DEVELOPING ENTERPRISE OPPORTUNITIES FROM PLACEMENTS TO GRADUATE CONSULTANCY IN LEAN SUSTAINABLE DESIGN

Tania HUMPHRIES-SMITH[1] **and Clive HUNT**[2]
[1]Associate Dean (Technology & Design), School of Design, Engineering & Computing, Bournemouth University
[2]Senior Lecturer, School of Design, Engineering & Computing, Bournemouth University

ABSTRACT
This paper reports on the adaption of a model for consultancy of using graduates working on a contract basis for Bournemouth University (BU) but within a client organisation, and managed by a member of academic staff. The model is based on BU Design graduates undertaking a 6 month consultancy under the direction of an academic.
The adapted model, discussed in this paper, offers consultancy in the area of lean sustainable design, a research specialism of the Sustainable Design Research Centre. The paper discusses the industrial relevance of design education and how design education and design research are strengthening each other with industrial relevance and investigates how to exploit existing relationships with companies who employ undergraduates on placement.
It is envisaged that in order for graduates to work effectively as consultants, they will need additional development in the area of sustainable design and lean design. To address this possible shortfall a short continuing professional development (CPD) course is being developed, which will be offered to perspective consultant graduates to provide training to them in appropriate areas. In order to manage the risk associated with using inexperienced graduates to conduct the consultancy work, the projects will be managed by academics as well as providing support, by way of mentoring, to the graduates during the consultancy periods. The paper reports on research undertaken with final year design students to determine the content of this short course.

Keywords: Sustainable design, lean manufacture, academic consultancy, design for manufacture, enterprise, curriculum

1 INTRODUCTION
The purpose of this paper is to report on the continuing development, at Bournemouth University in the UK, of a model for offering academic consultancy to industry, particularly SMEs, using graduates supported by academics. As reported in the literature there are a number of issues related to the traditional consultancy offered to industry by Universities, yet it is acknowledged that there is significant mutual benefit to be gained from academic/industry collaboration. This model is an attempt to overcome some of the difficulties cited. The paper links this model to a particular area of need for expertise in SMEs, namely sustainable design.

2 TRADITIONAL UNIVERSITY CONSULTANCY
Shugan [13] defines what consulting in the university context is considered to be about and also indicates its increasing acceptance over time as a legitimate academic activity. However, he points out that alongside the benefits for academics such as "contemporary management problems, data-availability, decision-making contexts"…

> Consulting puts considerable time demands on faculty…requires substantial investments in relationship management (Weiss 2001) and protracted investments in implementation (Berry 1997)

Bessant and Rush [1] state that competitiveness can be based upon ensuring the correct package of technological resources, skills and experience. They suggest that smaller companies in particular struggle to find this from within themselves and that this is where external sources can be effectively used. However, they go on to point out some of the difficulties for small companies of using consultants such as the lack of understanding of consultants of the particular needs of SMEs and lack of experience of SMEs of using consultants. They also points out that SMEs often are part of networks that can't access consultancy. Stephan [11] considers the implications that academics engaging with technology transfer can have for students and their courses and curriculum. Stephan suggests that to attract more students to the science and engineering area more use, in terms of publicity, should be made of career opportunities and of collaborations. Interestingly, the ideas expressed in both these papers and Hamel and Prahalad's work link with the idea that is also being investigated as part of the whole project which is that there is untapped potential for productive collaboration with companies which offer 40 week placements to undergraduate students.

Wright [14] sets out the range of initiatives that have been developed in the UK to develop relationships between universities and their local industry, including the role of regional development agencies (RDAs). These include incubation centres and enterprise hubs, fellowships, spinoffs, and interestingly, keeping graduates in the more remote regions where there are smaller companies rather than the brain-drain to larger more centrally located companies. Again, this links with the idea of matching companies offering undergraduate placement, often regionally located and SMEs with graduate consultancy. Wright concludes that all the current models have not overcome some issues including the identification of demand and supply.

Thus, traditional consulting is not always feasible, nor affordable, particularly by small and medium size enterprises (SMEs). Similarly, Knowledge Transfer Partnerships (KTPs), although often very effective for SMEs are not always feasible due to length of time to set up or insufficient strategic business need, this includes the recent Mini KTP initiative which still does not offer sufficient speed and flexibility for many SMEs. An alternative model of consultancy was piloted by Dr Tania Humphries-Smith at Bournemouth University over a 6 month period in 2008. Two graduates from the BSc Computer Aided Product Design course at Bournemouth University worked on an hourly paid contract basis as BU staff but operated on a day to day basis within the client organisation, and were supported and managed by Dr Humphries-Smith. In this instance the consultancy was the development of an existing concept design for a very small design company. Dr Humphries-Smith also provided additional input in this case, in the form of Design Reviews and facilitation of qualitative research activities, such as focus groups. Reflecting on this experience indicates that graduates are likely to need additional professional skills in order to function effectively in the consultant mode, the exact nature of the input required needed to be determined by this study. This model has similarities with the concept known as Placement Plus, whereby, an undergraduate student placement is directly supported by an academic and also with the STRIDE initiative, whereby graduates can undertake placements but has important differences discussed in the conclusion.

3 THE NEED FOR SUSTAINABLE DESIGN

The ideology of the Societal Marketing Concept has been around for a number of years and incorporating the long terms interests of society is recognised as a serious contending business philosophy. Kotler and Levy [9] described it as "sensitively serving and satisfying human needs". The Body Shop, which raised concerns about animal testing on cosmetic products, is among those organisations that ensured that the needs of customers were satisfied alongside meeting those of society as a whole. Hunt and Reynolds [8] cite the company as being at the forefront of the ethical brand whilst Stokes [12] contends that the body care market has been heavily influenced by the company. Consumers are seeking products that are believed to have less impact on the environment. Toyota introduced it's hybrid electric car, the Prius, with just 104g/km CO_2 which, according to Davis and Moy [2], has "achieved remarkable success" by doubling its sales in the US and UK from 2004 to 2005. As well as citing Toyota, Davis and Moy point also out that companies like Café Direct are thwarting industry trends by producing "better than Fairtrade standard" freeze-dried coffee by sourcing "all of its coffee and tea direct from growers" thus giving a fair price direct to the growers. Neglecting sustainable design issues is no longer an option for organisations or their designers [8]. For an organisation to sustain competitive advantage, it is necessary for their products to be optimised in

terms of customer satisfaction and to ensure company profitability whilst meeting environmental challenges.

The terms sustainable product design and eco-design are used interchangeably and "involves the strategic use of design to meet current and future human needs without compromising the environment" [3]. To date, with little exception, sustainable product design has been focussed upon the "imbalances or trade-offs between the demands of society, the environment and the economy" [3] which has been endorsed by a shift in environmental policy and changes in the law. The European electronics and automotive manufacturing sectors have responsibilities which have been prescribed by initiatives which require them to develop sustainable products. These clearly demonstrates the legal responsibilities that businesses have to reduce the environmental impact of their products and it is becoming increasingly recognised that sustainable design approaches are key to achieving this as well as helping business to secure competitive advantage in the market place.

Maxwell and van der Vorst [10, p884] highlight the "need for mainstream, pragmatic approaches to sustainable product development". Clearly their thinking follows the ideology of the Societal Marketing Concept by developing products in a sustainable manner which is both cost effective whilst meeting customer needs. Maxwell and van der Vorst [10] identify that, amongst other things, organisations must adopt a strategic level approach if sustainable product development is to be implemented effectively in organisations. This sentiment is echoed by the industrial and enterprise work of the authors of this paper. Eco-design has been around for some time and concepts such as design for disassembly are now readily accepted in forward-looking companies. The emphasis here is on saving money and the environment by eliminating wasteful design activities.

Over 50 years ago the Toyota Motor Corporation pioneered the principles and practices of Lean. Lean is now the most commonly used approach that is adopted by organisations to help them develop a culture of continuous improvement and is seen as a dominant approach to deliver customer value and to eradicate waste. Most commonly, Lean Manufacturing has been used with enormous success by the manufacturing sector but has tended to be limited, as the term suggests, to the production or manufacturing areas of businesses and it is not uncommon for organisations to report their costs being cut by as much as 10% to 40%.

Whilst the principles of lean are commonly applied to the manufacturing facilities of organisations, and perhaps to a lesser extent to administrative functions, the uptake of the principles applied to existing and new product development is less common, probably because unlike activities in manufacturing or administration, those involved in design cannot be replicated or reproduced readily. Having the capability of taking a Lean approach to design can, therefore, be seen as competence that will enable competitive advantage. Organisations that take a "Design for Lean" approach will see their business as being about making money through meeting the needs of its customers. Lean manufacturing is about eliminating waste and non value added activities and getting it right first time. Without too much thought, it is not too difficult to appreciate that a designer's focus on aspects such as Poka Yoke (mistake proofing) or design for assembly, the use of multifunctional parts, modular assembly and the minimisation of parts and materials will help their organisation reduce rectification costs, redesigns and other wasteful activities.

The ability of an organisation to meet the particular needs of its customers through a complex mix of skills and technologies is a core competence and, therefore, is not easy for competitors to copy. Developing and maintaining core competencies, therefore, is one way of gaining competitive advantage, as organisations will inevitably strive to compete on capability. Hamel and Prahalad [5] endorse this view and comment that, "competition for competence leadership typically antedates competition for product leadership".

As the activities that form the design process tend to be less prescriptive than those activities which are associated with manufacturing and administration there are relatively few businesses which take a Design for Lean approach, accordingly the numbers of businesses adopting a "Lean Sustainable Design" approach will be fewer. To assume that there is no waste to be eliminated during the design phase of a new product development would be naïve. Specifically, "Lean Sustainable Design", as the term suggests, combines an eco-design approach by way of using a mix of tools and techniques which are analogous to those of lean manufacturing, however, to adopt the tools that are used within Lean manufacturing per se would not be appropriate. What is needed, is a framework that can be applied to the development of a Lean Sustainable Design approach which will enable new product development to be taken through a lean journey.

The need to include sustainable design in the higher education curriculum was set out by HEFCE [6] in 2005. Simultaneously the Engineering Council [4] added the need for professional engineers to also engage with the sustainability agenda to their requirements. However, as Humphries-Smith [7] sets out in some detail there are considerable issues related to embedding sustainable design, as defined by the three pillars, into the design and engineering curriculum. These include the packed nature of the engineering and design curriculum and the scale and complexity of sustainable design. Humphries-Smith also reported that there was a clear gap between academics perceptions of the extent of coverage of sustainable design in the curriculum and students' perceptions. The study concluded that there is a good level of awareness of eco-design issues and to some extent the tools and techniques associated with them, such as life cycle analysis. However, the wider issues covered by sustainable design are much less widely perceived and even less understood [7, p272].

The student respondents in the Humphries-Smith study were studying in the same courses in the same institution as this study. Thus, it would be reasonable to conclude that graduates in this study will need some additional knowledge and skills before they would be in a position to engage with consultancy, even academically supported, in lean sustainable design. However, further investigation was needed regarding the understanding of sustainable design was required to ensure the training was appropriate.

3.1 Problem Statement

While the pilot study detailed above proved that a model to offer consultancy using graduates supported and managed by academics has the potential to be successful this now needs to be developed to enable a Lean Sustainable Design graduate consultancy service to be offered that integrates existing business practices with the sustainable design development process. As the literature review indicates this is an area that SMEs find particularly challenging. It is also envisaged that to enable these graduates to work effectively in this area they will need additional development in the area of sustainable design and lean manufacture. Therefore, it is proposed that a short continuing professional development (CPD) course, to offer them initial training in these areas. The short course ran during the Easter vacation for interested final year students, thus not requiring additional costs. Before such a course could be offered it was necessary to determine the content of the course, which will need to be based upon the current knowledge of these graduates. It is the determination of this that is reported in the rest of this paper.

4   METHODOLOGY

In order to ascertain what content is required for the CPD course an investigation was conducted with final year students on BA/BSc Product Design, BSc Design Engineering and BSc Computer Aided Product Design courses at Bournemouth University. The earlier Humphries-Smith [5] study asked the following questions via paper based questionnaire:

- To what extent are you aware of sustainable design issues?
- To what extent do you apply sustainable design tools/techniques?
- To what extent do you think all designers/engineers should be aware of sustainable issues?
- To what extent do you think all designers/engineers should be able to apply sustainable design techniques?
- Would you have considered a course that produces a graduate who is a specialist sustainable designer? Please give reasons for your answer.
- What do you consider sustainable design to be?

In order to build upon the information gained in the previous study this investigation adopted a qualitative methodology, while the method of data collection chosen took the form of 3 focus groups, one per course. Each course was briefed about the nature of the project and volunteers were sought. Each focus group consisted of 6-8 participants. The use of focus groups enabled a more exploratory approach which resulted in rich data. To ensure consistency between each focus group the same researchers conducted each focus group using a semi-structured approach using the following questions which were aimed at exploring what personal development they require and also confirming what knowledge development they require:

- What training would you need to become a graduate consultant?
- What do you think lean manufacture is?
- Have you ever been taught to consider parts counts; disassembly and assembly techniques; economical use of materials;

- What do you think sustainable design is?
- Have your been introduced to the three pillars/dimensions of sustainable design?
- Have you ever been taught to look at LCA, renewable resources, materials (recycling etc),

The investigation followed ethical research guidelines and ensured that participation was voluntary, that all participants had given permission for their data to be audio recorded and for the data to be used anonymously for research purposes, including publication.

Additionally, meetings were conducted with senior managers of a number of SME's local to Bournemouth University in order to gain feedback upon the proposed model and determine if it was likely to meet their requirements.

5   RESULTS

Three focus groups were held, using a common set of questions, all being conducted by the authors. Each focus group lasted between 45mins and 1 hour. The participants were volunteers who at an earlier briefing to each final year cohort, had expressed an interest in both being considered as graduate consultants after graduation and also in taking part in the focus group.

The focus group opened with a discussion around what they thought a consultant role might be – this received mixed response with one group in particular being very unclear about the role of a consultant and confusing it with contract work. All groups felt they would require input on how to conduct themselves as graduate consultants and also training in giving appropriate presentations and how to deal with company employees. This is illustrated by a comment from one participant:

"If there are different methods of contacting people, or dealing with them, just, errm how you are getting your brief and just if you need any questions answered can you just phone up any time or…"

Discussion then focused on their understanding of lean manufacture and sustainable design, generally their understanding of these concepts and the techniques that underpin them were in line with the researchers expectations based on teaching schemes and working as part of the course teams. Again one group seemed to have a rather poorer grasp on the materials than the other two. It became apparent that slightly different experiences in the second year study of each group accounted for this. Fortunately, this has been resolved for the future due to a common framework structure implemented in 2008. Most participants needed some direction to see the link between techniques they had covered, largely in their second year studies and the concepts of lean manufacture and sustainable design. All participants commented that they needed to develop in terms of applying the theories to practice, and one participant said their experience

"… was only ever conceptual. It was only ever theory based. It was never something we did in a project. It was nothing we had ever had practice with."

Although one group felt that their final year projects were requiring them to develop these skills anyway.

It also became apparent that a few participants had not undertaken a placement in the third year of their course and that they lacked a vital understanding of how companies operate and how to operate professionally as a designer/engineer.

Meetings with senior managers of SMEs in which the idea of graduate consultants was explored from an industry viewpoint provided invaluable information to the project. These exploratory meetings identified four key concerns: 1) the time taken by the graduate consultant in providing appropriate solutions to their design problems; 2) whether the graduate consultant would be able to adjust to the organisation from a cultural perspective, this concern was related to the graduate being perceived as doing someone else's job; 3) for an SME, offering consultancy on Lean Sustainable Design might be seen as being too narrow – the expectation here is that the graduate should offer a wider portfolio on which s/he could consult; 4) that businesses know that they must give consideration to sustainability issues but responding to the customer demands of today, and despatching orders, will always be seen as more important.

6   CONCLUSIONS

The output of this investigation has been the development and refining of the required content of a CPD course aimed specifically at 'about to be' graduates from BA/BSc Product Design; BSc Design

Engineering and BSc Computer Aided Product Design courses at Bournemouth University. The aim of the course was to prepare them for undertaking graduate consultancy as described in this paper.

Due to a lack of experience and confidence it was decided that only students who had undertaken a placement should be eligible to become graduate consultants. The course ran over three days during the Easter vacation. Day 1 focused on lean design, Day 2 on sustainable design and Day 3 focused on ensuring the students were prepared for their role of consultants and understood what is expected of them in this role. The learning and teaching method utilised lectures for delivery of missing theories followed by group work applying the theories to real life products. This was achieved by using the students final year projects as case studies and working in pairs, simulating the client/consultant relationship undertaking a lean sustainable design analysis on each others' final year projects, culminating in a presentation of that analysis. This format was determined based upon the fact that participants in the focus groups had expressed a significant need for experience in applying theory to practice. This enabled missing theories/concepts in sustainable design particularly related to the socio-centric dimension but also to clarify application of tools and techniques related to the eco and techno-centric dimensions – this was done through the use of two web-based resources www.informationinspiration.org.uk and www.sociocentricdesign.com .

The model outlined here offers SMEs access to high level skills in an affordable and flexible form, tailored to their requirements which none of the other models, such as KTPs, traditional or mini, or undergraduate or graduate placements can offer. This model offers graduates who already have at least 40 weeks work experience as designers, with knowledge of lean sustainable design, supported by experienced academics. Additionally, as the graduates are employees of the university they can access the staff and physical facilities available at the university, therefore providing an opportunity to open the consultancy to almost any discipline.

An idea that was suggested by participants was to set up a web based resource to which they could refer when acting as consultants for sources of further information – this idea will be further investigated.

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