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Development of a Distance-learning Based Postgraduate Programme on Sustainable Architecture

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ABSTRACT

A broad set of multidisciplinary and domain-specific skills is required to create sustainable architecture. Of particular significance are the skills needed for sustainability appraisal and collaborative decision making - highlighted by the construction industry and the government. The development of skills for effective integration of sustainability concepts into the management of architectural projects is vital for the Initial Professional Development (IPD) and Continuing Professional Development (CPD). The Higher Education (HE) is now faced with the challenge to address skills gap and to create a learning environment suitable for IPD and CPD. To reflect the changing needs of the industry, a flexible distance-learning based postgraduate programme on sustainable architecture has been developed at the Department of Built Environment, University of Central Lancashire. This paper reports on the philosophy, course structure and teaching and learning methods of the course.

Keywords

Sustainable architecture, skills development, postgraduate programme.

INTRODUCTION

The UK construction industry employs 1.5 million people and accounts for up to 8% of Gross Domestic Product (GDP). As well as its economic significance, the industry is responsible for nearly 45% of all carbon emissions in the UK. CO_2 and other greenhouse gases are responsible for global climate change. Similar picture can be found in other developed countries. For these reasons, the construction industry has a significant influence over the future of sustainable communities. For enhanced sustainability in the built environment, issues related to the fragmentation (see Austin *et al.* 2002) in the industry needs to be addressed. The actions needed to overcome fragmentation and unsustainability in the built environment concerns the following aspects of skills development, among others:

- further development of professional and trade skills, as discussed in (Barker 2004), and
- the need for a new range of skills (Egan 2004) to addresses the changing nature of the built environment.

In addition to the domain specific skills, Egan (2004) emphasised the need for generic skills related to behaviour and knowledge and skills such as the ability to create a vision, leadership to achieve buy-in to the vision, communication, teamworking, project management and process re-engineering. The complexity of decision making for sustainable architecture demands a new set of skills in appraising for sustainability and collaborative problem solving. Developments in

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building simulation mandate the need for analytical skills among architectural and related professionals. New courses need to be developed to integrate these skills as well as upgrading the existing ones.

The distance-learning based postgraduate programme discussed here aims to address the *skills gap* in the context of sustainable architecture. The flexible framework enables different modes of delivery to suit varying needs of specific learning modules and allows course participants to progress at their own pace. The modularization of learning materials makes the programme suitable for the IPD and CPD; i.e. the development and enhancement of skills for sustainable communities. Delivery by e-Learning and residential workshops aims to widen participation among professionals in full-time employment in the UK and abroad. Virtual building technologies and software environment have been integrated in the course for collaborative decision making and virtual teamwork. Sustainability appraisal using simulation tools is adopted as an integral part of the programme. The programme aims to develop:

- a critical awareness of contemporary issues in energy, environment and sustainability informed by the frameworks for sustainability and research on climate change and energy efficiency in buildings,
- the application of principles emerging from the consideration of sustainability issues to changing professional practice contexts,
- cognitive, experiential, analytic and synthetic skills enabling graduates of this programme to engage in collaborative decision making for sustainability in a multidisciplinary setting,
- knowledge and skills necessary to appraise design proposals for sustainability using analysis and digital based tools for both urban environments and individual buildings - new or existing, in different climatic and geographic contexts,
- detailed understanding of the relationship between building form and environmental performance, especially the dynamic and adaptive potential of the building envelope for different building types in different geographic contexts,
- an in-depth awareness of the relevant sustainability and energy efficiency guidelines and legislations in the UK and EU,
- the ability to identify, retrieve and assess the rigour and value of published research as the source of alternative perspectives which inform and underpin the sustainable architecture decision making process and investigative research, and
- creative and innovative approaches to investigative research including the review, evaluation and selection with justification of appropriate research methodologies and the communication of findings in an objective, coherent and professional manner.

PHILOSOPHY

The term 'sustainable' in the context of the development of this programme refers primarily to the micro and macro environmental sustainability in the built environment. Although, the wider issues of sustainability: social, economic and cultural are discussed throughout the programme, the philosophical basis for this course is underpinned by the following:

Contextual understanding

Planetary climate change affects regions differently as described in (Dow and Downing 2006). A comprehensive understanding of the contextual issues of global warming is thus necessary. Regional factors such as climate, location and potential for integration of renewables are considered to be of primary concern. Compliance with environmental regulations is another context that needs to be addressed in training for sustainability, as highlighted in (CIC 2003).

Integrated assessment tools and analytical design

Advances in building simulation (see Augenbroe 2002; Malkawi 2004) and engineering analysis, in particular in Finite Element Method (FEM) and Finite Difference Method (FDM) (see Kelliher 1999) imply that a significant part of environmental design problems can now be formulated mathematically. Building simulation tools have applications beyond environmental performance or life cycle assessment; e.g. pedestrian movements (Jian *et al.* 2005), layout and circulations (Radford and Gero 1988; Liggett 2000), etc. Increased processing power of computers now allows architects/designers to take advantage of simulations in decision making, which can be taken further by deploying mathematical optimisation techniques. The benefits of deploying optimisation techniques in the design process have been observed in: (Gero and Kazakov 1998; Al-Homoud 2000; Wright *et al.* 2002; Mourshed *et al.* 2003b; Wetter and Polak 2005). The programme aims to encourage the adoption of analytical methods in decision making for sustainability.

Multidisciplinary collaborative skills

In a recent report titled *"Skills for Sustainable Communities"*, Egan (2004) stressed on enhancing collaborative skills to deliver sustainable communities; a view shared by the majority in the industry. In a collaborative environment, the product or goal is considered as a social construct driven by a shared goal. Multidisciplinary team members are required to work in unison, regardless of whether they are separated by time and/or space. Collaboration for sustainability has two dimensions: collaboration between geographically dispersed team members and between stakeholders from different professional backgrounds. The programme aims to address both the issues through the *diversity of professional backgrounds in the programme* and diverse *geographical locations of students*. Students will be given the opportunity to enhance technological and social skills for collaboration through integrated project work and assessments.

Interoperability

Interoperability among stakeholders and processes remains a major concern for effective collaboration and sustainable development (Mourshed *et al.* 2002). Distributed virtual building technologies are making inroads into the construction industry and future professionals need to be trained in the use and application of such technologies in a distributed environment.

Innovation

Drawing on the outputs from recent conferences and international declarations such as Agenda 21 (UNCED 1992), Thom (Thom 1998) showed how the objective of engineering had been redefined over the past decades from the '*open and unfettered application of technology*' to the '*creative application of technology*' to achieve sustainable development. In other words, *innovation* holds the key to the sustainable development in a globalised world.

COURSE STRUCTURE

The postgraduate programme on sustainable architecture builds on the success of the existing distance-learning (DL) based programmes in the department and adopts a similar concept of modular learning blocks. The programme comprises nine modules with a number of credits attached to it. A module consists of a block of study material complete with its own aims, objectives, assessments and reading materials. The number of credits attached to a module denotes the amount of work and time a student needs to put in to achieve stated learning outcomes. A full module has a credit rating of 20 and a half module, 10. Notionally, 10 hours of student effort equates to one credit point. The flexible nature of the programme allows course

participants to progress at their own pace and according to their needs. As various modules are completed, the total stock of credits builds up to a points total which then triggers one of the exit awards: Postgraduate Certificate (PgCert) / Postgraduate Diploma (PgDip) / Master of Science (MSc) in Sustainable Architecture. Each of the exit awards are linked with the key stages of skills development as shown in Figure 1. The key stages focus on specific aspects of skills for sustainability, which are not necessarily exclusive to that stage. For example, PgCert focuses more on the understanding for sustainability but application of the principles and innovation for sustainability are touched upon. PgDip builds on the understanding developed in PgCert but focuses more on the appraisal for sustainability and applications of technology. MSc gives students the opportunity to apply knowledge gained in previous stages to innovate/improve upon existing processes and products, in this case buildings. Multidisciplinary collaborative project work underpins most of the learning modules, allowing both synchronous and asynchronous learning. Learning modules are given in Table 1.

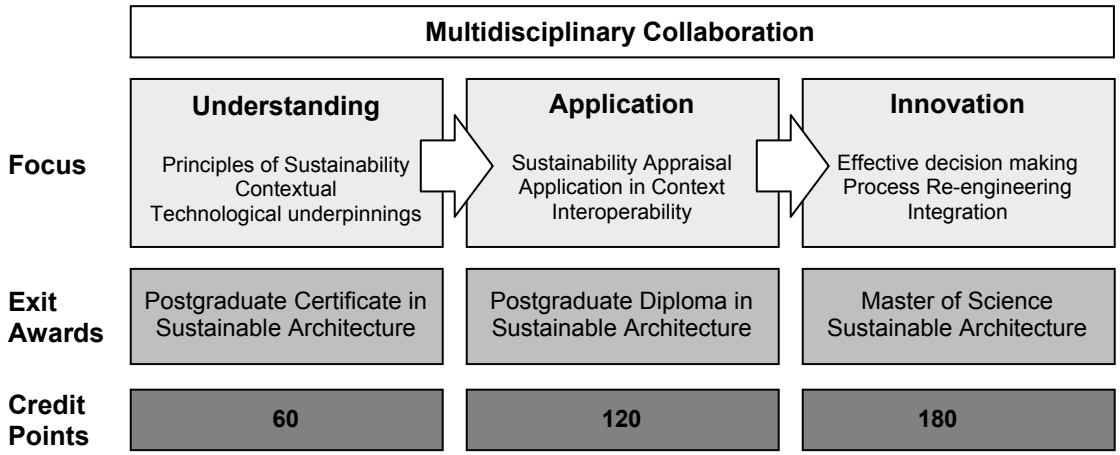

***Figure 1**: Key stages, focus of each stage and exit awards.*

***Table 1**: Sustainable architecture programme structure.*

	No.	Module title	Value	Points
Understanding	PgCert (Postgraduate Certificate):			
	BN3504	Built Environment Informatics	1.0	20
	BN4521	Energy, Environment and Sustainability	1.0	20
	BN4522	Sustainable Architecture in Practice	1.0	20
Application	PgDip (Postgraduate Diploma): PgCert in Sustainable Architecture plus			
	BN4523	Sustainable Building Services	1.0	20
	BN4524	Building Simulation	1.0	20
	1 (one) option from below			
	BN4506 BN4516	Environmental Law Urban Regeneration	1.0	20
Innovation	MSc (Master of Science): PgDip in Sustainable Architecture plus			
	BN4508	Research Methods	1.0	20
	BN4509	Dissertation	2.0	40

TEACHING AND LEARNING

Theoretical framework

Because of the distributed nature of the course, integration of learning technologies on sound theoretical underpinning is vital to the success of the programme. Theoretical framework adopted for this programme considers constructivist and collaborative approaches as discussed in (Moreno *et al.* 2006). Integration of a constructivist learning model in postgraduate sustainability education is also suggested by Fisk and Ahearn (2006), because of the advantages of maturity and experience brought by the participating students. Importance is given on the context - learning and professional, to allow students to build knowledge by doing activities closer to the real world and by collaborating with each other. Students are empowered to acquire knowledge and skills for sustainability through a journey of achieving shared objectives as well as own goals. Information Technology is used as an enabler/supporter for the building of knowledge rather than as a static repository of learning resources.

eLearning environment

A web-based distributed virtual learning environment facilitates teaching and learning in this programme. The system also acts as the primary means of communication between the staff and the students. WebCT[1] has been chosen as the eLearning system for this purpose because of the availability of staff skilled in the use of the program for instructional design. The availability of technical staff trained in supporting students throughout the programme is another factor considered for the selection of the system. The implementation of WebCT builds on the experiences gained from running other DL based courses in the department. The eLearning system integrates electronic resources (e.g. documents, presentations, lectures, eBooks, etc.), tutorial sessions and the workshops.

Virtual design studio

Since the development of hypermedia in the early 1990s, several universities experimented with the idea of virtual design studio involving distributed collaboration between students and staff separated by time and/or space. Some examples can be found in (Maher *et al.* 1999; Rügemer and Russel 2000). The method implemented here takes the concept further by integrating collaborative CAD environment - based on interoperability. ArchiCAD from Graphisoft[2] has been chosen as the virtual building platform. Students will develop design ideas collaboratively using native teamwork facilities in ArchiCAD, which is similar in principle to the Versioning Systems used in Distributed Software Development. Interoperability comes into play when students simulate the buildings designed in ArchiCAD using EnergyPlus[3], an integrated whole-building energy simulation program developed by the US Department of Energy. For further details on integration of simulation in design, see (Mourshed *et al.* 2003a). It is reported by Gross and Do (1999) that the students' skills relating to the use and manipulation of Computer Aided Design (CAD) and visualisation largely determines how successfully they will achieve the learning outcomes, hence emphasis is placed on collaborative CAD skills during induction workshop.

Face to face interaction and social networking

Based on a study involving two groups of UK and US students working collectively and individually in the context of a remote design studio, Dunne (2005) mentioned the importance of face to face interaction in building working relationships between temporally distributed students. Evidence from the programme leader of the DL based Construction Law programme at this department also suggests that induction workshop plays a vital role in cementing relationships between course participants. This programme is therefore designed to start with

an induction workshop to introduce students to the various aspects of the course, such as Object Oriented CAD, VLEs and Distributed Learning and Working. Built-in course/module bulletin boards help to maintain and enhance the relationships developed during the induction week. The primary goal is to facilitate knowledge building rather than providing a discussion forum, although the importance of the latter in the learning process is not understated.

Synchronous interaction

Learning in a distributed context can add value to the process if synchronous interaction is provided along with the asynchronous ones. The programme integrates web-based chat as a general platform for synchronous interaction among participants, tutors and guest presenters. Real-time and interactive video presentations and discussions augment text based chats; this allows the presenter and the audience to interact more effectively. Seminars and presentations can be archived for future *on demand* access and reference. Adobe Breeze[4] has been chosen as the virtual presentation system, which is also used in other DL based programmes in the department. Remote desktop sharing takes this a step further, for example, by allowing students to share sketchboard type programs and resources on each other's shared disk space during collaborative design and/or writing.

CONCLUSION

Development of a flexible and distance-learning based postgraduate programme on sustainable architecture is presented here. The programme has been designed to accommodate the needs of professionals working as Architects, Architectural Engineers, Architectural Technologists, Quantity Surveyors, Planners and Sustainability Consultants in public/private sector. Integration of digital-based sustainability assessment tools and collaborative CAD-native environment within a spectrum of modules will address the education and skills gap as identified by the stakeholders' reports. The programme is undergoing validation at the University of Central Lancashire. First intake is expected in 2007.

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NOTE

[1] WebCT, eLearning system. http://www.webct.com/

[2] Graphisoft. http://www.graphisoft.co.uk/

[3] EnergyPlus, whole building integrated simulation program. http://www.energyplus.gov/

[4] Adobe Breeze, web Conferencing system. http://www.adobe.com/products/breeze/