1. Introduction

As part of the pre-requisites for the bachelor’s degree in Industrial Engineering, students in their final year of study are required to complete an engineering project in which fundamental industrial engineering knowledge and skills are applied. The project, executed over two semesters from February to October, forms an essential part of the training and industry exposure of Industrial Engineering students at the University of Pretoria. The total project carries a total of 40 credits or 400 learning hours, equivalent to approximately 2.5 months of full-time work.

2. Project Phases

The project consists of the following four sequential phases:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Project planning</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>a. Background</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Problem Statement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Project Aim &amp; Key Deliverables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Project Approach</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Problem Investigation and Literature Review</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>a. Critical analysis of literature and the problem environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Identification of solution requirements and solution evaluation measures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Data gathering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Suggestion of an appropriate solution development approach</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Detailed design and/or problem solving</strong></td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td><strong>Completion and presentation of results and final report</strong></td>
<td>2</td>
</tr>
</tbody>
</table>

The key milestones and timelines during the first semester are detailed below:
First Semester Milestones of Final Year Project

<table>
<thead>
<tr>
<th>First Semester Milestones</th>
<th>Date (2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Definitions submitted by Industry Partners</td>
<td>From Nov 2014</td>
</tr>
<tr>
<td>Submission of Project Topic by student</td>
<td>20 February</td>
</tr>
<tr>
<td>Project Topic and project leader allocation</td>
<td>27 February</td>
</tr>
<tr>
<td>Submission of Project Proposal for assessment</td>
<td>20 March</td>
</tr>
<tr>
<td>Submission of Preliminary Project Report for assessment</td>
<td>14 May</td>
</tr>
<tr>
<td>Presentation Examination (oral)</td>
<td>26 May – 28 May</td>
</tr>
</tbody>
</table>

The students have the freedom to define their own project topic, but it is expected that most projects will originate from industry and be initiated by a definition of the project by an industry sponsor. Industry support is essential in order to identify suitable projects.

3. Critical Learning Outcomes

A number of ECSA outcomes should be addressed during the execution of the final year project.

ECSA 1: Problem solving

Students only achieve this outcome once they complete their project, demonstrating that they have solved the engineering problem, using a systematic problem solving method including:
- Analyse and define the problem and criteria for an acceptable solution.
- Identify necessary information and applicable engineering and other knowledge and skills.
- Generate and formulate possible approaches to the solution of the problem.
- Model and analyse possible solution(s).
- Evaluate possible solutions and select the best solution.
- Formulate and present the solution in a report and oral presentation.

ECSA 2: Application of scientific and engineering knowledge

Students apply knowledge of mathematics, basic science and engineering sciences from first principles to solve project-related problems.

ECSA 3: Engineering design

As part of their final year project students are required to:
- Clearly define an existing design and/or problem.
- Develop supplementary methods, tools and or techniques that can assist them with a design/solution.
- Design a solution approach to solve the identified problem.
- Apply appropriate engineering methods, skills and tools in the problem solving approach.
- Test and validate all the results.

ECSA 4: Investigations, experiments and data analysis

As part of their final year project students are required to understand a project environment and gather/document all information and data to be used in development of a design/solution for the identified problem. They have to:
- Investigate and represent the problem and problem environment.
- Analyse existing literature that can assist in design and/or problem solving.
- Analyse data gathered during problem investigation.

ECSA 5: Engineering methods, skills and tools, including Information Technology

As part of their final year project students are required to:
- Identify available industrial engineering methods, tools and/or techniques that can be used in design and/or problem solving.
- Select the most appropriate method(s), tool(s) and/or technique(s) for design/problem solving.
- Develop supplementary methods, tools and or techniques that can assist them with a design/solution.
ECSA 6: Professional and technical communication
As part of their final year project students are required to:
• Document their results in a scientific, professional and appropriate style.
• Present their results orally. Students are assessed based on the following questions:
  - Is the attention of the audience captured and kept?
  - Does the explanation and pace of the presentation fit the audience's capacity?
  - Is the presenter's speech clear and posture approachable?
  - Is the use of language consistent and acceptable?

ECSA 7: Impact of engineering activity
Students need to take cognisance of the impact of the engineering design on the socio-technical context where the solution will be implemented.

ECSA 8: Individual, team and multidisciplinary work
Students are required to complete their final year project individually.

ECSA 9: Independent learning ability
As part of the final year project students need to demonstrate independent learning during all phases of the project, but specifically during problem investigation and literature analysis.

4. Industry Project Definition (Topic Description) Requirements

The aim of the Project Definition is to briefly describe the background and rationale for the project, the high level project objectives and expected key deliverables and initial scoping of the project in terms of the field of study and boundaries of the investigation and solution.

A project will typically involve the analysis, improvement, optimisation or design of a defined business process, operation, complex system or a component thereof. Important criteria for the evaluation of the suitability of a project are:

1. Clarity on the expected benefit or value add of the project
2. The application of industrial engineering principles, tools and techniques
3. Clear evidence of engineering analysis and design, that is an improved or new approach, model, process, facility or system needs to be developed or formulated. In exceptional cases the project might be purely investigative in nature, but the complexity and value add need to be clear.

The Project Definition should provide sufficient details to allow a student to select the project based on his/her areas of interest (if defined by an industry sponsor) and to allow the course coordinator to make a judgement on the suitability of the project and to allocate a project leader with the necessary expertise.

As a guideline, the following key aspects should ideally be covered in no more than a one page Project Definition:

• Brief background on the company, environment and project
• Rationale for the project in terms of expected benefit and building on previous work
• Project scope, defining the area or department within which the project will be executed and solution developed. Key policies or constraints that might apply to the project solution development, expected key deliverables of the project.
• Tools and techniques that can be used (if possible)
• A suggested high level outline of the approach that can be followed (if possible).
• A mentor/sponsor to guide the student from an industry perspective.
• Project application process and contact details.
Examples of Project Definitions are available on http://ie.up.ac.za/ ("Industry Collaboration").

The project definition will provide the basis for the student to develop a project proposal, including background, problem statement or needs requirement, project aim and specific objectives, project approach, resources required, deliverables, and timelines. Students are expected to gain a full understanding of the problem and investigate alternative approaches to develop a solution in the project proposal.

5. Key Responsibilities of Project Sponsors

A project mentor/sponsor is the key contact within the company, should be able to provide the best guidance on the project and is most likely to gain from the success of the project. The project sponsor has the following important responsibilities:

1. Selecting a suitable candidate to conduct the project (industry may require a project application process to select a suitable candidate).
2. Confirm his/her role as project sponsor, duly authorised by the company. Multiple sponsors can be appointed, but is not advised.
3. Review and approve the Project Proposal, ensuring that it clearly defines the problem to be investigated by the student and that the project aim, scope, deliverables and approach is acceptable.
4. Review and approve the Project Report, ensuring that information is accurate and the solution addresses the problems and/or design requirements of the defined project.
5. Ensure that sensitive confidential information or intellectual property of the company is not disclosed in the document.
6. Acknowledges the intended publication of the document on UP Space.

A Project Sponsor Form is available to obtain sign-off from their Project Sponsors.

6. Intellectual Property Ownership of Project Reports

The University of Pretoria has Intellectual Ownership of the project documents delivered by the student. Project reports from previous years have been published electronically on UP Space. It is the student’s responsibility to liaise with the industry sponsor to establish whether the final project report may be published. If not, the following is suggested to protect company sensitive or confidential information:

• Make use of a fictitious name representing the Company, e.g. ABC, XYZ, etc.
• Withhold, exclude or adjust important confidential or sensitive data, such as design drawings or financial information.

****************************