

Leadership in a technological environment

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Abstract: *A three year co-curricula Engineering Leadership Programme was commenced at Monash University, Melbourne, Australia in 2007. Approximately 60 new students enter the programme each year so that currently approximately 160 students are in the programme. The first cohort graduated from the programme in November 2009. The programme includes major industry input and support. The programme was a major commitment by the Faculty of Engineering to future leadership and excellence in the engineering profession. The vision and boldness of the programme has paid off by the increased connection with industry and the increased number of high achieving students that are attracted to engineering at Monash University.*

The development and implementation of the Engineering Leadership Programme are discussed in the paper

KEYWORDS: *Engineering leadership, leadership modules, case study, personality type, people skills*

Introduction

The Faculty of Engineering at Monash University, Melbourne, Australia, introduced a three year co-curricula undergraduate leadership programme as part of a bold attempt to attract high quality students and produce leaders of the future for the engineering profession. The approach and programme have proved to be very successful with students and industry. This paper describes the background to the development of the programme and the structure and implementation of the programme. The Leadership Programme produced its first cohort of graduates in November 2009.

Background to programme

At a Skills Shortage Workshop, held by the Department of Mechanical Engineering in July 2006, the industry participants indicated a lack of leadership skills as a weakness in engineering graduates. They further indicated the increasingly global nature of engineering as a challenge for which graduates are currently not well prepared.

In response the Faculty of Engineering offered 50 Engineering scholarships each year and invited the recipients to join the Leadership for a Technological Environment programme (LITE).

The following timeline shows the development of the overall programme:

- August 2006: Initial skill shortage seminar organised by the Department of Mechanical Engineering
- September 2006: Proposal for Leadership Programme submitted to University
- 19 December 2006: Proposal presented to and accepted by Monash Engineering Foundation
- January 2007: Proposal discussed with various industry representatives
- February 2007: First Phase I residential held
- September 2009: Final Module in programme presented for the first time
- October 2009: Students set up student leadership society
- November 2009: First cohort of graduates receive certificates of completion at industry dinner

The leadership programme has been strongly supported by the Faculty of Engineering, principally through the Dean of Engineering and the Monash Engineering Foundation, which is a group of engineers set up to encourage and support new initiatives and engender linkages with industry.

The leadership programme has been resourced by a part-time director (the Associate Dean, Teaching of the Faculty of Engineering), and a full-time manager.

Literature review

When the research for the development of the Monash leadership programme was done approximately four years ago, the author naively thought that an internet search would unearth hundreds of engineering leadership programmes that could be grouped together into a consensus programme, slightly modified and put forward as a tried and trusted model in no time at all. In fact very few explicit examples were found to be of any great benefit. Some existed but were interesting but passive seminar series, others required students to engage in some leadership aspects within a general management subject that touched on leadership. Almost nothing showed up as an explicit, well structured comprehensive leadership programme, either curricula or co-curricula.

In 2006 Peter Taylor, Chief Executive of Engineers Australia, the professional body for engineers in Australia presented a keynote address entitled 'Engineers – Leaders, Managers, or Both?' to the Engineering Leadership Conference (Taylor, 2006). The address asked the questions 'Is there a typical engineer and what does he or she look like? and, What are the traits that we might expect to find in a good leader or a good manager?'. He mentioned leadership traits of loyalty, integrity, courage, decisiveness, dependability, empathy and fairness. The address also talked about the use of the Myers-Briggs Type Indicator or MBTI and the need to understand yourself.

Ireland (2005) discussed the layers of leadership and the characteristics of leaders for different situations such as change or innovation, production or consistency, or a people leader. He also discussed the concept of emotional intelligence which regularly appears in the leadership literature.

Hargreaves and Evans (2006) talk about 'Values driven leadership' which covers where the values come from, such as personal, organisational etc. They talk about value driven leadership creating a sense of belonging, a sense of identity and a sense of purpose.

Ruth Graham (Graham *et al* 2009) in a study of engineering leadership education programmes for MIT confirmed the author's comments on the lack of leadership courses. Graham stated that 'One interesting finding that emerged through the study is the dearth of formal networks, events and research programmes in *engineering leadership education*'. Graham found that the major programmes were 'often directed by a relatively high-profile, highly passionate champion, on whom the success and continuation of the programme largely rests.'

Graham *et al* (2009) found major differences in attitude to engineering leadership education between the USA, Europe and Australia. Graham noted that in Europe the notion of educating students in leadership did not sit comfortably with many engineering faculty and the overall visibility of these types of programme is low which supported the authors experience three years earlier. Many Australia engineering educators interviewed by Graham (Graham *et al* 2009) also expressed discomfort with the concept of selective programmes in leadership development. Concerns were particularly focussed on how students should be selected for such programmes and whether leadership ability or potential can be demonstrated in an application process. Graham only found one 'explicit' programme in engineering leadership in Australasia and that is the programme discussed in this paper. Graham found that the vast majority of 'explicit' engineering leadership programmes are based in the USA. She found that US-based interviewees were very comfortable and familiar with the concept of educating leaders. The only concern raised by US engineering academics related to the ability of current engineering faculty to deliver effective leadership programmes and the difficulties of identifying suitably qualified staff from outside their own institution. This comment is one that the author strongly identifies with and endorses. It is one reason why engineering leadership programmes will tend to remain co-curricula rather than embedded in engineering courses. The issue of elitism is one that will be discussed later on in the paper. Graham *et al* (2009) found that the 'most ambitious program of engineering leadership education investigated in the study is the recently established Gordon-MIT Engineering Leadership Program.' (Gordon-MIT Engineering Leadership Program)

Graham *et al* (2009) note that the majority of programmes identified in the study used some form of psychometric testing as part of leadership development.

The key elements distilled (not in any particular order) from the major engineering leadership programmes investigated by Graham were:

- Global or cross-cultural context
- Contribution to society or environment
- Personality profiling exercises
- Transformational experiences
- Hands-on and real-world projects and experiences
- Residential camps
- Mentoring
- Self evaluation and self-reflection
- Student-led design
- External advisory groups

As Graham *et al* (2009) comment 'The majority of programmes currently in operation are relatively new (less than 5 years old since their inception) and therefore are not in a position to provide the community with proven models of success or long-term longitudinal data on the impact of their educational approach'.

The other general characteristics noted are that the majority of the programmes are managed at the faculty or school level (rather than at the departmental level) by a relatively senior faculty member with a small project team, operating predominately outside of the curriculum. Graham also noted that the size and position of such programmes allows for high levels of flexibility (and risk taking) to develop new educational approaches to *engineering leadership education*.

Monash leadership in a technological environment programme

Objectives of programme

The main objective of the programme is to address the lack of leadership skills in our engineering graduates.

The programme is not based on improving technical skills; hopefully this is done within the various engineering programmes. Rather it is about improving people skills through developing improved Emotional Intelligence, understanding the importance of ethics and the ethical construct, understanding the importance and impact of work place diversity such as cultural, religious and age diversity, innovation and personality type and finally leading to how to successfully implement change management.

Most of the above skills, while important in engineering, cannot readily be taught by engineering academics as they do not have the correct training and background, and often do not possess the characteristics themselves. It has also been found difficult to use academics from other faculties to run the modules as they require a very different focus to the normal semester long intensive in depth analysis of a subject complete with assignments.

For the reasons outlined above, many of the facilitators have organisational behavioural backgrounds. The programme developers have worked closely with the facilitators to work out what is required in a particular module and what can reasonably be achieved in the module timeframe.

Structure of programme

The programme is spread over three years, is co-curricula, and consists of annual residentials, nine modules and industry work experience. The three year duration allows the students to develop and mature, and to consolidate their learning and experiences. Each year (or phase) of the programme starts with a residential which has a bonding component, particularly in Year 1, as well as a specific purpose described below in the residential section. The structure of the programme is shown in Figure 1. Each year builds on the previous year and increases in complexity and challenges.

The first year of the programme covers the generic topics of what is leadership, communications skills and critical thinking. The second year introduces ethics and sustainability (which is seen as closely connected to ethics) in relation to engineering and technology. People skills then draws on these plus the previously dealt with communications skills and critical thinking. The third and final year raises the level of difficulty further to include the concept of innovation and globalisation which covers cultural and other types of diversity including virtual teams. Everything in the programme leads to the final module on Change Management.

It is emphasised (particularly to the students) that this is not a three year degree programme in leadership. The programme introduces the main topics that a future leader is expected to know and be competent in, however, each module only consists of five to seven hours of content and interaction. It is emphasised to the students that it is a starting point on the path to leadership, not the final point. It requires the individual to constantly question themselves and further develop their leadership skills over time. From student comments (see later) it is obvious that they have been implementing many of the lessons within their undergraduate course which indicates that the programme is working.

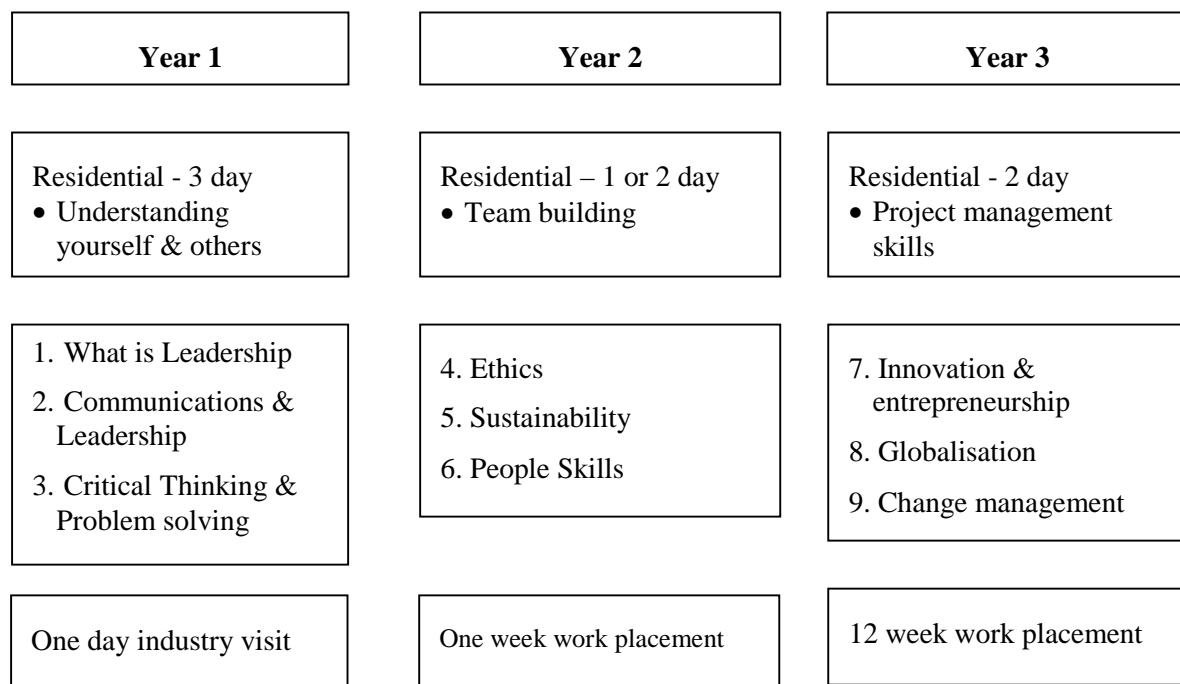


Figure 1: Structure of Leadership in a Technological Environment Programme

Entry pathways into programme

There are two entry pathways into the programme:

- invitation based on academic performance at the end of Year 12 (age generally 17-18 years)
- application and interview process at the end of first year of any engineering degree

The first approach was adopted to attract high performing students to engineering at Monash University. This represents approximately 50 to 60 students each year and they are all in the top 1% to 2% of the Year 12 cohort in the state of Victoria in Australia. All of these students are offered annual scholarships worth A\$6000 for the duration of their four or five year degree. This represented the faculty’s commitment to excellence for the engineering sector. Interestingly there has been major criticism of this approach both from the Monash Engineering Foundation and industry partners. The argument is that high academic performance does not mean that the individual is suitable to be a leader. This has often been supported by the individual’s experience that they were not initially a high academic achiever but have since become a leader. There would also appear to be some issues

within industry with dealing with academically brilliant students. Issues of non-practicality of brilliant students, lack of commitment to technical engineering as opposed to management, and desire to be fast tracked are arguments used against this entry approach.

This entry approach was taken on pragmatic grounds. First the faculty wanted to attract high performing students and this approach has worked extremely well. Second, the faculty felt there was a need to challenge these students beyond the first year engineering degree experience, hence the invitation into the leadership programme.

The criticism of course has some basis in that not all high academic achievers do or will make good leaders. However, the inverse also applies in that not all lower academically performing graduates automatically make good leaders.

In response to the criticism, an additional entry pathway was developed, that of application and interview at the end of the first year of engineering. This pathway is open to all students in their first year of engineering. Each year approximately 10 students have been accepted into the programme through this pathway. The advantage of this pathway is that students must demonstrate that they have a genuine desire to be leaders of the future. This is judged by their past actions and their future potential. The selection panel consists of the director and manager of the programme and members from the foundation and industry.

The observation is made that the majority of students invited into the programme based on academic achievement would also be selected through the interview process as they have often exhibited leadership qualities through school, sporting and social and volunteering activities.

Residentials

Originally there was only intended to be a two day residential at the start of Year 1. The first residential has now been expanded to three days and at the request of the students, residentials have been added to the start of year 2 and 3.

Residential 1 (Year 1) introduces the programme, the concept of leadership and allows the students to have fun and bond in a relaxing but structured environment. The final day is devoted to starting the process of self awareness and understanding. On day 3 all students complete the Myers Briggs personality type assessment. The remainder of the third day is taken up with small facilitated workshops (maximum of 15 students per workshop) that explore the various Myers Briggs characteristics. This aspect is essential to explain what the personality characteristics mean and is further developed in Module 1. This self awareness is now strongly embedded throughout the programme and has been accepted as important and useful by the majority of the students. Frequently, without prompting, members of industry panels in the various modules refer to personality types and characteristics which reinforces the importance of the concepts within industry. Finally students get to meet engineering academics and engineers working in industry at a dinner at the end of Day 2.

Comments from students on the residential are: 'Great session, engaging, Surprisingly practical', 'Encourages us to increase the energy in the room to get us excited & motivated to do our best', 'Physical challenges were good and helped to express a totally different form of leadership', 'The activities with the facilitators. Especially the Extro/Introvert exercises. Very insightful, eye opening', 'Knowing what makes me stressed, makes my life easier', 'Finding out the type of person I am'.

Residential 2 (Year 2) concentrates on developing team building skills. A number of exercises are done ranging from simple to complex to examine team building skills. The tasks do not relate to engineering problems and therefore do not rely on engineering knowledge. The important part of the exercises is the team debriefing as to what happened and why and in particular how it might relate back to personality types. It is always interesting to see who dominates (or tries) and who hangs back but still contributes when asked. The activities have been found to be very worthwhile.

Student comments on the residential are: 'Involved everyone - gave different people a chance to lead', 'Team bonding activities - easier to meet people you haven't talked to before'.

Residential 3 (Year 3) concentrates on Project Management. This topic has been stated to be important by many engineering companies and is currently not covered in any of the nine modules. In 2010 the residential was facilitated by the Australian College of Project Management. The content was based on workshops the College currently deliver to the engineering profession, hence ensuring

relevance. The residential also introduces the year long group project which requires the use of project management skills.

Student comments on the residential are: 'It was all helpful material explained in a new way', 'Was interesting and engaging, has given a very good intro to the project', 'Really useful program, great way to kick off project', 'Very well planned, important for our course

Leadership Modules

Modules need to be interesting, engaging and interactive. The basic model used is that each module has a part (a) and part (b) led by a presenter/facilitator. Part (a) of the module tends to be more information/content driven while still being interactive. Students are usually given a group task to be completed before the next part which is generally two to three weeks later. Part (b) starts with the group task feedback and how it related to the previous content. This is followed by an industry panel which discusses their experience in relation to the topic of the module, followed by a question and answer session. This interaction with industry and reinforcement of the fact that the topic is of importance to industry has proved very popular with students. Role plays and group interaction is sometimes used if an industry panel is not considered appropriate. Again, students love the role play as it is a very interactive way of reinforcing messages.

What is Leadership: The Myers Briggs personality assessment occurs at the Year 1 residential together with several workshops to help understand the different personality types. This module continues the discussion of personality types and understanding the individual's strengths and weaknesses. It also covers: management versus leadership, factors determining leadership capacity, leadership styles, values and behaviours and a major section on emotional intelligence. An industry panel discusses how personality profiling is used in their work place. This module sets up the background for the remainder of the programme. Personality types and self awareness is constantly reinforced throughout the programme.

Communications & Leadership: This module is about communicating with people, individually and in teams; it is not how to write a report or give a good presentation, albeit that they are worthy skills. The objective of the module is to produce good effective communicators. Issues covered include: Who is the audience, passive/active listening, personality types and how it impacts on communications, tips for improving communication skills and barriers to achieving good/effective communication.

Critical Thinking & Problem Solving: Many engineers saw this module as problem solving only as that is what engineers do. However, what is often missing from engineering courses is the critical thinking component. This module looks at various types of thinking and then investigates a critical thinking model which the students then have to apply to an engineering problem. Students have found the structured thinking approach useful in their undergraduate degree.

Ethics: This is one of the most difficult topics to present well as it has the potential to be dry and boring. The topic is taught through considering both general and engineering issues and then looking at them through a number of different ethical constructs. The topic is not simply about the technical side of engineering disasters. The facilitator of the module has a philosophy background. The objective of the module is for students to take away several different models for looking at engineering issues from an ethical perspective. Despite the difficulty of the content the students have connected well with the module and indicated that they enjoyed the way it made them think about issues and challenged them.

Sustainability: Understanding sustainability is important for all engineers. The importance and need for sustainable design & development is covered, as much from a driver for good engineering business practice as from a technical viewpoint, in other words it is important to appreciate the business case for sustainability. Various models for implementing sustainability are investigated.

People Skills: This module builds on the Communication Skills Module. The module deals with how to deal with difficult people and difficult situations to achieve a desired outcome; how to recognise difficult situations and people, and therefore act early to solve problem; understanding Emotional Intelligence and how to use it in various situations; development of skills to handle difficult people and situations including negotiation, assertiveness and influencing skills.

Innovation & Entrepreneurship: The innovation process is part thinking and part culture. In order to innovate, an individual or group must learn to not only navigate an idea from conception through to

implementation, but to also create the culture which enables and encourages the multiple thinking styles necessary to achieve those goals. The module covers: how to innovate (tools and techniques to generate ideas, and then challenge and evaluate those ideas), creative cultures (identify the appropriate thinking culture at each stage of the innovation process), and organizational inoculation (why ideas don't survive in the typical organization, how to remain engaged until you become empowered, and inspiring and leading innovative teams).

Globalisation: All engineers need to be able to work effectively in a global environment; however, it is of particular importance for leaders. This module concentrates on cultural and other forms of diversity in the workplace, as well as the issues of working in virtual teams. It therefore relates back to communication and people skills as well as personality types and emotional intelligence.

Change Management: This is the final module in the Leadership programme and it therefore brings together almost all of the previous modules. The module covers: What is change?, the drivers for change, reactions/responses to change, models/processes to achieve desired changes, and evaluation of the process & progress of change.

Industry input

Industry involvement and support of the programme is crucial to its effectiveness. It has always been stated that the programme must interact closely with industry and is not meant to be purely academic. If industry had not wanted and supported the programme then it would not exist. The programme has been developed in response to the needs of industry as expressed in a workshop on skills shortage held by the Engineering Faculty at Monash University, as well as numerous personal conversations with members of industry. At the initial planning stage, the programme was discussed and tested with members of industry to see if the structure was satisfactory and that it was likely to produce the type of graduates that industry said they wanted and needed. The current structure is essentially what was originally setup, that is, the nine module titles are basically what was originally proposed although their implementation has grown and developed (and expanded) as a result of greater experience and understanding of what worked and what did not.

Industry has generously provided staff as guest speakers and facilitators, as well as being members of industry panels related to various topics.

As shown in Figure 1, there is increasing industry involvement throughout the programme. In Year 1 the students visit one or more companies for half to one day. This is to investigate how companies operate, what engineers do in the work place, and to investigate aspects of management and leadership. This has worked well as the students are excited to get access to engineers and companies so early in their course. They have invariably been excited by the generosity and enthusiasm of the engineers that they have come in contact with. The concept ranges from two students shadowing/interviewing a middle level manager through to groups of eight students meeting various people and groups within a company to get an overall idea of how the company works.

In Year 2 students are individually linked with companies in their discipline for one week's work experience between semester 1 and 2. This aspect is currently perhaps the weakest link in the programme. The better companies do a great job of providing worthwhile and meaningful tasks for the students. Unfortunately some companies see this as a negative experience as the students are generally only part way through the second or third year of a four or five year degree and therefore are not immediately employable. This part of the programme is seen as the start of the relationship development process between companies and students (prospective employees) but unfortunately not all companies have this perspective, particularly in the economic downturn that occurred in 2009.

In Year 3 companies are expected to provide 12 week work experience during the long vacation. This is seen as a continuation of the relationship building between companies and students. It is hoped and expected that this will lead to full time employment with the company when the student graduates. If this occurs then it is a low risk employment strategy for the company as the student knows the values of the company and how they fit with their own set of values, and the company knows how the students fits with its requirements.

In addition to the above, industry has provided A\$800,000 over the next four years to fund scholarships to support students in the leadership programme. These will be named company scholarships which provide work experience and mentoring opportunities over the duration of the student's undergraduate study experience.

Annual dinner

An annual dinner is held at the end of year. This was not part of the original programme but has developed into a major component of the programme. It brings together all the students in the programme, senior University leaders such as the Vice Chancellor, Chancellor and all the Deputy Vice Chancellors, the engineering faculty executive consisting of the Dean, Department Heads and Associate Deans, the Engineering Foundation members and industry guests. In November 2009 this totalled 280 people. It is a major showcase of the programme and students to industry. Many students obtain vacation work experience as a result of talking to industry representatives at the dinner.

Student responses

The following are quotes about the leadership programme from the first graduating cohorts of students.

Student 1 (Male): The programme was a great resource when it came to the personal development of skills lying outside the narrow band of engineering, but are still vital for any leader (not only in engineering) to possess. This included such things as improving skills in communication and the ability to deal with change management so as to make us overall better equipped to deal effectively with people on a day to day basis. Another positive from the programme was that it never shied away from plunging us into the deep end, challenging us with things that sometimes we thought we were not ready for. Examples of this were a week's work at a proper engineering company when we were all only still in second year as well as the massive challenge of undertaking to research and put together a formal report outlining our recommendations for the rebuilding of a sustainable Marysville after the bushfires.

Student 2 (Male): The innovation methodology presented in the programme was very accessible as well as being transferable to many areas beyond the engineering environment. Since this module I have referred back to the ideas presented there, and found them extremely useful in numerous situations. Since beginning the Leadership Programme, taking on a leadership role as part of my future employment has become much more achievable than I ever would have previously thought. The knowledge I have become equipped with has also helped to increase my confidence in my own abilities.

Student 3 (Male): The programme challenged me to think differently in certain situations and provided me with the insight to react in a positive and effective style to challenges which arise. It helped me to develop my communication and negotiation skills and provided a terrific forum for discussing and trialling different techniques. This was really enjoyable, and the value of good communication was frequently demonstrated by our diverse guests. Since the first session three years ago I have been applying the things which I have learnt through the programme, and I consider it to have been a great educator.

Student 4 (Female): I have no doubt that the skills we have developed throughout the Leadership Programme will be invaluable in both our personal and professional lives as they have strengthened our knowledge and awareness in areas not covered in a conventional engineering degree. The Leadership Programme has been a great opportunity to network with like-minded peers, be inspired by successful engineering professionals and broaden our knowledge of human behaviour and interaction from a range of inter-disciplinary experts.

Student 5 (Female): Through the many inspirational talks and simulating activities throughout these three years, I have identified my strengths and weakness, developed a more confident self and equipped myself for life after university. Through the Myer Briggs personality test, I have gained a better understanding of my personality and other different types of personality, this helped me greatly when interacting with others. By understanding more of myself, I have grown to be more confident.

Conclusion

The paper describes the development and implementation of the Leadership in a Technological Environment Programme in the Faculty of Engineering at Monash University. The programme has major industry involvement and support. The first cohort graduated from the programme in November 2009 and from student comments the programme has had a profound influence on their development towards being future engineering leaders. Finally, the Leadership programme has significantly raised the profile of the faculty with industry and has been deemed to be a success.

References

- Ireland, V. (2005) Leadership in Engineering, Engineering Week 16 August 2005, available from http://www.engineersaustralia.org.au/shadomx/apps/fms/fmsdownload.cfm?file_uuid=3B3486A0-E03D-8120-5085-A8A045DF4030&siteName=ieaust [accessed 27 January 2010]
- Gordon-MIT Engineering Leadership Program, MIT available from <http://web.mit.edu/gordonelp/> [accessed 27 January 2010].
- Graham, R. ,Crawley, E., Mendelsohn, B.,R. (2009) Engineering leadership education: A snapshot review of international good practice White paper sponsored by the Bernard M. Gordon-MIT Engineering Leadership Program, available from <http://web.mit.edu/gordonelp/elewhitepaper.pdf> {accessed 27 January 2010}
- Hargreaves, D. J and Evans P. (2006) Values Driven Leadership, *Engineering Leadership Conference 2006 – Engineering For Today And Tomorrow*, Melbourne, August 2006
- Talyor, P. (2006) Engineers – Leaders, Managers, or Both?: a Keynote Address to the *Engineering Leadership Conference 2006, Engineering For Today and Tomorrow*, Engineers Australia, August 2006

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