

CHAPTER THREE

THE CDIO SYLLABUS: LEARNING OUTCOMES FOR ENGINEERING EDUCATION

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INTRODUCTION

We will now develop a comprehensive approach to answering the first of the two questions, central to the reform of engineering education, posed in Chapter Two.

What is the full set of knowledge, skills, and attitudes that engineering students should possess as they leave the university, and at what level of proficiency?

Said another way, what are the desired learning outcomes for engineering education?

This question highlights the tension between two apparently conflicting needs—one that has its origin in the recent history of engineering education, as described in Chapter Two; the other, the ever-increasing body of technical knowledge that graduating students must command. It is our responsibility as university educators to introduce them to this broad body of disciplinary knowledge. On the other hand, engineers must possess a wide array of personal and interpersonal skills; and product, process and system building skills that will allow them to function in real engineering teams and to produce tangible benefits to society.

The CDIO Initiative has developed an educational approach that attempts to resolve this tension and to address the complete needs of our students. This approach entails first developing a comprehensive understanding of the knowledge, skills, and attitudes needed by the contemporary engineer, that is, the desired learning outcomes. The development of this understanding is the subject of this chapter. The curricular, pedagogical, and assessment strategies to facilitate meeting these learning outcomes are addressed in the next six chapters of this book.

This chapter describes the development and content of the CDIO Syllabus, a codification of contemporary engineering knowledge, skills, and attitudes that constitute the foundation for the reform of university engineering education programs. Engineers might view the Syllabus as a *requirements document* for engineering education. For education specialists, it will

be viewed as a comprehensive statement of learning outcomes. Both are equally valid interpretations.

It is our aim that we move toward a resolution of the tension in contemporary engineering education by providing a complete enumeration of the knowledge and skills that graduating students should possess. This enumeration should be sufficiently general to allow it to be applied to all branches of engineering. It should be sufficiently detailed to be useful in curriculum planning and learning assessment. The first half of the chapter describes the development of the Syllabus, addressing the first part of the central question, “*What is the full set of knowledge, skills, and attitudes that engineering students should possess as they leave the university?*”

Traditionally, the second part of the central question—*at what level of proficiency?*—is decided internally by university faculty, by consensus, or by the choice of individual instructors. We advocate an approach that includes stakeholders from among students, faculty, university staff, alumni, and industry representatives in consensus to set the expected level of proficiency for each learning outcome. There is nothing that limits the two essential steps in this process—complete enumeration of outcomes and stakeholder engagement in setting expected levels of proficiency—from applying to any educational endeavor. The chapter also presents a generalization of this process to broad areas of education.

CHAPTER OBJECTIVES

This chapter is designed so that you can

- explain how the content of the CDIO Syllabus is derived from engineering practice
- describe the content and structure of the Syllabus
- explain the rationale for specifying learning outcomes in personal and interpersonal skills; and product, process and system building skills, as well as in technical disciplines
- describe how to engage stakeholders within and outside the university in the development of detailed learning outcomes
- outline a process for developing learning outcomes for engineering education that can be generalized to all disciplines

THE KNOWLEDGE AND SKILLS OF ENGINEERING

The required knowledge and skills of engineering are best defined through the examination of the practice of engineering. In fact, from its conception as a profession early in the 19th century until the middle of the 20th century, engineering education was based on engineering practice. As explained in Chapter