Using Skills Gap Analysis in Construction Management to Stimulate a Demand led Model of Curriculum

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Abstract

The broad spectrum of the construction management discipline and the depth of career opportunities open to its graduates creates the need to possess a competitive portfolio of knowledge and skills. In the multidisciplinary environment of the modern construction sector a graduate must be able to demonstrate not only a technical competence but a depth of underpinning skills to effectively manage a project. This paper investigates if the skills and knowledge areas obtained by graduates undertaking Construction Management programmes at Higher Education level are aligned to those skills and knowledge areas that industry recognise as their priority and how competent fresh graduates are within the workplace. The data, captured for the development of a Euro-wide curriculum model questioned 136 Built Environment academics, recent graduates and senior industry figures via means of in-depth interviews, questionnaires and a focus group. The aim of the Tech Transfer project where this research was undertaken was to develop a curriculum responsive to the needs of industry. The research undertaken for the project developed a methodology in which to address a means not only of identify where the skills gaps occurred but how commonly these were perceived amongst graduates, managers and academics. Having identified the gaps the paper provides a means of measurement to present which are the most identifiable gaps of knowledge and skills. The paper acknowledges the need to re-balance the construction management curriculum between core knowledge and "softer" skills.

Keywords: construction management, employer engagement, knowledge, skills

1. Construction management education

Construction management has an academic history within the UK that has a footprint in many disciplines, particularly that of civil engineering. Since the 1980's there has been an improved professional recognition of the role of the construction manager. This resulted in an increased demand for educational provision to prepare those seeking to develop a career in this area. The rapid growth in the subject area has resulted in diffuse interpretations of what construction management constitutes which incorporate site, project and business management aspects. Similar to the proposed definitions of Wing et al. (1998) and Love and Haynes (2002), construction management is defined for research and educational purposes of this study, as a body of knowledge established and accepted as explaining the most effective management of construction projects.

The Construction Management Association of America (CMAA) identifies seven key areas of responsibility that fall under the remit of a construction manager: project management planning, cost management, time management, quality management, contract administration, safety management, and construction management professional practice which includes specific activities like defining the responsibilities and management structure of the project management team (www.cmaanet.org). Construction Management involves an array of services, skills and trades that must be brought together and managed to ensure a construction project is completed efficiently. According to Young (1989), Construction Management must incorporate processes from the planning, design, construction and post construction phases for the purpose of achieving project objectives including the management of quality, cost, time and scope.

The Council of Heads of the Built Environment (CHOBE) and the Centre for Education in the Built Environment (CEBE) have jointly produced State of the Nation for Built Environment Higher Education report in 2010. This analysis of course provision encompasses building, surveying, architecture, real estate, property and construction management subject disciplines. Quantitative research carried out as part of the State of the Nation report found that construction management courses made up 8.7% of courses on offer across the built environment. Undergraduate degree programmes accounted for half of this share of course provision; whilst one in four construction management courses are at postgraduate level. Foundation degree construction management courses are taking a significant share accounting for 15% of provision at this level.

The growing professional recognition of construction management as a discipline was demonstrated in 1980 by the award of Royal Charter status to the Chartered Institute of Building (CIOB). The CIOB is one of several professional bodies that have a footprint within construction management including The Royal Institution of Chartered Surveyors (RICS) Chartered Institute of Building Services Engineering (CIBSE) and the Chartered Institute of Architectural Technicians (CIAT). This proliferation has created an environment that blurs the recognition of one clear route towards professional recognition. The alternate view of this disparate professional recognition in the industry is that it promotes a multi and increasingly interdisciplinary professional environment. The discipline has progressively enhanced its standing and recognition. According to Langford (2009), this adheres to the Biglan model of discipline classification that requires both the existence of models of thought

that are in turn codified. The construction sector had a dedicated training board until 2004 in the Construction Industry Training Board (CITB) which was subsumed into Construction Skills which is a UK wide Sector Skills Council. Construction Skills through various engagement initiatives such as National Skills Academies (NSAfC); and Construction Ambassadors and Accelerating Change in Built Environment Education (ACBEE) have attempted to engage stakeholders in the sector and the educational supply chain to improve the skills and competencies of those in the sector.

The diversity of construction management as reflected in the professional bodies that support its activities should be celebrated but the clarity of routes for progression through to formal professional recognition could be more explicit. Langford (2009) notes that construction management is most suitably defined as a discipline with boundaries which span over several professions and conjoin with other disciplines. Ashworth notes *"Construction management started as a vocational discipline, relying on those who teach tomorrow's practitioners knowing how the theories actually work in practice. Today the pattern of staff recruitment has shifted more towards staff with higher academic qualifications and research capability and so acquiring the attributes of an academic discipline"(*2009, pp 46-7*).* The interdisciplinary and heterogeneous nature of construction management has resulted in the growth of the discipline generating limited recognition from both within and beyond the built environment.

There is an increased focus upon the commercial value attached to the role of the construction managers. Griffith (2004) outlines operational and managerial priorities such as the role and function of the site manager, the organisational structure and the corporate planning process which strives to achieve best practice and in doing so offers the client a "sustainable competitive advantage". This view is supported by Young who recognised the need of the industry to *"provide a truly professional service, which is qualitatively superior and gives value for money"* (1988, pp 4). The development of a 21st century construction manager should take into account project management, professional management and technical competence develops a more interdisciplinary approach (Love & Haynes, 2001). In all normative attempts to define construction management there is a focus upon skills, knowledge and competences. Murdoch and Hughes (1996) present the need for a balanced professional who combines knowledge and expertise backed by appropriate qualifications along with recognition from other professions, particularly within the sector.

2. Key skills for construction management graduates

Table 1 represents a synthesis from the current built environment literature regarding skills and knowledge relevant for construction management education. It indicates how the eminent literature supports a balance between formal and informal skill areas. According to Akintoye (1998), informal or "softer" skills that include team working and communication are seen as skills that must be developed individually and contextually.

Table 1: A synthesis of skills and knowledge areas from sources of reference

Knowledge/Skill Factor	*Leiper Q, Khan T (1999)*	*Edum F., McCaffer R (2000)*	*Teerajetgul, T.. et al (2009)*	*Egbu C, (1997)*	*Cieszynski K, et al (2005)*	*Dainty, B. & Millet (2001)*	*Akintoye (1998)*	*Young B. A (1989)*	*Love P, Haynes N (2001)*	*Total*
Knowledge of ICT packages & Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	*9*
Ability to communicate effectively		✓	✓	✓	✓	✓	✓	✓	✓	*8*
Ability to work as part of a team	✓	✓		✓	✓	✓	✓	✓	✓	*8*
Knowledge of Associated Technology	✓	✓		✓	✓		✓			*7*
Ability to think commercially	✓	✓	✓	✓	✓	✓	✓	✓		*7*
Knowledge of Building Processes	✓	✓	✓	✓		✓	✓		✓	*7*
Leadership/Responsibility	✓	✓	✓	✓	✓		✓		✓	*7*
Financial Knowledge		✓	✓	✓	✓	✓	✓	✓		*7*
Familiarity with legislation	✓	✓		✓	✓		✓	✓		*6*
Ability to negotiate	✓	✓		✓	✓				✓	*5*
Ability to work with detailed	✓		✓				✓			*4*
Problem solving			✓			✓	✓		✓	*4*
Ability to model using CAD		✓			✓	✓		✓		*3*
Flexibility		✓	✓		✓					*3*
Knowledge of environmental issues	✓				✓					*3*
Presentation Skills			✓			✓	✓			*3*
Knowledge of Health and Safety	✓			✓						*2*
Knowledge of foreign language									✓	*2*
Project Management Skills					✓					*1*

Katz (1971) and El-Sabaa (2001) identified technical, conceptual and human skills as the three defining categories of management competencies. Table 1 supports the view that technical skills, such as construction process and associated technology are recognised in the literature as vital knowledge to any prospective construction manager. Such skills are almost taken as a given for the majority of the construction workforce. Conceptual skills refer to the capacity of a manager to make contextualised decisions which may refer to local factors, and broader economic, environmental or political circumstances. Essentially, this is the capacity to see beyond the immediate decision making sphere and will require a manager's confidence in both his/her technical and human skills. A high degree of importance is afforded in the literature to these conceptual skills. Human Skills incorporate the capacity of a manager to build, manage and develop a team using sound communication, effective

rewards and motivation. Evidence shows that a diverse skill set is required and expected from construction management graduates. There must be a combination of the technical, conceptual and human skills but these must be applied flexibly, with appreciation given to external factors that all have the capacity to impact upon projects to varying degrees.

There are some knowledge and skills elements that despite being continued features of the Construction Management curriculum are not widely cited by current research as providing significant benefit. Since this research was part of European wide Tech Transfer project, there was much significance given to foreign language or adopting a global/European approach to the subject. This view may be subject to change with the impact of migrant labour and globalisation. Essentially, employers are looking for a graduate who has a balance of technical knowledge, a contextual awareness that as the global economy impacts upon firms in the construction industry increasingly is all the more important. These quantifiable knowledge and skills areas must be balanced with strong personal attributes including team working, communication, and negotiation and presentation skills.

Existing literature on skills required for construction managers demonstrates some convergence of views regarding the most important knowledge and skill areas a graduate should demonstrate. It is necessary to address this empirically and determine if these areas of perceived importance are being delivered as part of the curriculum and how effectively graduates undertaking studies in construction management are able to apply the skills and knowledge they have obtained in the workplace. This study will move on to address how curriculum provision within construction management covers the competencies and body of knowledge to produce a graduate who is prepared for the site. Hence, an examination is required to understand the expectations of academia and industry in providing skills and knowledge to produce a capable and competent construction management graduate.

The 2006 ConstructionSkills Annual Report found that Britain's construction industry would require 348,000 new recruits by 2010. This prediction would result in the industry requiring a further 87,000 staff across the whole industry. Of this number, 36,000 were anticipated to be at managerial level. Such forecasts indicate that within the construction industry the demand for jobs requiring high level skills would increase significantly. Labour shortages will undoubtedly place a premium on skilled workers and push up construction costs. As the UK focuses increasingly upon creating a knowledge economy which is competitive on a global stage, the need for skills in the workplace has been at the forefront of policies, curriculum development and industry's strategic planning. The National Employers Skills Survey (2009) found that more than a third of unfilled vacancies in the UK's construction sector are due to lack of skills and overwhelmingly (75% of responses) cite lack of experience or recent recruitment as the main reason for this. The survey also found that 13% of construction companies report skills shortages among their employees. The Leitch review of skills (HM Treasury, 2007) highlighted that one third of adults in the UK do not hold a basic school leaving qualification, double the proportion in Germany. It also highlighted that whilst the UK produces 0.25million graduates per annum this figure is 4 million in the USA and China.

After Leitch the imperitive was to identify areas that were competitive or potentially competitive, globally. In addressing the need for skills UK industry, business and HE also had to focus upon areas of skill deficiency. Chan and Dainty (2006) differentiate between skills shortages and skills gaps. A

skills shortage is identified as a recognisable deficiency of experience within a particular area that slows productivity and lessons competitive advantage. A skills gap is a recognisable deficiency in the effectiveness of an employee in carrying out specified tasks. Shortages lend themselves to more quantitative analysis whilst gaps require a more qualitative interpretation from employers, educators and recent graduates as highlighted in the data utilised in this study. The breadth and fragmentation of the role of a construction manager makes the skills gaps experienced across the profession significantly more and a greater challenge to address.

Skills shortages are not a recent situation throughout the sector, with clear cycles of peaks and troughs that coincide with levels of economic prosperity. This has been clearly played out in the UK within the last 20 years. A deep recession in the early 1990's brought in large numbers of full time students and decimated part time recruitment. Emerging from this period of recession a combination of job losses, loss of aging senior and experienced meant that when the green shoots of the economic revival were first felt in the construction sector there were evidently large gaps of skilled colleagues to lead in building the recovery. The construction industry is often seen as a barometer of economic prosperity with corresponding impact initially and directly upon employment which in turn creates gaps in skilled professionals in the area.

The CBI education and skills survey of 2008 (www.cbi.org.uk) found that employers want graduates who can communicate and work well as part of a team and that these attributes are seen to be of greater importance than the actual degree classification a student achieves. This study also found that a graduate able to demonstrate relevant work experience such as a placement as part of their course ranked as vitally important. In looking beyond generic views on skills gaps the cause and effect of these gaps upon construction management as a discipline can be analysed in greater detail.

3. Skills gaps for construction management graduates

Literature from the last 15 years indicates that gaps in graduate skills predominantly occur in the softer skill areas or those which fall into Katz and El-Sabaa's "human" skills area. The curricula of built environment is pressured to include technical and theoretical content in order to achieve professional body accreditation. This has meant that traditionally there was less room in the timetable for softer skills such as communication, negotiation and presentation. Thus, it has traditionally proved difficult to develop human skills within built environment disciplines. Such a flexible and dynamic approach that incorporates all three of Katz's skill areas is seen as highly desirable by the industry. Technical skills are sufficiently covered in HE course provision and the graduates entering the workplace are seldom criticised for lacking knowledge of the fundamental principles of the industry. However, what could be developed further is an understanding of why these principles are used and when thus improving the flexibility and preparedness to adapt to new processes that was noted as a gap (Farrell and Gale, 2000).

In addressing the skills gaps, how and where the skills and knowledge are gained by graduates entering a career in construction management is of importance. A significant debate exists as to the most appropriate environment in which to equip construction managers with the skills and knowledge

to practice efficiently. Should a Higher Education Institution (HEI) focus upon the provision of theoretical underpinning knowledge concepts and principles whilst leaving the acquisition of practical experience to be gained when the graduate enters the workplace? Traditionally the role of the University was to convey fundamental theories which would in turn be utilised in a practical context when called upon.

Hammer and Champy (1993) have identified that training addresses the "how" of a particular task or operation whilst education broadens the approach to understand "why" a task is required in the first place and what the impact of its implementation might be. Haltenhoff (1998) postulates that those emerging from higher education are not as productive as they might eventually develop into being but will have a greater general capacity to take on a broader area of responsibility over the span of their careers. Though initially not as productive, a graduate will have the breadth of knowledge and opportunity to apply this with increased exposure to site based activities and as a long term investment the potential of a graduate to add to a firm's portfolio of experience is recognised. Back (1988) noted in his interviews with senior, experienced construction managers that recent graduates were guilty of being unable to present anything other than a text book solution to a problem. Student learning is significantly enhanced if they are able to relate a calculation or a theory to practice but it is often difficult to precisely define a real world problem. Educationalists have recognised that incorporating practical training with the rationale of providing technical expertise (Young 1989) and that for a management course to have value and meaning in any sector it must embrace operations in the field. To keep up with the developments in sites, projects, client priorities, contractual arrangement and human resources there should be learning materials and modes of study that enhance a student's capacity to attempt to replicate good practice in a practical setting. This can be achieved by case studies, industrial guest lectures, placements and as those questioned as part of the primary data capture for this study felt, that including practical elements in the curriculum was important as it gave a real world perspective to students.

4. Research methodology

Guided by the principles of the interpretive research paradigm, the operational aspects of this research are based on survey research method. Questionnaire surveys provide an efficient way of collecting data from a large sample as the respondents are asked to answer the same set of questions (Saunders et al, 2007). Dillman (2000) suggests that three types of data variables can be gathered from questionnaires; opinions, behaviour and attributes. An opinion variable discloses what the respondents believe or their feelings about a subject; a behaviour variable records the experience of the respondents regarding a subject; and the attribute variable reveals the characteristics of the respondents. As the research is heavily focused on the collection of attitudes regarding the capacity and competence of construction management graduates, an opinion survey was conducted. The demand of the construction industry and supply of higher education are identified in order to determine how effectively a HE course prepares a construction management graduate for the workplace.

For this purpose, 136 Built Environment academics, recent graduates and senior industry figures were surveyed via means of interviews and questionnaires. Table 2 provides the profile of respondents participated in the survey. Snow ball sampling was used for the selection of senior practitioners and graduates. Collected data was analysed using descriptive statistics (SPSS version 16 software) to draw recommendations regarding the balance between core knowledge and skills. Finally, a comparison of skills gaps in Tech Transfer participant countries is presented as part of this research.

Table 2: Survey response rate

Genre	*Sample*	*Completed*	*Response*
Academics	*65*	*53*	*81.5%*
Senior practitioners	*49*	*30*	*61.2%*
Recent graduates	*121*	*53*	*43.8%*

5. Data collection and analysis

Table 3 shows the ranking of key skills and knowledge areas, relevant for construction management education. These 18 key areas were selected based on literature review (as reviewed in table 1) and after discussions with Tech Transfer project participants. On the other hand, Table 4 ranks attainment of theses key areas based on survey findings of academics, graduates and senior managers. Skills gaps in construction management education were calculated using attainment levels in the selected skills and knowledge areas.

Table 3: Importance of skills and knowledge areas for construction management education

Skills and Knowledge areas	*ACADEMICS*		*GRADUATES*		*MANAGERS*		*TOTAL*	
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Mean(I)*	***Rank***
Knowledge of construction processes	*4.58*	*1*	*4.76*	*1*	*4.57*	*1*	*4.64*	***1***
Ability to work as part of a team	*4.32*	*2*	*4.73*	*2*	*4.47*	*2*	*4.50*	***2***
Ability to effectively communicate	*4.25*	*4*	*4.69*	*3*	*4.37*	*4*	*4.43*	***3***
Knowledge of associated technology	*4.09*	*8*	*4.27*	*9*	*4.43*	*3*	*4.27*	***4***
Knowledge of ICT packages & systems	*3.77*	*14*	*4.37*	*6*	*4.27*	*5*	*4.14*	***5***
Presentation skills	*4.10*	*7*	*4.33*	*7*	*3.17*	*12*	*3.87*	***6***
Ability to negotiate	*3.74*	*15*	*4.55*	*4*	*3.10*	*13*	*3.79*	***7***
Familiarity with associated legislation	*3.79*	*13*	*3.51*	*13*	*4.07*	*6*	*3.79*	***8***
Ability to model using CAD	*3.23*	*16*	*4.43*	*5*	*3.70*	*8*	*3.79*	***9***
Knowledge of environmental issues	*4.00*	*10*	*3.51*	*13*	*3.83*	*7*	*3.78*	***10***

Ability to work with detailed information	*4.13*	*5*	*3.90*	*10*	*3.30*	*10*	*3.78*	***11***
Ability present a reasoned argument	*4.13*	*5*	*3.57*	*12*	*3.30*	*10*	*3.67*	***12***
Ability to think commercially	*4.06*	*9*	*3.59*	*11*	*3.33*	*9*	*3.66*	***13***
Flexibility	*3.92*	*11*	*4.31*	*8*	*2.57*	*17*	*3.60*	***14***
Sense of responsibility	*4.29*	*3*	*3.29*	*16*	*3.03*	*14*	*3.54*	***15***
Creative thinking	*3.89*	*12*	*3.49*	*15*	*2.80*	*16*	*3.39*	***16***
Awareness of European/Global context	*2.75*	*17*	*3.27*	*17*	*2.87*	*15*	*2.97*	***17***
Knowledge of foreign languages	*1.92*	*18*	*1.90*	*18*	*2.50*	*18*	*2.11*	***18***

Table 3 shows a wide range of agreement between various groups of respondents on the importance of the selected skills and knowledge areas for construction management education. However, disparity between responses can be seen between academics and industrial respondents (graduates and managers) in ICT related knowledge and skills and softer more personal skills. While academics favour more of knowledge and skills industrial respondents desire practical knowledge and skills for their day to day activities. Views on the attainment of skills and knowledge are more disparate between respondent groupings (Table 4). This is evident when addressing technical and softer knowledge and skills, such as teamwork or communication.

Table 4: Attainment of skills and knowledge for construction management education (based on importance ranking)

Skills and Knowledge areas (Ranked based on importance)	*ACADEMICS*		*GRADUATES*		*MANAGERS*		*TOTAL*	
	Mean	*Rank*	*Mean*	*Rank*	*Mean*	*Rank*	*Mean(A)*	***Rank***
Knowledge of construction processes	*3.34*	*2*	*3.65*	*1*	*3.63*	*1*	*3.54*	***1***
Ability to work as part of a team	*3.37*	*1*	*3.43*	*6*	*2.83*	*8*	*3.21*	***3***
Ability to effectively communicate	*2.94*	*8*	*3.53*	*4*	*2.50*	*16*	*2.99*	***6***
Knowledge of associated technology	*2.85*	*12*	*2.69*	*14*	*3.00*	*3*	*2.85*	***10***
Knowledge of ICT packages & systems	*2.94*	*8*	*3.65*	*1*	*3.50*	*2*	*3.36*	***2***
Presentation skills	*3.17*	*4*	*3.04*	*9*	*2.57*	*14*	*2.93*	***8***
Ability to negotiate	*2.62*	*14*	*3.43*	*6*	*2.87*	*7*	*2.97*	***7***
Familiarity with associated legislation	*2.94*	*8*	*3.65*	*1*	*2.70*	*11*	*3.10*	***4***
Ability to model using CAD	*2.55*	*16*	*2.63*	*16*	*2.97*	*4*	*2.71*	***16***
Knowledge of environmental issues	*2.85*	*12*	*2.94*	*11*	*2.67*	*12*	*2.82*	***13***
Ability to work with detailed information	*3.13*	*5*	*3.45*	*5*	*2.40*	*17*	*2.99*	***5***
Ability present a reasoned argument	*3.04*	*6*	*3.02*	*10*	*2.57*	*14*	*2.87*	***9***
Ability to think commercially	*2.60*	*15*	*2.94*	*11*	*2.97*	*4*	*2.84*	***11***

Flexibility	*3.02*	*7*	*2.65*	*15*	*2.67*	*12*	*2.78*	***15***
Sense of responsibility	*3.21*	*3*	*2.57*	*17*	*2.07*	*18*	*2.61*	***17***
Creative thinking	*2.87*	*11*	*2.82*	*13*	*2.80*	*9*	*2.83*	***12***
Awareness of European/Global context	*2.08*	*17*	*3.41*	*8*	*2.93*	*6*	*2.81*	***14***
Knowledge of foreign languages	*1.51*	*18*	*2.25*	*18*	*2.73*	*10*	*2.17*	***18***

5.1 Synthesis on skills and knowledge areas

The knowledge of building construction processes was viewed as the most important by all groups interviewed. Graduates and senior managers feel that knowledge of construction processes both carry equal first ranking whilst academics rank this only second behind their attainment of ability to work as a part of the team.

Attainment in this area was felt to be a combination of acquiring generic principles alongside specific company processes. A senior academic noted when questioned that *"It is difficult to teach a standardised set of procedures when companies might approach a task slightly differently"*. A senior manager noted he would like to see graduates demonstrating their capacity to use theoretical applications in higher end problem solving and project activity. This individual sought to challenge the most creative minds to apply their exposure to the most up to date research.

Teamworking was noted as the second most important skill with broad agreement being reached upon this from all three respondent groups. As Latham (1994) recommended, the need for team working spanning and crossing discipline boundaries in the sector is vital. In addressing how effectively graduates actually team work in the workplace the feedback indicates that academics see this as the highest ranking area of attainment. This, potentially, reflects that HE course delivery is beginning to incorporate more group work. However, the view from senior managers and recent graduates regarding how well team working skills actually are attained is mixed.

Graduates felt that their most significant area of attainment was their ICT skills and familiarity with legislation associated to the industry. For academics and senior managers the area of legislation was not seen as of great importance. When exposed to modern project life cycles, including contracts, health and safety, procurement in an increasingly litigious environment a sound grasp of associated legislation is of great value. In the use of ICT, industrial respondents (graduates and managers) disagree with academics on both the importance and how well this skill is demonstrated in the workplace. Senior managers shared the view of graduates that ICT was both important and relatively well attained (with a mean score of 4.27 for importance and 3.5 for attainment).

This study has found agreement between the respondent groups on the skill areas of most and least value. Foreign languages and a global/European contextual awareness were weighted with little importance from all groups. All rated that language skills as being of little importance and attainment of these skills matched this value. However this trend was slightly distorted by senior managers recognising that graduates did show some language capacity. Increasingly Construction Management courses attract students with a both a broad and strong academic background, along with more

students learning part time whilst in the workplace and with operational parameters becoming increasingly global and migrant workforces an ever present part of the fabric of the modern construction site language skills are called upon.

5.2 Perception of academics, graduates and senior managers

Addressing graduate attainment managers and graduates agree there is significant attainment in construction processes Academics recognise attainment in areas of team working, leadership and management. Academic responses note that the curriculum has changed to accommodate not only the provision in terms of group projects but also recognition within marking criteria and specific study skills packages.

Managers recognise that the most significant areas of attainment for graduates are in construction processes, ICT, associated technology and the ability to think commercially. It is perhaps pertinent that managers focus on these areas as they are priority factors to themselves from a business and operational perspective. However, the areas of knowledge and skills managers felt demonstrated the smallest levels of attainment were the ability to communicate and a sense of responsibility. These skills were reported by managers as fundamental from a perspective of looking to develop those who would lead the industry in the future. As a senior manager replied "Processes and technology you can train for - personal attributes are important and a graduate coming into my firm must show me this as their raw material."

Graduates recognised that the most significant areas of attainment for them were in the "harder" knowledge areas such as processes and legislation and the more recently developed areas of ICT and associated technology. There is, significantly, a lack of the softer more personal skills attributed by graduates as positively attained. The ranking for skills such as ability to teamwork or communicate effectively are given a relative value, but come behind the more tangible work defined areas of process and technology.

5.3 Skills gap in construction management education

Skills gap in construction management education are calculated by evaluating what is expected from and what is delivered by those graduates entering the industry. Initially, this research concentrates on the importance of construction management skills areas whilst the second part of the survey assesses the attainment in the identified skills areas. Both these measures were combined to build skills gap.

Skill level can be calculated using a weighted average formula:

$$Overall\ attainment\ of\ skills\ and\ knowledge = \sum_{i=1}^{n} I_i A_i \Big/ \sum_{i=1}^{n} I_i$$

Where,

i = 1-18; skills and knowledge areas
A_i = Attainment of i^{th} skill and knowledge area
I_i = Importance of i^{th} skills and knowledge area

Since 1-4 Likert scale was used for scoring attainment,

$$A_i \text{ Max} = 4$$

Therefore,

$$Percentage\ of\ skills\ gap = \left(4 - \sum_{i=1}^{n} I_i A_i \Big/ \sum_{i=1}^{n} I_i\right) / 4 \times 100\%$$

Table 5 presents skills gap percentage of partner countries of Tech Transfer project based on this formula. It is evident that the United Kingdom has the lowest construction management skills gap at 26.19%. In contrast, skills gap at Slovenia is at 48.69% showing significant difference in the role of higher education in providing skilled construction management workforce to construction industry. Even though construction management, as a discipline is a relatively immature one, in the UK it has a more robust history than its project counterparts. Areas of importance were shared across the partner nations and as per the UK focused strongly upon construction process, ICT and the softer skills of teamwork and communication. It is in these personal softer skills where the most significant skills gaps occur. The gap is much more pronounced than for the "harder" knowledge areas such as knowledge of legislation where the mean gap across project partners is only 1.00.

Table 5: Construction management skills gap in Tech Transfer project

Country	*Percentage of skills gap in construction management education*
United Kingdom	26.19%
Greece	31.36%
Poland	34.79%
Czech	40.93%
Hungary	45.81%
Slovenia	48.69%

In comparison to EU project partners the UK's skills gap was by far the smallest, however the partners involved were mainly taken from developing and emerging EU nations. In the UK the gap is smallest in the technical knowledge areas, correlating with the high importance and attainment.

6. Conclusion

Demonstrated by the wealth of government and sectoral policy drivers during the last ten years it is clear there is a strong emphasis upon skills in the UK. The development of skills at all levels, but

particularly at higher levels is the imperative that will ensure the UK remains competitive within the global knowledge based economy. There is a tension as the technical knowledge that underpins construction management cannot be replaced in importance or attainment and remains the most significant element of course content. However, the balancing of technical knowledge with "softer" more interpersonal skills such as teamworking, communication and negotiation are recognised as significant. These elements of a graduate's personal qualities are less "learnt" rather they are "developed" by an individual. Thus, it is vital for HE to continue to harness and develop the learning opportunities provided by the workplace. In summary, it's not just the fundamental principles of the discipline that makes a graduate employable. It is their capacity to apply their technical knowledge contextually in practice and with regard to the human element of the role that senior managers would seek to ideally recruit.

The model of curriculum that was proposed as part of the Tech Transfer project took into account the need for flexibility and continuing professional development. In responding to the feedback of stakeholders and addressing where the skills gaps were most significant assessment the curricula was shaped to ensure graduates would gain knowledge of theoretical, organisational, technological and leadership elements of the construction management role via practical problem based learning examples. The curriculum model develops contextual learning and balances harder knowledge with softer skills. Blended via practical application to give a real site experience to the learner the model was created to address those softer skills identified by those surveyed yet incorporate them with relevance and meaning.

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