

Engineering Graduate Employability – an international comparison.

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INTRODUCTION

The motivation for this study came from three common narratives linking economic development and graduate employability. The first narrative is that the western economies having lost a large proportion of their manufacturing production to low labour countries, such as China, need to focus on the 'knowledge economy'. The second narrative, which points out the weaknesses the knowledge economy strategy cites the 6.6 million fresh graduates that left Chinese universities in 2011[1] and suggests that knowledge work may eventually follow production work to China. However the third narrative challenges the quality of the graduates being produced. Zheng[2] and Venter[3] suggest that employers are disappointed by the quality of graduates moving into employment. A report from the McKinsey Global Institute [4] stated that only 10% of Chinese engineering graduates were considered employable, compared with 80% of UK engineering graduates.

The majority of discussion about graduate employability has taken place in the Western world. The UK, and other Anglophone, companies have carried out many studies to develop graduates' employability attributes conceptually, and also empirically. The research on graduate employability in China is still in early stages. This study interviewed selected Chinese employers to determine their perspectives on graduate employability and whether their conceptualisation of employability attributes differed from the literature.

1 BACKGROUND TO THE STUDY

1.1 Graduate Employability UK

There has been a lot of research in the UK both about the definitions of employability and the attributes that are considered to make a graduate employable. The UKCES[5] compared twenty published papers on the definition of employability and found no consistency in theory but similarity in practice. The definition of employability proposed by the UK's ESECT has been widely accepted in the

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UK as: “a set of achievements, skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupation.”[6]

The attributes that create employability have been investigated by many researchers. The CIHE[7] indicated that companies believe that social skills and personality type are more valuable than degree qualification and IT skills; regardless of the size of the industry. Team working and communication skills were seen as the most important attributes for new graduates. The NCWE[8] also suggested that communication skills and team working are the two most important attributes of graduates. Even in 1995, the AGR [9] indicated that employers consider ‘soft’ skills to be very important.

Employability is also defined by attitudes and motivation as well as skills. The surveys from the CBI in 2008[10] and 2009[11] showed the importance of ‘positive attitude’. The IoD conducted a survey[12] from directors’ viewpoint, which placed a positive attitude as the 7th most important factor in recruiting new graduates.

The importance of degree result has been debated for many years. The four CBI Education and Skills surveys showed that the importance of degree results dropped in every year compared to work experience. The CIHE report[7] also said that paper qualifications and the reputation of institutions have very low importance and a 2:1 degree is considered good by HR staff when they are recruiting new graduates.

Interestingly, the importance of working experience weights more than degree results in a number of surveys. Not only the four years’ CBI surveys confirmed that working experience has always remained as one of the top three most important attributes when recruiting new graduates, and its importance increases in every year, but also the DfES [13] stated that the UK’s companies prefer graduates with practical experience as they strongly believe that they have better understanding of real careers.

1.2 Graduate Employability China

In China, there are many papers defining the term of ‘employability’ of employers and graduates. Traditionally, the definition of employability in China is known as *jiù yè* (就业), which literally means “the ability to find a job”. In order to unify the definition between the UK and China, Wang and Cui [14] suggested a more appropriate translation of the UK definition of employability, *kě gù yòng xìng* (可雇用性) that describes the combination of personality, knowledge, skills and characteristics that a successful employee should possess.

The research into enterprises’ expectation for graduates in China is limited. A survey by LIU [15] showed that communication, learning ability, team work, integrity and interpersonal ability are the top five factors for Chinese enterprises. From Heffernan’s [16] research, six attributes including executive ability, communication, desirable persona, working enterprise, adaptive skills and professional knowledge were identified as the most important criteria to the Chinese enterprises. Li *et al.* [17] showed that the reputation of institutions and degree results will affect the recruitment process. The limited existing research in China investigated enterprises in very diverse fields. For instance, LIU’s [15] research covered a range fields of business such as government agencies, banking, services and IT industry. Not only was there limited available relevant research, but more importantly it did not have well defined focus.

As part of a development plan, the Chinese Ministry of Education issued an official document specifically for engineers, “Opinions on Education and Training Plan for Excellent Engineers[18]”. It stated that it is necessary to establish an universal engineers’ standard that has to be accepted by both industry and universities. Two categories of engineers’ standards were suggested. One is a general standard for engineers holding different degrees and the other is for engineers in a specific engineering discipline. The statement of the general standard is converted by Jian [19] into competencies as shown in *Table 1*:

Furthermore, in order to improve students’ professional engineering and creative skills, the Ministry of Education encouraged and supported the approaches of enterprises to establish national level “engineering practice centre” for students doing “real” practical experience for the education plan for engineers[18][19].

Inner quality	Hard skills	Soft skills
Engineering professional morality & Social responsibility	Ability to operate and maintain the manufacturing and production system	Personal development skills
Creativity and innovation	Mathematical skills	Analytical skills
Awareness of good quality, environment, health, safety and service	Theoretical understanding (study ability)	Problem solving skills
	Engineering professional knowledge	Ability to deal with emergency
	Management & business skills	Team work skills
	Knowledge of relevant technology standards	International and multi-cultural awareness
	Knowledge of relevant policy, law and regulations	Communication skills
		Organisational skills
		Flexibility/adaptability
		Practical application (ability to apply theory into practice)

Table 1: Chinese engineers' competence standards Jian[19]

2 RESEARCH METHODOLOGY

The results in this paper are taken from 6 case studies of large Chinese employers researched as part of an MPhil dissertation. The selection criteria of the 6 case companies were:

- Large companies: over 10,000 employees with an annual turnover of more than 400 million Yuan
- China based industrial company: state-owned or private
- Business sector: industry-based and recruiting engineering graduates from universities
- Location: mainland in China

The selection of interviewees was aimed at staff in human resources (HR) department. The reason being that HR people are the first stage in the company interacting with engineering graduates just from universities and therefore they have better perception of the 'raw' engineering graduates. The HR staff targeted were people with high level positions, managers or above, as they have better understanding of the company's mission and its expectation and requirements of engineering graduates.

2.1 Design of case study and questionnaire

Since there was no existing relevant research on large industrial companies' expectation for engineering graduates in China, an initial questionnaire was sent to each case company and the feedback used as guidance for a following in-depth phone interviews. The questionnaire included two parts: recruitment information and questions about the quality of Chinese engineering graduates. The purpose of the first part was to collect general recruitment information from the company such as number of engineering graduates recruited each year etc. The second part asked the companies to score the importance and satisfaction ratings of thirty engineering graduates' skills and attributes. The thirty attributes were designed from three sources based on literature review:

- The engineering graduates' attributes expected by UK's industry in existing reports;
- The graduates' attributes expected by Chinese enterprise in existing reports;
- The engineering graduates' attributes and skills expected by the Chinese government and defined in the general engineers' standard.

The numerous attributes from these three sources have overlaps with each other and were summarised and condensed to give thirty attributes.

The phone interview was structured into four steps:

- Overall impression of engineering graduates
- Discussion of the attributes in the questionnaire
- Discussion of the recruitment and the training programme
- Discussion of the Chinese HE system

Each interview took around of 30~50 minutes and the conversation was recorded and then transcribed in order to facilitate data analysis.

3 INTERVIEW RESULTS

3.1 Initial Recruitment and Development Practices

The engineering discipline preferences of the six companies were Electrical, Electronic and Power Engineering as the most desirable followed by Mechanical, Technical and Manufacturing Engineering. In contrast, Civil and Building related engineering is not popular among the companies interviewed. One company recruits students from building and architecture, as their business has spread into real estate. It was noticed that three companies preferred to recruit graduates with similar background as their business activities. In contrast, three companies recruits graduates from almost all engineering disciplines. This suggests that the basic training in most engineering courses is similar and highly transferable. According to one of the interviewees, it is not difficult for chemical engineering graduates to work in the motorcycle industry as they have fundamental engineering knowledge and skills which, with appropriate training, will allow them to succeed in their jobs.

The initial roles expected of engineering graduates cover the entire value chain of industrial activity, from R&D through production to sales. Manufacture/Production roles in the factory are the most popular first role for engineering graduates. According to one company, engineering graduates must start working in manufacturing to understand the application of technology in real life; otherwise, they cannot develop technology based on the needs of real situations.

Interestingly, three companies indicated that engineering graduates are highly preferred in the sales department. All three believed that engineering graduates will have a good understanding of the company's products, manufacturing process, technology and maintenance which will improve sales results. Sales representatives must understand requirements of the customers in order to ensure the solutions they proposed are correct.

Each company has its own policy for allocating engineering graduates to various departments in the company. There are two types of allocation; one based on process or development needs allocating graduates to front-line departments like manufacturing or departments across the whole value chain. For example, one usually expects engineering graduates to start in front-line technical roles such as field services and manufacturing engineering in order to help them familiarise themselves with the company and understand the application of technology in real life. The second type is to allocate engineering graduates according to their strengths and motivation.

The interviewees regarded degree results and reputation of institutions as two key factors when selecting applicants. They emphasized that engineering graduates from key universities such as 'Project 211' and 'Project 985' universities are preferred. In particular, one company only considers graduates from the top 30 universities in China. The main reason for this preference is that institutions with higher reputation are believed to have better qualified teachers, more developed teaching facilities and better curricula.

In addition, companies also stated that regardless of the institutions the graduates attended, their degree results are expected to be above average, as the results demonstrates the graduates' grasp of technical knowledge, analytical ability and more importantly, it reflects their personal attributes. Companies believe that the graduates' attitude in university can suggest their attitudes to their future work. However, although results are important, certain attributes such as innovation and creativity are welcomed by the companies. According to one, graduates who are excellent in such areas but with poor results will still be recruited, and might even enjoy a higher salary.

3.2 Attributes ranked by Importance

The importance of the thirty attributes was ranked by the six companies in the questionnaire and a standardisation process applied, the top five and bottom five attributes are listed below in *Table 2*.

	Attributes	Rank
High rank of importance	Working attitude	1
	Practical application	2
	Technical skills	3
	Capability of working hard	3
	Creativity and innovation	5
Low rank of importance	Political consciousness	30
	Knowledge of technology standards	29
	Working experience	28
	Commercial and business awareness	27
	Management skills	26

Table 2: High rank of importance & Low rank of importance

3.3 Skills gap

The skills gap is calculated by subtracting the importance score from the satisfaction score ranked by the companies for each attribute individually. Using the same standardisation method applied to the rank of importance, the average of standardised skills gap for each attribute is compiled as shown in *Table3*.

Interestingly, it clearly shows that the attributes with high skills gap rank also have very high rank of importance. In other words, skills gaps mainly exist in the attributes which the companies see as highly important.

	Rank of Skills gap	Rank of importance
Capability of working hard	1	4
Working attitude	2	1
Practical application	3	2
Creativity and innovation	4	5
Problem solving skills	5	8
Engineering knowledge & technical skills	6	3
Flexibility	7	10
Team work skills	8	7
Organizational skills	9	13
Degree results	10	11

Table 3: Top ten attributes in the rank of skills gap

4 DISCUSSION

4.1 Differences in attribute priorities between UK and China

4.1.1 Working Hard

The highest Chinese priority of working hard generally does not appear so directly in the UK studies. It could be related to 'positive attitude' which does occur and is ranked 7th in the IoD study [33]. According to one Chinese company, "Attitude determines everything", and as well as working attitude being ranked as the most important priority in its own right it is seen as linked to two other component attributes – cultural fit and integrity and loyalty

The ability to work hard was highly valued by all the six companies. This is particularly true in manufacturing companies, where manufacturing and production work are always expected to be the first positions for engineering graduates. They must have a professional working attitude and the capability of working hard to undertake the intensive workload in a tough manufacturing working environment. For example, a paper company stated that the working environment in paper-making factory is not comfortable. The temperature in the working area is high and the workload is heavy, which presents a challenge for new employees, especially those who are experiencing a transition period from students to professional workers.

Two companies stated that new engineering graduates expect high payment job positions and a comfortable environment like the R&D department working in an office. "Sometimes some of the engineering graduates just give up or change their jobs when they meet obstacles" four companies made the same complaint. Others suggested the reason for the poor working attitude and the lack of capability of working hard is the one-child policy. The majority of families in China have only one child who is doted upon and thus lack the ability to handle work and stress.

A good working attitude will also help graduates to blend in with the company's culture. The top criterion of four companies in recruiting engineering graduates is the graduate's commitment to the company's culture and their motivation to work for the company. A fit with the company's culture and a long term development plan are seen as encouraging graduate retention.

Thirdly, working attitude is a measure of the graduates' loyalty to the company. According to some companies that have invested much in the development of core technology the potential loyalty of employees is the top priority when selecting people in order to ensure confidentiality.

4.1.2 Work Experience

Interestingly, working experience was given a very low importance score by five out of the six companies. Which is in contrast to the UK where internships are seen as a key way of improving employability.

The Chinese companies however thought that a summer internship was too short for the graduates to develop any useful skills and, if not carried out in the company of their eventual employment, there would be a mismatch between what the student learnt and anything the company considered useful. They were reluctant to create internship because of the resources required and confidentiality issues. One company welcomed engineering students with work experience and strongly believe that they will have better practical skills and adaptability which could be beneficial to their future work.

This seemed to be a self-reinforcing negative feedback since the companies did not value internships they did not put much effort into trying to arrange them in a way that could improve the graduates' skills and hence were disappointed with the outcomes.

4.1.3 Business views of the effectiveness of the HE system

In the UK there is a recognised need for Universities in engineering to have relationships with employers which is generally conducted through Careers Services, Industrial Advisory Boards and through visiting lectures and support for projects and research. While there is still criticism of the output of graduates this generally centres around transferable skills and the argument of how much of the early career skills development should be done in industry and within Universities.

When asked about the weakness and shortage of the Chinese HE system, companies pointed out several issues.

- Book-based teaching and exam-based assessment heavily restrain students' creativity and innovation. Chinese students are always good at improving detail and making things perfect rather than inventing new ideas. It also limits the students' independence in exploring problems and finding out solutions for themselves.
- Slack management system in universities. Chinese universities do not have the necessary restraints on students' behaviours, and high absence rate from lectures and high failure rates are very common in Chinese universities.
- Ineffective education structures with weak theoretical teaching
- Engineering graduates are weak at solid engineering knowledge and universities should strengthen theory teaching. The first two years' teaching are common courses including history, Marxism theory, political economy etc. The engineering knowledge only starts to be delivered in the third year.
- Old and out-of-date technical knowledge in universities

The companies claimed the majority of industrial enterprises in China have to retrain the engineering graduates to improve technical skills after they join in the company.

5 CONCLUSIONS

This study has challenged some of the stereotypes of Chinese engineering graduates as seen from the UK. They are generally seen as being hard working, well motivated and with a high level of analytical skill. There are, however, seen as having some shortage in innovative capacity. The Chinese employers however, see them as lacking the capacity for high work and adaptability to tough working conditions and being poorly prepared for an engineering career. Interestingly the Chinese Government's Plans seem to focus on the soft skills agenda which is seen as important in the West but apparently not valued by this small sample of employers. Interesting further work might be to see if the Chinese who study overseas are rated differently by the Chinese employers.

The other interesting aspect is to compare the required attributes with those common in the western dialogue. The ability to work hard is seldom mentioned in the UK although coded language about self-motivation, proactiveness etc. is reasonably common. This may be a feature of direct vs. indirect choice of language but it could also reflect a softer management style that reflects wider concerns such as stress and work-life balance.

Engineering is a global business and there is a significant level of engineering capacity in China, and India the western industry needs to better understand the capabilities of early career engineers and university graduates from these countries if it is to make the best use of this capacity and maintain its competitiveness in the global knowledge economy.

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