

# **A Proposed Learning Journey for the 21st Century Global Engineering Manager: An Australian Perspective**

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## **1. Introduction**

As world leaders continue to navigate around the global financial crisis and potential global recession, future engineers aspiring to management will need to rethink their learning journey and pathway planning to management in order to be more prepared to tackle a more globalized, integrated, dynamic and ever-changing world. Engineering managers in the 21st Century must be prepared to operate in a very different environment to that of the 20th Century of which engineering management education is mostly based on. Question may be asked, “Are we training 21<sup>st</sup> Century leaders based on 20<sup>th</sup> Century educational paradigms?” This paper is intended to initiate further discussion and research into this important area of the development of the future engineering leaders and nation builders of tomorrow.

## **2. Literature Review**

### **2.1 A Call to Collaborate**

There has been a call for reform and collaboration in engineering education, particularly from industry for some time [1]. In Australia, this has been accentuated by the engineering related labour shortage currently experienced. This is reinforced by “Big Issues Roundtable” coordinated by the Committee for Economic Development of Australia [2]. Simons of The Smith Family [2] was quoted, “With educational transformation there is need for greater integration and porosity among walls, systems and sectors.” and “Business council of Australia expressed a concern about how business can come to the table in enhancing and driving change effectively in the education sector both in terms of design and strategy, programs that are effective in the marshalling of evidence that will bring about improved practice.”

This is further highlighted by the KPMG’s “Embracing Change? Global Construction Survey 2008” Report, “On a global level, there has historically been little or no collaboration between stakeholders such as companies, universities and governments” [3]. One example of this collaboration is the establishment of Mining Education Australia, where collaboration from universities and the mining industry saw the emergence of new capabilities and capacity to train mining engineering graduates. The message for the future is clear; collaboration is required from universities, industries and governments.

### **2.2 A Call to Consolidate**

An environmental scan performed by the lead author [4] highlighted that management education for engineers is already undergoing a transformation. There is evidence that indicates an increase in customization of curriculum and delivery, increased corporatization of education, and a proliferation of short-courses and workshops. Some examples that illustrate this shift are Engineers Australia’s “Engineering Education Australia” and “Professional Development Program”, engineering professional organization’s partnerships with Melbourne Business School and Chifley Business School, and in-house leadership development operations such as GHD Business Schools, SKM Consulting and Qantas Engineering. However, there is also some evidence that these activities are causing congestion in the market place, and increasingly there is a call from the engineering profession to consolidate this professional development market [5].

### **2.3 A Call to Revitalize**

Recent literature initiated by the Commonwealth of Australia, Innovation & Business Skills Australia, Australian Institute of Management, and Engineers Australia [4][6], has indicated that engineering managers of the 21st century need to operate in a global and often mobile environment, encounter complex and often

conflicting issues, need to be culturally aware, have to deal with multiple stakeholders, technology driven and possess strong team leading skills and interpersonal skills. They may also find work-life balance difficult, and most of all, must possess strong technical acumen in the relevant industry. This is further supported by recent research on Australian Chief Executive Officers (CEO) who have an engineering degree in Australia [6].

One of the reasons for this change in training preference is mainly as a result of the curriculum gap in the existing training of engineers as the operating engineering environment evolved. This is indirectly highlighted and addressed in the Australian Learning and teaching Council's (ALTC) Review of Engineering Education led by King [1]. This observation is further supported by Trevelyan [7] of UWA that engineering educators often have a narrow view of what constitutes "real" engineering and neglect the "human" side of engineering in the curriculum.

Galloway [8] in her book titled "21st Century Engineer: A Proposal for Engineering Education Reform" argues for the need to broaden current and future engineers' skills sets to become not only technically competent but also competent in communication and management practices. These soft "fundamental capacities", she believes, are still not being taught at either undergraduate or postgraduate levels, and proposes a new Master's degree in Professional Engineering Management. Galloway paints the new global landscape where mega projects, sustainability, infrastructure security, and multicultural work teams pose challenges for which engineers may be unprepared. She lays out non-technical areas in which engineers must become proficient: globalization, communication, ethics and professionalism, diversity, and leadership (ie. 21st Century Skills Set). She summarized the case for radical curriculum renewal with, "an engineering educational system that has not kept pace with the demands of the marketplace". The message states that revitalization of the curriculum and delivery is long overdue.

#### **2.4 A Call to Recognize and Articulate**

Management education is often about aligning the needs of the organization, the focus on bringing the employee visions and values into line with those of the organization and their development is linked to the wider corporate strategy [9][10][11]. To Human Resource (HR) managers and Learning & Development professionals, learning is much more than just creating courses, it's about managing the people. Corporate education programs are enable companies to link the development of their employees to business goals and performance. Training courses are not the core requirement of leadership development and need to be integrated into wider process of feedback and structured experience.

Within the HR profession, there is a growing recognition that formal training accounts for only a fraction of organizational learning [12]. Disseminating knowledge in a formal classroom is both very expensive and inefficient, and most HR professional have a "70-20-10" approach to leadership development [13]. That is, learning is broken up into 70% on the job, 20% as feedback and learning from others through mentoring and coaching, and the last 10% through learning programs. In some ways EA's Professional Development Program recognizes this trend by progressing graduates to chartered status using Career Episode Reports with opportunities for mentoring within the program. Therefore, the question arises on how to provide recognition and articulation of informal learning at the management level.

There is also the ongoing debate over what type of training and development is required; Management vs Leadership debate [14][15] and the Team Oriented Leadership vs Individualized Leadership. Finally, there are senior engineers and managers acting as mentors for graduates; however, it must be asked who is supporting and mentoring the mentors and whether this is necessary. Would an "Engineering Leader Support Network" be an avenue for peer support and networking?

The foreseeable changes in the dynamics of the working environment of engineering managers of the year 2020 will also likely contribute to another significant environmental shift in the management education market place. In a near future world where products such as "Facebook", "Twitter", "Wikipedia" and Web 2.0 will dominate, the question is posed, "What is the next paradigm in personal development, professional development and postgraduate education delivery and curriculum for the engineering managers of the 21st

century. Equally important is how can universities position themselves to strategically benefit from this opportunity?" The authors propose that the new paradigm for educators is a matter of role transformation from a teaching perspective to one of "a coach, a mentor and facilitator of learning rather than purely as educators".

### **3. Transformative Paradigm**

Though the study is ongoing, it is interesting to note that there is an early indication that a "learning journey" concept is forming and this will be discussed further.

From an earlier study [6] conducted by the authors on CEO attributes (who have engineering degree), it was noted that the most important attribute required by CEOs, identified in the study was "Integrity". From the published results, integrity had the highest average importance compared to the next highest for leadership. Leadership and integrity thus are of major focus in this paper. Other important areas were communication, business acumen, strategic planning, and financial management. However, unsurprisingly, integrity was not seen as requiring training, and a large extent considered to be an inherent character trait rather than something that could be 'taught'. However, this paper proposes that educators can nurture and facilitate this "learning" of integrity by introducing an accelerated personal ethically journey. This can be manifested in the form of philanthropic activities by (say) placing engineering executives into charities during their learning journey. For example, Qantas aircraft engineering and maintenance services senior management team participates in the "Executive Leadership Development" program that aligned leadership development with corporate social responsibility by placing them in a charity called "Foodbank" [16]. Beside the ability to identify and resolve business issues, strategic and commercial skills, cross-functional communications, and leadership attribute, Qantas identified that adaptability and agility are key factors to business in the future.

This observation is well supported by the recent IBM's report "The Global Human Capital Study 2008: Unlocking the DNA of the adaptable workforce" [17] in that an adaptive workforce is required to respond to competitive and quickly shifting global markets, a precursor for future organizational success, however, workforce adaptability remains elusive to many. Creating an adaptable workforce requires more than a series of HR programs, it starts with leadership and the ability to "crack the code" for talent. In some ways, the shift in "management" emphasis satisfies the ongoing debate between leadership and management [14][15], that indeed management skills is important in engineering, leadership skills are paramount.

According to the Economist Intelligence Unit's "Foresight 2020" report [18], globalization and networking technologies will enable firms to use the world as their supply base for talent and materials. As a result, effective collaboration will be become very important. The boundaries between different functions, organizations and even industries will blur. It adds that running an efficient organization is no easy task, but even success there will unlikely to offer any lasting competitive advantage, where personal chemistry or creative insight matter more than rules or processes. Engineering managers of tomorrow will have to lead an adaptive workforce.

In addition, engineering managers will face the prospect the complexity of managing four generations of workers, from baby boomers to "Generation Z" (born after 1995), plus managing an increasingly diverse workforce in gender and culture [19]. Diversity will be a large component of the learning journey. Damain Burton of Asciano Group who completed an Executive Master of Business Administration (EMBA) at Melbourne Business School with 25 other students [20] says of his cohort, "There were lawyers, IBM executives, KPMG partners – it was fantastic to get that exposure. You discover a whole range of things about them and yourself." Doug Roem, an electrical engineer by training, now CEO and managing director of scrap-metal company, Metals Trading completed his Master of Business Administration (MBA) at INSEAD business school in Fontainebleau of France [21]. He says "The key attraction of INSEAD was its diversity. US business schools are much less diverse. INSEAD offered cultural and ethnic diversity, but also a huge amount of professional diversity." Dr. Paul Kroon, of University of Queensland (UQ) has an international reputation for his research in molecular genetics, and is completed a one-year intensive MBA with his own university. He says that an important factor was the opportunity to study with students from around the world. A third of his fellow students were from overseas, including US, Indonesia, Singapore and India [22].

Though *Engineers Australia* (professional body for engineering in Australia) is actively looking at developing the leadership aspects of the engineering workforce with their educational products, it is observed that there is an over-reliance on structures that focus on compliance and competencies, as opposed to a learning journey approach inclusive of personal, professional and educational development. It can be argued that there is no one-size-fits-all approach for the 21<sup>st</sup> century where “boxes” can be ticked for engineering managers.

Boston Consulting Group’s report “Vision 2020” [7] noted that managers of the year 2020 should have the following attributes and skills:

- Able to manage a global workforce and diversity in the workplace, and high adaptation to various cultures,
- Possess intellectual grunt, highly analytical and decision making skills, and a deep knowledge of the industry or enterprise,
- Possess high emotional intelligence and strong inter-personal and leadership skills,
- Possess a life-long learning and explorative attributes, and
- The ability to balance work/life demand requiring high energy levels and resilience.

In a recent survey conducted by IBM, “The Global CEO Study: Enterprise of the Future” on 1130 CEOs and leaders of public and private institutions [23], it found that:

- Organizations are bombarded by change and many leaders are struggling to keep up; 8 out of 10 CEOs see significant change ahead and the gap between expected change and their belief in their ability to manage it has almost tripled since the Global CEO study of 2006;
- CEOs view more demanding customers as an opportunity to differentiate;
- Most CEOs are adapting their business models, with two out of three implementing extensive innovations.

The enterprise of the future was described as:

- Hungry for change, shaping and leading trends, comfortable with unpredictability, value and goals providing alignment and cohesion;
- Constantly surpassing customer demands and expectations;
- Strategically designed to access the best capabilities, knowledge and assets from wherever they reside in the world and apply them wherever needed;
- Disruptive by nature, shifting the value proposition, overturning traditional delivery approaches and reinventing itself and its entire industry
- Moving beyond philanthropy and compliance to reflect genuine concern for society in all actions and decisions.

Based on these descriptors, the enterprise of the future will be nimble, innovative and better at recognizing and facilitating faster and more extensive collaboration on a global scale. It will be adept at social networking and real-time collaboration to improve communication across its global organization to spread good ideas and solve problems faster. It must remain active at managing business while trying our bold business innovations. The message to engineering managers of the future is clear, instead of shrinking their focus and budgets around aspects such as R&D, Marketing, HR, etc., they need to be investing in those things that will have the workforce ready for fluid transformation. It will require transformative leadership and genuine integrity combined with strong commercial and technical acumens.

Another aspect that needs to be considered is developing confidence [24]. Confidence separates the true leader from the pretenders. Leighton Holdings and Australia Post chairman David Mortimer states, “The more effective people are those who can grasp the imagination of their team. They have the personal magnetism and intelligence to build around them and to continue to embrace talent within their organization. That’s another way of saying they’re confident.” Burton of Asciano Group [20] also says “It prepares you remarkably well. It’s an intangible, but a direct benefit of doing the MBA, as much as anything else, has been confidence.”

An under-rated component of leadership development is in intelligence leadership. Aspiring engineering managers would be advised to take their seriously as a study [24] showed that 19% of S&P/ASX100 leaders

achieved honors in their undergraduate degree. There is little consistency, at least at the undergraduate level, about what the leaders of the S&P/ASX100 companies studied. 18% studied commerce, 7% studied economics and 14% studied engineering while 17% have a bachelor of science. Only 3% studied law and 3% studied medicine. At the postgraduate level, 25% have an MBA, and 7% have no tertiary qualifications. This defies the myths that only individuals with commercial background succeed as managers. It is also interesting to note that there is little correlation between higher educational attainments at prestigious schools and better managerial qualities in a 2005 study [25] by Gottesman & Morey of Lubin School of Business, Pace University; ie. will be more adaptive and innovative, and more likely to possess characteristics that may improve firm performance.

Mortimer [24] stated that “There are 2 types of managers; those who are outstanding people-people, who combine that with high level of intelligence and are quite frequently visionary. And then there are those who, in my mind, are risk managers.” The Warren Centre for Advanced Engineering at the University of Sydney is establishing a new department of postgraduate teaching and research in engineering leadership [26]. It will offer masters courses to the best engineering graduates in various disciplines from around Australia, many of whom would already have experience in industry. Students will learn how to analyse markets, how to gain an understanding of other fields of expertise and how to lead an engineering team. In addition to classroom learning, students will carry out field work in a company and write a thesis in industrial innovation or R&D program.

This observation is well supported by the authors’ own study on CEOs who have an engineering degree [6]. The interesting element of the data is that a large cohort had non-management qualifications; 19.5% higher technical qualification and 8.5% had PhD qualification. These observations provide some evidence that it is beneficial to include a research-based component into the learning journey.

The question must be also asked of the adequacy of MBA programs to provide the personal, professional and educational development of engineering managers. The answer so far hasn’t been a “no”, it is a “not yet but watch this space”. There is an acknowledgment by business schools around the world of the need for transformative reform. Brailsford, head of UQ Business School, suggests radical changes to curriculum to focus on personal and ethical decision making, and to get back to fundamentals [27]. He agrees with the feeling among MBA educators internationally that some significant decisions on content are required. Green, dean of business at University of Technology Sydney [27] says “The MBA will evolve because an MBA that a stand still is a useless MBA ... People will challenge paradigms and provide new solutions and ideas.” However, he says specialized masters will still have their place but the MBA will be particularly relevant because “it is the only degree that combines a comprehensive grounding in all the functional areas of management”.

In the shadow of the last statement, what if it is possible to extract the best of an MBA and integrate it into the proposed learning journey. It can be argued that the best candidates to host such programs are in the engineering faculties as they should possess the capacity to teach both technical and management curriculum for engineering managers.

#### **4. The Learning Journey**

The dynamic and integrated nature of the globalised world is argued to have significant implications for the learning journey of engineering managers of tomorrow. Business schools are acknowledging the need for transformative reform in their programs; however, engineering faculties have been slow to react to meet the challenges in the postgraduate arena given the significant opportunities to exploit the inherited comparative advantage. The new paradigm for educators is to take a life-long learning perspective to their client, in this case, the engineering managers. Educators have to be retrained and re-equipped to be able to mentor and facilitate personal, professional and educational development of individuals.

The proposed learning journey should be positioned in a transformative educational structure that:

- Has a seamless integrated environment between academia and industry;
- Has a clear and unambiguous vision as a concentrated body of stakeholders;
- Has a revitalised curriculum that is sustainably transformative with the dynamic and integrated global environment;

- Have mechanisms to recognise and articulate work-integrated and informal learning;
- Have 21<sup>st</sup> century skill sets embedded within a revitalised curriculum.

The future environment requires engineering managers that are transformative leaders who possess:

- Ability to nurture and lead an adaptive workforce;
- Ability to manage diversity and multiple-stakeholders;
- Genuine social and ethical attributes;
- Strong emotional intelligence;
- Strong intelligence leadership;
- Confidence in presence and abilities;
- Strong business and commercial acumens;
- An in-depth knowledge of one's industry.

It is proposed that the learning journey starts not long after undergraduate studies are completed, in the early years working as a graduate engineer. It should incorporate and integrate personal, professional and educational development with close supervision by mentors, both within the company and university. The workplace becomes the classroom, and the classroom becomes the workplace. The former is where work-integrated and informal learning are recognised and captured for articulation; the latter is where the research-based learning is part of the company's innovation or R&D program. These scenarios will be able to build-on in practice the necessary "soft-skills" but also develop rigour in "intelligence". It is envisaged that the learning journey may involve short-term placements in another industry such as banking or the arts.

There is a case for self-directed but collaborative peer-driven learning in a philanthropic environment where there is a melting pot of diverse profiles of participants but also of the recipients of the charitable work. The learning in these philanthropic environments will hopefully develop the ability to manage diversity and be adaptive, but also to develop empathy for social concerns.

In conjunction with mentoring in the personal development, these may be conducive aids for developing "integrity". The learning journey will still encompass elements of a revitalised curriculum studies in engineering and management; with classroom sessions consisting of various industry types, multiple disciplines, cross-faculties and even cross-institutions internationally. It is possible to complete the learning journey in an intensive 3 year timeframe, but a more realistic 5 year timeframe is recommended as the step for most graduates to management starts generally after 6 years of work experience [6]. The learning journey incorporating personal, professional, and educational development should enable future engineering managers to develop the confidence to be effective as transformative leaders operating in dynamic and integrated globalised world. The learning journey should be reinforced by peer-support networking in a virtual social network which students and alumni can access across institutions.

## **5. Conclusions**

The changing environment for future engineering managers demands a new paradigm and this paper proposes a revitalized framework and refreshed curriculum for personal, professional, and educational development especially in postgraduate education for engineers. The key theme is the need for a transformative educational structure to train transformative leaders of tomorrow. This may involve work-integrated learning, mentoring, peer-facilitated learning, exposure to philanthropy, diversity, and challenges in the form of intellectual rigour and agility. The fluid nature of the management education market has introduced many new influencing factors and opportunities. This changing need in delivery and curriculum preference is as a result of the increasingly dynamic and integrated globalised world. It may require collaborative idealism from the stakeholders to achieve desired outcomes. There is a need for future transformative leaders in our engineering managers. This paper presented a new paradigm and proposals to reform the existing framework to achieve enhanced attributes of future engineering managers, and to provide a mechanism for sustainable curriculum reform in engineering management education. The authors recognize that this proposal may set a task that is too great, and politically, very sensitive to any individual champion (or university) to act on. Though history have shown that change is often a result of reactive actions, it is hopeful that foresight and vision may play a part in ensuring the future generation of

engineering managers will be well positioned to exploit and excel their comparative advantage in the global stage of mega engineering projects, within fluid, diverse and integrated environments.

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