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How current theoretical discourses, methodologies and practices in international engineering business, contracts and procurement are changing the educational development of engineers

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ABSTRACT
This paper discusses how current theoretical discourses, methodologies and practices in international engineering business, contracts and procurement are changing the educational development of engineers, by creating a need for engineers with a set of skills that differs from that which suited the industry in the past, when business was less internationally focused.

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The perspective and outlook of the construction industry has changed and it has become more customer focussed. A few years back, the sector was considered as inefficient, with cost and schedule overruns, delayed payments, higher work related accidents, an unfavourable workplace, and one that was not ready to accept change. However, forces of change have swept the construction sector, bringing forth a number of opportunities for growth. Recognising the potential for growth, the UK government has introduced the Construction 2025 vision, which visualises a leading position for UK construction firms. The focus is on developing people, creating a smart industry that is efficient, forming a sustainable sector where growth and leadership will drive the sector forward (Construction 2025, 2013).

It is clear that the sector faces challenges from its old inefficient image, and there is a pressing need for a new workforce that can deliver transformational challenges. The competition for skilled personnel will be high and construction firms must be able to recruit, retain, and develop skilled staff. To meet these challenges, education has reinvented itself, and the curriculum now includes several new practices related to green construction, sustainability, digital design, simulation, building information modelling, international business orientation, communication and leadership skills and several other new practices. The next sections discuss the manner in which education and its focus have changed.

I. INTRODUCTION

The growth of globalisation and the challenges forced by the economic recession brought increasing levels of unemployment. These and many other external forces have woken the academic world from the earlier pedantic studies to more application oriented teaching. Current job requirements are such that the fresh recruit must be ready to fit into the organisational workforce and be ready to contribute to the organisation output with minimal amount of training. The employability level of the student has become important, and the approach of the educational institutes is to make the students fit and ready for work by outfitting them with new skills. This approach is different from the earlier era when students were imparted teaching through elaborate pedagogy, with the focus on theory and minimal focus on practical skills.

This document examines the current theoretical discourses, methodologies and practices in international engineering business, contracts and procurement and the manner in which they are changing the educational development of engineers, by creating a need for engineers with a set of skills that differs from that which suited the industry in the past, when business was less internationally focussed. The focus of this study is on the construction industry.

II. CHANGES IN ACADEMICS AND TEACHING

The construction sector in UK contributes £90 bn to the UK economy, or about 6.7% of the total GDP. The sector provides employment to 2.9 million workers, supervisors, and managers, and with the economy recovering, the sectors is poised for growth.

small business are making use of globalisation and expanding in international markets. However, to become successful in international markets, small businesses must have staff with new skills. The new skills include making use of low cost communication, developing regional trade alliances, and facing competition by expanding into international markets. US universities and colleges are redesigning their curriculum to train the staff with such new skills. Accordingly, business schools in US have developed a strategy of internationalising the curriculum and programs with international dimensions (Schuster et al., 1998). Technology is incorporated into their curriculum and classroom to prepare them better for the rapidly changing business environment. Colleges have changed their accreditation guidelines, and used technological development to meet the local and regional business community needs. US colleges have undergone a globalisation, and added several international courses and content to their programs. Some of the skills developed include knowledge in international marketing, international finance, international trade and exports, and cross-cultural human relations skills (Reynolds & Rice, 1998).

The line of argument is about changing the college curriculum is the pressing need for colleges to adopt new teaching methods. Conrad and Newberry (2012) point out that despite the best efforts of the academics, a gap remains in the area of communication skills for new business graduates. One of the reasons for this gap is that the industry demands outcome based skills, which can be taught. However, comprehensive outcome skills are lacking. A study by the National Commission on Writing (NCW, 2004) shows that less than one third of the employees had sufficient writing and oral communication skills that organisations value. Many firms consider writing and oral communication skills for promotion and hiring. Kirby and Romine (2009) argued about including communication assessment in course content, since employers want these skills in the employees. Passow (2012) points out that modern engineers play complex roles that the traditional technical roles. Instructors and academics must be sensitive to understand the communication skills and needs of businesses. Some of the skills needed are listening, interpreting the communication, suspending judgement, and avoiding other mental activities. Another study by Symes et al. (2013) indicates that employers in Australia required engineering graduates with increased business and communication skills, and behaviour that is more professional. Academics do not include such concepts and practices in their curriculum, and this must be improved.

The previous sections have argued about the skills sets and curriculum in the western countries, and there was no mention about graduate engineers in

2.1 Concept of Engineering Work and Education Need

Researchers have often asked questions about the work that engineers do, and the skills they need to become successful in their firms. Engineering practice in USA evolves continuously and is upgraded to keep pace with new technology, and to prepare engineers for the future. Anderson et al. (2010) carried out studies in six engineering firms in USA to understand the work practices, similarities, and the skills that are needed at the workplace. Among the skills that are most needed are problem solving, team working, communication skills, working within the constraints of time and budget.

Vincenti (1990) argues that engineering involves significant uncertainty, and that the path to the solution is often messy, relying on practice generated knowledge rather than pedantic training. Bucciarelli (1996) argues that engineering work needs interdisciplinary coordination, and that it is a social process, where the scientific law, executive mandate, and customer needs are factored into the equation. Trevelyan (2007) continues with this theme and argues that interdisciplinary teamwork and messy systems form the main work of the engineer's problem solving approach. The practical and technical problem solving tasks are linked with social interactions. Agreeing with this point, Sheppard et al. (2006) point out the importance of problem solving definition and the special knowledge required to find solutions.

These skills help to equip engineers for the workforce, and enhance their role in organisational practices. The research brings into focus the need for upgrading engineering curriculum and teaching students about various soft skills. It is also seen from the review of UK government policies that the focus is shifting from rigid academics to more of soft skills in multi disciplines (Construction 2025, 2013).

2.2 Developing Appropriate Skill Sets for Engineers

The previous section examined the ways in which engineers perceive additional job requirements. Levy and Dawkins (1989) point out that the Engineering Council in UK has recommended that engineers must undertake continuing education and training to keep them updated with changing technology and business skills. The authors indicate that engineers are well educated, trained and have sufficient experience to become successful managers, if they are given the right abilities and their skills developed. The main argument is that there should be a change in the curriculum and that teaching methods must consider the challenges that engineers face in their field.

Vibhakar and Smith (2004) support this line of argument, and point out that engineers from the

other countries. Part of the problem is because the curriculum of many countries is modelled around the earlier British and American methodology. Progress is seen in the Middle East colleges in areas of IT and other engineering disciplines. However, the gap between skill requirement and existing skills is considerable. With increased employee mobility, enhanced opportunities from globalisation, college across the world must consider the international level requirements for engineers. While technical skills and knowledge are mandatory, engineers must also have adequate exposure to international trade and business etiquettes. Many colleges ignore this aspect in their curriculum, and focus more on technical development.

As small enterprises grow and seek international opportunities, they must be staffed with engineering graduates having an optimum level of business and technical knowledge. As pointed out in the Construction 2025 vision, the UK government has recommended a greater involvement of the industry with academics. If this trend continues, and if academics are ready to accept help and intervention from the industry, then the vision for Construction 2025 will be met. The dependency of the industry to provide engineers with adequate business skills is high, but the curriculum must constantly evolve to meet these needs. This constant change in college education brings a certain instability and inconsistency, and it must be examined in detail.

IV. CONCLUSIONS

The discussions from the paper have shown that colleges have shown a willingness to move away from the traditional pedantic teaching model to a new model where soft skills are also taught. While technical skills are crucial for engineers, they must be given sufficient training in communication, leadership, and in managing international business. These skills help the engineer to identify internal business opportunities, and to help the organisation to grow. A gap still exists between the college curriculum and teaching methods and industry requirements. However, some level of improvements is evident and the intervention of the UK government would help to bring about this transformational change. The inertia among colleges to change must be overcome and colleges must become active partners, and provide the industry with engineers who are also business leaders.

developing countries. To become successful, they must have a balanced set of technical and professional skills. Ramadi et al. (2015) conducted a survey with 132 participants to evaluate the gaps between industry expectations and perceptions of engineering graduates' skill sets in the MENA regions (Middle East and North Africa). The studies indicate that there are significant gaps between manager's expectations, and satisfaction of graduate engineer's skills. A list of 32 skills was drawn, and these were arranged in eight categories such as Cooperation and continuous learning skills, Global, environmental, and social awareness skills, Problem solving and analysis, Business skills, etc. The study assumes significance since the skills and categories are relevant to all countries and businesses. The report indicates that the current college curriculum, does not impart these skills to the students.

III. DISCUSSIONS

Findings from the critical literature review indicate that there is wide concurrence among researchers about the need for graduate engineers to develop soft skills, in addition to technical skills. Some of the skills that businesses need are skills in communication, leadership, team working, international business skills, etc. Colleges in UK and US have accepted these requirements, and they have changed their curriculum to meet the needs of industries. However, there is still a considerable gap between the outcome-based skills that organisations need and the skills that colleges provide. It appears that college teachers are not fully aware of these needs, and hence, the teaching methods, teaching models, still focus on theory and pedantic knowledge. Some progress is seen since some colleges have aligned their curriculum with the industry requirements. The UK government has created the Construction Vision 2025, and engineers with hard technical and soft business skills are needed to make use of the new opportunities. Part of the new awareness comes from the industry requirement of looking abroad for new opportunities. Since the vision is to create a large pool of graduate engineers with relevant skills, colleges have to upgrade their curriculum and teaching methods. Engineers have to combine technical and social skills to develop messy solutions.

The discussions also indicate that a substantial gap between industry requirement and graduate engineer skills exists in the MENA and

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