Engaging employers and schools to support and facilitate the promotion of civil engineering courses among female students

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Abstract
This project’s main objective is to engage employers within the civil and construction sector, working in partnership with the Department of Civil Engineering (DCE) at the University of Greenwich as well as schools and colleges within the Kent region, to promote the study of civil engineering related courses/programmes amongst female students.

This project also proposed to raise funding from its partners and sponsors (mainly Atkins Global) to sponsor individual female students financially as well as providing mentoring and guidance throughout their studies.

As part of its deliverables, this project endeavoured to attract a group of female civil and construction engineering practitioners to participate as mentors to female students for the duration of their studies.

The measurable outcomes of this project have included the creation of an original and innovative partnership between the University of Greenwich, the construction industry and schools and colleges within the region. It will also result in the development of publicity and marketing materials created for a specific purpose that could be disseminated and used by others. This project ultimately aims to secure high attaining and focused female students studying civil and construction engineering related subjects at the University of Greenwich.

This project highlights a significant and current issue within the engineering sector as a whole and the civil and construction industry in particular.

Keywords: engineering, construction, female participation, employer engagement

Background
Every year, the School of Engineering (SoE) at the University of Greenwich, like other universities within the sector, visits a number of schools and colleges to promote engineering and technology courses to year 12 and 13 students. The SoE and the Department of Civil Engineering (DCE) also organise a significant number of activities as part of one-day events for students of different ages to visit the University of Greenwich in order to expose them to various aspects of engineering education.

It is an established fact that engineering courses do not attract female students in sufficient numbers in the UK. According to the Engineering UK 2011 report, engineering and technology is the most under-represented STEM subject group when it comes to gender. Consistently for the last eight years the proportion of female applicants to engineering and technology has remained at 12%, although the overall number of applicants has increased over this time period.

Anecdotal statistics suggest that only 15% of the female population studying in higher education choose to study engineering and engineering-related courses.
To that effect, a significant amount of effort led by the Engineering Council and engineering professional bodies was devoted to the promotion of engineering studies amongst the female population in the UK. Parallel to this, the National HE STEM Programme introduced initiatives for the promotion of engineering studies and awareness of such subjects at school and college levels. (This report will not detail the large number of activities that the Programme delivered successfully within that context.) However, despite all efforts, existing trends demonstrate that any increase in the UK female population choosing engineering as a career is insignificant.

This project set certain targets to investigate the perception of professionals within the civil and construction engineering industry of this gender disparity and also to identify area/s that industry could effectively, in partnership with the higher education sector (although small scale within the capacity of this project), suggest ways to address this issue.

The following bullet points have been identified as main underlying factors surrounding this project:

- There are insufficient students, particularly female, coming through to engineering and specifically to the civil and construction industry.
- According to the ICE, IStructE and IMechE, nearly 65% of chartered engineers in the UK are over 55 years old.
- Female students are under-represented in the civil and construction industry.

**General purpose and specific objectives of activities:**

- In collaboration with industrial partners, produce promotional and marketing materials aimed at female recruitment from schools, primarily at regional level.
- Engagement of female graduates of the DCE, in the role of “ambassadors”, to promote programmes and participate in visits and presentations to schools and colleges.
- Gain employers’ support in participating in the organised school liaison activities.
- Engagement of existing MEng undergraduate female students to promote the programme and mentor next year’s intake.
- Acquiring sponsorship from partnering companies and organisations as one of the incentives to be offered to a specific number of successful female applicants.

**Rationale**

Female students form slightly more than 50% of the UCAS applications in the UK every year. A large proportion of applications to engineering courses come from the male population of applicants.

Table 1 depicts the number of female engineers within the three disciplines of civil, mechanical and chemical engineering achieving the Chartered Engineer status for the period 2000 to 2009. These figures, compared to male engineers achieving the CEng status within the same institutions, can only be described as insignificant!

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICE</td>
<td>82</td>
<td>91</td>
<td>128</td>
<td>117</td>
<td>132</td>
<td>188</td>
<td>148</td>
<td>141</td>
<td>125</td>
<td>156</td>
<td>1,308</td>
</tr>
<tr>
<td>IMechE</td>
<td>56</td>
<td>74</td>
<td>63</td>
<td>75</td>
<td>67</td>
<td>70</td>
<td>81</td>
<td>78</td>
<td>72</td>
<td>80</td>
<td>716</td>
</tr>
<tr>
<td>IChemE</td>
<td>65</td>
<td>66</td>
<td>55</td>
<td>54</td>
<td>42</td>
<td>54</td>
<td>72</td>
<td>57</td>
<td>79</td>
<td>68</td>
<td>612</td>
</tr>
</tbody>
</table>
According to the Guardian Professional Higher Education Network, applications for the academic year 2012/13 have fallen by more than 9% with the opening of a worrying gender gap: applications from men were down 7% and from women by 10.5%.

Table 2 shows the available statistics on the number of undergraduate and postgraduate students in the UK for the academic year 2010/11, according to HESA, in terms of gender.

<table>
<thead>
<tr>
<th>Number of students for academic year 2010/11</th>
<th>Undergraduate</th>
<th>Postgraduate</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total female</td>
<td>1,092,315</td>
<td>318,775</td>
<td>1,411,090</td>
</tr>
<tr>
<td>Total male</td>
<td>820,260</td>
<td>269,940</td>
<td>1,090,200</td>
</tr>
</tbody>
</table>

Table 3 depicts the statistics for qualifications obtained by students in HE in engineering and technology courses at HEIs in the UK by gender for the academic year 2010/11 according to HESA.

<table>
<thead>
<tr>
<th>Engineering &amp; technology</th>
<th>First degree</th>
<th>Foundation degree</th>
<th>Other undergraduate</th>
<th>Total undergraduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>3,735</td>
<td>185</td>
<td>425</td>
<td>4,345</td>
</tr>
<tr>
<td>Male</td>
<td>19,175</td>
<td>1,760</td>
<td>4,580</td>
<td>25,515</td>
</tr>
</tbody>
</table>

The above and similar available statistics and information provided ample support for the team to undertake this project in investigating the reasons why, and in shedding some light on, the contributing factors behind such a low level of female engagement in engineering and, in particular, civil and construction engineering courses in the UK. According to the Engineering UK 2011 report, civil engineering showed the largest growth in qualifiers of all the engineering sub-disciplines, growing 62% over the previous six years and 13% in the last year. The growth in qualifiers has been strongest amongst male students, which increased 65% over six years compared to 47% for females.

The SoE and the DCE have a long-established track record of activities which engage schools and colleges within the context of promoting HE STEM agenda programmes. Each year in excess of 30 visits and school liaison activities are organised for this purpose by the SoE.

The DCE at the University of Greenwich endeavours to work closely with industry in order to provide high quality education and training opportunities for future engineers which will fully prepare them for the competitive job market. To this effect, the DCE has established a robust professional relationship with major civil and construction engineering companies, including Atkins and Mott MacDonald, as well as charitable organisations and trusts such as the Rochester Bridge Trust.

The Department has been involved with a number of STEM related projects in the past. These include working with the ICE and IMechE as well as local authorities in promoting STEM subjects at schools and colleges. The DCE has also been focused on the issue of promoting engineering subjects among female students for many years. It is necessary to emphasise that the shortage of female engineers in the UK is the subject of a wider debate and discussion within the sector as well as by governmental bodies.
The approach

In order to realise the objectives of this project, the team paid particular attention to working with professionals within the civil and construction industry. It was of paramount importance to the team to establish information and knowledge reflecting the opinions of civil and construction engineering practitioners (at all levels) on the subject under investigation.

In this endeavour, the representatives of the participating industrial partners are all accomplished and established professionals well placed within their organisations (Chief Executive, Director, Project Director and Manager) who in the first instance will take the findings and achievements of the project back into their organisations. The University of Greenwich’s DCE Industrial Advisory Committee consists of 13 more members representing companies and organisations within the civil and construction engineering sector.

Apart from the general approach of the project explained above, the focus of this case study is on one of the activities that the team organised and participated in within the context of female students’ awareness of civil and construction engineering studies.

Background to the case study

Three strands of activities were to be followed in achieving the objectives set for this project:

1. Designing a questionnaire to be disseminated amongst civil and construction engineering professionals to establish their observations and experience in engagement of female engineers and their backgrounds within the discipline.
2. Interaction primarily with schools and colleges for females in secondary education within the Kent region.
3. To design and disseminate a questionnaire amongst academics within civil and construction engineering education in order to establish their views on the lack of female students within the sector.
4. To design and disseminate a questionnaire amongst engineering professionals of disciplines other than civil engineering.

It is necessary to emphasise that tasks 3 and 4 were not identified as part of the methodology in the original bid but it was recognised that their coverage was equally important. Work on these areas has started and is near completion. Results will be compiled and analysed and subsequently forwarded to all stakeholders. This case study focuses on items 1 and 2 above.

To that effect, a questionnaire was designed and disseminated amongst civil and construction engineering professionals. A population of 200 was targeted. To date, 35 responses have been received and analysis was carried out accordingly. The results (which will be provided in a complete manner separately soon) demonstrate that civil engineering practitioners predominantly believe that bursaries and sponsorships for women to study civil engineering are a positive idea. They also predominantly question whether lack of awareness, cultural reasons and the education system in the UK are main reasons for female students not to be attracted to civil and construction engineering courses.

The following cross-tabulation analysis demonstrates some of the findings of this case study. As mentioned earlier, a full analysis of the findings will be provided in a format for possible publication purposes.

Q1. In which sub-discipline/division of civil engineering do you work?
Q9. What is your gender?
As can be seen in Figure 1 above, female engineers tend to favour disciplines such as transportation and geotechnics within the civil engineering industry. However, it is important to mention that only three female engineers (out of nine respondents) have been participating in the survey. Therefore, this data cannot be considered representative.

Q3. In your opinion what are the main reason/s why relatively few women in the UK are interested in a career in civil engineering?

Q9. What is your gender?

The graphs in Figure 2 illustrate that the majority of male respondents perceive that the lack of women engineers in the industry is due to cultural reasons. On the other hand, female engineers believe that there is a need for awareness first and then cultural reasons.

Q4. Do you think construction/civil engineering employers are promoting “sufficiently” the engagement of female engineering?

Q9. What is your gender?
As can be seen in the graph above (Figure 3), there was a clear correlation between male and female perception of the construction/civil engineering sector and professional bodies and their involvement with women in engineering.

Moreover, both males and females believe that industry is involved in promoting the discipline among female students, although still at a relatively low level.

Q5. Do you think providing an incentive such as bursaries/sponsorships for women to study civil engineering is a good idea?

Q6. Do you think the construction/civil engineering sector and professional bodies are doing enough to promote female civil engineering in the future?

The chart (Figure 4) shows that, generally, the respondents have agreed that providing incentives such as bursaries would potentially attract more female students to study civil engineering courses. Nearly all the respondents are optimistic in thinking that the construction/civil engineering sector and professional bodies are doing enough to promote female civil engineering.
In terms of the second item of the case study, the report concentrates on an activity (World of Work Day at Simon Langton Girls’ Grammar School, - Canterbury, Kent) that provided ample opportunity to underpin certain aspects of the set objectives of this project.

Simon Langton Girls’ Grammar School organises an annual event for its pupils within the context of a “World at Work Day”. The DCE participated in this event, utilising the opportunity to promote the set objectives of this project. During this event, a significant number of other institutions interact with female students from years 12 and 13, promoting and providing information about specific subject areas.

In this event, the DCE devised an activity consisting of a presentation about engineering and a group activity which involved planning, designing and constructing a tower made of recyclable materials. The students were provided with instructions and supervised throughout the event. A group of 25 students participated in this event. They were divided into five sub-groups, each being tasked with building the tallest and most stable tower for the first prize!

**Objectives for World at Work Day**

- Raising awareness and understanding of the civil engineering discipline for interested students within the subject area.
- Interacting with students, and investigating their knowledge and awareness of the subject area and the availability of information about programmes and career paths.
- Engaging students in a particular civil engineering subject, and providing them with an opportunity to experience what a civil engineering education is about.
- Demonstrating the importance of teamwork and knowledge sharing within the context of accomplishing a task.

**Results**

The following depictions demonstrate activities and feedback that the team received from the participating students.

![Figure 5: Girls during the tower building exercise](image)

![Figure 6: Girls at the closing session presenting their work](image)

**Girls during the tower building exercise**  **Girls at the closing session presenting their work**

- I really enjoyed the creative activity in the engineering workshop. It gave me an opportunity to share and gain skills.
- The practical activities gave me an idea of what people do every day if they have that particular job.
- I learnt that engineering is used in everything and not just cars. Also to be good at creative marketing, you need to be imaginative.
- I enjoyed building a structure in engineering.
- I enjoyed playing with the remote control car in engineering and making up my own brand in creative marketing.
Learning about different jobs that originally seemed boring.
I learnt about job opportunities I didn’t know existed before.
Enjoyed getting hands-on experience in practical work in engineering.
We learnt about some careers and what’s involved with them and I wouldn’t have considered those careers beforehand, such as engineering.

This event established the fact that providing visual applications of engineering work and their applications can be very effective in drawing female students’ attention to careers in engineering.

Discussion, summary

One of the strengths of this project was considered to be the partnership between academics and professionals within the civil and construction engineering discipline. To that effect, the Industrial Advisory Board members of the DCE at the University of Greenwich were engaged with this project in a constructive and caring manner. It was evident that they were concerned about the low number of female graduates coming into the industry and equally believed that any improvement with respect to engagement of female engineers within the sector in the future will only benefit the discipline in terms of much needed quantity and quality.

The results of questionnaires, when completed, will provide a strong platform for academics and professionals to embark upon in terms of devising certain approaches in attracting female civil engineers of the future. The findings will also provide sufficient ammunition for the other stakeholders within the higher education system to invest more accurately in possible improvements for engaging females in engineering.

No doubt the set objectives of this project have been achieved. However, as mentioned earlier, the team recognised that wider and more comprehensive investigation and research is required to encompass views of other stakeholders (academics, professional bodies and professionals belonging to other sectors of engineering and technology disciplines).

The team secured substantial funding to provide bursaries for higher achievers amongst the female population of students who would consider civil engineering as their future career. This project secured 10 x £2,000 bursaries per year as part of its activities. No doubt this project provided significant support to the team in achieving this goal. From the next academic year, a specific number of female students will directly benefit from these bursaries.

The project experienced certain setbacks in its duration and one which stands out above all is the need to plan and organise presentation activities to schools and colleges that will fit in with their timetable. This did not seem to be an issue at the start of the project. However, it proved to be a rather interesting challenge to fit into the already planned activities of schools and colleges. To that effect, better planning and earlier communication with schools and colleges is advisable for organising such activities in the future.

The project successfully managed to engage the female graduates and existing female students of the DCE in delivering its set objectives.

It is important to emphasise that, in the process of engagement with the civil and construction engineering industry, a positive impact was created within the context of increasing awareness of professionals within the discipline of the existing situation. The assumption was that full awareness already existed, but our experience clearly showed that by bringing the subject to the attention of professionals and practitioners, their focus and awareness was raised.

Overall, the team believes that the project successfully addressed a very important issue that surrounds the further and higher education sector in the UK, although on a small scale. There is no doubt that if the funding had not been made available to the team, this contribution could not have been made.
Further development

It is the plan of the author and his team to continue their research and development in this subject. A considerable quantity of data is currently under analysis which will provide ample ammunition and support for the team to explore securing further funding for a more comprehensive study.

Acknowledgement

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