that the application of an ecological model leads to a richer understanding of how the

process of innovation applies to the introduction of new electronic technologies in education and training.

2. INNOVATION AND E-TRAINING

The process of innovation involves getting new ideas accepted and new technologies adopted and used. Introducing new methods of e-training into an organisation is an example of innovation, and the factors that support and inhibit the adoption of these new methods should be identified. Our research shows that acceptance of an innovation is affected more by the complexity of interactions between the people within an organisation than any supposedly objective characteristics of the innovation itself (Tatnall, 2002; Tatnall & Davey 2002a, 2002b). We argue that to accommodate these complexities, and to provide a useful socio-technical perspective, an 'ecological' model (Tatnall et al., 2002b) dealing with the interactions of human and non-human actors within the 'ecosystem' of the organisation provides an effective approach to understanding innovation.

Rogers' (1995) suggests that there are four main elements to adoption: the characteristics of the innovation itself, the nature of the communication channels, the passage of time, and the social system through which the innovation diffuses (Tatnall, 2002). He argues that the attributes and characteristics of the innovation itself are particularly important in determining the manner of its diffusion and the rate of its adoption, and outlines five characteristics of an innovation that affect its diffusion: relative advantage, compatibility, complexity, trialability and observability. We argue, however, that this approach is too simplistic and that a better model would put more emphasis on the people involved.

Borrowing ideas from innovation translation in actor-network theory (Latour 1986, 1996, 1999; Law 1991) we will argue, rather, that it is interactions between people and technology that are all important, as potential adopters may either accept an innovation in its present form, modify it to a form where it becomes acceptable, or reject it completely. An innovation translation approach has been shown to be useful in considering ICT innovation in small business (Tatnall & Davey, 2002b) and in education (Busch 1997; Bigum 1998; Tatnall 2000; Tatnall & Davey 2001).

Recent research has illustrated some of the complex processes people go through in deciding whether or not to adopt an educational technology (Naidu, Cunnington & Jasen 2002). In this paper we incorporate some of the concepts of innovation translation into an ecological framework in which we will consider how adoption of e-training might occur in organisations. This

socio-technical approach enables identification of factors that do not emerge from traditional approaches to innovation.

3. AN ECOLOGICAL MODEL OF INNOVATION

Ecology is concerned with interrelationships between living things and between living things and their environment. It has two key underpinning biological principles: organisms behave in ways that optimise the balance between their energy expenditure and the satisfaction they obtain, and organisms operate within a competitive environment that ensures only the most efficient of them will survive (Townsend, Harper and Begon 2000). These principles can be directly applied to an e-training implementation; when examining the potential for a new e-training method it can be useful to measure the effort required in its implementation, and the satisfaction likely to accrue from its use.

We must digress here to give a word of caution on the limitations and appropriate uses of models and metaphors. A model is not itself reality, but just a representation intended to fulfil some explanatory purpose; models thus always have limitations. A metaphor is a term 'applied to something to which it is not literally applicable, in order to suggest a resemblance' (Macquarie Library, 1981). Models and metaphors are useful only in viewing certain aspects of a complex system. Lovelock, devisor of the Gaia hypothesis, remarked that: 'You've got to use metaphor to explain science, it's part of the process of giving people a feel for the subject.' (Bond 2000)

Ville (1962) defines an ecosystem as 'a natural unit of living and non-living parts that interact to produce a stable system in which the exchange of materials between the living and non-living parts follows a circular path'. Habitat, ecological niches, and the exploitation of resources are all important considerations in ecology (Case, 2000; Krebs, 2001). An ecosystem is a complex entity due to the large number of living things inhabiting it, and to the variety of possible interactions between them (Tatnall et al., 2002a). The 'ecosystem' represented by the introduction of a new e-training technology or approach in an organisation contains the following 'species': e-trainers, e-training developers, software companies, company staff (students), managers and company administrators. The 'environment' can be considered to contain many inanimate objects relevant to the training, including: Tablet computers, Pocket PCs, software applications, textbooks, networks, programming manuals and so on.

In an ecosystem many different individuals and species typically occupy a similar space and can be considered to interact in several ways:

- Competition occurs when two individuals or species each strive for the same thing. When considering the introduction of a new e-training method and whether it will be able to compete successfully, it is useful first to examine the environment for any competing organisms.
- Cooperation is the situation in which each population benefits from the presence of the other, but can survive in its absence. We should examine the environment to see whether there are people, technologies and other elements that will cooperate with a new e-training method.
- Filling a niche, often by occupying an unfavourable location, is a technique used by some species to avoid competition. When considering a new e-training method we can look to see if a boundary exists around the situation intended for the method that will create a niche.

4. TWO SITUATIONS INVOLVING E-TRAINING

To make discussion of this new model real, let us talk in terms of two concrete examples of innovation and, by applying the model, attempt to show the advantages of our suggested approach.

Consider first an example of mobile e-training in a factory situation. A factory equips each employee with a Tablet PC fitted with wireless networking (probably IEEE 802.11b or something similar). This contains delivery software and a profiling program for the particular employee. As this employee moves through the factory, different machines will be used. For each machine the operating procedures and safety considerations are built into the machine and are made available through wireless networking. Software on the machine recognises the Tablet PC of a new operator and downloads content to the Tablet. The employee then has delivered the training package resident in the machine they are close to. The Tablet PC configures this to the learnt learning style of the employee. Is adoption of this innovation likely and if so, how might we best implement the system?

Secondly we will consider another example of mobile e-training and information provision, this time related to a firm of insurance loss assessors who specialise in industrial claims. Each loss assessor spends some time in the office assessing claims, but much of their time on the road, or examining damage at the premises of insurance clients. Each assessor is equipped with a Pocket PC (something like a Compaq iPAQ) and a mobile phone, each equipped with Bluetooth technology. The mobile phone also has a WAP (Wireless Application Protocol) interface using GPRS (General Packet Radio Service) technology. When the assessor is away from the office at a damage site the mobile phone can be sued to contact the office intranet and to download relevant information about the job. The assessor is also able to

download e-training materials relating to the particular insurance company concerned and the nature of the industry involved in the claim. Will an assessor make use of the training materials if they are delivered in this way, or wait until returning to the office to look at the printed manuals?

5. APPLICATION OF THE ECOLOGICAL MODEL

As previously noted, innovation is a complex process and to attempt a simple explanation is worthless. In the examples that follow we are forced, to some extent however, to simplify our explanations in order to fit the constraints of this paper. We trust that the reader will note this fact and make due allowances for the complexity of the real situation.

We will begin our consideration of each of the examples given in the earlier section by considering, in each case, whether any of the following ecological factors has any relevance:

- The environment in which the e-training innovation occurs.
- The energy expenditure in implementing and using the new e-training technology.
- Sources of competition for this new technology.
- Likely cooperative technologies and entities.
- Whether the new technology can find a suitable niche in which to thrive, free from competition.

In the factory situation the ecological model can be applied by considering factors in the environment that are likely to assist adoption and those that may inhibit adoption. The factory environment consists of a large, brightly lit open space, filled with various machines and the workers who operate them. Two environmental factors that may act to inhibit adoption are machine noise and the potential distraction of what is going on around the worker elsewhere in the factory. With the loss assessor out on the road, the environment is, probably, the assessor's car, Pocket PC and mobile phone. Parking well off the major road should lead to few distractions.

Energy expenditure can be examined in relation to the costs in setting up the new e-training system, and the difficulty or bother of using it. These can be measured against the perceived benefits obtained. In the factory, each machine needs to have identifying data, operating information, relevant software, and a radio networking interface installed. Each worker needs to be equipped with a Tablet PC. Each worker must also be taught how to operate this PC. The factory managers must decide whether the costs in setting up and using this system are lower than the benefits in improved productivity and a reduced number of work-related accidents. For the company of loss assessors the set-up costs would be lower – a Pocket PC

and mobile phone for each assessor and some additional hardware and software on the company intranet to allow them to access it. The manager will also need to decide whether the benefits obtained from this system are greater than the energy expended on setting it up.

Competition can come from many sources including other people within and outside the organisation, distractions, other technologies and old ways of doing things. In the factory, machine noise and other things going on around a worker may prove sufficient distraction to cause enough competition to the e-training to make it unproductive. If the worker needs to find out about a machine, but has the option of looking up a paper manual rather than using the e-training materials, this may also prove great enough competition to cause the e-training to fail. Out on the road the loss assessor does not have the option of looking up a paper manual, unless it was taken along when leaving the office, as might occur if it was decided that the e-training materials required too much energy expenditure to use.

A new training officer who is more attuned to e-training could be seen as an entity that would cooperate with this technology. A changed work situation may also act to facilitate cooperation. (It could also have the opposite effect.) In either example it is important to look for other people or technologies that may cooperate with the new technology as these can become staunch allies in the implementation.

In most situations it is probably desirable that the new e-training technology is used throughout the organisation, but in some instances it will find a niche where it is free from unwanted competition. It might be that only certain new machines in one section of the factory are equipped with this technology, or that only some types of operation are related to e-training. With the loss assessors it might be that this technology is only used by some assessors working with particular industrial clients and not used generally.

The point is that for each particular situation in which we were trying to determine the likelihood of a new e-training technology being adopted and used successfully, an ecological model would require the identification of a number of factors. These would include the nature of the environment, all entities and factors within the environment that might compete with or cooperate with the new technology, the amount of energy that needed to be expended in implementing it, and whether it should be implemented in whole or only in part.

6. CONCLUSION

In any field it is necessary to use language in framing research questions and in offering explanations. The discipline of ecology offers useful metaphors to accommodate complexity, and so the use of an ecological model can provide useful insights into whether or not an e-training innovation is likely to be adopted.

The main advantages of using an ecological model to consider whether or not a new e-training approach is likely to succeed in an organisation relates to a presumption of complexity and interaction. We are not, for one moment, suggesting that e-training *is* a biological system. What we are suggesting is that concepts of complexity and interaction in this field can be usefully applied to a more incisive consideration of an e-training implementation.

We also argue that use of such a model offers an opportunity to improve the chances of successfully innovation. It can do this through the ways that the new e-training method might improve the balance between energy expenditure and satisfaction obtained, or succeed through cooperation, successful competition or filling a niche. If a manager wants to increase the likelihood that a web-based training innovation will be adopted we suggest using the ecological model and examining the likely consequences. If these factors are taken into consideration while implementing the changes, the chance of successful adoption will be enhanced.

REFERENCES

Bigum, C. (1998). Solutions in Search of Educational Problems: Speaking for Computers in Schools. *Educational Policy. 12*(5), 586-596.

Bond, M. (2000). Father Earth. *New Scientist. 167*, 44-47.

Busch, K. V. (1997). *Applying Actor Network Theory to Curricula Change in Medical Schools: Policy Strategies for Initiating and Sustaining Change*. Paper presented at the Midwest Research-to-Practice Conference in Adult, Continuing and Community Education Conference, Michigan State University.

Case, T. J. (2000). *An Illustrated Guide to Theoretical Ecology*. New York, Oxford University Press.

Krebs, C. J. (2001). *Ecology - The Experimental Analysis of Distribution and Abundance*. San Francisco, Benjamin Cummings.

Latour, B. (1986). The Powers of Association. In J. Law. (Ed.), *Power, Action and Belief. A new sociology of knowledge? Sociological Review monograph 32* (pp. 264-280.) London, Routledge & Kegan Paul.

Latour, B. (1996). *Aramis or the Love of Technology*. Cambridge, Harvard University Press.

Latour, B. (1999). On Recalling ANT. In J. Law & J. Hassard (Eds.), *Actor Network Theory and After* (pp. 15-25). Oxford, Blackwell Publishers.

Law, J. (Ed.). (1991). *A Sociology of Monsters. Essays on power, technology and domination*. London, Routledge.

Macquarie Library (1981). *The Macquarie Dictionary*. Sydney, Macquarie Library.

Naidu, S., Cunnington, D. & Jasen, C. (2002). The Experience of Practitioners with Technology Enhanced Teaching and Learning. *Educational Technology & Society* 5(1), 23-34.

Rogers, E. M. (1995). *Diffusion of Innovations*. New York, The Free Press.

Tatnall, A. (2000). Innovation and Change in the Information Systems Curriculum of an Australian University: a Socio-Technical Perspective. *Unpublished PhD thesis*. Rockhampton, Central Queensland University.

Tatnall, A. (2002). Modelling Technological Change in Small Business: Two Approaches to Theorising Innovation. In S. Burgess (Ed.), *Managing Information Technology in Small Business: Challenges and Solutions* (pp 83-97). Hershey PA, Idea Group Publishing.

Tatnall, A. and Davey, B. (2001). *How Visual Basic Entered the Curriculum at an Australian University: An Account Informed by Innovation Translation*. Paper presented at the Informing Science 2001 conference, Krakow, Poland.

Tatnall, A. and Davey, B. (2002a). Information Systems Curriculum Development as an Ecological Process. In E. Cohen (Ed.), *IT Education: Challenges for the 21st Century* (pp. 206-221). Hershey, PA, Idea Group Publishing.

Tatnall, A. and Davey, B. (2002b). Understanding the Process of Information Systems and ICT Curriculum Development: Three Models. In K. Brunnstein & J. Berleur (Eds.), *Human Choice and Computers: Issues of Choice and Quality of Life in the Information Society* (pp. 275-282). Massachusetts, Kluwer Academic Publishers.

Townsend, C. R., Harper, J. L. & Begon, M. (2000). *Essentials of Ecology*. Massachusetts, Blackwell Science.

Ville, C. A. (1962). *Biology*. Philadelphia, W. B. Saunders Company.

BIOGRAPHY

Arthur Tatnall research interests include technological innovation, information systems curriculum, Visual Basic programming, project management, electronic commerce, and information technology in educational management. Bill Davey's research interests include methodologies for systems analysis and systems development, Visual Basic programming, information systems curriculum, and information technology in educational management. Arthur and Bill are both from Melbourne, Australia and have worked co-operatively together and on many occasions.