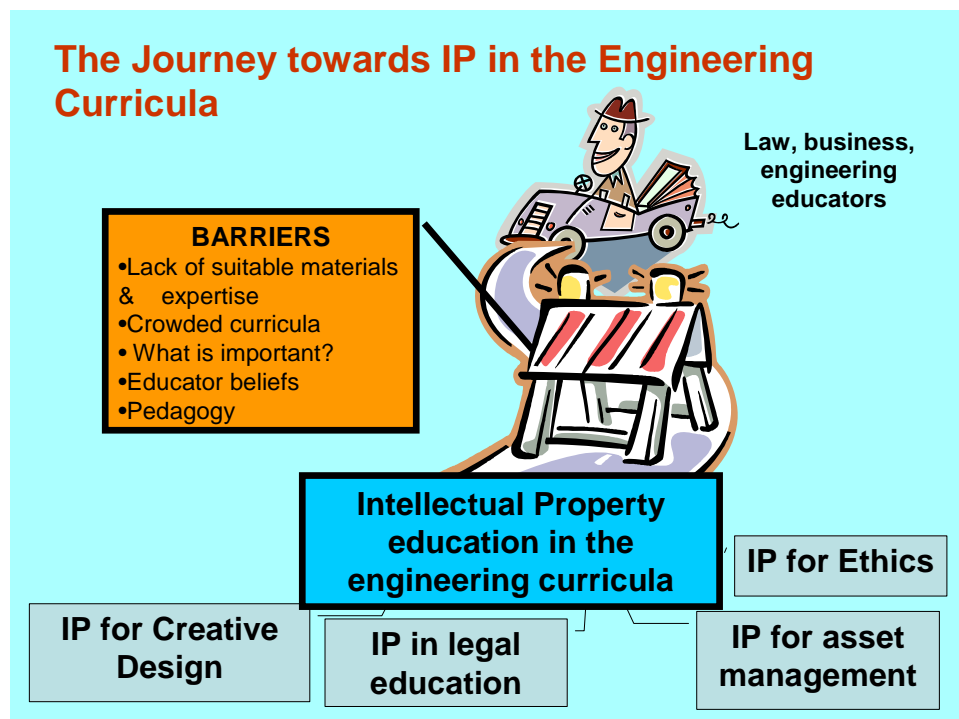


## The Journey towards Intellectual Property in the Engineering Curricula

Robert G. McLaughlan,  
*Faculty of Engineering, University of Technology,  
Sydney, Australia*

There is a widespread movement within tertiary education to build the capacity of engineering students to engage with enterprise. This is reflected within the accreditation requirements of professional bodies, stated industry needs, initiatives by government agencies and the emergence of related curricula content in some engineering courses. Entrepreneurship education for engineers relies on developing student capabilities in the business and the legal intellectual property domains as well as their traditional engineering capabilities.

Intellectual Property (IP) education has a particularly important role to play by supporting engineers in the creation of product or process development opportunities which have a unique and defensible IP. This is the fundamental basis upon which further entrepreneurial activity can be based. However the extent to which Intellectual Property has been integrated into Engineering and the basis upon which to further integrate it is currently poorly understood.



The process of trying to embed Intellectual Property education into the engineering curricula has similarities to the concept of a journey. There are a number of academics from different disciplinary backgrounds who are teaching IP. The vehicle for progressing IP is often entrepreneurship although in some courses legal studies may be the course/subject in which it is taught. Academics have identified a number of barriers to the adoption of IP into the engineering curricula. However a number of academics have managed to overcome these barriers and embedded IP in the syllabus. However there are a range of ways in which IP has been utilised in the curricula.

## How is IP now taught in the Engineering curricula\*?

- **IP for Ethics**

IP as a source of ethical issues

- **IP for Legal education**

IP as part of the broader legal fundamentals and principles: Law related Education

- **IP for Asset management**

IP Law & vehicles to implement (e.g copyright, patents, trade marks)

As part of idea-generation and venture-creation process

- **IP for Creative Design:**

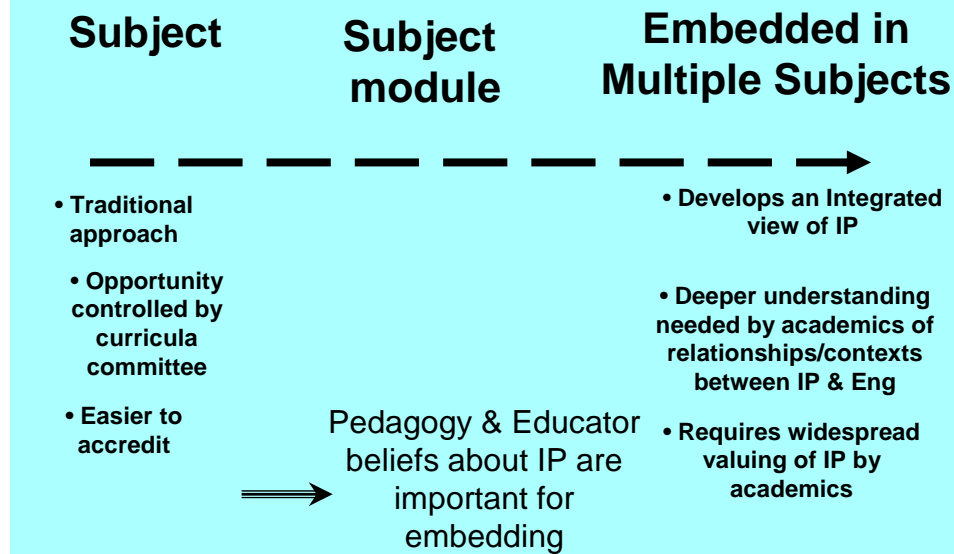
Engineering problems framed in IP and technology terms

**Great diversity in the meaning/engagement of IP for educators  
Literature best developed in computing sciences**

**\*based on analysis of published articles, teaching units may cover several aspects**

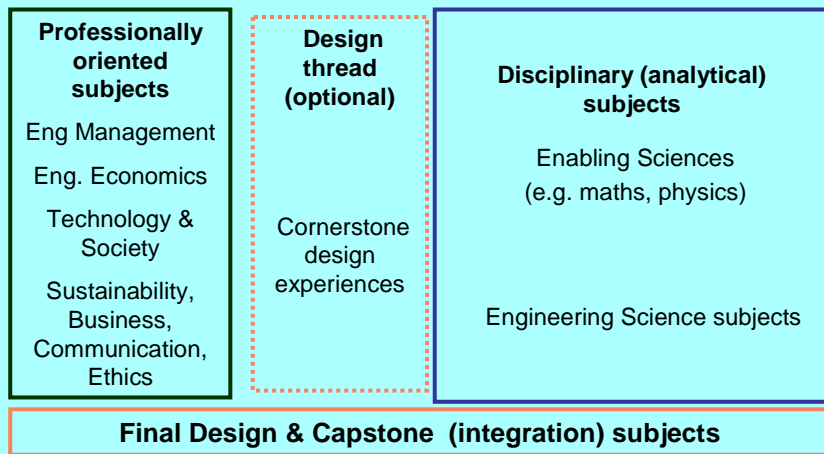
There is relatively little published literature on teaching IP into the Engineering curricula. The published studies which describe teaching activities where IP concepts have been introduced into the curricula can be categorised as treating IP within the Engineering curricula through four different ways. Firstly, IP has been introduced by focusing on IP Law and the vehicles used to implement it (e.g. patents, copyright, trademarks). This approach is often favoured when IP is introduced as part of idea-generation and venture-creation process in entrepreneurship or enterprise subjects. This could be considered IP for Asset Management. Secondly, IP has been introduced into the engineering curricula within a surrounding context of legal fundamentals and principles. The extent of the surrounding context may range from part of a lecture to a whole subject on Law related education. A third way that IP has been brought into the Engineering curricula is as a source for raising issues about social and professional responsibilities of engineers. This may be considered as IP as Ethics. There have been relatively few documented examples where IP has been taught for Creative Design. This requires an engineering problem to be framed in terms of both an IP and technologically solution. It should be stressed that these four identified approaches are not mutually exclusive and are categorised just to represent the extent to which IP can have many interfaces with the engineering curricula.

## Introducing IP into the curricula



Engineering is by its nature an integratory profession that seeks to bring together a design solution that embraces constraints such as economic, social, ethical, environmental, political, health and safety, manufacturability and sustainability. However engineering education struggles with how to bring these diverse data, concepts and skills into the engineering curricula in an authentic way. Some multi-disciplinary fields are well established in engineering such as engineering economics and engineering managements, while other emergent fields are trying to become established such as sustainable engineering and enterprise engineering. Approaches to integrating these 'fields/theme' range from stand alone subjects through to modules within subjects through to diffuse embedding across the curricula (e.g. Design/Writing/Ethics across the curricula). However each of these different approaches (stand-alone vs embedded) has particular features that make it attractive in different circumstances. There are a number of reasons which include pedagogic and pragmatic considerations as to why it may be desirable to embed IP across the engineering curricula. It must be recognized that as themes (such as IP) are sought to be embedded a much stronger understanding of the educational pedagogy which underpins his approach and that can be used to demonstrate effective learning is needed. Another important requirement is a better understanding of the academics conceptions of IP in engineering and in the undergraduate curricula. Successful embedding requires a greater number of staff to be involved since the material is located in multiple subjects and academics are often the gate keepers who control the introduction of these types of knowledge into the curricula.

## “Typical” elements of a 4 yr Engineering curricula:



⇒ Where does IP education interface with these subjects?

To more closely relate teaching to learning requires developing an appropriate pedagogy. A pedagogy which capture essential learning outcomes, and identifies appropriate teaching methodologies to achieve these outcomes. It is also important to understand exactly where the interfaces between IP and engineering meet. Whilst it is difficult to create a generic structure for all engineering curricula there are common elements that many syllabi share. There are “disciplinary or technical” subjects that build on the enabling science/mathematics subjects and which have a strong analytical focus. There are “professionally or practice” focused subjects that seek to broaden the ability of engineers to apply their disciplinary knowledge to engineering problems found in the workplace. Design focused subjects are a defining characteristic of the curricula which often distinguishes engineers from scientists. Traditionally these subjects occurred just as the end of the curricula but there is a trend to include a design thread across all years of the syllabus (e.g. Design across the curricula). In some cases the Design thread may be integrated with the professionally oriented subjects. For IP to be embedded within the engineering curricula there is a need to better understand exactly where it is appropriate to develop the different aspects of IP education.

## Outcomes & Pedagogies for embedding

What IP abilities are currently sought for course accreditation?

- Awareness of the importance of ....
- Ability to secure ....

What models to inform the practice of embedding are available?

- XXXX Across the curricula  
e.g. Design, Ethics, Writing.....
- Graduate attributes
- Emergent themes: sustainability, safety

What IP abilities are currently sought for course accreditation? The abilities sought by the Professional bodies who accredit engineering curricula in Australia, UK and the USA are relatively similar. They are signatories to the Washington Accord. Their accreditation criteria have statements relating to Intellectual Property that are at the ability level that students should show “Awareness of the importance of ....”. This could be taken to mean that their level of understanding needs to be sufficient that they can refer to something. The UK SPEC has gone one step further to expect students to have an ability to secure intellectual property. These accreditation criteria refer to the minimum expected outcomes and various other stakeholders in the education of engineers have greater expectations of their student abilities in IP.

What models to inform the practice of embedding are available? Since the current institutionally based engineering educational reforms started in the 1990’s there has been a greater focus on different approaches to meeting educational outcomes that require engineering education to be broadened. These different models may provide guidance for understanding appropriate ways to embed IP education. There is a trend for “embedding xxxx Across the curricula”. There is a scant but emerging literature on initiatives to embed design, ethics and writing. There has also been significant work done on trying to get academics across the curricula to recognise and develop “graduate or generic outcomes”. These often include aspects like critical thinking, communication, teamwork and other abilities which sometimes fall into what engineers often call professional skills. A third area where an embedded approach to developing engineering abilities is being sought is within the newly emergent fields of education for sustainability and safety education. We appear to be at a relatively early stage of understanding which approaches are most effective and what the necessary factors for success are at an institutional level.

### Some pedagogic questions

A number of key questions are emerging when we try to develop an appropriate pedagogy for the embedding of IP into the engineering curricula.

- To what extent is a general grounding or scaffolding of law needed for engineers to place IP Law and practice in the context of their engineering activities?
- To what extent is disciplinary contextualisation of IP needed for staff/student engagement?
- Can we define IP Education for engineers in terms of knowing about IP rather than introductory specialist knowledge & understanding of IP?
- Is a logical, sequenced knowledge- building model for IP education in engineering necessary for student understanding? If so, what is the sequence? What about project-based learning models?

Whilst it appears that we have many questions, we are making significant headway into better defining the problem which is the necessary pre-cursor to solving it.

### Biography

ROBERT McLAUGHLAN is the Head of the Core Curricula Program in the Faculty of Engineering at the University of Technology, Sydney. The Core Curricula are a range of subjects which are compulsory for all engineering students and embrace the more professionally oriented, non-disciplinary specific areas of engineering. Robert has a disciplinary background spanning geography, engineering and education with research interests involving environmental engineering and multidisciplinary engineering education. Another current project involves working with a Regulatory Authority to embed Safe Design in the undergraduate Engineering curricula. His previous work with online education and sustainability has won national and international teaching and learning awards