

# A New Paradigm in Management Education for Engineers in the 21<sup>st</sup> Century: A Proposal for Reform

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***Abstract:** Management education for engineers has been confined to traditional management programs offered by business schools, often in the form of an MBA. However, the changing environment for future engineering managers demands a revitalised framework and refreshed curriculum for professional development, especially in postgraduate education. The fluid nature of the management education market has introduced many influencing factors such as corporatisation of management education and proliferation of short courses. This change in delivery and curriculum preference is mainly as a result of the changing dynamics and needs of both employers and employees within the engineering context. Hence, this paper presents to the engineering profession a new paradigm and a proposal to reform the professional development framework and curriculum renewal for engineering management education within an Australian context.*

## Introduction

Management education for engineers in the past has often been confined to traditional management programs offered by business schools focusing in technical skill sets (ie. Accounting, Finance, Marketing, HR, ICT, International Business, etc) often in the form of a Master of Business Administration (MBA). In recent years, there is a proliferation of short-term courses and intensive workshops from non-traditional education providers and in-house training operations which can be applied immediately in the workplace, such as specific engineering topics, sustainability, innovation, communication, team-leading and leadership development programs. This new and latest entry to the management education market in the last 10 years has taken considerable market share away from the traditional "semester-long" formal postgraduate qualification sector, and this trend is likely to continue as "corporatisation" of management education accelerate. This change in delivery and curriculum preference is mainly as a result of the changing dynamics and needs of both employers and employees within the engineering context (Goh 2007; Goh, Coaker & Bullen 2008). However, it is often difficult to monitor and manage the accreditation and articulation of these short courses and workshops, leading to disparity in the standards of management education being received by engineers in curriculum and delivery. This scenario presents an opportunity for the engineering profession and education providers to reform the professional development framework and invest in sustainable curriculum renewal for engineering management education within an Australian and global context.

## Literature Review

### The call to Collaborate

There has been a call for reform and collaboration in engineering education, particularly from industry for some time (King 2008), and it has been accentuated by the labour shortage been experienced in Australia currently. This is reinforced by "Big Issues Roundtable" coordinated by the Committee for Economic Development of Australia (Sibillin 2008). Dr Rob Simons of The Smith Family 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" (KPMG International 2008). One example of this collaboration is in the establishment of the Mining Education Australia, where collaboration from universities and the mining industry saw new capabilities and capacity to train mining engineering graduates. The message is clear; collaboration is required from universities, industries and governments.

### **The call to Consolidate**

An environmental scan performed by the author (Goh 2007) highlighted the management education for engineers are undergoing a transformation in that there is evidence to point to an increase in customization of curriculum and delivery, increase corporatisation of education, and a proliferation of short-courses and workshops. Some examples to illustrate are Engineers Australia's EEA and Graduate Development Program, engineering professional organisations' partnerships with Melbourne Business School and Chifley Business School, and in-house leadership development operations such as GHD Business Schools, SKM and Qantas Engineering. However, there is 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 (Goh 2008).

### **The call to Revitalise**

Recent literature initiated by the Commonwealth of Australia (2005), Innovation & Business Skills Australia (Nicholson & Nairn 2006; Karpin 1995), Australian Institute of Management (2003), and Engineers Australia (EA) (Hammer 2008; Burrowes 2008; CELMQ 2005; CELMQ 2006; Engineers Australia 2006), has indicated that engineering managers of the 21<sup>st</sup> century will be operating 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, possess strong team leading skills and interpersonal skills, may 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 managers who have an engineering degree in Australia (Goh 2007; Goh, Coaker & Bullen 2008). 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 Carrick Review of Engineering Education led by Professor Robin King (2008). This observation is further supported by Professor James Trevelyan (2008) of UWA in his comment that engineering educators often have a narrow view of what constitutes "real" engineering and neglect the "human" side of engineering in the curriculum.

Patricia Galloway (2008) (CEO of Nielsen-Wurster Group, a management consulting group based in Seattle, Washington, USA) in her book titled "21<sup>st</sup> 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. 21<sup>st</sup> Century Skills Set). One of her quotes summarised the case for radical curriculum renewal, "an engineering

educational system that has not kept pace with the demands of the marketplace". The message is very clear; revitalisation of the curriculum and delivery is needed and long overdue.

### **The call to Recognise and Articulate**

Management education is often about alignment the needs of the organisation, 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 (Gannon 2008; Ryan 2008; Efrat 2008). To Human Resource (HR) managers and Learning & Development professionals, learning is much more than just creating courses, it's managing the people. Corporate education programs are enabling companies to link the development of their employees to business goals and performance. Training courses are not the core requirement of leadership development but 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 organisational learning (Kirkbride 2008). Disseminating knowledge in a formal classroom is incredibly expensive and inefficient is also another view expressed in literature. Most HR professional refer this view in the form of the "70-20-10" approach of leadership development (Lominger & Eichinger 2002). 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 is recognising this trend by progressing graduates to chartered status using Career Episode Reports and opportunity for mentoring within the program. Therefore, the question must arise on how we can provide recognition and articulation of informal learning (and also short courses) at the management level.

There is also the ongoing debate over the type of training and development is required; Management vs Leadership debate; Team Oriented Leadership vs Individualised Leadership. Finally, we have senior engineers and managers acting as mentors for graduates, however, one must ask 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? It is hopeful that this will be investigated as part of this proposal.

### **A New Paradigm**

Furthermore, the mentioned foreseeable changes in the dynamics of the working environment of engineering managers of the year 2020 will likely contribute to another significant environmental shift in the management education market place. In a future world where "Facebook", "Wikipedia" and anything virtual will dominate, one must then pose the question, "What is the next paradigm in professional development delivery and curriculum for the engineering managers of the 21<sup>st</sup> century, and how can universities position their curriculum and delivery to strategically benefit from this opportunity?" The author propose that the new paradigm is in the philosophical value of been "facilitators of learning rather than as an educators" from both the teaching and learning perspectives. This paper presents a proposal that endeavours to explore and answer this question.

### **Support from the Engineering Profession**

The proposal will have to gain institutional support from the various stakeholders such as Engineers Australia to ensure traction in any recommendations that may arise from this project. The author acknowledged that the market for management education extends beyond engineers, however, the theme of this proposal calls for customisation and collaboration, though it may be a factor to watch during the consultation process. It may be the case where there is room for the engineering profession to influence some programs but there will be other training opportunities of which is out of the scope

of this project. There is also a need to consider and address the political factors in the various stakeholders within and across their organisations, and it is envisaged that this will be investigated during the consultation process.

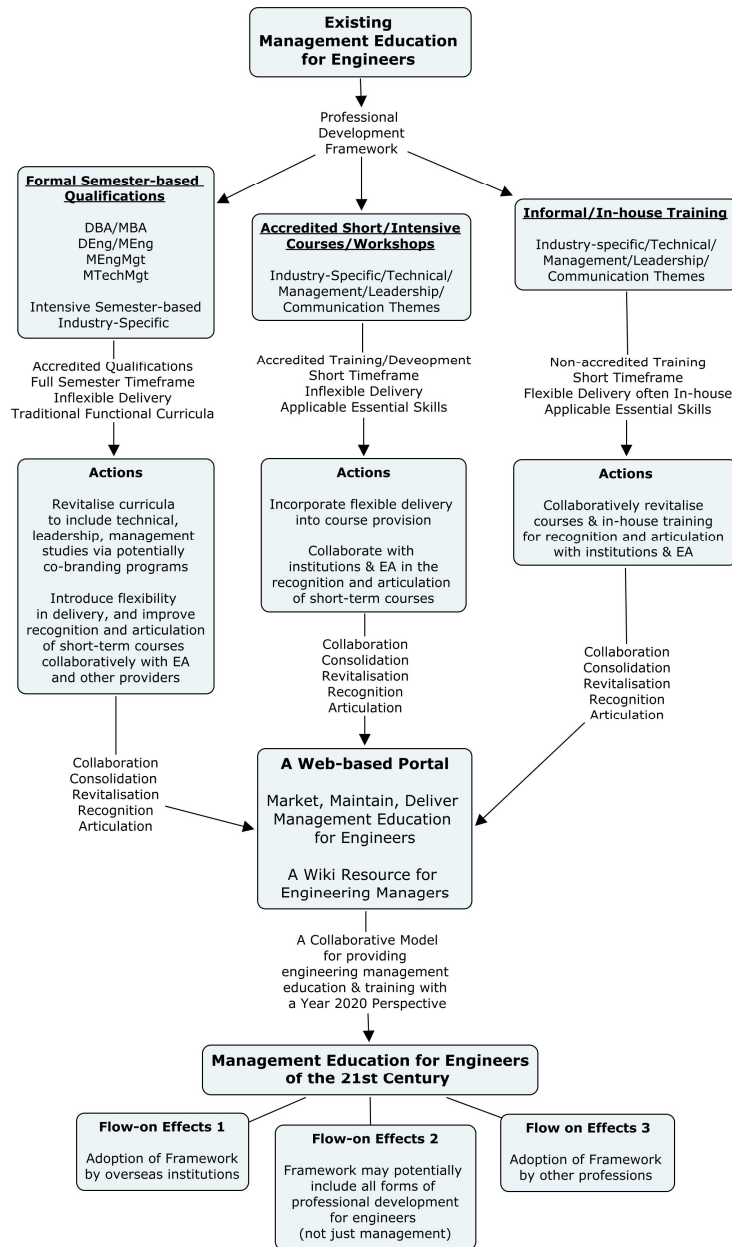
## **The Proposals**

The proposal described in this paper is disintegrated into two proposals of which the first proposal focus on establishing a sustainable framework for professional development of engineering managers (Framework Development Proposal), and the other proposal focus on the curriculum renewal by incorporating 21<sup>st</sup> century skill set and imbedding it into the engineering management curriculum (Curriculum Renewal Proposal).

## **Framework Development Proposal**

The proposed framework to be developed is centred on the opportunity to consolidate the fragmented nature of the engineering professional development market, and to create a sustainable mechanism for curriculum renewal and an ideal environment for flexibility in the programs and multi-modal delivery. The framework should be a mechanism for collaborative effort in consolidating, revitalising, recognising and articulation (C<sup>2</sup>R<sup>2</sup>A) of multi-modal courses in engineering management, which will hope to enhance flexibility in delivery and portability in the professional development qualifications. In addition, there should be a mechanism for sustainable curriculum renewal and peer-mentoring support for mentors, and this proposal suggests a peer-network support group (similar to mySpace or Facebook) and a wiki resource (similar to "wikipedia") as a way for sharing and fine-tuning of topics related to engineering management.

If successfully implemented, the framework may be an exemplary for global integration of professional development for the engineering profession (and possibly other professions) that transcend borders and companies, but yet provide accessibility to the individual and smaller organisations, and hence increase the portability of the qualifications and professional status in a global arena. This project will also help to strengthen the leadership and capacity of the learning and teaching institutions to maintain relevance to the training needs of the engineering industry and profession. The project framework is illustrated in Figure 1.



**Figure 1: Project Framework to reform Management Education for Engineers of the 21st Century**

## Aims of the Project

This project aims to:

- Develop a new collaborative framework for maintaining and delivering management education for engineers at all levels of management which will meet their respective professional development requirements;
- Develop a platform to facilitate training and education providers to consolidate, revitalise and efficiently deliver programs;
- Improve accessibility for individuals and smaller engineering organisations, and also to allow larger organisations to streamline their training and development operations as they expand their operations globally, i.e. flexible and mobile courses that can be articulated into formal qualifications;
- Elevate the recognition and articulation of informal learning and continuous professional development in the form of accredited qualifications in an engineering career;

- Improve education/training providers' distribution channel to the market pool;
- Create a platform for continuous updating of curriculum and a focus on reinvestment in their area of expertise;
- Improve collaborative linkage between universities, industry, and professional society "Engineers Australia".

### **Approach of the Project**

The project will take on the following stages:

- Part 1: Environmental scan within the engineering industry to investigate future implications for education and professional development needs of engineers at all levels of management within an Australian context in the form of focus groups and surveys to stakeholders.
- Part 2: Investigate the dynamics and implications of engineering management education "corporatisation" in Australia, including political factors within and across organisations.
- Part 3: Constructing a collaborative institutional model for professional development for engineering managers in association with Engineers Australia and participating institution with the view for consolidation, revitalization and articulation.
- Part 4: Implementation of framework in the form of an integrated web-based professional development portal (with peer networking capabilities) and Wiki infrastructure for engineering managers being developed and commissioned.
- Part 5: Dissemination of project outcomes via Australasian Association of Engineering Education and Engineers Australia with electronic media, workshops, and seminars about the portal to the engineering management profession.
- Part 6: Evaluation of project model and outcomes.

### **Anticipated Deliveries and Outcomes**

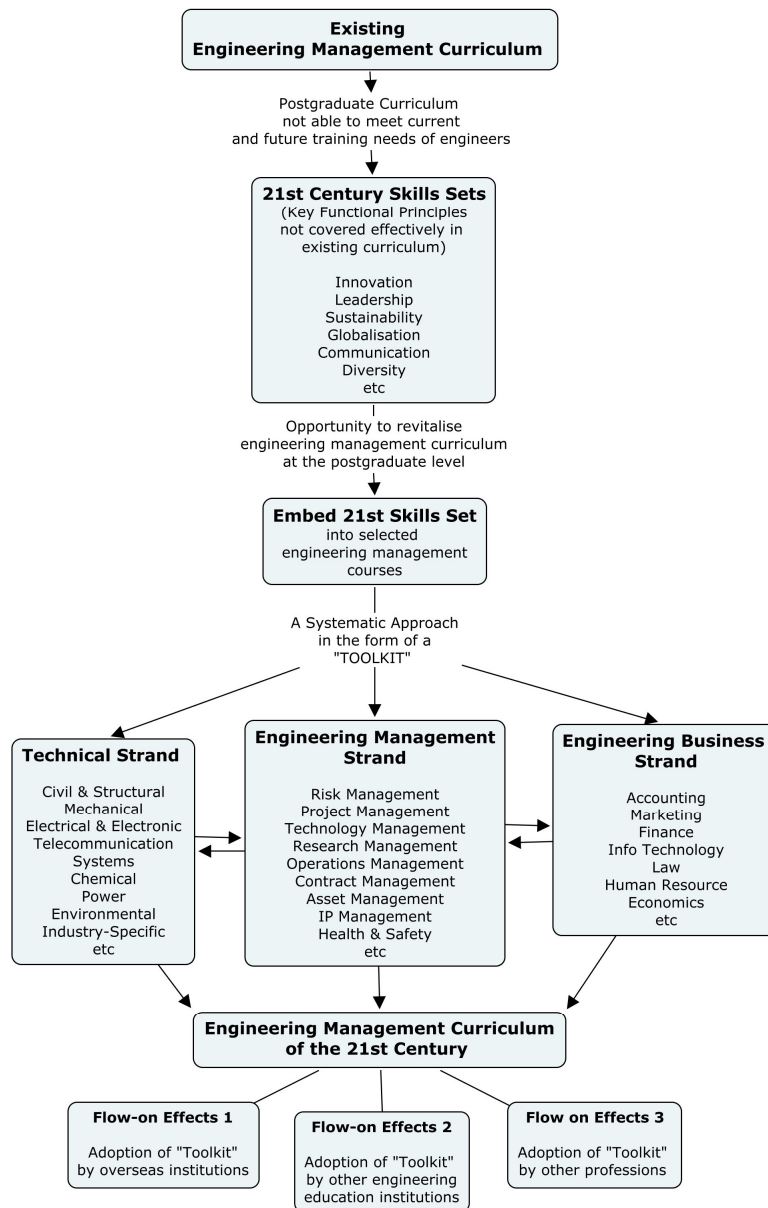
The project anticipates the following outcomes:

- A web-based portal for marketing, maintaining and delivering flexible and mobile management education (and a "wiki" resource) for engineers at all levels of management which will meet their respective professional development requirements for the individual to global organisations;
- A platform to facilitate training and education providers to consolidate, revitalise, articulate, and efficiently deliver programs with the year 2020 perspective;
- A pathway for recognition of short-term professional development in the form of accredited qualifications in an engineering career;
- Increased leadership, capacity and collaboration between universities nationally and internationally with industry and professional association "Engineers Australia" which could potentially result in flow-on projects.

### **Curriculum Renewal Proposal**

At an anecdotal level, many engineering faculties around Australia are investigating the Prof Robin King's recommendations (King 2008) for engineering curriculum renewal at the undergraduate level. It may be argued that it is unrealistic and unachievable to imbed all necessary graduate attributes at the undergraduate levels. Therefore, the postgraduate management training becomes crucial in the ongoing professional development of engineers. However, there is limited evidence to demonstrate initiatives in renewing engineering management curriculum at this stage (Galloway 2008). And it may both be inefficient and possibly ineffective to train engineers to be equipped with "21<sup>st</sup> Century Skills Set" in addition to engineering management training. Therefore, the optimal scenario may involve embedding the relevant skills set into the existing management education curriculum. This project

proposes to imbed potentially 3-5 principles (may include Innovation, Leadership, Globalisation and Sustainability to form the 21<sup>st</sup> Century Skills Set) into a revitalised engineering management curriculum. The project framework is illustrated in Figure 2.



**Figure 2: Project Framework for Embedding 21st Skills Set into Engineering Management Education**

### Aims of the Project

This project aims to:

- Revitalise engineering management curriculum at the postgraduate level to meet the current and future training needs of engineers;
- Embed 21<sup>st</sup> Century Skills Set into engineering management education;
- Elevate the recognition of continuous professional development in the form of accredited qualifications in an engineering career;
- Create a “toolkit” for other non-participating institutions to adopt the curriculum renewal recommendations;

- Create a platform for continuous updating of curriculum in collaboration with the engineering profession;
- Improve collaborative linkage between universities, industry, and professional society "Engineers Australia".

### **Approach of the Project**

The project will take on the following stages:

- Part 1: Environmental scan within the engineering management education curriculum at the postgraduate level in Australia.
- Part 2: Identify and address key issues with curriculum renewal in engineering management education.
- Part 3: Identify and recommend key functional principles as part of the "21<sup>st</sup> Century Skills Set".
- Part 4: Construct a streamlined method for imbedding the recommended functional principles, and package it in the form of "toolkit" for dissemination.
- Part 5: Implementation of imbedding functional principles into selected engineering management courses as exemplary for showcasing the "toolkit".
- Part 6: Dissemination of project outcomes ("Toolkit") via Australasian Association of Engineering Education and Engineers Australia with brochures and electronic media, publications and conferences, and offering of the revitalized engineering management courses to the engineering profession.
- Part 7: Evaluation of project model and outcomes.

### **Anticipated Deliveries and Outcomes**

The project anticipates the following outcomes:

- A selected series of revitalised engineering management courses imbedded with 21<sup>st</sup> century skills set (functional principles which may include Innovation, Leadership and Sustainability principles) which will meet the current and future training needs of the engineering profession at the postgraduate level;
- A platform for continuous updating of engineering management curriculum;
- A platform to disseminate the outcome of this project for adoption by other institutions in the form of a "toolkit";
- Increased capacity and collaboration between universities with industry and professional association "Engineers Australia" which could potentially result in flow-on projects.

### **Conclusions**

The changing environment for future engineering managers demands a revitalised framework and refreshed curriculum for professional development, especially in postgraduate education. The fluid nature of the management education market has introduced many influencing factors. This change in delivery and curriculum preference is mainly as a result of the changing dynamics and needs of both employers and employees. It may require collaborative idealism from the stakeholders to achieve desired outcomes. This paper presented a new paradigm and a proposal to reform the professional development framework to achieve enhanced flexibility and portability, and to provide a mechanism for sustainable curriculum renewal in engineering management education.

The author recognises that C<sup>2</sup>R<sup>2</sup>A may be a task too great and politically ultra sensitive to any individual to act on; Collaboration between large and traditional institutions does not come naturally,



Consolidation will mean winners and losers, Revitalisation takes work and investment, Recognition of informal learning is hard to measure and accredit, and Articulation from multiple pathways and streams are a logistical nightmare. 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.

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