IMPROVING PROFITABILITY OF DESIGN ENGINEER CONTRACTORS IN THE PROCESS INDUSTRY THROUGH DESIGN EDUCATION AND TRAINING

Darryl OKEY, Kevin IONS and Ahmed ABBAS

Teesside Manufacturing Centre (TMC), School of Science and Technology, University of Teesside, Middlesbrough, Tees Valley, TS1 3BA, UK

ABSTRACT

In the United Kingdom and globally, power plant industries of chemical, oil and gas process plant, are increasingly using three-dimensional design software tools to design, build, and manage the operational lifecycle of plant. In the field of integrated computer design and engineering applications, AVEVA PDMS (Plant Design Management Systems) is arguably the global leader in process plant design and lifecycle management tools. For companies in the North East Tees Valley region of the United Kingdom, it is an important consideration to provide design skills in keeping with the evolving technologies of the process design industry, and incorporate an appropriate engineering design skill base into the operational practice of the company. This in turn has lead to local industry supporting continual learning opportunities for their design engineers and managers.

Keywords: Blended learning, process industries, three-dimensional computational design, academe

1 INTRODUCTION

The process industry represents 25% (£9bn) of the United Kingdom North East region's GDP and employs 34,000 direct employees working in the various sub-sectors of chemicals, pharmaceuticals, specialities and biotechnology, with a further 280,000 employed indirectly [1]. The sector is growing with significant investment and a number of major projects planned, including the development of several new plants in the North East region including a new £2bn crude oil processing plant at Wilton International site [2].

The process industry is increasingly using three-dimensional design software tools to design, build, and manage the operational lifecycle of process plants. For companies in the North East, it is an important consideration to provide design skills in keeping with the evolving technologies of the process design industry, and incorporate an appropriate engineering design skill base into the operational practices of the company. This has led to local industry supporting the Continuing Professional Development (CPD) of their design engineers and managers.

The process industry in the North East Tees Valley is experiencing a market-led demand for designers with specific three-dimensional computational design skills and knowledge [2]. Many engineers currently involved in process plant design and engaged

in using non-application specific Computer Aided Design (CAD) software, have requirements to develop vocational skills using industry standard process systems. Operational disciplines include mechanical engineering design, pipe-work engineering, structural design engineering, electrical and instrumentation design. At present, it is difficult for companies in the Tees Valley to provide such an appropriate technology skill base, as there is a shortage of people in the Tees Valley with skills necessary to meet the increasing demand for new process plant capacity. This has led to a 40% increase in project costs [3]. Concurrently, there is an increased demand for access to Higher Education from 70 million globally in 2003, rising to 160 million in 2025[4].

During the last five years, the University of Teesside has delivered a range of short, introductory three-dimensional modelling process plant design courses to 154 engineers employed in the region. Courses delivered include one-day non-accredited 'taster' sessions, full-cost 30 hour non-accredited courses and a University accredited module valued at 10 credits. This development through the Teesside Manufacturing Centre (TMC) an enterprise, teaching and research unit of University of Teesside (UOT), and the Tees Valley Engineering Partnership (TVEP) engaged in the initiative of tailored design education development and delivery for process engineering design.

This paper demonstrates how the program has moved from a traditional academe delivery, and developed into a suite of flexible modular courses, presenting a blended learning methodology. In this paper, we present the application of the methodology through illustration and discussion.

2 METHODOLOGY FOR BLENDED LEARNING

In this section, we introduce computational methods developed in presenting design for lifelong learning to the process industry sector across the United Kingdom and beyond. The drawing together of different approaches employed provides this educational design solution. The series of courses presented covering three-dimensional plant design modelling are in direct response to evidenced local demand from engineers in the UK North East region. Plant Design Management Systems (PDMS) provide enhancement to career prospects within the field of process plant design.

2.1 Design Approach – The Initial Learning Model

From the outset, three-dimensional mechanical computer aided design (CAD) was deployed as the development and delivery tool to regional manufacturing SMEs. Initially in 2002, a small team within the University of Teesside, School of Science and Technology, progressed a module developed in collaboration with Tees Valley Engineering Partnership (TVEP), and funded by the Learning Skills Council (LSC).

This initial module presented learners with the opportunity to gain specific knowledge in mechanical CAD modelling through a combination of traditional teaching methods and live demonstrator case studies from within industry. Despite successful learner intake in four of the planned five sessions, difficulties arose in attaining required attendance for the remaining programme delivery. Our findings of the time, illustrate the cause to be rooted in widespread accessibility of low to mid cost 3D mechanical CAD solutions within the SME manufacturing industry. Allied to competitive purchase and maintenance costs of both software and hardware tools, the SME marketplace chose vendor provided training as included in the purchase agreement.

In response to industry demand, Plant Design Management Systems (PDMS) exemplified the design and three-dimensional modelling of piping and plant within the process industry. Representing part of the HILT programme (High Level Training for

Engineers, a training programme offered by the University of Teesside). Table 1 illustrates differences between course structure and delivery in progressing from mechanical computer aided design to demand-led process plant design modelling.

Table 1 Initial Learning Models

LSC Model
Classroom based
3D mechanical CAD
Lecture and demonstrator delivery
Tasks workbook
Structured delivery
Set course duration
Non-accredited module
Continual assessment

LSC

- Level: Non-accredited module
- Resource packs
- Tutor delivery
- 48 hours contact study time
- 4 hours per week, evenings 5pm to 9pm
- Certificate of completion

HILT

With the HILT programme saw tailored response directly related to employee development and organisational needs. Industry and academically developed and delivered, offering up-to-date techniques and technologies.

- Level: UCPD if 3 x 10 credit modules undertaken
- Single, 10 credit module option
- Roll-on roll off
- Resource packs
- Email support
- Tutor delivery
- 100 hours study (48 contact hours & 52 hours self study)
- 4 hours per week, evenings 5pm to 9pm

HILT Model
Classroom based
PDMS Plant
Lecture and demonstrator delivery
Structured delivery
Set course duration
Test assessment / Progress assessment
Accredited module
Optional UCPD
Roll on roll off

2.1.1 Progression toward blended learning: CPE-ASET Model

Feedback from learner attendees (industrial contractor and manager), of the HILT course identified a requirement for a flexible learning approach offering continuum into the workplace. Funding provided the formation of a virtual centre based within the University of Teesside. Centre for Professional Excellence Applied Science, Engineering and Technology (CPE-ASET) is an initiative funded by Northern Way; a collaboration between the northern Regional Development Agencies of Yorkshire Forward, ONE North East and the Northwest Regional Development Agency (NWDA). As a project, CPE-ASET brings together eight Universities located in the North of England. The project works in collaboration with employers to provide demand led, flexible learning opportunities at Higher Education level. Skill and competency driven learning, developed into a process for growth at company organisational and designer contractor (the employee) levels. The resulting methodology has developed from the following progression:

LSC model > HILT model > CPE-ASET models (flexible and full cost short courses).

3 FRAMEWORK FOR A BLENDED LEARNING MODEL

Current research identifies an artificial gulf between formal and informal learning [5].

We present a methodology of process industry tailored design education, development and flexible delivery. The methodology produced met professional development needs

of engineers employed in a range of disciplines. In this section, we illustrate how we arrived at a model for blended learning through a process of course development and delivery to industry. From seeds of the previous LSC and HILT models, similarities in learning advancement provided a natural progression into blended and e-learning environments. This follows a structured approach akin to models illustrated in Epic Group Research and learning plans from NIIT [6], where HILT is pivotal in the provision of the blended learning methodology of this paper. The framework model demonstrates the design and deployment of a process sector blend that is a demand-led, task driven methodology, developed upon current principles in blended and e-learning hypothesis.

As a tool, blended learning is not a new idea, what is new is the fruitful mix of possibilities [7]. Unfortunately, no one single formulaic blend offers a guarantee of achieving optimum learning outcomes, more over, many different blends apply to differing solutions. Learning components identified within the NIIT framework are as follows: *Skill driven learning / Attitude driven learning / Competency driven learning.* EPIC Group research illustrates four levels of blend of differing approach and criteria when combined provide sustainability within a learning community achieved by means of structured and psychological levels. Figure 1 illustrates this hierarchical structure.

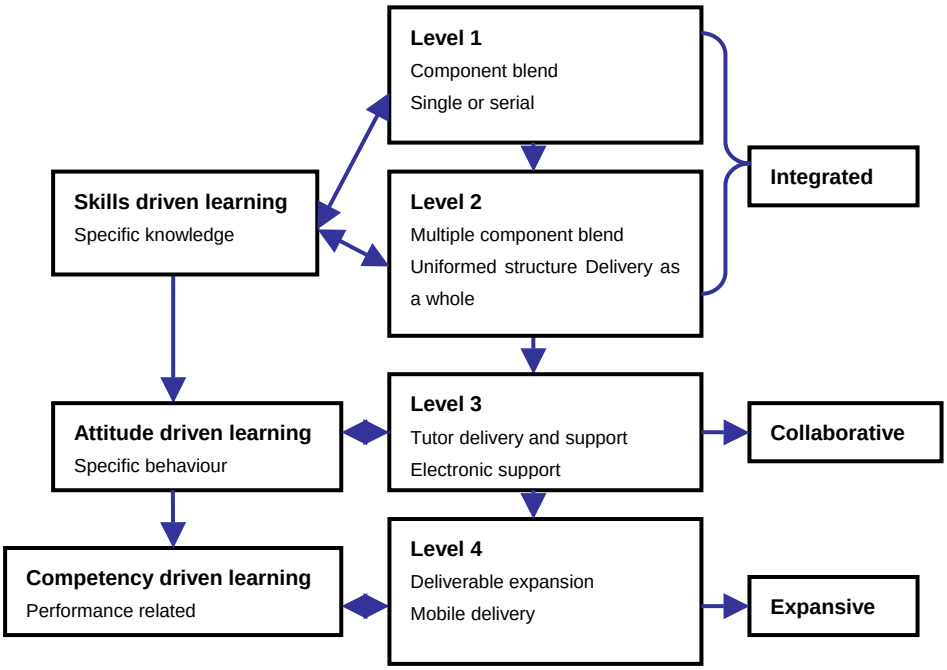

Figure 1 Hierarchical Skills

3.1 Developing an Optimal Blend

Highlighted in Fig 2 below, we can see the development of a blended framework for distributing learning beyond traditional academe boundaries and into the learner workplace. This University blend presents a learning framework of the following four stages: *Technology based visual > self-study > classroom based workshops > workplace learning.*

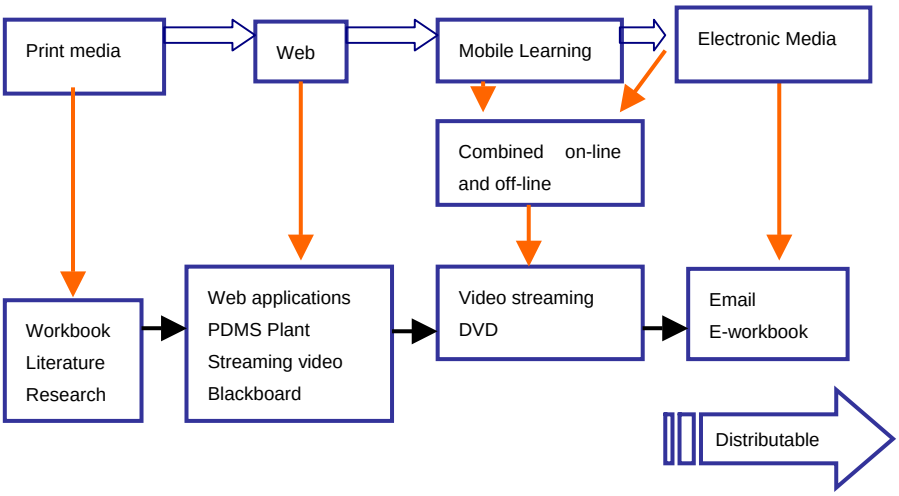

Figure 2 University Blend Model

3.2 Uniqueness of the Framework Model

This framework is unique in it is the only such educational blended learning model designed and developed around software tool PDMS, specifically for the process plant industries. As we have shown, the framework is a combination of a blend of elements, presenting overlap similar to current research models [8]. The blend offers around 60 hours of high quality, flexible, self-paced learning materials. The objective is to present innovative course design, delivery and content; enabling learners to develop practical process design skills and competencies using computational three-dimensional modelling software, and providing the following in Table 2.

Table 2 CPE Blended Learning Model

CPE Blend Model
Classroom based
PDMS Plant
Tutor support
Tasks workbook
Video tutorials
Electronic workbook
Structured delivery
Set course duration
Email support
Telephone support
Tailored content

- Attention to people and motivation
- Combination of visualisation technologies utilising a global market leader in process plant solutions
- Scalability and maintainability by means of appropriate demand-led choices.
- Expansive learning into organisational workplace.
- Progression onto nationally accredited UCPD.

Figures 2 and 3 below illustrate a typical workshop learning session and provide a video tutorial screen output example.

Figure 3 Workshop Session

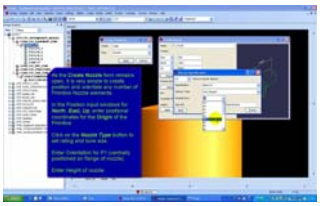

Figure 4 Video Tutorial Screen

Benefits of Adopting the Methodology

Adopting this methodology provides learners with an understanding of the principles and applications of process plant design using industry standard modelling software of Plant Design Management Systems (PDMS).

Organisational benefits

- Tailored programme of employee development and organisational need.
- Industry and academically developed, delivering current technologies.
- Assignment to increase competitive advantage and improve business processes.
- Evening study with minimal interruption to the working day.

Employee benefits

- Personal development with potential UCPD certification.
- Professional development for enhanced skills and career development.
- Learners develop practical plant design skills and competencies.

4 CONCLUSION AND FURTHER WORK

The region's design engineers define the effect of this presented methodology**.** Results of the programme include analysis of training needs undertaken with engineers employed in several process design companies in the region including Aker Kvaerner, ABB and Siemens VAI. This example demonstrates Universities of Higher Education (HE) can design and deliver flexible, demand led learning to address skills shortages resulting in economic benefits to a region and illustrates the value to industry of collaboration with Universities. A survey conducted with eighteen engineers who completed one or more of these courses, demonstrates continuing demand of the delivered framework. Of those surveyed, 89% indicate enrolment onto a level 4 course of national certified accreditation using industry standard modelling software [9].

A future continuum of this work is to develop the blended learning model into an accredited UCPD built upon PDMS. Further research will evaluate the effect of this learning programme upon the earnings potential of participating employees and the consequential impact upon their employers companies.

REFERENCES

[1] Nepic, *Skills Gap in Chemical and Pharmaceuticals Industry*. September 2006

[2] University of Teesside, *Questionnaire submitted to process industry course students.* December 2007.

[3] Nepic, *Skills Gap in Chemical and Pharmaceuticals Industry*. September 2006

[4] -------- " -------- -------- " -------- -------- " -------- --------" --------

[5] Donald Clark, Epic, *Problems of the Past/Picture of the Present/Facing the Future Conclusion*. 2006, 15.

[6] Phil Race, Kogan Page, *The Open Learning Handbook.* 1994, 16.

[7] Donald Clark, Epic, *Problems of the Past/Picture of the Present/Facing the Future Conclusion*. 2006.

[8] Purnima Valiathan, *Blended Learning Models.* August 2002.

[9] University of Teesside, *Questionnaire submitted to process industry course students.* December 2007.

Darryl Craig OKEY
University of Teesside, SST
Middleborough Tees Valley TS1 3BA UK
d.okey@tees.ac.uk
+44 (0)1642 342481