THE INTERNET AND THE RE-ENGINEERING OF TRAINING PROCESSES

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ABSTRACT

This paper is concerned with the role of information technology and in particular the Internet, in re-engineering training processes. The project is aimed at exploiting existing Internet technologies in implementing new processes and in providing an integrated and structured teaching environment. This work presents a rationale for a new approach to training and details the resulting re-engineering process. Four main processes were identified in the re-engineering of the training programme: skill identification, curriculum development, training and evaluation of the programme. The implementation of the new programme has focussed on curriculum development with an emphasis on a suite of software tools that were developed in order to illustrate and support business and industrial processes. A number of modules have been written using Web development technologies, including HTML and Java.

KEY WORDS: Internet, Web, training, re-engineering, processes

1. INTRODUCTION

This work is part of the AutoTrain Project, which aims to introduce new methodologies to the European automotive industry and, in particular, through the automotive supply chain. Its primary focus is the provision of a *low cost information and communication resource* and the setting up of an infrastructure via the Internet.

Concern over adequate training today is forcing many organisations to turn to universities in order to provide courses for employees of all levels. Universities have the necessary resources to produce comprehensive and responsive programmes that should accommodate the needs of industry [1].

The scope of this work covers two aspects. The first of these concerns the re-engineering of training programmes, and the second deals with curriculum development.

2. INDUSTRIAL PROCESSES AND INFORMATION TECHNOLOGY

It is widely agreed that information technology is shaping the industrial landscape and is contributing to the demise of the traditional organisation. This is manifest in three areas [2]:

1. Increased flow of information through wider use of telecommunications.

2. Instantaneous interaction between buyers and suppliers through electronic brokerage.

3. Tighter coupling between inter-organisational processes thanks to electronic integration.

This multifaceted concern brings into play different processes: functional, cross-functional and inter-organisational. A functional process is confined to one function in a department. The process is self-contained with clearly identified interfaces. Control and performance are crucial in this set-up. Cross-functional processes, on the other hand, involve several interdependent functional activities that require co-ordination and communication. Finally, inter-organisational processes are characterised by greater interaction and collaboration between distant industrial partners. The concurrent activation of these processes requires the establishment of an infrastructure to support control and communication.

Information technology is also having a significant impact on the business world as an enabler in re-engineering organisation processes [3]. The processes of interest are designed to give organisations the competitive advantage they seek, through quality improvement, cost reduction and promotion of environmentally friendly policies and practices.

3. TRAINING

With the complexity of the tasks involved in manufacturing and the role of IT in driving the manufacturing process, training and staff development acquire a strategic importance. It is, for instance, often argued that adequate training is necessary for the productive use of IT [1].

Training is seen as a way of enhancing the employability of the workforce. One of the stated aims of training programmes is to set up an infrastructure that can satisfy the current needs of industry, and which can also accommodate future trends.

Increasingly, the move towards *knowledge economies* means that the knowledge and skill levels of a workforce is crucial to the competitiveness of an enterprise. This applies to the whole organisation as new technologies and methodologies become embedded throughout the business. Further, the *half-life* of knowledge is decreasing as the rate of change increases and the speed of introduction of new technologies accelerates.

All of this leads to an increasing need for training within companies and throughout a person's career (life-long learning). The cost, however, can be very high, both directly through the costs of training and indirectly through the trainee's not being productive whilst undertaking training.

3.1 MODELS OF LEARNING

On the academic front, the advent of telecommunications and the Internet is forcing many professionals to reassess their approach to teaching and learning. Laurillard [4] identified four models of learning, as part of an effort to take into account the wider scope of instructional strategies afforded by the Internet.

The first model identified, 'learning through acquisition' is akin to traditional modes of teaching, where the mode of delivery includes publications on the Web and broadcasting. In the second model, 'learning through discussion', the emphasis is on the face-to-face approach, a context that can be created by computer-mediated communication. The third model, 'learning through discovery', requires a specific framework and promotes the use of computer-aided simulation, for example, as a means for experimenting and reinforcing learning outcomes. In the fourth model, 'learning through guided discovery', the teacher acts as a guide in the exploration of the variety of resources available on-line.

3.2 THE TRADITIONAL APPROACH

Given the complexity of manufacturing processes, strategic importance must be given to training and staff development. The traditional approach to training however is inadequate. It reflects a product-based culture. It is characterised by a lack of communication, opaque activities and it is often provided in-house. The programme may be fixed and is frequently ad-hoc. In the extreme, it involves one single, monolithic process with poor skill identification. The mode of delivery is driven by necessity and expediency rather than by careful planning. Few resources are devoted to specific training programmes. Traditional training methods are often inefficient. They are unresponsive and inflexible because the training is driven by the supply side: training takes place when the provider is able to provide it and in a form which they can supply. They also deliver training that is not tuned to the requirements of the trainee.

On the whole, the traditional approach is reactive and is confined to the lowest model of learning, 'learning through acquisition'. The traditional approach to training is failing to meet the demands that an increasing competitive market is putting on modern organisations.

4. RE-ENGINEERING OF TRAINING PROCESSES

New technologies, and in particular internet delivered training, offers the opportunity to provide *just in time training*, that is training which is delivered when it is required and in the form that is required. It can be tuned to the needs of the trainee and his employer. By analogy with industrial methods, this is often called a *pull* rather than *push* model.

A modern approach to training should aim at forming an educated workforce, which can adapt to a changing environment. This approach should be proactive and, unlike the traditional approach, should be process-based, interactive and flexible. Its scope should accommodate the models of teaching that Laurillard [4] identified (and others that may emerge).

4.1 RATIONALE AND REQUIREMENTS

The re-engineering of training processes is motivated by a number of factors:

- Significant evolution of the relationship between customers and suppliers, and between industrial partners.
- Marked change in industrial working practices with an emphasis on quality assurance.

- Narrow focus on process identification, process interface and process improvement.
- Increasing reliance on IT in process implementation.
- Wider access to the Internet, the Web and various media resources.

Training is nowadays seen as a means of empowering employees, so that they have effective control over the processes with which they are involved. To that effect, the new training processes should therefore:

- address the needs of the industry by providing relevant and focussed high quality training, with an emphasis on curriculum development.
- provide adequate instruction on quality assurance and statistical process control.
- allow flexibility and customisation of processes to meet new situations.
- take full advantage of software systems in order to teach about IT, and its potential for driving and supporting new processes.
- create a framework for interaction and collaboration.
- exploit the ubiquitous nature of the Internet and the Web.
- provide an integrated and interactive teaching environment.

4.2 THE RE-ENGINEERING PROCESS

Davenport's approach to process re-engineering includes five stages: identification of processes for redesign, identification of change enablers, development of process vision, study of existing processes and design and the implementation of new processes [3]. The five stages of the re-engineering process, applied to the training programme, are detailed below:

1. *Identify process for redesign*. The focus is on training, and the traditional monolithic training programme is an obvious candidate for redesign.
2. *Identify change enablers*. The primary enabler in this context is information technology. IT is also, in this case, an implementer, and one of the driving forces behind the redesign process.
3. *Develop process visions.* It is important to ensure that the new training processes are relevant, and that they provide the trainees with the necessary skills required by the industry. This requires a close co-operation between industry and educational institutions.
4. *Study current processes*. The characteristics of the traditional approach were presented earlier. Its limitations have already been identified above, in section 3.2.
5. *Design and implement new processes*. Four new processes are introduced: skill identification, curriculum development, training and development. The new training processes are inter-organisational, since the implementation of the new processes may involve many organisations and stakeholders.

5. TRAINING PROCESSES AND CURRICULUM DEVELOPMENT

The re-engineering of the training processes should address the need to provide trainees with the necessary skills, required by the three types of industrial processes.

5.1 TRAINING PROCESSES

The four processes that make up the training programme are considered below, in more detail:

- *Skill identification*. The skill level of the trainees must be assessed with respect to the existing industrial processes. Skill identification is a function of the core business processes of the organisation and the environment in which it operates.
- *Curriculum development*. This phase is central to this project. It covers the structure, the content and the learning outcomes of the training programme. One of the requirements is that the curriculum and its implementation should be responsive to the needs of the stakeholders, affordable and easily customised.
- *Training*. This process concerns the practical implementation of the curriculum and the active involvement of trainees in the programme. This entails delivery of courses, access to and interaction with a suite of Web-based curriculum units.
- *Evaluation*. This phase deals with the evaluation of the whole training programme. It is concerned with the validation of the three previous stages. Has the skill gap been filled? Is the curriculum appropriate? Is the skill identification adequate?

5.2 CURRICULUM DEVELOPMENT

The Internet offers a cheap and ubiquitous communication infrastructure. The underlying technologies provide support for platform independence, simultaneous access to information, access to various media resources and supports collaborative work, thus leading to the potential for greater interactivity. In addition, the widespread availability of Web resources offers a framework for the implementation of flexible modes of learning, including asynchronous distance learning [5].

Another important consideration is that these technologies are available across the workplace, training centres and the home. This leads to the possibility that training can be integrated across all of these locations and integrated into other activities.

The primary focus of this project, up to now, has been on curriculum development, although there has also been some delivery of training and evaluation (These will be a major focus through the remainder of the work). This involves the development and adaptation of curriculum materials and the provision of an integrated learning environment to support learners and trainers.

The aim of the project has been to support the automotive supply chain within Europe and so the selection of curriculum areas developed has been driven by the needs of this sector. The training needs have been identified through analysis of the requirements identified by the trainees, their employers and by the customers of this sector. In particular, the OEMs and first tier suppliers have a very clear understanding of the training needs of their supply chain.

The major areas identified were quality issues, cost reduction, environmental legislation and requirements, IT, soft skills and, outside of the UK, technical English. Of these, we have focussed upon quality, cost and environmental training. There has also been a focus upon providing additional resources, for instance links to legislation or business support services. This is seen as important, both to provide added value and to integrate the learning into business activities.

The development has built upon standard internet tools (e.g. HTML, Java and WebCT [6]) and has been constrained to work effectively across commonly available communications links (e.g. whilst there is some use of video, this is optional for users of low bandwidth connections).

Curriculum development

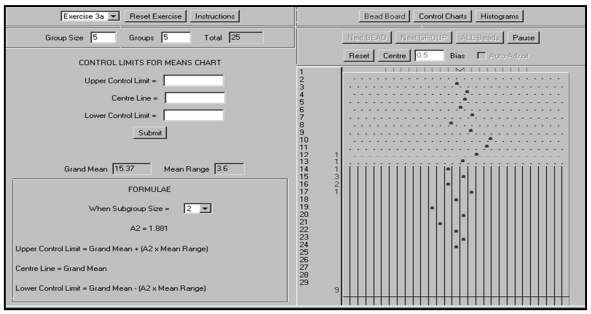
One aim of this work has been to explore different ways in which curriculum materials can be developed, the use of different learning methodologies, the ways in which it can be delivered and how it can be integrated into the workplace. This seeks to inform future developments. To this end, a number of different methodologies have been developed:

- Development. The development process has adopted several different approaches in order to compare the effectiveness and costs of each method:
    - Semi-mechanical translation of existing learning materials.
    - The adaptation of existing courses. This involves translating, adapting and extending existing materials to take advantage of the opportunities for interactivity, new media etc.
    - Developing bespoke web-oriented learning materials.
- Learning methodology. Several different styles of teaching/learning have been implemented. These range through:
    - Directed and didactic approaches
    - Exploratory approaches, through the use of virtual laboratories and simulations.
    - Task oriented. The development of work related tools which integrate learning and other support so that learning takes place opportunistically as the task is being performed.
- Delivery. Whilst much of the material can be used stand-alone. The project is also supporting other methods. For instance, on-line support from tutors and peers or embedding the on-line materials within existing courses as an augmentation to traditional learning.

Two areas where materials have been produced are statistical process control and environmental management. The statistical process control (SPC) modules support a wide range of audiences as well as learning methods. Some modules, for instance those aimed at production workers, are very directed and aim to teach procedural skills (e.g. how to use particular charts to control a production process). Others are aimed at managers and supervisors and seek to give a motivation and an intuition of process variability and control.

Figure 1 shows a simulation of a bead board which is used to give an understanding of statistical variation, process control and the methods used to implement SPC.

Figure 1 - A bead board simulation and exercises



Another module, on Environmental Management Systems, leads the learner through the development of an environmental management plan for their company and provides learning incidental to and in support of this task.

An integrated teaching environment

An important part of most learning/training that takes place, particularly within industry, is the support that is provided for the learners and for the managers of their learning.

Trainees are provided with an integrated and structured learning environment which manages their learning, records their performance and provides supporting tools and aids - for instance through simulations, calculators, notepads, virtual processes and so on. They are also provided with tools that can support communication with tutors and their peers.

As well as this, it is important to provide support for the management of their learning through monitoring progress and assessment. This can be very important to trainers/tutors and to managers.

We have used WebCT [6] as the underlying course management system. This is an entirely server-side system which provides some tools to support computer mediated communication and to track and monitor usage and progress. The basic tool set has also been augmented by custom tools. Whilst WebCT is only one of several packages available that perform this function it matches the needs of this project well without constraining the scope for the use of many instructional strategies and development methodologies.

5. CONCLUSION

Changes in technology and in business practice have provided both an opportunity and a requirement for changing the way in which training is developed and delivered. The development of training within this new context can be driven from many directions. Within this paper we have argued that the use of process re-engineering methodologies can provide a useful framework within which to work. The methodologies of process re-engineering have been successfully applied to a wide range of business domains and when applied to training systems it does appear to provide a mechanism that can improve the quality and cost effectiveness of the results.

The work described here has focussed upon the identification of industry needs and the development of curriculum materials and environments. In the future, there will be further work on the identification of individual needs and the delivery and evaluation of training. Whilst much of the progress within internet-based training has, up to now, been focussed upon the infrastructure and curriculum development, it is likely that the future developments will be more influenced by the development of sophisticated software tools and architectures to support the identification of user needs and the adaptation of learning materials to these needs. The integration of these and other tools will also be important.

6. ACKNOWLEDGMENTS

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