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Identifying key competences of industrial design and technology graduates in small and medium-sized enterprises

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Abstract
Industrial design graduates can be true 'agents of change' in manufacturing industry and nowhere is this potential more valuable than in Small and Medium-sized Enterprises (SMEs) where flexibility and speed of response are essential and which make up 94% of the UK economy. However, little research exists which examines the people - the initiators of change - in the light of emerging needs of SMEs in the UK. There is a huge potential amongst the SME sector to capitalise on industrial design graduates but for a number of reasons their skills and values are not fully exploited. With a growing higher education (HE) sector in design and related studies and a growing industrial base of SMEs there is an important need for research which would (i) help industrial design graduates secure employment in this significant element of the UK economy; (ii) assist HE with curricula development relevant to the needs of SMEs and (iii) help SMEs to harness the skills of industrial design graduates.

This nine month project, which began in January 1999, seeks to address these points via a study of industrial design graduates employed by SMEs. 12 SMEs have been identified and each has employed, for a minimum of two years, a graduate from the Industrial Design and Technology BA/BSc programme offered by the Department of Design and Technology at Loughborough University. Particularly important to the research is the existence, manifestation and exploitation of 'competences'.

Keywords: industrial design, graduate employment, competences, curriculum development

Introduction

This paper introduces a research project which seeks to identify the contributions which graduates of the Department of Design and Technology have made to small and medium-sized enterprises (SMEs) in recent years. The project, entitled Graduates into Small and Medium-sized Organisations (GISMO), identified 12 organisations, each employing less than 120 people, who became the focus for the studies. Each organisation employed at least one graduate of the Industrial Design and Technology degree programme offered at Loughborough University. Each study consisted of a questionnaire to senior managers and the graduate concerned plus follow-up focused interviews. The nine-month project, which employed one research associate, is currently at its mid point and this paper addresses three central questions:

- Why should the SME sector of the British economy, and particularly that concerned with manufacturing, be of particular interest to design programmes within Higher Education Institutions (HEIs)?

- How can HEIs identify relevant competences in their graduates and, particularly, what research methods might be most suitable?

- What are the implications of the research findings for curriculum development at Loughborough and, more widely, what are the implications for undergraduate industrial design education in other HEIs?

The inquiry was instigated by anecdotal evidence, accumulated over several years, that

the industrial design graduates at Loughborough University were making contributions which exceeded the initial expectations of their employers. If these various skills, attitudes, competences and values could be identified and their application documented then they might be useful to all design graduates as they sought and established themselves in employment. Furthermore, it became clear that the manufacturing sector of the economy was dominated by SMEs. They make up approximately 94% of companies engaged in manufacturing in the UK and it was apparent that they potentially provided a significant pool of employers of design graduates. However, SMEs have their own distinctive business priorities and it was likely that there would need to be a two-way dialogue if more design graduates were to find employment with SMEs. Clearly there needed to take place some illumination and dissemination of current good practice and therefore the 12 case studies facilitated an articulation of the key competences which had been developed before, during and after, undergraduate design education. It was also perceived that various modules could benefit from the experiences of graduates and their employers and thus the findings are intended to assist later curriculum development within the Department.

Aims and Objectives of the GISMO Project

Aims: To provide information which would:

i. enable graduates to market themselves more effectively and successfully - particularly in small and medium sized manufacturing enterprises in the British economy

ii. illuminate the potential advantages for an SME in employing a graduate of the Industrial Design and Technology degree programme at Loughborough University

iii. enable the Department to undertake appropriate curriculum development to further address the expectations of graduates of the Department and employers in the SME sector.

Objectives:

i. to identify 12 relevant SMEs and graduates of Industrial Design and Technology for the research

ii. to identify new and emerging needs of SMEs which undergraduate design education may be in a position to address

iii. to identify key competences, skills, values and attitudes in those selected graduates via an appropriate programme of research

iv. to disseminate these key competences to graduates, SMEs and to the wider research community concerned with design education

v. to facilitate appropriate curriculum development - initially at Loughborough but ideally involving other HEIs.

The Need for the Research

Design education has emerged as a major aspect of higher education (HE) provision. Demand for places is high from potential students who see strong employment opportunities. The 'old' and 'new' university sectors in Britain have a world-wide reputation for developing competences with broad and flexible applications through design education. Many of the ways these competences are developed and combined are unique to design education (see Samuels 1997). Industrial design graduates, particularly, can be true 'agents of change' (Hawkins and Winter 1997 p47) and nowhere is this potential more valuable than in SMEs where flexibility and speed of response are essential. However, little research exists which examines the people - the initiators of change - in the light of emerging needs of SMEs in the UK. There is a huge potential amongst the SME sector to capitalise on our innovative industrial design graduates but for a number of reasons their competences, skills, values and attitudes are not fully recognised. With a growth in undergraduate design courses and a growing industrial base of SMEs there is an

urgent need for research which would inform the interface between them and match curricula to the nature and needs of SMEs.

The central thesis to the research proposes that certain qualities of a first degree in industrial design are valuable but ill-defined and poorly exploited by the SME sector. While new research into this phenomenon has begun (notably at the University of Central England in their 'Reflections and Destinations' project) little information currently exists to test this thesis. This lack of information, which is partly a consequence of the relative youth of design as a degree subject, has a number of effects:

- it provides a barrier to employment of design graduates in SMEs

- it restricts the take-up and exploitation of relevant competences in a wide range of SMEs

- it hinders any real development of a relationship between HEIs and SMEs and consequently this limits appropriate university curricular development in design and related subjects.

Innovation and SMEs

Not only are SMEs significant for job creation, research has linked the success of SMEs to improving national economic growth (Storey 1987). By their very size, SMEs have the potential for flexibility. Generally, they can adapt their particular business activities more easily than large companies. They can respond to market changes more speedily than can those who carry larger stocks of materials or who have large commitments in production. This is not to say they are more economically secure since economic statistics highlight the vulnerability of SMEs - particularly in financial matters such as debt recovery and cash-flow. Rather, the potential for flexibility enhances an organisation's ability to adopt an innovation-focused culture. In the absence of business advantages accruing from size then the ability to harness the methods and procedures of an innovation culture is likely to be one of the most significant factors in economic success for an SME. If innovation

is so important to SMEs engaged in manufacturing industry then this has implications for the personnel profile it requires and it is here that industrial design graduates may be able to make a contribution.

For SMEs to be successful and grow they need to be innovative - with tangible evidence seen in, for example, superior new products or services; new methods of operation resulting in improved market position or increased profits leading to growth. Proactively pursuing innovation is important to competitiveness but many SMEs struggle with this. Partly the problems are the result of limited or costly availability of capital to finance research and development but, perhaps more importantly, many of the problems stem from the limited skills base within SMEs. The Small Business Research Trust recently highlighted the lack of skilled and trained personnel in SMEs and identified this as one of the significant business problems for companies of this size (Dale 1994). SMEs can fail to recognise that they have a skill shortage problem and even where this is perceived it is often viewed as a shortage of low to intermediate skilled production workers rather than highly skilled professionals (Scott et al 1995). It would seem that in order for SMEs to improve their competitiveness then changes to established attitudes may be necessary. One possible way for SMEs to improve their situation would be to increase their skill pool via the employment of graduates who matched the particular needs of the sector. Research by the Advisory Council on Science and Technology (ACOST, 1990) has shown that one of the most direct routes of acquiring expertise in UK companies is through employing science, engineering and technology graduates. Bosworth and Wilson (1993) have also identified a direct link between the employment of qualified scientists and engineers and an improvement in a firm's economic performance. Generally then, there is some evidence to suggest that employing a graduate can, potentially, allow SMEs to improve their knowledge and performance; to update their business and technology skills and to confront the issues of an innovation culture. However, there is much less evidence to substantiate the particular benefits of employing an industrial

design graduate and hence the establishment of the GISMO project. What is needed is a survey of those SMEs who have employed an industrial design graduate. Such research could explore the relationship between the particular competences of industrial design graduates and the particular requirements of SMEs in the manufacturing sector.

While large enterprises are the traditional graduate recruiters, with many taking on a set number of graduates each year, increasing graduate numbers over recent years has meant that larger organisations have not necessarily been able to maintain their proportion of available graduates. There has grown a surplus of graduates in the labour market, which SMEs could exploit to their advantage. Less than 1 in 4 SMEs currently employ graduates, compared to 80% of large companies (Hawkins & Winter 1996). Studies into why SMEs have been reluctant to employ a graduate have revealed concerns about the cost and expectations of graduates; their immediate usefulness and the relevance of the graduate's education. In other cases, managers in SMEs have not been aware that they require graduate level skills; they have not been acquainted with the competences of graduates or they have been unwilling to let a recent graduate exercise responsibility in established practices (Binks 1996).

Where SMEs have been willing to employ a graduate then they have specified that graduates be able to work effectively within a small business environment. SMEs need employees that are flexible, innovative, possess problem solving skills and have an ability for independent learning. Employees in SMEs often have to function in multiple roles and good communication skills are important for working efficiently. Unlike larger organisations there is rarely an induction programme in SMEs for graduates, meaning that graduates in SMEs do not receive the type of on-the-job training which can prepare them to be an effective employee. Understandably, SMEs often focus on their short-term business needs - requiring someone immediately, rather than recruiting for longer term goals. Therefore SMEs would also expect graduates to make an immediate contribution to the

organisation. All this means that the graduate cannot rely on their specific degree knowledge to be successful in an SME. They will also need to possess a range of personal skills and competences to complement their academic ability. Clearly HEIs will need to re-examine how they are preparing future graduates for employment in the SME sector and update their degree programs where necessary. These initial findings, from earlier work and from a literature survey assisted the design of the questionnaire and the interview schedule which are discussed in the next section.

Methodology

The project adopted a case study method of investigation. Approximately 100 letters of invitation to take part in the research were distributed to graduates of the Industrial Design and Technology programme. From the replies, 12 graduates and their respective SMEs were selected. Three of the graduates were female with the remainder being male. In each case the graduate had been in continuous employment with that SME for at least one year. The earliest year of graduation was 1988. Most of those involved in the research had between three and six years of professional experience in total since graduation. It was anticipated that all the SME managers would have substantial experience in their (and perhaps other) organisations (i.e. in excess of 3 years). The limited number of replies from graduates in appropriately sized organisations largely determined the selection of the case studies but where choices had to be made the criteria included evidence of successful product innovation in competitive markets; evidence of good management practice regarding employment of graduates and the perceived importance of innovation and creativity across the organisation.

The case study approach potentially offered a richness of information relevant to the illumination of phenomena and it was this capacity which was valuable to the project. Each case study consisted of between two and four semi-structured interviews preceded a week earlier by a questionnaire to all interviewees. These offered flexible and adaptable research tools and the protocols for

using the technique are well established (see, for example, Cohen & Manion 1989). The use of qualitative as opposed to quantitative data can be of real benefit to such illuminative research (see Powney & Watts 1987). A transcript was made of each interview. The analysis documented commonalities between interviewees within SMEs; commonalities across SMEs and unique findings regarding competences of graduates.

The questionnaire sought responses to five sections which were intended to illuminate the quality and extent of competences including skills, knowledge, attitudes and values of the Loughborough graduate in five different but related fields. A copy of the same questionnaire was completed by the graduate and by one of the senior managers in the SME facilitating a comparison of the potentially different perceptions of the graduates' competence in the five fields. Each section asked respondents to rate their level of agreement with approximately 10 statements by placing a tick in one of five boxes ranked between strongly disagree, disagree, don't know, agree, and strongly agree. For each of the five fields, these questions were followed by two or three further questions which would become the starting points for the interviews. In each interview these were supplemented by further questions about the particular SME; the graduates feelings about the strengths and weaknesses of the course and more general questions concerning the match between competences and demands. It was felt that the advance warning of these interview questions would be helpful to the interviewees and would better focus the discussions. Questionnaires were completed and returned prior to the interviews and analysis of these assisted the construction of particular questions relevant to each case study. All the interviews took place in April or May 1999. Some interviews consisted of one group meeting while others were conducted as individual interviews and this was directed by the availability of staff within the SMEs. Each interview was recorded on cassette tape and a transcript of each interview was produced for later analysis.

The fields/sections were:

i Communication-related competences

This section was concerned with relationships and communication within and outside of the organisation and included written, verbal and graphic communication. Questions also explored the effectiveness of the graduate in explaining and 'selling' ideas; directing and managing others and working as part of a team. The follow-up questions were: *What communication or relationship skills did you expect before the graduate took up the post?* and, *What communication or relationship skills do you think s/he could have developed before employment?*

ii Practical competences

This section sought responses on the graduates' competences regarding the use and working of resilient materials. It required judgements regarding the ability to use tools and machinery, to understand material properties; to exploit relevant processes and to achieve a high level of finish. The follow-up questions were: *What practical skills, knowledge and competences did you expect before the graduate took up their post?* and, *What practical skills, knowledge and competences do you think could have been better developed before employment?*

iii Management competences

This section inquired about gathering, organising, administering and managing information. It asked respondents to rate the graduates' ability to manage their time and to manage several jobs at once. It also asked about their ability to assess the quality of their own work and that of others including their contribution to teamwork. It asked about the ability to be proactive and self-reliant plus the effectiveness of negotiating skills. The follow-up questions were: *What management skills, knowledge and competences did you expect before the graduate took up their post?* and, *What management skills, knowledge and competences do you think could have been better developed before employment?*

iv Innovation competences

This section was concerned with innovation, creativity and problem-solving. It asked for judgements on the graduates' effectiveness in perceiving and articulating problems; offering

creative interpretation to existing problems and making quick and effective assessments. It also inquired about graduates ability in developing their own ideas and the ideas of others. The follow-up questions were: *Have you used your problem solving skills outside of your role as a designer?* and, *How useful have these skills been outside of the design function?*

v IT competences
As well as direct skills and abilities with hardware and software this section sought responses regarding the graduates' competence to identify the future IT needs of the SME with regard to product research and development, management, communication and marketing.   The follow-up questions were: *What IT competences do you think are most important for your function within the company? What IT competences did you expect from the graduate before employment?* and, *Which IT competences do you think could have been better developed?*

Findings and Discussion to Date

At the time of writing only a few of the case studies had been completed and the conference presentation will provide a more comprehensive review. Nevertheless a number of important observations emerge already.   A nucleus of competences are developed by undergraduates and these have been further improved during employment. Graduates were found to meet employers' expectations but there is room for improvement. Employers expect to play a role in developing graduate competences but also expect graduates to make a contribution from day one.

Communication-related competences

Interview transcripts reveal that graduates possess good presentational skills and knowledge plus the ability to get the point across quickly - which is seen as important in some instances. Also found to be important was the clarity of communication, particularly in teamworking and in presentations. Graduates stated the importance of confidence and highlighted the role of

Loughborough University in providing an appropriate environment for building the confidence needed to be an effective communicator. Inexperienced graduates potentially lacked the ability to judge the appropriate style of a presentation - particularly in client presentations. Often they were too formal or too informal and employers thought that preparation here was important. For example, some knowledge of the psychology of meetings and body language could be advantageous. Sketching skills were viewed to be vital to teamworking:

'I have experienced many levels of the use of sketching. One extreme is a team standing around a table arguing and all rapidly sketching to aid communication. Nobody outside the team could have sensibly followed what was going on but the ideas were evolving very quickly and the result was work that was of a higher level and done very, very much quicker than any one of the team could have hoped to do on his own. The sketch sheet was very untidy and very full but very valuable. Sketching, and especially using it for team communication, is a very efficient and high quality tool, even though it may not look high tech. Simple is often best.' (Woolston, April 1999)

Practical competences

Managers in the SMEs indicated that they expected design graduates to be able to make convincing models and at least know how to use hand tools, if not be proficient in the use of machinery. Overall it was found that managers were happy with the general level of practical skills but were prepared to spend time further improving these skills.

Discussion relating to better developing the graduates' practical abilities indicated that the graduate could have been more knowledgeable about manufacturing processes, and it was proposed that guest lecturers visiting from industry may be able to provide more detailed and recent knowledge concerning the selection and use of various manufacturing processes.

Management competences

Initial findings reveal that SMEs did not expect highly developed team management competences from design graduates. In junior design related positions these may not be directly applicable but people management skills and knowledge can be of benefit to the graduates' wider career directions. However, it was felt that graduates could have better abilities with project management and time management, with more emphasis in HE on teaching the application of time management techniques. Also it was felt that students could be better prepared for working to short-term deadlines - turning round projects very quickly. It was suggested that more projects with short, sharp deadlines may usefully prepare students for the pressures of working in industry. Of paramount importance to SMEs is the ability of graduates to be flexible and to be able to manage the activities of more than one job.

Innovation competences

Particularly important to the interviewees was the existence, manifestation and exploitation of creative skills. It is anticipated that such skills will be found to have application in more than 'new product development'. Creative skills may manifest themselves in innovative production and assembly decisions, sales and marketing interpretation or more generally via communication or interpersonal relationships. It is this broader application of innovation skills and knowledge which is presently ill-defined and undervalued but which is perceived as essential to the successful working of SMEs.

Creative, problem solving skills were viewed as central to the role of a designer. Evidence was found that problem solving skills, taught and developed during undergraduate study, have been of the utmost importance to the success of graduates in and outside of the design role. One graduate put his success down to being able to creatively solve problems - an ability he attributes to his education at Loughborough. Many graduates rated themselves as poor researchers and would now view researching skills as an important aspect of design education.

Competence with Information Technology

Initial findings reveal that employers vary considerably in their expectations of graduates' information technology skills. Graduates indicated that they valuably progressed in this area - in some cases from a low level of knowledge and ability before university. Employers suggested that more emphasis could be placed on developing 3D computing skills in undergraduate industrial design because SMEs found it an expensive undertaking to send a graduate on a 3D modelling course.

Overall, graduates felt that Loughborough University had prepared them well for their careers, enabling them to obtain employment. However, as some graduates did not obtain employment as designers it was felt that undergraduates could be better prepared for obtaining work outside of the design role. Graduates need to be taught the value and application of their skills outside of design. Also it was felt that students could usefully gain more guidance from professionals in industry: for example, the expertise of a professional injection moulder, or lectures by a representative of the British Tool Makers Federation, which SMEs felt would have been advantageous to the company and would have helped with the graduate making more of an immediate contribution. In the long term, employers indicated that design graduates have provided them with skills and knowledge they did not possess allowing the company to explore and expand the business into new areas which, without the graduate, might not have been possible.

Conclusion

The importance of innovation to British industry has been promoted for many years. The Department of Trade and Industry (DTI) has established an Innovation Unit and recent conferences, such as 'Breakthrough Innovation for New Product Development' held at the Kensington Palace Hotel, London (1996), and which attracted leading industrialists, have proposed an important relationship between the management style and workforce skills within SMEs and their

ability to generate market-leading innovative products. Furthermore, the importance of SMEs to the national economies within the European Union has been widely recognised. However, the necessity for HEIs to address the relationship between competences developed as a result of industrial design education and industrial enterprise has been less well acknowledged. Young graduates can bring a great deal of creative skill to all kinds of enterprises but few studies have achieved a clear understanding of the contribution which innovative and creative employees can make to business and industry. Those that exist concern the absorption of graduates into distinct and well established domains within large organisations but it is in the SME sector where specific contributions can be made. These contributions remain ill-defined and research is needed to document their existence, to promote their benefits to SMEs and to encourage their development in higher education.

Graduates of Industrial Design and Technology at Loughborough have a proven ability for innovative and creative work in the field of design. Graduates from the Department of Design and Technology have been employed by organisations which are household names such as Hoover, Xpelair, JCB, and Dyson. Less well known is the important role that young graduates have played in smaller design-based or innovation-driven companies. Often it is these companies with fewer than 100 employees who require a broad range of skills and abilities from graduates. They demand that creativity and innovation underpin not merely those activities associated directly with new product development but other less obvious activities such as information handling, evaluating policy, implementing decisions, specifying, negotiating, presenting and other interpersonal skills.

The GISMO project is documenting the manifestation of well-managed creativity in successful and competitive SMEs. It presents new knowledge regarding both the changing

demands of smaller businesses and the economic value to SMEs of industrial design graduates. The project provides HEIs with information on which to base curriculum development. It will, hopefully, identify the value of, and new priorities for, innovation education in HE institutions.

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