Industry Input into the Education of Undergraduate Engineering Students through Sponsorship*

FAKHTEH SOLTANI
Engineering Centre for Excellence in Teaching and Learning, Loughborough University, Loughborough, UK and Department of Computer Engineering, Faculty of Engineering, Arak University, Arak, Iran. Email: F-soltani@araku.ac.ir

DAVID TWIGG and JOHN DICKENS
Engineering Centre for Excellence in Teaching and Learning, Loughborough University, Loughborough, UK.

There is a lack of high quality engineers entering industry. In addition to this, the rate of producing new generations of engineers is failing to cope with the changing demands of employment. Further development of the relationship between higher education institutions and industry is needed to avoid crucial impacts on the productivity and creativity of businesses. Sponsoring students and degree programmes is a successful example of university-industry collaboration which can be an effective way of ensuring that sufficient graduates with the right knowledge and skills enter industry. It enables employers to maintain a close relationship with students and university departments as they will be involved in the education and initial training of engineers. The results and methodology of a research project being undertaken to determine the influence of industrial sponsorship on students, academia and employers is presented. The results of a series of students, academics, and employers' surveys are also presented. Conclusions are drawn on the outcomes of sponsorship for academics, employers and students.

Keywords: industrial sponsorship; employers-students links; engineering education; professional skills

1. Introduction

Engineering is about the application of scientific knowledge in a business context to produce an economic output. As industry plans to meet the technical challenges of the 21st century, there is a need to focus on the people who are the most important part of the industrial systems. Today, the business world more and more requires engineers who can design and deliver products and complete solutions relating to complex systems. Employers of any size need engineers, who are professionals to guide the industry to a successful future. This highlights the role of engineers in society and developing a successful economy and indicates the need for a more 'professional' higher education with a stronger focus on key skills and sustainable links with industry [1–3].

Engineers need technical knowledge and skills, and the ability to apply their knowledge. Engineers also require the ability to work in globally distributed teams across different cultures [2, 3]. Engineering education involves the development of critical thinking and problem solving abilities in students. Engineering education organisations should enhance the learning experience of students and provide an environment to prepare the students to obtain the knowledge of facts (knowing what) and the skills (knowing how) for lifelong learning [4, 5].

In fact, undergraduate education is the point of departure from which engineering graduates either enter in the world of work or continue their studies through postgraduate courses. Therefore, academic staff should play a key role in preparing the graduate for the 21st century and students must know the way the world around them works and be able to contribute to the society responsibly [6–8].

In addition, industry needs to increase its investment in engineering education. The Lambert Review [9] showed that companies are considerably more successful if they use universities and other higher education institutions as a source of information or as a partner. Therefore more effective and closer collaboration between industry and university engineering departments is essential for preparing new employees [1, 2, 10]. The collaboration provides the opportunity for universities to recognise the changing requirements of industry and ensure that graduates have the required skills. Successful collaborations have extensive rewards for both parties, in addition to the benefits generated for the economy from technology transfer [1, 2, 11].

The teaching of transferable skills and the involvement of industry in the education of students have been a high priority in the UK for a number of years and the needs for closer relations between industry and universities have been highlighted in various government white papers and reports [1, 2, 9].

This paper is a part of a research which considers the use of real learning spaces and support in both universities and workplaces and how they impact on

student knowledge and attitudes. It paper presents the analysis of a subset of the data obtained from students, academia, and industry, as well as the relevant literature reviewed in order to answer the following research questions:

- Is there a link between influence on the curriculum, student skills and programme quality?
- How does industrial sponsorship influence learning outcomes of degree programmes?
- What impact does sponsorship have on student employability?
- How students' awareness of sponsorship could be increased?

1.1 Sponsorship

The term 'sponsorship' has many meanings. Klincewicz defines it as: 'an agreement, in which the sponsor undertakes an action with economic nature for the sake of a sponsored subject' [12]. Sponsorship is a two-dimensional relationship which involves mutual benefit to both sponsors and sponsored. In fact, successful sponsorship is concerned with achieving a return on objectives and investment [13].

In education, sponsorship is financial assistance provided by a sponsor in the form of a salary, bursary, award or allowance during the course of study. Sponsors mostly offer sandwich courses or industrial placements and provide opportunities for the students to gain work experience and professional training throughout their degree studies. Sponsorship could help students to complete their university course without going under huge amounts of debt. The student finance has been an important issue for many years; however, sponsorship as a source of student earnings has rarely been debated. Sponsorship schemes are offered by a range of organisations but industrial sponsorship is the most common type and some degrees such as Engineering, IT, Physics, Chemistry and Business related courses attract more sponsorships than others [14, 15].

1.2 Aims and objectives

There has been considerable debate on the need for greater interaction between industry and universities. It is a requirement of accreditation by professional bodies for industry input into the curriculum and also exposing students to contact with industry either within the taught elements of their programmes or on work placements enhances student learning [1, 2, 9, 16].

This project has investigated industry input into the education of undergraduate engineering students through the sponsorship programmes and the role of sponsorship in contributing skill gaps in engineering graduates. It aims to determine how a long term relationship between students and employers improves the education of undergraduate engineering students and examines engineering students' achievements of sponsorship.

2. Methodology

The research captured existing practice across sponsored and non-sponsored undergraduate degree programmes within the Faculty of Engineering at Loughborough University together with a number of national and international schemes. It employed both qualitative and quantitative methods to collect and analyze data. A range of different groups of students with and without sponsorship (including placement students) have been chosen to compare their views about sponsorship and the long term relation with industry.

A group of 669 undergraduate students in the Civil and Building Engineering, Mechanical and Manufacturing Engineering, and Systems Engineering were surveyed. The total number of students who completed the questionnaire was 448, giving an overall response rate of 67%.

Thirty four senior managers in major companies in construction, mechanical and manufacturing engineering, and systems engineering took part in the research. Twenty eight of the companies offer sponsorship to students and 6 do not offer sponsorship but do employ students for a year out placements. The academic staff at engineering departments in Loughborough University and the industrial liaison officer in the faculty of Engineering in Loughborough University were also invited to take part in this research to express their views on sponsorship.

Several sources of evidence were used to obtain multiple measures of the same phenomenon and triangulation was used to utilize how the research findings match with each other. Interviews, observations, review of the documents, and questionnaires were exploited to gather evidence from multiple sources such as different groups of students in different years, academic staff and employers.

3. Results

The data presented in this paper are a subset of those gathered from:

- first and final year Civil Engineering and Systems Engineering students at Loughborough University;
- final year Civil Engineering students at Southampton University;
- final year Civil Engineering students, sponsored

through the Institution of Civil Engineers Quest scheme;
- senior academic staff across the faculty of engineering in Loughborough University; and
- companies in construction, mechanical and manufacturing engineering, and systems engineering disciplines.

3.1 The stakeholders' views on the long term sponsorship

This research revealed that the participating parties are positive about the benefits of sponsorship as in today's world:

- employers need access to highly qualified graduates who can perform at high standard in order for them to survive in the competitive business world;
- universities need more contact and feedback from employers in order to recognize the frequently changing requirements of industry and hence update their programmes; and
- students need to access the work environment as early as possible during their degree studies to develop their professional skills over the years in order to be 'marketable' and keep their skills level as high as the industry needs.

The stakeholders all agreed that sponsorship adds value to the education of the undergraduate engineering students and dispel the belief among the students that engineering is no longer a viable career.

3.2 The impact of sponsorship on graduates' skills and degree programmes quality

Universities have many different ways of linking students to employers. Work experience for students is organised in different ways, ranging from programmes providing students with short term placements to programmes providing them with four years of sponsors' support. This research aims to identify the impact of integrating 'long term' relationship of up to four years into the students' university experience. Being sponsored by a company is a good opportunity for students to spend time in the company during their vocational placement and summer work to develop their

skills. Several years experience put the sponsored students ahead of the graduates who have not been in industry. The employers stated that the sponsored graduates have better knowledge of engineering disciplines and a greater ability to apply theory in practice, both of which are very important skills in preparing graduates to face real world challenges.

The following section provides the academics and employers' perceptions of the impact of sponsorship on the quality of degree programmes. The interviewees were asked about the number and quality of graduates and how they think that offering sponsored undergraduate programmes would improve the quantity and quality of graduate engineers and the quality of university programme. The results (Table 1) show that there are not sufficient graduates available in some disciplines to meet industry's needs.

In addition, the interviewees stated that in some areas employers feel the quality of available graduates is not sufficient to meet their specific industry needs. These findings are in line with other studies of recruitment which revealed that many employers had difficulty in filling positions in the engineering related areas [2, 7].

The interviewees agreed that sponsorship provides employers to opportunity to influence on the curriculum, which would noticeably improve the quality of graduate engineers and university programmes (Fig. 1). The degree courses or modules that had been jointly developed between industry and university are examples of best practice in education of the undergraduate students. These courses could be a solution to the problem of skill shortages and the lack of appropriately qualified graduates available for recruitment.

3.3 Sponsorship support of students learning

The learning cycle suggests that it is not sufficient to only have experience in order to learn. It is necessary to reflect on the experience to make conclusions and formulate concepts which can then be applied to new situations. The learner must make the link between the theory and action by planning, acting out, reflecting and relating it back to the theory [17].

The sponsorship schemes facilitate students

Table 1. Academia's view on the quality and quantity of graduates

Department	Are there sufficient graduates available?	Is the quality of available graduates satisfactory?
Civil & Building Engineering	No	Yes
Electronic & Electrical Engineering	No	Yes
Mechanical & Manufacturing Engineering	No	No
Aeronautical & Automotive Engineering	No	Yes
Materials	No	Yes
Chemical Engineering	No	No

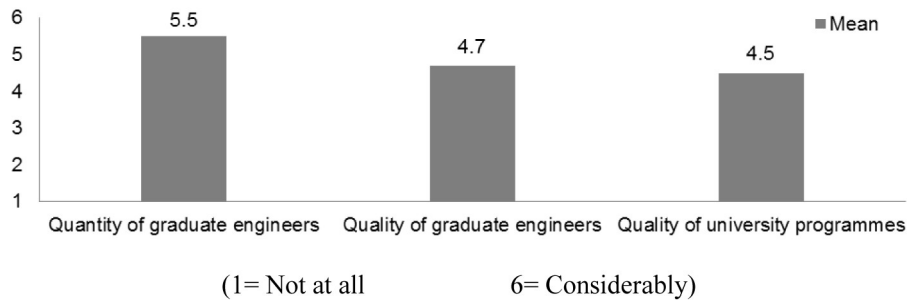(1= Not at all   6= Considerably)

Fig. 1. Impact of the sponsored programmes on students and department (Mean).

learning by enabling them to learn from their experiences. During sponsorship, students take activities which include the four phases of Kolb's experiential learning cycle so that students would engage in a continual cycle of experiencing, examining, explaining, and applying.

This suggests that sponsorship could play an important role within the Kolb learning cycle, allowing students to reflect on their experiences and use feedback from tutors and supervisors to process their ideas, take ownership of them and integrate their new ideas into future assignments.

It should also be bore in mind that the aims of any work-place learning need to be set out to support students to achieve learning outcomes of their programmes.

The students agreed that sponsorship has supported the achievement of the following learning outcomes of their programmes quite a lot: the management of projects; leadership skills; use field equipment competently and safely; observe, record, process and analyse data; apply knowledge in a professional environment; communicate effectively; and work in a team environment. The results indicate that overall respondents have a high awareness that their links to a sponsor have a major impact on the development of the learning outcomes linked to employability skills.

3.4 Sponsorship support of employability skills

Lack of communication, team-working and interpersonal skills are common weaknesses in graduates

entering to industry [18]. This section explores the role of sponsorship on helping students to gain these skills and preparing them for the workplace. In order to identify what the employers expect from new graduates, the participants were asked to rank on a scale of 1–6 (1 = Not important, 6 = Very important) how important each of the following is in offering job to a candidate: team working, personality, motivation, communication skills, professional skills, and academic reputation of university.

As shown in Fig. 2 behaviour factors are just as important as technical and theoretical factors. This highlights the importance of a long term relationship between students and industry as it could help the employers to monitor and choose their future employers and help students to prove their personalities and abilities to work in professional settings.

Figure 3 compares the important factors that employers consider when offering a job to a candidate with the students' perception of how sponsorship contributes to the development of these factors. As the figure shows, the students stated that sponsorship has a positive effect on team working, communication and other professional skills, as sought by employers.

These findings are in line with the findings from the CBI report [8], which revealed employers strongly value employability skills and positive attitudes. Students and universities should be aware of the importance of these skills, which make graduates more employable after graduation.
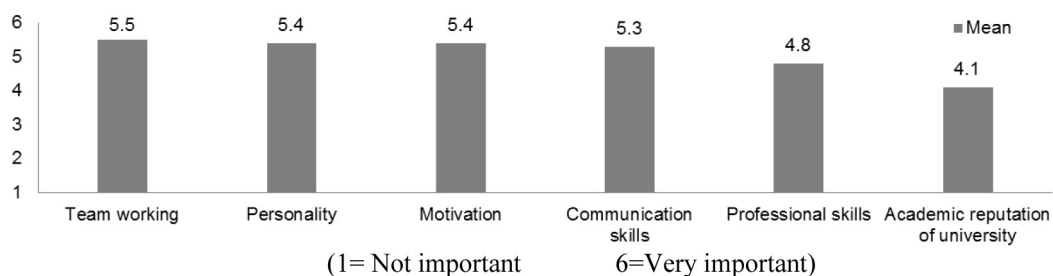
Another issue revealed by the recent studies [16,

(1= Not important   6=Very important)

Fig. 2. The importance of different factors in offering job (Mean).

Work in a team environment

The management of projects

Leadership skills

Communicate effectively

Apply knowledge in a professional environment

—◆— The importance of different factors affecting employers' decision in offering a job to a candidate (Mean)

—■— Students' perception of sponsorship support of the selected learning outcomes (Mean)

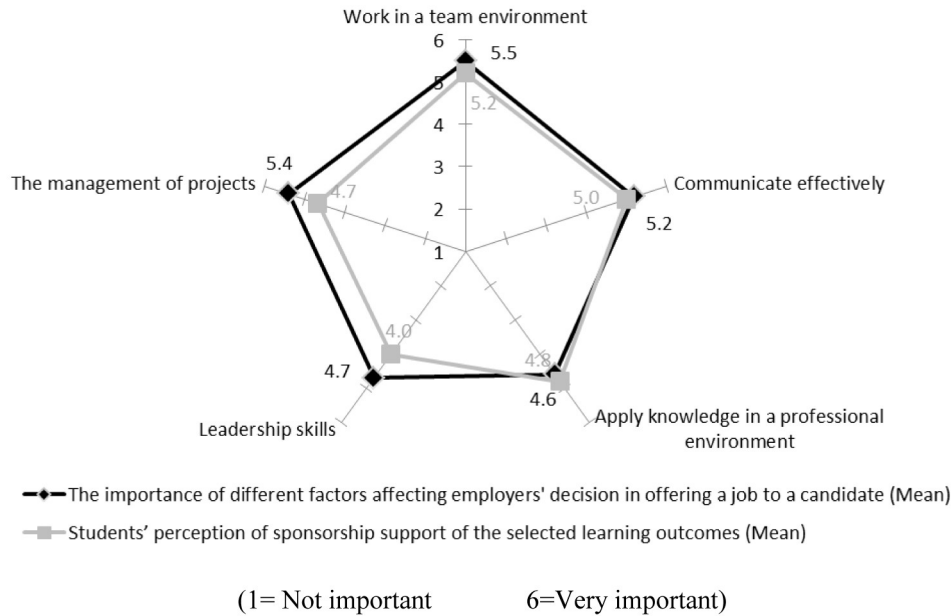(1= Not important   6=Very important)

Fig. 3. Sponsorship support of employability skills (Mean).

19] is that many engineering graduates have little desire to take up an engineering career. The results of this research show that being sponsored by a company means that they are more likely to take employment in engineering (Fig. 4): 65% of the sponsored students will accept a job offer they have received and stay with their sponsoring companies, while 25% have not decided yet and 10% will not accept the offer. The results for non-sponsored students are 43% will accept the offer, 46% have not decided yet and 11% will not accept the offer.

Of those sponsored students who will not accept the offer or have not decided to accept the offer only 9% stated that they will move out of engineering while the result for the non-sponsored students is 20%. There is huge competition in the market for bright graduates and this research illustrates that the number of sponsored students is affecting the number of graduates available for employment by other companies. Non-sponsoring employers could face increased recruitment difficulties in particular areas.

3.5 Students' awareness of sponsorship

Despite all the benefits of sponsorship, the results of the students' survey revealed that 23% of students did not apply for sponsorship when it was available. Therefore, the student awareness of the benefits that accrue from sandwich training and financial aid availability needs to be increased. This section looks at the interviews and responses to an open-ended question within the survey which invited respondents to say what might be done to increase students' awareness of sponsorship.

The employers stated that the university has to do more advertising on the website, at open days and in the prospectus to increase students' awareness of sponsorship. The university should develop an
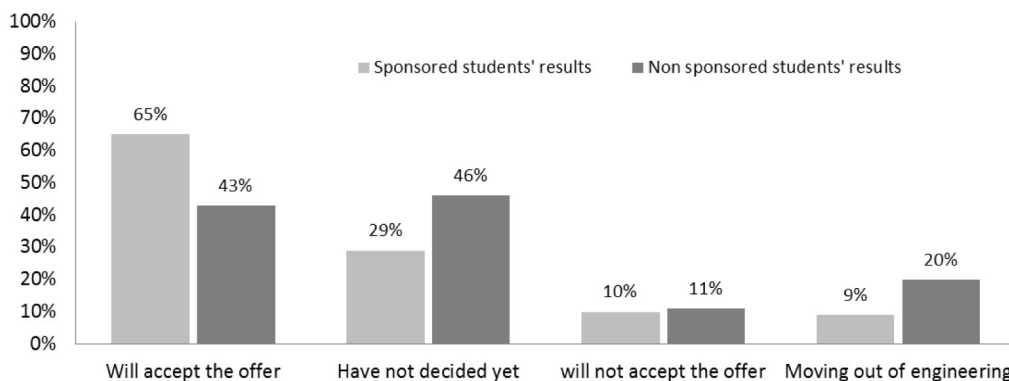

Fig. 4. Students' decision regarding the job offer.

Table 2. Crosstabulation of awareness of the scheme and understanding of the scheme

		Understanding of the scheme					
		Very unclear	Unclear	Slightly unclear	Slightly clear	Clear	Very clear
Aware of the scheme before	No	0%	14%	29%	43%	14%	0%
coming to university	Yes	0%	3%	5%	12%	**74%**	**6%**

expectation amongst students that they should seek sponsorship and/or industrial placements, by direct promotion during University open days and lectures. It should be seen as essential that students link themselves to companies if they want to be competitive in the graduate job market. Companies could join the effort and put the information on their websites and brochures. Students should also find out about it themselves by linking with good career advisors. More advertising at schools and in national newspapers before students choose their universities could be very helpful. As Table 2 shows, students would have better understanding of sponsorship, if they were aware of it before coming to university. This could generate more application for the sponsorship schemes.

4. Discussions

Amongst the most important findings of this study were the close views of the students, industry and the academic staff on the sponsoring of undergraduate engineering students. Also there was no significant difference according to demographic factors such as different engineering disciplines or industry sectors. The results show that the parties taking part agreed that sponsorship is a way forward in linking university and industry and brings long term mutual benefits for all parties.

Sponsorship provides continuous training and learning throughout the degree studies over a four/five year period and this helps the students to learn how to cope with the uncertainty that goes with the changes in all employment sectors. The students cited that sponsorship is a superb method gaining an understanding of what is learnt and how it is applied to real life situations. The students agreed that their link to a sponsor has had a major impact on the development of those programmes learning outcomes which are linked to employability skills.

Sponsorship adds important values to the department in form of improving the quality of their programmes and funding further activities. It increases a university's relationship with companies and thus provides better information on industry trends and understanding what the focus in industry is.

The employers confirmed that sponsorship schemes provide opportunities for employers to influence the curriculum. They also have 4 years to assess the candidates before offering employment and this helps them to get an individual who understands theirs company's processes and ethos. They were very positive about their long term commitment to sponsorship and they stated that the reality of sponsorship meets their expectations and there were no signs of withdrawal.

The results suggest that the publicity material for the schemes should be reviewed to make the students aware about the sponsorship schemes run by the department before choosing their course and before arranging any other sponsorship. It could generate more applications for sponsorship.

5. Conclusions and recommendations for future work

This paper focused on a study of the significance of industry input into the engineering education through sponsoring undergraduate students during their degree studies. The students scored the time that they have spent in the sponsoring companies as an invaluable opportunity to gain a range of knowledge and skills to work effectively in industry. They consider this has made them more 'marketable' for the future. Through the sponsored programmes, departments build links with industry. They also get input from industry to identify skill gaps in their graduates and provide opportunities in new technologies which would noticeably improve the quality of the graduate engineers and the university programme. The sponsorship schemes are real commitments to the alignment of courses to the needs of industry. The degree courses or modules that had been jointly developed between industry and university are examples of best practice in education of the undergraduate students.

The scope of this research was on the sponsorship schemes among the Faculty of Engineering in Loughborough University, a number of other schemes were investigated. Studying the other schemes is a topic worthy of investigation. The academia study was drawn from a particular group of the staff who had experience of working with industry at the teaching and their views may

not be representative of the experience of other academic staff. Further longitudinal and cross section studies should be carried out to include a larger survey sample, including other universities, other engineering disciplines, and industry sectors over a longer timescale. A further longitudinal study should be carried out with the students who have been surveyed during this research. This would highlight the areas of success and the areas which need further improvement.

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Fakhteh Soltani is a lecturer in Computer Engineering at Arak University with extensive experience in engineering education research. Her research interests include curriculum development and assessment of student learning. She was a researcher in Loughborough's Engineering Centre for Excellence in Teaching & Learning (2006–2010).

David Twigg was a senior lecturer at Loughborough University and a member of Loughborough's Engineering Centre for Excellence in Teaching & Learning who just recently retired.

John Dickens is Professor of Engineering Education at Loughborough University, in a part-time capacity since his recent retirement. He was Director of the Higher Education Academy Engineering Subject centre (2000–2011), and Director of Loughborough's Engineering Centre for Excellence in Teaching & Learning (2005–2010) and is a National Teaching Fellow.