This paper presents how Mechanical Engineering students/graduates in Sustainability/Energy Management area, or engineering students/graduates in generic terms, can enhance their employability, performance and engineering careers. It includes methods for gaining knowledge and expertise required for practicing junior consulting engineers, during studying at university. The benefits include:

– Increased opportunities for employment
– Increased confidence and shorter status as a junior engineer
– Better remuneration

The paper also addresses challenges and provides better understanding of requirements of modern energy management consulting practices. The proposed learning method can effectively be adopted in teaching engineering students by recognised energy management practising experts.

Key words: Sustainability, Engineering Education, Cost effectiveness, Innovative Energy Management, Employability

1. Introduction

Difficulties that engineering graduates face include:

• gap between learnings acquired at university and requirements at the workplace in order to achieve competency of a professional engineer,
• challenges of a competitive market,
• communication with recruitment agents,
• producing competitive CV,
• learning job interview techniques,
• selection of employers.

There is also a need to address issues of internship and a typical junior engineer status in that context. Many vital areas of competency required for graduate professional engineers need to be addressed, as there is a lack of focus of employers on integrated continual professional development (CPD) of junior staff beyond
their business goals, leaving graduate engineers with a lot of uncertainties, frustration, reduced chance for a proper CPD, prospective employment and prolonged period, measured in years, with low salaries.

These shortcomings can be overcome through a structured, integrated approach at a university, by engaging practicing expert consultants as instructors or mentors, via a structured educational program (through tutorials, workshops & customised work experience) that would complement a standard curriculum.

2. Method

The method proposed in this paper considers implementation of an integrated practical professional engineer skill program, via completion of two modules:

MODULE 1 – In-class learning, provided by outsourced practicing senior consultants and expert professional engineers.

MODULE 2 - Structured work experience with selected consulting companies, and detailed guidance for students/graduates, leading to enhancing their employment opportunities.

Concept of learning involves: revisiting key theoretical concepts, gaining knowledge related to the requirements of relevant engineering market and consulting practices, and analysis of the most recent research on good practices, state of the art, applied to engineering projects, that follow the world most modern engineering sustainability trends. The projects demonstrate, in a transparent way, the most cost effective and innovative sustainability design, technologies and control strategies.

More specifically, this paper focuses on the importance of sustainable approach in Mechanical Engineering practice. For example, it is demonstrated through the cost effective control optimisations of computerised HVAC (Heating, Ventilation, and Air Conditioning) systems employed at commercial and other properties (office buildings, shopping centre, hospitals, art galleries, museums, public building, hotels and the likes), where in excess of 50% of energy is used by HVAC Services.

Return on investment on innovative energy efficient control optimisations is often measured in months, not years, which significantly increases their chances for approval and implementation.

However, the proposed method of learning is applicable to any engineering discipline.

3. Details of the proposed structured educational program

Tutorial activities of MODULE 1 are very diverse, ranging from revisiting relevant key principles and various engineering skills, to understanding consulting environments, enhancing employment opportunities and expectations of future employers.

3.1 MODULE 1 - Tutorial Activities

• Revisiting Theoretical concepts – Phase 1 – Design of equipment - Revisiting basic thermodynamics principles required for understanding of basics of opera-
tions and design of HVAC (Heating, Ventilation and Air Conditioning) Systems – several workshops that would include analysis of various HVAC equipment and various HVAC design concepts, using project documentation (including the actual HVAC Design and energy audit reports of Sydney facilities – office buildings, museums, shopping centres, hotels, clubs). Selection of equipment - Heat load modelling using CAMEL ACADS BSG software.

- **Revisiting Theoretical concepts - Phase 2** – Design of controls – basics of HVAC Controls and analysis of various HVAC control concepts employed at the local facilities. Introduction of BMS Control concept – LAN schematics, BMS Point List, BMS Functional Description, graphics, alarms, etc.

*Schematic 3.1 – Typical HVAC System for commercial properties – office buildings, public building, shopping centres, museums, art galleries, entertainment centres.*

- **Advanced HVAC Control/BMS concepts** – with a focus on energy efficiency
• Basics of Energy Management – topics would include: processing and analysis of energy interval and other energy data, sub-metering concepts, BMS trend logging, comfort conditions versus energy savings, energy saving calculations, esti-

- **Basic Australian Standards and other regulations related to HVAC Design and Energy Management**- AS 1668.2 (Ventilation Code), AS 3598 (Energy Auditing), AS 3666 (Cooling Towers), BCA – Section J.

- **Basics of HVAC Equipment and Control Maintenances** – typical scope of works, typical operational, comfort and energy management issues encountered with HVAC and BMS maintenances, and rectification measures.

- **Commissioning of energy management/energy efficiency** projects – importance, typical issues and rectification measures.

- **Basics of energy auditing** – scope of work, planning and execution – request for various information/documentation, site visit, induction and WH & S requirements, communication with various parties (Facility Management, internal and external maintenance contractors, admin personnel, security, etc), expected issues and how to resolve them, observations, measurements, engineering, financial and environmental analysis, and writing reports.

- **MS Word, Excel and PowerPoint** - Minimal requirements.

- **Advanced Design and Energy Management concepts** – analysis of implemented projects and necessity for an ongoing consulting support to clients.

- **Enhancing career opportunities – Consulting environment** - Overview of nature and operations of consulting companies including their set of expectations.

- **Consulting office environment: non – engineering aspects** – team environment – administration requirements, behavioural standards, working hours, clothing, verbal and written communication, soft and hard documentation, hierarchy, DOs and DONTs.

- **Consulting office environment: engineering aspects** – working in a team environment including effective communication and productive collaboration when planning and implementing a project. Typical responsibilities and requirements in an engineering role. Overview of general expectations from young engineers in a professional role- importance of understanding given instructions and asking for clarifications/support initially and on an ongoing basis. What is required to be perceived by management as a good worker and a colleague?

- **Understanding receivers of services - Clients** – overview of typical clients and their representatives – expectations, site visits, meetings and communication. Request for information. Smooth project management. Typical issues and rectification measures. Professional conduct.

- **Consideration of various engineering memberships** – EA, ASME, AIRAH, ASHRAE, - pros and cons.
• Expected additional qualifications and professional memberships – EA, NABERS, ASHRAE, EEC.
• Importance of Continual Professional Development - Use of Internet, networking, employers’ educational programs, publications, seminars, conferences, etc.

3.2 MODULE 2 - Work experience and enhancement of opportunities for employment

• Work Experience content negotiated with consulting companies, as a part of university course, which includes development of students’ skills, contributing to their capability as future professional engineers.
• Preparation of and participation in actual projects – various phases which maximise exposure to the above engineering and non-engineering aspects of consulting environment, with the aim to acquire a set of targeted/planned engineering skills, from Junior to Senior Engineer.
• Preparation of CV, negotiation technique with recruitment agents, preparation for job interviews.

4. Conclusions

Implementation/Trial of the proposed educational program for engineering students is recommended. Expected outcomes of the proposed enhanced learning are:
• Students/graduates will acquire practical knowledge and expertise required of a professional engineer while studying at a university, and thereby enhance their future employment opportunities.
• Students/graduates will better understand operations and requirements of consulting environment in engineering and non-engineering terms, and therefore become confident to fulfil junior engineer role and to understand the key aspects of intermediate & senior engineer functions.

Whilst this paper is focused on Mechanical Engineers specialised in Energy Management Area, the concept can generally apply to any other engineering discipline.

Acknowledgements

The author acknowledges the contribution made by Dragana Koncar, tutor at Western Sydney University - School of Education, and the reviewers of the paper.

References