Introduction

Emotional intelligence (EI) has been hailed as being an essential skill that individuals need to possess for effective organisational performance. However, this has not been applicable to all industries. Male-dominated professions, such as engineering, have been characterised as being influenced by aggressive management styles, fierce competition, tight profit margins and adversarial relationships (Smithers and Walker, 2000; Walker, 2001). Indeed, engineering workplaces continue to be uneasy environments for professional women, despite the success of women in mathematics and science at university (Gill et al., 2008).

In this masculine environment, emotionality simply implies 'emotional strength', connoting the suppression of, and control over, emotions (Domagalski, 1999). In such professions, men are often deterred by the term 'emotion' itself, as their performance tends to be assessed against certain stereotypes which support and foster decisiveness, toughness, self-reliance, resolution and control (Loosemore and Galea, 2008). On the other hand, engineers are increasingly challenged to emotionally engage with a broad range of internal and external stakeholders. Indeed, recent research (Boyatzis, Rochford and Cavanagh, 2017; Walther, Miller and Sochacka, 2017) positions EI as critical to engineers. However, current efforts to educate emotionally intelligent engineers are hindered by the lack of a conceptually cohesive understanding of, and language for, applying EI to engineering education.

Therefore, whilst research supports the need to nurture functioning interpersonal relationships in engineering (and, by extension, male-dominant professions), many efforts to this effect are hampered by masculinity stereotypes permeating the industry. Within this enduring, albeit changing, sector engineering offers a unique context to demonstrate the 'trainability' of EI to engineering students, an area that this chapter aims to illustrate.

Emotional Intelligence (EI)

EI suggests that some people might be more socially and emotionally effective than others in certain aspects of life (Goleman, 1995; Salovey and Mayer, 1990). Goleman, at the beginning of his book on EI, cites Aristotle's words: '[A]nyone can become angry – that is easy. But to be angry with the right person, to the right degree, at the right time, for the right purpose and in the right way – this is not easy' (Goleman, 1995: ix). For Aristotle, those people who know

their emotions and know how to deal with them at the right time have a significant advantage in all aspects of their lives, which manifests as the first reference of EI and the importance of emotion in human relationships (Langley, 2000). Similarly, EI involves an array of capabilities, competencies and skills that Goleman categorised in five domains: self-awareness, self-regulation and persistence, motivation, empathy and social skills to handle relationships (Goleman, 1995). Essentially, the first three are personal competencies that determine how people manage themselves, while the remaining two are social competencies which determine how they manage relationships. In particular, empathy – the ability to know and experience the emotions of another person (Duan and Hill, 1996) – is already recognised by the engineering education literature as a core skill, practice orientation and way of being (Walther et al., 2017) and involves showing that the other person's thoughts and emotions are understood and communicated. As such, engineers face challenges when they are to manage project groups and be leaders for organisations because such positions demand skills in social competence and empathy (Rasoal, Danielsson and Jungert, 2012).

In this respect, EI has been proposed as an intrinsically important element in engineering education so that graduates are not only prepared with engineering fundamentals, but also for success and actual on-the-job skills (Riemer, 2003). More specifically, construction firms are seeking graduates with exceptional management and leadership skills to be able to improve interpersonal relationships and to successfully fulfil projects (Dulaimi, 2005), highlighting the influence of academic education and formal training on engineers' behaviour. Moreover, the skills that engineering graduates ought to have include interpersonal skills, teamwork, and motivation (Dulaimi and Langford, 1999). It should be noted that EI should not be considered as a replacement for knowledge, ability or job skills, but instead it enhances work skills. However, Goleman has highlighted that EI abilities were about four times more important than an individual's IQ in determining professional success and prestige – even for those with a scientific background (Goleman, 1998).

EI and Engineering Education

The engineering profession has a long and distinguished history. The word engineer originates from the word *ingeniator*, meaning ingenious in Latin. Engineers have historically been the primary designer and maker of tools (early engineering achievements go as far back as 5500 BC with the use of metal tools and weapons), their role has evolved with the advance of technology from an independent, self-sufficient and highly motivated inventor to an inter-

dependent team member of the business world (Yurtseven, 2002). The perception of the engineer has also been transformed in the eyes of society from a know-it-all inventor and tinkerer to a highly skilled and narrowly specialised technical expert.

So, why is Engineering, in particular, the subject of this chapter (apart from the clear link with the book's theme)? Firstly, recent evidence by the Harvard Business Review, shows that thirty-four out of the 100 best performing Chief Executive Officers in the world, in terms of market capitalization of their companies, have undergraduate or graduate degrees in engineering (HBR, 2018). Part of the explanation is that engineering breads an ethos of building things that work and it teaches people to try to do things efficiently and eloquently with reliable outcomes. Secondly, the second most popular course for male students who choose to study in the UK (second most popular destination for higher education studies in the world) is engineering and technology (Bhardwa, 2018). Yet, for females this is not a popular degree, as the engineer's stereotypical negative image of the socially inept genius can inhibit student recruitment (Yurtseven, 2002). Moreover, there is little evidence that EI is part of the engineering curriculum, in any country.

A growing stock of studies suggest that EI is important for functioning interpersonal relationships (Caruso and Salovey, 2004; Lopes et al., 2005) and especially linking EI competencies with an engineer's effectiveness or engagement. Similarly, a series of chapters in the construction literature draw attention to the alleged relevance of EI in this industry (Mo, Dainty and Price, 2006; Thurnell, 2004). Recently, a study by Boyatzis et el. (2017) drew on 30 years of longitudinal studies showing that EI and quality of relationships can be significantly improved with the appropriate pedagogy emphasising the building of one's vision, developmental approaches to EI, developing a shared vision with others, and inspirational coaching. Therefore, if EI has such an impact on outcomes, the interest in enhancing it by means of training or recruiting high EI individuals accelerates. Not only is the business case for EI compelling, it is becoming more and more apparent that because of the complex and dynamic nature of relationships in engineering, good interactions among project actors are crucial to the success of the project. EI, in turn, is thought to be a crucial ability to this end (Mo, Dainty and Price, 2006) and, unsurprisingly, scholars in the realm of construction have turned their interest to EI (Butler and Chinowsky, 2006). In this respect, EI has been proposed as an intrinsically important element in engineering education (Riemer, 2003). From an

educational management perspective, it seems plausible to incorporate the concept into engineering curricula at universities.

Planning EI skills in engineering education

One question that schools of engineering may ask is, "can we do more to increase the probabilities that students will develop into good managers and leaders?" One way to do this is to incorporate management skills components into engineering curricula. Indeed, EI needs to be embedded within an organisational system for it to be effective (Fitzgerald, 2003). Similarly, it should also be integrated within the educational structure of engineering studies for it to be effective and reinforced in the learners' minds. Introducing and exposing engineering students to EI literature and skills from an early stage of their degree has proved to be beneficial in facilitating student learning at one particular polytechnic in America (Goleman, 1998). An engineering student will never be able to improve their personal, interpersonal and social skills if they only stick to aspects of the project with which they feel comfortable. Exercises that promote EI skills can be integrated into the course, examples of which are described below.

The major goal of the management skills course should be to teach engineering students the requisite managerial skills to develop their emotional intelligence. 'Skills' imply that one can develop and improve upon them. One approach that has been shown to be effective in helping students to develop and improve their management skills is based on social learning theory (Bandura, 1977), which is based on the premise that people learn by observing and interacting with others, and through observing and copying a 'role model' – known as behaviour modelling (Goldstein and Sorcher, 1974). Social learning theories are considered 'humanist' because control for learning is placed in the hands of the individual and behaviour is shaped by social relationships that influence the individual's beliefs, values and perceptions (Harrison, 2009). This theory proposes that an integration of cognitive and environmental determinants produce a more adequate explanation of human behaviour than focusing on strictly environmental determinants (Manz and Sims, 1980). According to Whetten and Cameron (2002), one useful way of incorporating social learning theory concepts into a management skills training program comprises five components: skill assessment, skill learning, skill analysis, skill practice and skill application. For example, as part of their degree, engineering students may spend a few weeks in the field with experienced manager engineers to learn about the job and what is expected. After the field training, the students can attend workshops to

develop the skills they observed in working with their manager engineers models. Based on the pre and post emotional intelligence assessment, Latif (2004) found that the management skills course amongst some pharmacy students resulted in a significant improvement in students' emotional intelligence. A critical highlight of the implementation of this course was the realisation that developing management skills related to emotional intelligence requires a great deal of individual determination and persistence.

The concept of emotional intelligence has also links with reflexivity and reflective abilities (D'Cruz, Gillingham and Melendez, 2007). Asking students to provide insight into their personal emotional reactions, their potential impact on the self and others, as well as how they might affect decision-making processes and personal wellbeing are key elements of reflective practice (Wilson, Ruch, Lymberry and Cooper, 2008). Incorporating a reflective practice has the capacity to help students make connections between the course content and professional practice, to develop their critical thinking abilities and facilitate insights into personal motivations, assumptions and beliefs (Knott and Scragg, 2008). The capacity to manage emotional reactions effectively, frequently in complex care settings, is central to the role of a manager. Therefore, supplementing communication skills across the curricula, and not in a standalone module, has more chances of contributing to students' higher EI levels. More particularly, this can include the delivery of oral presentations in engineering studies and incorporating communication and presentation skills in the marking structure of reports so that students treat them more seriously. Other EI interventions that have been implemented in MBA, medical and business students, as well as in project management practitioners include: a half-day workshop on mental health (Abe et al., 2013), a 2 full-day EI workshops, a 1-hr coaching and feedback session, and two 75-min webinars (Chen et al., 2014), a semester management course on EI (Clark, Callister and Wallace, 2003), a 2-day and 2-week EI training to project managers (Clarke, 2010; Turner and Lloyd-Walker, 2008), a one 4-hr EI workshop and seven sessions over seven months (Fletcher et al., 2009).

Experiential learning approaches, which involve embedding the student in the actual experience of communication, with opportunities for debriefing and re-application, provide opportunities for the development of self-awareness. This theory is most closely associated with the work of Kolb (1984), which was in turn based upon the earlier works of Dewey (1936). For this type of learning to apply, the learner must firstly engage in a concrete

experience, what then follows is reflection on that experience, the learner will then go through a process of abstract conceptualisation in which they draw conclusions from what has been learnt (i.e. what worked, what did not work), and finally, they apply or test what has been learned – active experimentation. These four stages make up the learning cycle. According to Kolb (1984), one needs to complete all four stages, to learn from experience. The inclusion of any experience or activity into the curriculum is relevant here. Also, studying abroad (Andreasen and & Wu, 1999), learning through real life case studies (Kreber, 2001), can further be examples of experiential learning. In the classroom, videotape playbacks of oral presentations also stimulate reflection in the student, to help students build on past learning. In addition, role-play can encourage self-awareness, while role reversal will contribute to the students' understanding of empathy, of knowing how the other side perceives engineers. Indeed, such context-specific role-play will help to strengthen those skills within the engineering framework. Mentoring and on the job training of young, technically proficient engineers can also be an effective experiential approach (Farr and Brazil, 2009). Invite young engineers, as part of the training process, to observe or participate in meetings can help young engineers to develop soft skills, whilst it exposes them to several levels of responsibilities.

Practical applications to enhance EI amongst engineering education can also be enhanced with the use of Problem-Based Learning (PBL) to underpin the curriculum. This is a key pedagogical approach that uses a problem as a trigger for students to develop solutions, whilst learning from the process and using evidence to support their decisions (Klegeris and Hurren, 2011). Typically, PBL begins with an unstructured real-world problem which the students need to define and bring into focus before it can be explored (Aditomo et al., 2013). Students must identify what knowledge they need to solve the problem and must take the lead in seeking out and obtaining this. Hence, the key feature of PBL is that the purpose is the acquisition of new knowledge, rather than the application of existing knowledge (Aditomo et al., 2013). The pedagogical emphasis is firmly upon the process that students go through when solving the problem – the process is more important than the results (Klegeris and Hurren, 2011). It is therefore a fundamentally different approach to education than the traditional 'chalk and talk' approach. PBL can be a suitable curriculum component for developing a student's emotional intelligence (Evans, 2009), where the curriculum is defined by the tutors and described in a series of problems or work scenarios, rather than in a series of lectures. Students working in groups (or individually) are exposed to scenarios that a professional engineer would face, normally written to a template, which encourages students to explore the breadth and depth of

the engineering spectrum'. Given that PBL places students in a situation where interpersonal skills are important, it provides a useful forum whereby students begin to understand the characteristics of their own emotional intelligence. Practical examples include the University of Liverpool and the University of Edinburgh, which have also chosen to include an exercise involving student-peer appraisal. The students are asked to provide structured, constructive feedback and award a notional 'mark' on how well their peers have performed in PBL.

The benefits of PBL, such as the development of social and cognitive skills (Leal Filho et al, 2016), have been recognised in engineering education, where it has a long and well-established pedigree (Edström and Kolmos, 2014). However, despite this, there are contradictions in the literature. For instance, Buchanan et al. (2016) argue that PBL is effective at developing students' critical thinking and problem-solving skills, whereas Koh et al. (2008) disagree. Moreover, whilst challenging the benefits of PBL, Kirschner et al. (2006) argue that its effectiveness is outweighed by the fact that it can overload students. Nevertheless, PBL encourages students to learn and is highly motivational because students can see the link between the problems they are trying to solve and real-world applications (Barrows, 1996). Moreover, the nature of problem-based studies means that there may be more than one solution (Cotič and Zuljan, 2009). This, of course, is ideal from the context of EI.

It is noteworthy, that some of the above examples of activities, such as role-models, field trips to sites, mentoring, use of real-life case studies, follow-ups and networking have been identified as a few of the most significant reasons that middle-school and high-school girls value as important to join an engineering degree (Heller and Martin, 1994). Key to the success of the approach is the need for tutors to be flexible and to respond quickly to differences in the ability and personality of their students (Savin-Baden, 2007). It is also crucial for assessments to be carefully designed so they are appropriate and align with the learning processes facilitated by the tutors (Hendry et al., 1999). Moreover, success depends on the quality of the problems that are given to students (O'Grady, 2013). Perhaps the most important success factor is the learning environment itself. This must be appropriate to the problems under investigation, teaching methods must support reflection and collaboration, and there must be adequate independent study time built into the programme (Hendry et al., 1999).

Challenges of integrating EI in the engineering context

Despite the many benefits that EI can provide to engineering management, there are still the contextual circumstances of the profession that make it so unique and impose challenges to the implementation of the concept in engineering education. As already mentioned, the construction and engineering industry is one of the most male-dominated and aggressive industries (Smithers and Walker, 2000). Nevertheless, the impact of expressing and displaying anger, a negatively-perceived emotion, has yielded positive organisational outcomes and perceived effectiveness. For example, if anger were an inappropriate emotion to display in this particular profession, it would be questionable whether project managers would enact it to be effective in their job. Smyth vividly described construction as a profession that 'is based upon the street fighting man', where 'the pressure is great, (and) verbal abuse and shouting are the weapons to instil fear and maintain power in the office corridor' (Smyth, 2000: 12–13). This delineates the parameters within which the typical management style in construction tends to fall. To a significant degree, Lindebaum and Fielden (2010) argue that it is actually good to display anger as such behaviours may be a prerequisite for surviving in this sector, especially against the backdrop that engineering and construction are characterised by aggressive/authoritative management styles, adversarial relation-ships, tight profit margins, fierce competition and the imperative to be able to respond to extreme short-term pressures at work. Hence, it is unsurprising that this results in the industry's preference to recruit assertive candidates, who are perhaps better able to cope with the 'survival of the fittest' maxim (Cartwright and Gale, 1995). Given these unique features of the profession, the argument that the expression of anger suggests lack of emotional regulation and is persistently associated with leader ineffectiveness, as posited by popular as well more scientifically inclined writers (Goleman, 1998), becomes a rather untenable position. However, the management of this anger (and other negatively-perceived emotions) is a skill heavily embedded in emotionally intelligent people. As Lewis (2000) argues, in specific organisational contexts choosing the appropriate emotions to express reflects a leader's ability to respond in an effective way.

Conclusion

This chapter has argued for the need to integrate EI skills in the contemporary engineering education, as an increasing prerequisite to become better communicators, team-workers, and reflective and empathic practitioners of engineering. Enhanced integration of EI skills will, in turn, enhance the work skills of graduates, particularly with regard to communication skills. Ultimately, EI skills can be integrated into university teaching, whether it is at the basic

instructional level, social and experiential learning, in a work-based learning structure or as a part of PBL-based education. The incorporation of several components of the fundamentals of EI in engineering curricula will facilitate advanced communication skills in order to allow young engineers to integrate and adopt to the contemporary issues of the modern workplace (e.g. increasing mental health issues, conflict, work-life balance etc.). However, given the traditionalist nature of many engineering curricula, this may take some time before change is evidenced. It is also recognised that to change the climate of this male-dominated profession will not happen over-night. Educators and engineers will need to be shown both by word and example that a judicious blend of hard and soft skills is needed to ensure long term success. The earlier the development process is started, the more time is available to grow into a leadership role. As educators ourselves, we must never forget our obligation to younger students of leadership and provide the mentorship needed for success.

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