How effectively do current learning methodologies prepare graduates to innovate in the UK workplace?

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The value to construction as a sector of innovative practices has been recognised as increasingly significant. However how do we imbue students with a capacity to drive towards innovation and work innovatively and who should be involved in this process? This need has been recognised across the increasingly delineated borders within the EU. Out of this need, in September 2006, a EU funded project with the end outcome of producing a postgraduate qualification focused on innovation and technology transfer knowledge was approved.

A desk study to ascertain the current levels and methods of delivery has already provided a state of the nation report upon which to build. Participants in the project will use this foundation to conduct a series of in depth interviews and questionnaires that will target the key stakeholders (recent graduates, academics, industry, national support and national sectoral support bodies) Dialogue with these group aims to determine the perceived strengths and weaknesses in the current delivery of innovation within the curriculum, whose needs the system is satisfying and what the key factors influencing training systems for innovation in construction are. The aim is to gather evidence that will identify where gaps of skills and knowledge exist, and with an informed picture of how innovation is currently integrated into the curriculum and the demands of the sector in each partner country begin to tailor a postgraduate module to meet the demand. The postgraduate model developed will consider comparatively the scope of the curricula, the learning methodologies and the standards for evaluating the quality of what is delivered and that a uniform criteria for the granting of awards is agreed.

This paper will analyse the methodological development of innovation module, and how liaison between higher education, industry and national support bodies seeks to produce a relevant input into the curriculum.

Keywords: Curriculum, Engagement, Industry, Innovation, Skills.

Background

In the UK Built Environment represents a sector of the British economy that accounts for 8% of the UK GDP 2.1 million people and generates £152 billion of turnover (SSA, 2007) and has witnessed considerable growth, particularly in the last 5-10 years. Following the recommendations of the 2003 Leitch Report future economic growth and competitiveness must be based on the foundations of an appropriately skilled workforce.

> *"Productivity is increasingly driven by skills. The ability of firms to succeed in the face of growing international competition depends increasingly on the skilled labour force they can draw from. Skilled workers are better able to adapt to new technologies and market opportunities. Higher levels of skills drive innovation, facilitate investment and improve leadership and management. For innovation to be effectively implemented, businesses must be able to draw on a flexible, skilled workforce. (Leitch Review of Skills, 2003)*

The Centre for Education in the Built Environment (CEBE) is involved in a European Union Vocational Education and Training project to develop a pan-European programme focussing upon technology transfer and innovation for Construction Management students at postgraduate level. To understand fully what the scope and content of this programme should contain it has been necessary for each partner nation to undertake an evaluation of current training curricula at academic level and how adequately they are prepared to implement innovation in the workplace. The strategy for the research is to evaluate what currently the level of provision is across the UK, to elicit the views of a representative sample of educationalists recent graduates, and more senior colleagues from within the industry. The identification of gaps in the skills, knowledge along with views on the drivers and barriers for upskilling the workforce in innovative processes can then be fed through into a more demand led programme focusing upon the transfer of knowledge between the HE and industrial elements of the learning experience.

This study will focus upon the UK findings with a view to comparing the views of the upper and lower demographic of industry and their academic counterparts with regard to the most appropriate skills, methodology and environment to create a workforce ready for and capable of innovative practice.

Methodology

In order to provide a base line for the project each partner agreed to provide a "state of the nation" report which would identify the key factors influencing both the educational and vocational learning systems. The relevant stakeholders required identification and their level of impact recognizing. Finally the extent to which external influences such as of public policy, industrial changes, university-industry collaboration was identified by all project partners as key information as to give a clear representation of each national education system.

This was carried out as desk based research. General data upon numbers of students enrolled, course provision was derived from the Higher Education Statistical Agency (HESA) and the Department for Education and Skills. More sector specific information was derived from Construction Skills one of 25 national sector skills councils which have a specific and sectorally focused remit to increase opportunities to boost the skills and productivity of everyone in the sector's workforce. Other sources included associated Professional bodies, representation from HE and policy documentation such as the UK Governments 2003 White Paper on the Future of HE.

The second stage of the research was to gather more analytical findings. A two stage process of in-depth interview followed by questionnaire was chosen. The initial in depth interviews sampled ten respondents (two of from each of the following groupings: Academia, Suppliers, Recent Graduates, Construction Industry Representative, Design Practice Representative) The in depth interview focused upon skills acquisition and application in the workplace, engagement between HE and industry and the barriers and drivers for innovative practice. The ten interviews were carried out either face to face or by telephone, transcribed and coded into categorically themed areas

This methodology was also chosen to act as pilot for the scope of the questionnaire which constituted the second phase of data collection. . This structured questionnaire was directed to 50 academics, 100 graduates of between 1-5 years post qualifying experience and 50 senior managers from industry. Data gathering for the questionnaires was achieved through a series of telephone interviews and the direction of alumni, industry listings, professional body contacts to a on-line questionnaire. Responses from the 200 returned questionnaires were coded to allow meaningful evaluation of issues and themes to be derived and presented.

Results

State of the Nation Report

The report found that the state of the Built Environment course provision in the UK is particularly buoyant. Built Environment programmes of study have recovered from a serious decline in enrolments during the mid 1990's but now all programmes of study recruit to predetermined targets as agreed by the institution and the funding councils.

Construction or related programmes are offered at 63 out of the 116 Universities in the UK and the demand for places on these programmes of study is now greater than the number of places available. This is due in part to buoyancy of the sector currently and the considerable career opportunities that exist in both the UK and overseas for these graduates. The provision of construction relation programmes in UK Universities prides itself on providing opportunities at the various levels of complexity and intellect and it allows for students to progress. The attraction of the sector can be demonstrated by the rise in the number of postgraduate conversion courses and the significant take up of them by non-cognate undergraduates wishing to enter the industry.

Undergraduate programmes are now almost fully developed to meet the needs of industry and is usually informed through Employer Advisory Committees, the requirements of the professions and the different professional bodies via accreditation and the research interests of the academic staff employed in each department. The links with business and industry are strongest where either a school offers a range of part time programmes or undertakes research in collaboration with industry and practice.

All UK courses are likely to undergo some form of accreditation by their relevant professional body and criteria awards usually in areas such as entry qualifications, accommodation, research performance, curriculum content and quality assurance. Accreditation encourages the continual update of programmes to reflect industrial and commercial trends and can foster strong links with the accrediting body at national and international level.

The key decision makers affecting Built Environment educational provision from a funding and strategic point of view is the Higher Education Funding Council (HEFCE) whilst other policy makers, quality assurance agencies and funding councils also play specific roles. Sectorally, Built Environment can derive support and direction from its own sector skills council, Construction Skills formed in 2003. This grouping has an important role to play in providing the industrial and commercial dimension that will help universities and colleges when designing their programmes of study. ConstructionSkills seeks predominantly to improve business performance, qualify the workforce and improve the image of the industry and recruitment.

In-Depth Interviews (IDI's)

In order to provide an evaluation of the appropriateness of curriculum content the first section of the IDI concentrated upon the skills knowledge and competencies of the new graduates and how well an employers expectation was met by the current levels of skills and knowledge. As Fig.1 demonstrates the fundamental principles of construction and it's technical application was the predominant expectation from all industrial respondents and this was seen as attained by current graduates.
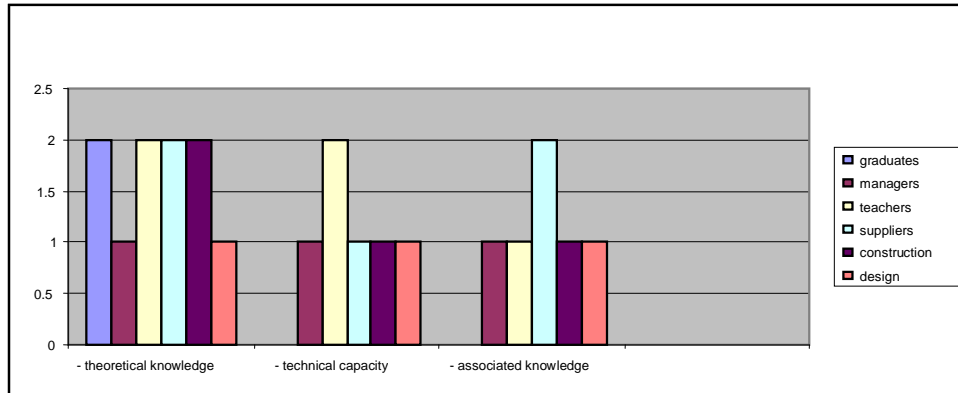
Figure 1:.Graduate Knowledge - Strengths

The main expectations from employers in addition to technical capacity included a familiarity with legislation, computer literacy and associated knowledge such as theory of drawing/ measuring. The main skills weakness however was in practical applications such as workshop capacity. Employers were most keen to see graduates display problem solving, communication and presentation skills. In addressing why potentially graduates are not reaching the workplace with these skills and knowledge areas the respondents felt the programme of study may offer too superficial a view of a broad range of topics. The key gaps in skills were identified as mainly on the "softer" skills that are more aligned to personal development than technical competencies.
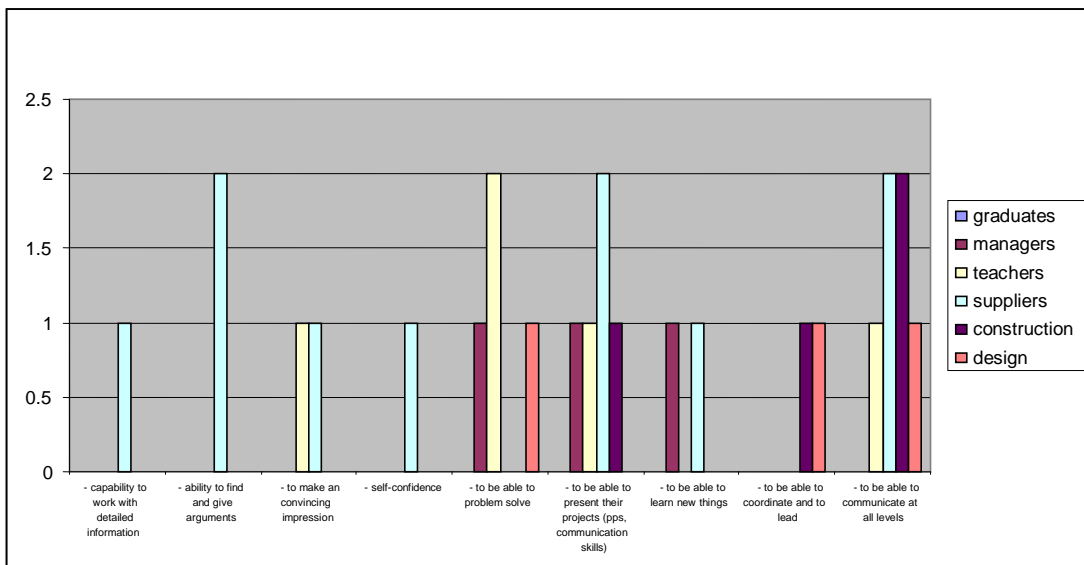

Figure 2: Skills Gaps Identified in Current Graduates.

Curriculum design was held responsible for the gaps in skills and knowledge from recent graduates entering the Industry. Respondents from both construction and design indicated that an excessively rigid system of curriculum design in the UK is the main reason whilst both academic and supply chain respondents indicated that the gaps were the result of an overly superficial approach to course delivery.

When questioned as to who brings most impetus for innovation to companies all sections of respondents stated the importance of graduates, fresh from their studies with new ideas and both

the enthusiasm and ambition the beginning of their career offers. The whole supply chain was recognised in responses from all respondents however in this question thus the importance of an integrated approach to project management from supplier to client is seen as a key driver for innovative working.

All respondents identified that the main barrier to innovation was financial constraints and this was closely followed by an unwillingness to try something new by client and contractor. Often welcoming innovation is offset with a company's primary concern with delivery and budget.
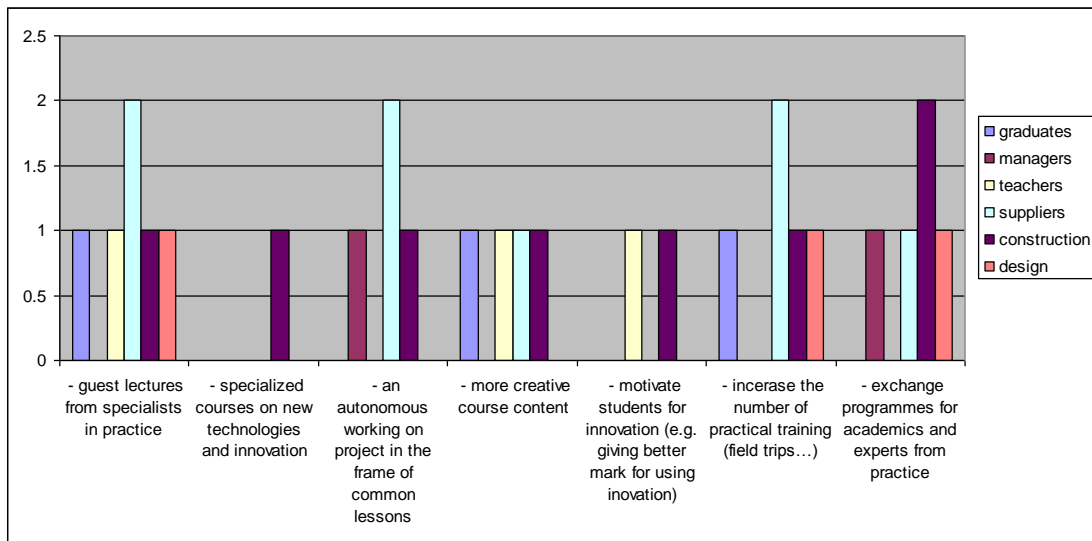

Figure 3: *Suggestions to increase the innovative content in HE curricula*

Appropriately skilling the workforce and developing the sector to innovate has to come through dialogue between industry and HE. All respondents saw the construction companies themselves as having the most significant role to play in maintaining this communication process, but that public sector offices such as regional development agencies, city councils and architectural offices have a role to play. Barriers to this collaboration were seen industry respondents as a lack of understanding from HE of the operational constraints practice often presents and the fast paced demands of the sector. Whilst HE respondents felt there was an excessive focus upon profit to allow for creativity and innovation to flourish.
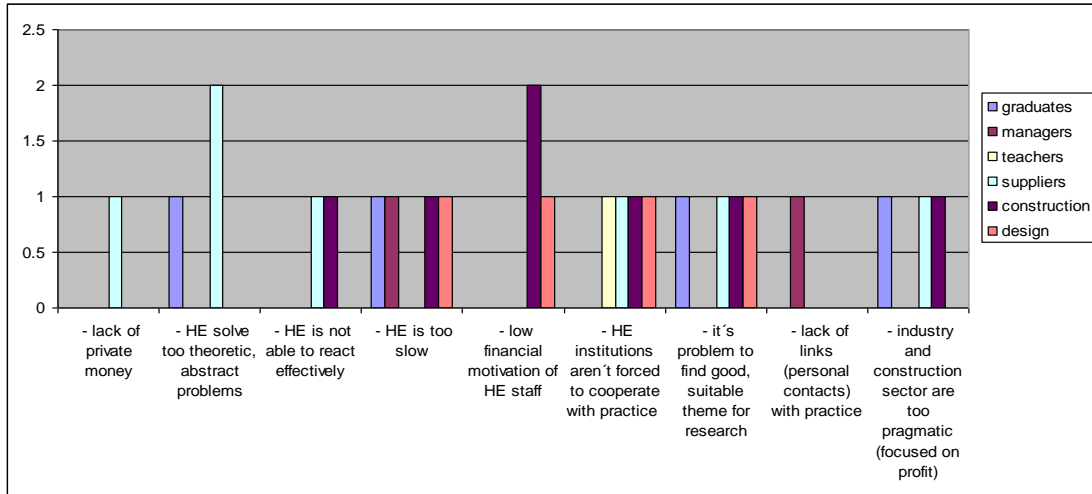
Figure 4:Perceived Barriers for Collaboration Between HEI's and Industry

Questionnaire

As with the indepth interviews the questionnaires began with an assessment of the skills knowledge and competences of graduates entering the workplace. These were assessed both in terms of their level of importance and attainment using a Likert scale measurement. Table 1 demonstrates that all value highly the underpinning principles and technologies that support learning in the sector and attainment levels are high.

Skills ranked by attainment and perceived importance by graduates, academics and senior industry respondents.								
Importance %			**KNOWLEDGE AREAS**	**Level of attainment %**				
1 = High 5 = Low				definitely not	limited level	partially acquired	definitely acquired	
1 77.4	66.6	78.4	Knowledge of building construction processes	0	9.5	47.2	43.4	
2 15.1	33.4	19.6		0	6.6	26.6	66.6	
3 0	0	2		0	2	31.4	66.6	
4 3.8	0	0						
5 3.8	0	0						
1 26.4	46.7	49	Knowledge of associated technology	1.9	34	41.5	22.6	
2 62.2	52.3	33.3		0	6.6	26.6	66.6	
3 7.5	0	13.7		0	31.4	68.6	0	
4 1.9	0	4						
5 1.9	0	0						
1 28.3	20	13.7	Familiarity with legislation associated with the sector	0	18.9	60.3	20.7	
2 34	46.6	23.5		0	46.6	46.7	6.6	
3 24.5	33.4	62.8		0	2	31.4	66.6	
4 9.4	0	0						
5 1.9	0	0						
1 34	66.6	15.7	Knowledge of environmental issues	1.9	26.4	56.6	15.1	
2 34	33.4	19.6		0	53.3	47.7	0	
3 30.2	0	64.7		0	24.5	56	19.5	
4 1.9	0	0						

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Table 1 (continued)

Importance %

	Academics	Snr Industry Managers	Graduates	SKILL AREAS
5	0	0	0	
1	1.9	0	0	Awareness of European/Global context
2	13.2	13.3	66.6	
3	47.2	60	31.4	
4	34.0	26.7	2	
5	3.8	0	0	
1	17	40	43.2	Knowledge of general ICT packages & systems
2	51	60	51	
3	24.5	0	5.8	
4	7.5	0	0	
5	0	0	0	
1	3.8	0	0	Knowledge of foreign languages
2	5.7	0	4	
3	9.4	40	25.5	
4	39.6	40	32.4	
5	37.7	20	41.1	

Level of attainment %

SKILL AREAS	Group	definitely not	limited level	partially acquired	definitely acquired
Awareness of European/Global context	Academics	9.4	69.8	17	3.7
	Snr Industry Managers	0	20	60	20
	Graduates 1-5 yrs experience	0	15.7	32.3	52
Knowledge of general ICT packages & systems	Academics	0	26.4	52.8	20.7
	Snr Industry Managers	0	26.6	13.3	60
	Graduates 1-5 yrs experience	0	12	32.4	55.6
Knowledge of foreign languages	Academics	56.6	35.8	7.5	0
	Snr Industry Managers	0	53.3	33.3	13.3
	Graduates 1-5 yrs experience	0	80.4	13.7	5.9

Academics
Snr Industy Managers
Graduates 1-5 yrs experience

Table 1 highlights that environmental issues are seen with growing importance by all response groupings but that the levels of actual knowledge are behind the curve of requirements. In the ICT based learning environment which students find themselves it does not prove a surprising finding that importance and attainment are matched as high in this area. The knowledge of languages was perceived as something of a welcome bonus but not an essential skill for the graduate entering the workplace by all groupings who responded.

Skills ranked by attainment and perceived importance by graduates, academics and senior industry respondents

Importance % 1 = High 5 = Low				SKILL AREAS	Level of attainment %			
					definitely not	limited level	partially acquired	definitely acquired
1	47.2	6	23.5	Ability to work with detailed information	-	13.2	60.3	26.4
2	35.8	37.	43.2		-	60	40	-
3	5.7	30.7	33.3					
4	5.7	6	-		-	9.8	35.2	55
5	5.7	-						
1	54.7	53.7	72.5	Ability to communicate effectively with client, public service and site management	-	13.2	60.3	26.4
2	30.2	46.3	23.5		6.6	33.3	60	-
3	7.5	-	4					
4					-	6	35.2	58.8
5	7.5	-	-					
1	67.9	66.6	75.5	Ability to work as part of a team	-	20.7	62.2	15.1
2	17	33.4	24.5		13.3	26.6	33.3	26.6
3	5.7		2					
4	5.7				-	4	49	47
5	7.5							
1	26.4	46.6	7.8	Creative thinking	-	26.4	60.3	13.2
2	41.5	53.3	31.3		-	60	33.3	6.6
3	26.4		52.9					
4	5.6				-	23.5	70.5	6
5								

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	Col 1	Col 2	Col 3			Col A	Col B	Col C	Col D
1	37.7		13.7	Ability to develop and present a reasoned argument		-	13.2	60.3	26.4
2	62.2	60	31.3			-	66.6	27.4	6
3	0	20	55			-	15.7	66.6	17.7
4		20							
5		20							
1	15.1		60.8	Ability to negotiate		3.7	45.3	35.8	15.1
2	52.8	33.3	33.3			-	46.6	53.3	-
3	28.3	33.3	5.9			-	4	47	49
4	3.7	33.3							
5	1.9								
1	45.2	40	17.6	Ability to think commercially		5.6	41.5	37.7	13.2
2	30.2	60	41.3			-	40	33.3	26.6
3	15.1		23.5			-	27.5	51	21.5
4	3.8		17.6						
5	5.7								

The main barrier to students obtaining the skills and knowledge seen as most important at the start of their careers. Mixed views on the amount of practical training were expressed with 70.6% of recent graduates feeling that too few meant they were not adequately prepared whilst 66.6% of senior managers disagreed that there was currently not enough provision of practical preparation for the workplace. All agreed that the HE course provision was both interesting and served to motivate students as individuals to improve their understanding of the subject area.

Given the survey was feeding into European wide research a question was asked regarding the value of foreign language. This was seen by academics, managers and recent graduates as something of a bonus but not something they would seek out as a major priority in recruiting.

In addressing the usefulness of hands on practical elements of the curriculum the most significant response (av. mean response between the three groupings of 70.6%) was that it was of great importance in providing a real world context to the individual's learning. This was backed up by the second most popular response which indicated that applying practice to theory embedded the knowledge at a deeper level with students. Indeed many respondents surveyed agreed with both statements but in choosing the most relevant opted to for the real world context. In contrast to this response there were 26.6% of senior managers who felt that it was not always necessary to give students this approach as they would expect the company who employs them upon graduation to train them in their own specific processes and systems. This view was not shared by either academics or more recent graduates.

How well prepared a graduate should be to innovate upon entering the workplace presented a mixed response from the academic, graduate and managerial respondents as Fig. 5 indicates the majority of graduates and academics feel largely there should be preparation as part of the learning experience throughout HE but that this should be tempered with the reality that fresh graduates may not always be given the opportunity to engage with the most innovative activities within a particular organisation
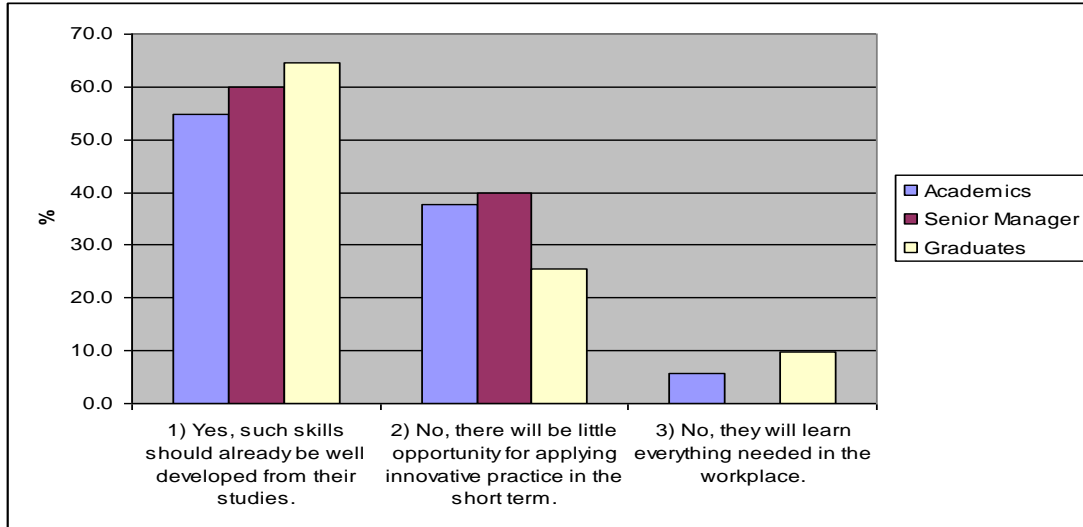
Figure 5:Opinions on Graduates' Readiness and Opportunity to Innovate in the Workplace

The most appropriate means of upskilling the workforce in general with the capacity and ability to innovate offered mixed response with the academic respondents feeling Compulsory Professional Development (CPD) was the most effective method whilst learning in the workplace was shared by graduates and senior managers as a more appropriate learning methodology.

The linkages between practical application as part of the curriculum and preparedness to innovate. As in previous answers the recent graduates believed strongly in the development of a more practically based curriculum a view only partially supported by academics and senior colleagues. The most divisive view was on the value of the guest lecture from industry. Many senior industry figures and recent graduates were not convinced of the value added this approach presented. All respondents however felt that a practically based course would be an attractive module choice as it allowed theoretical application.
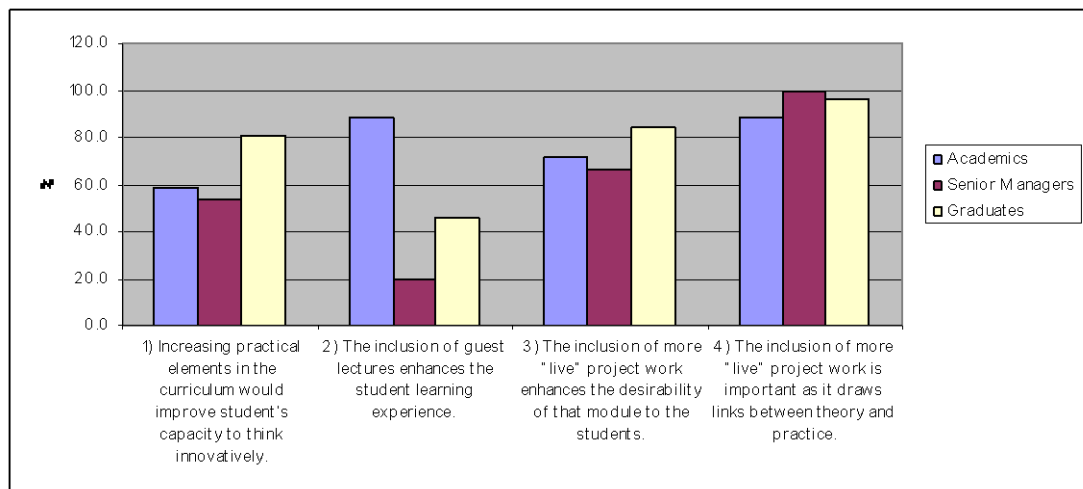

Figure 6:Perceptions of the Most Appropriate Means of Increasing HEI/Industry Collaboration

The major encouragements for industry in approaching HE to work collaboratively was viewed as the awareness of the research expertise lying within this area. HE is seen as having the time and space to drive research forward and the know how of accessing funding to develop these activities. . Industry

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however sees certain distinct barriers as to why it does not engage more freely with academia and the research it pursues What industry perhaps does not always know or understand is where specifically in HE the expertise may lie or indeed how to approach academics in order to access this knowledge. Fig 7 demonstrates that time and practical constraints are the most significant detractors that currently prevent industry from considering closer working practices with HE.
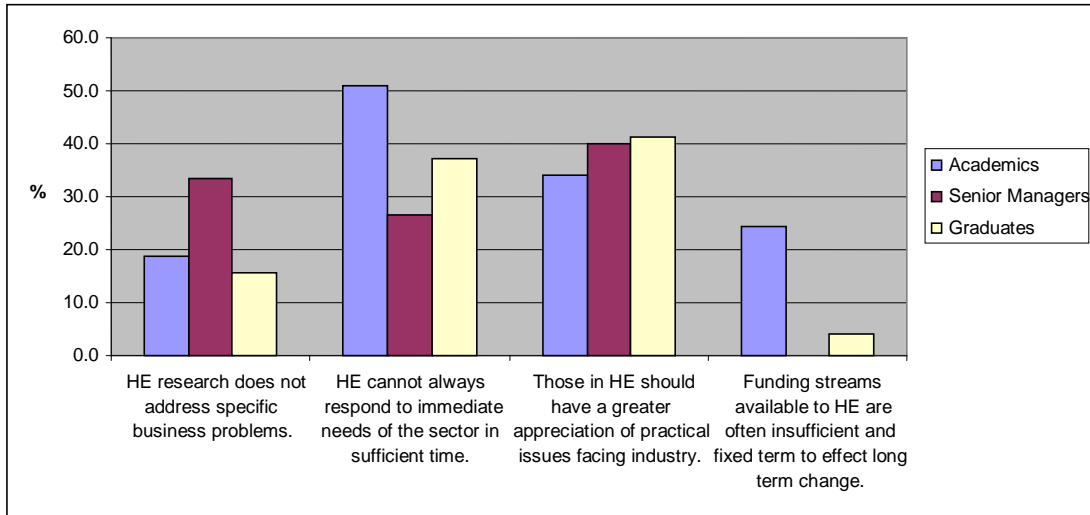

Figure 7:Percieved Barriers to Industry Engaging with HE

The environment for innovation clearly shows that all stakeholders see gaining knowledge and competency in this area must be as part of a process of lifelong learning. In agreement with the views expressed by both Leitch and Lambert reports there is agreement that innovative work can seriously contribute to economic growth although the more senior managerial respondents were noticeably not so encouraged by this proposition. Information relating to innovation and innovative practice was felt to be in the public domain but it was also felt some pointers to where it was stored was needed. Views were split on the development of a specific module or programme dedicated to innovation; more recent graduates feeling that this would be appropriate whilst senior managers and academics did not feel this was necessary or of value.
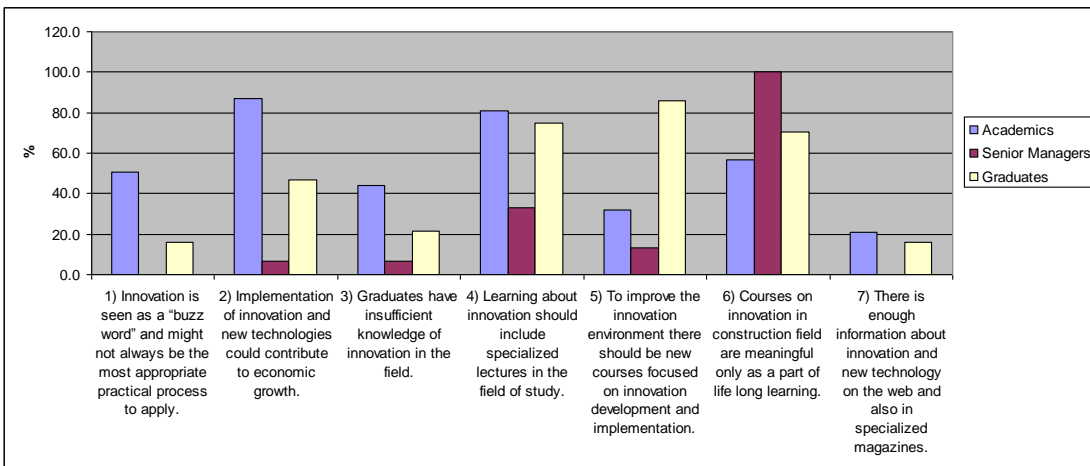

Figure 8:Factors Affecting the Environment for Implementing Innovation

Conclusions

The underpinning knowledge for the subject areas in the built environment appears to be delivered to the required level and employers are satisfied with the level of competencies. The theoretical underpinnings are evident, what is felt lacking, particularly from the more recent graduates is an opportunity as part of their studies to apply this. The prescription of course content by the accrediting professional bodies (namely the Royal Institution of Chartered Surveyors and Chartered Institute of Builders) has lead to a level of inflexibility and both industrial and academic respondents felt that provision across the UK may benefit from allowing specialist centres to develop and prevent the curriculum from spreading itself too thin. The reality being that HEI's will deliver the core curriculum content as demanded by the respective institutions but will flavour the curriculum with the specialist knowledge of its teaching staff. There was a view that more focus should be placed upon interdisciplinary working however particularly respondents from the design subject community felt that forcing this too early in an Undergraduate's academic journey might prove overwhelming.

Employers expect a degree of functional literacy, the ability to work with often complex information and for an individual to input into discussion, problem solve and it these more generic skills rather than the theoretically based ones that employers indicate are lacking. Increasingly curriculum design is taking into account these "professional skills" but it is not universal. The industrial responses to both the in depth interview and questionnaire felt that formalising the personal skillset of students as part of the curriculum would enhance their readiness to meet the challenges of the workplace bringing flexibility, problem solving and enhanced communication skills to their roles.

The most recent graduates felt that the key barrier to them gaining appropriate skills and competencies was the lack of practical content within the curriculum. This view was challenged by the academic responses who see the constraints to delivering large scale practically based courses with relation to time that can be dedicated to site based activity, health and safety compliance and the standardisation of an assessment criteria for what may possibly be a wide ranging cohort. This is not to deny the value of hands on learning. In the UK the significant rise in part time study allows for students to apply their theoretical knowledge in the workplace. The increased use of VR, simulation tools and modelling also allows an improved practical understanding into the curriculum.

It is clear that a relationship between HE and the sector it serves is essential in achieving the leading edge skills government seek to make the UK competitive within the global economy. Industry does recognise the expertise is there within the HE community what it does not always know is where specifically it lies and how to access it. Moreover it fears that academia is too slow and ponderous for the pressures of profit, delivery and solutions that it demands to remain competitive. All respondents felt that the individual companies and practices within the sector had the most significant role to play in the innovation process. All have a relationship of varying depth with potentially a variety of HEI's and these relationships should be channelled to shape research outputs that have meaning and value for the sector. In pursuing common goals both the research integrity of the academia and the operational issues of industry can be developed into meaningful outputs.

A graduate's use in the innovation purpose is welcomed but is tempered with practical consideration. The expectation is that the basic ingredients of theoretical knowledge and personal skills are there. With some moulding to specific company procedures the enthusiasm, most recent exposure to the latest techniques and research findings ensures that their contribution is recognised as being of considerable value. This was particularly evident from the more recent graduates surveyed who had reached more middle management positions as they were empathetic to this cycle. Noted by the more senior managers and some design – based practitioners was the practical consideration that not all new graduates get to cut their teeth on innovative projects. Most decisions regarding the implementation of innovative process come from management level down and are in the main based upon economic considerations. Thus a graduate may have to overcome a resistance to change, the desire to channel budgets towards innovative working practices and the balance between learning ones craft with more mundane tasks alongside more

developmental work. Not all graduates are of equal calibre and the focus upon innovation should be directed where it is appropriate. There will naturally be students who are more predisposed to innovate than others. This should be appreciated and recognised not just by the employer but by an individual in recognition of their own capabilities.

Awareness and upskilling on innovative practice was overwhelmingly viewed as part of lifelong learning. The delivery of a specific module or programme was not supported as widely as something that should be imbued either across a curriculum or as part of a CPD programme. There was support for secondments or shadowing activity to occur between both HE and Industry to enable an improved understanding of the operational issues, challenges and opportunities and resources implications faced. The guest lecture system was welcomed by more recent graduates however academics and senior managers were less enthusiastic. Some teaching staff were wary of the slot being used as a recruitment opportunity or that a company-centric view of a specific process might skew a students viewpoint. This system of delivery has had positive response from final year undergraduate students at the University of Salford who had a "masterclass" approach to the topic of innovation.

Employer engagement has been seen by successive Governments as an important element in addressing the UK skills agenda to increase the performance of the sector. Industry and higher education can all gain by working together and stand to gain through the contribution of the other. The need for fundamental change through more integrated working, embodying a partnership approach with the construction industry are evident in Constructing the Team (Latham, 1994) and Rethinking Construction (Egan, 1998). Furthermore, the Construction Skills Network Report (2006) forecasts that an average of 87,000 new recruits per year for at least the next five years will be needed to meet expected demand.

In the UK this need for improved dialogue has been met by two initiatives that the Centre for Education in the Built Environment has been involved with. Accelerating Change in Built Environment Education seeks, through a performance measurement framework that outlines levels of engagement to foster and improve dialogue between the professional bodies, industry and HE. Addressing the need for industry and practice to be aware of where the specific research expertise lies and in turn for HE to realise where specific industry issues arise the Construction Knowledge Exchange has developed a demand led approach to meet joint needs with the advancement of the sector and knowledge transfer as its key goal.

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