

## Chapter 7

# Observe, Conceive, Design, Implement and Operate: Innovation for Sustainability

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### ABSTRACT

*Innovation within organisations permits the transformation of knowledge into applications for the development of new knowledge and new organisations that are able to respond to the needs and changes of the society. However, how can we establish a framework for acquisition of the skills needed to manage successful initiatives for innovation in organisations and how can we guarantee the sustainability of these innovations? In order to provide an answer to these questions, this chapter presents a proposal for the promotion of sustainable innovation based on the engineering cycle of Observe, Conceive, Design, Implement and Operate (OCDIO). For this purpose, we reviewed examples of innovation in some world class universities, analyzed cases of education for innovation and developed a case study. We conclude that the OCDIO cycle was set up in a framework that enables the development of sustainable innovations through a permanent cycle of observation and adjustment of the systems designed to resolve problematic situations. The phase of observation allows the professionals facing the challenges of innovation inside organisations to obtain the relevant information for the conception, design, implementation and operation of sustainable engineering systems that take into account the relevant economic, social, technical, environmental and cultural aspects.*

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## INTRODUCTION

“...The world is becoming increasingly more complex and connected, the advance of science is accelerating, and socio-technical problems are abundant” (Steiner, Ramírez, Hernández, & Plazas, 2008, p 141). This rapid process of change implies that organisations and society in general should be ready to constantly adapt to their changing conditions and evolve in order to survive in their environment. In order to accomplish this goal, innovation has become a key element that enables organisations to respond to the increasingly demanding and complex conditions of the market (Evans, Parks, & Nichols, 2007).

Innovation within organisations permits the transformation of knowledge into applications for the development of new knowledge and new organisations that are able to respond to the needs of the society (Edmondson & Nembhard, 2009). “In the future, only companies that make sustainability a goal will achieve competitive advantage. That means rethinking business models as well as products, technologies, and processes” (Nidumolu, Prhalad, & Rangaswami, 2009, p. 1). In this sense, new companies with an innovative spirit are able to take the place of established companies which have become old and tired, creating an innovative attitude that generates a higher level of development (Thurik, 2009).

However, how can we establish a framework for the acquisition of the skills needed to manage successful initiatives for innovation in organisations? In addition, how can we guarantee the sustainability of these innovations? In order to provide an initial answer to these questions, we need to develop a way to introduce innovation into the education of the professionals that are going to be part of organisations, promoting the development of innovative ideas from different fields of action or simply favouring a continuous process of innovation in the daily running of organisations. We have to keep in mind that innovation generates value in many different ways, and not only in terms

of the final sale price; it also adds social value, intellectual value, improves the competences of the organisation (not only commercially but in terms of the quality of production) and helps to clearly define the objectives of the organisation (Organisation for Economic Co-operation and Development [OECD], 2004).

Traditionally, engineering as a profession has been one of the disciplines in charge of leading the processes of innovation generated in the Academy or in the production sector. For this reason, many schools of engineering have highlighted the importance of the development of skills in order to tackle the challenges of innovation in the market, so that these skills may be used in the future to create successful projects (Siller, Rosales, Haines, & Benally, 2009). One initiative that had been gaining ground in recent years is the CDIO cycle, which aims to structure education in engineering based on the cycle of observe, conceive, design, implement and operate. This proposal is intended to assist the transformation of innovative ideas into real projects using the CDIO cycle (CDIO, 2010; Crawley & Brodeur, 2008). The aim is that the engineering professionals of the future will have effective communication and teamwork skills and an innovative attitude, which will allow them to successfully carry out sustainable innovation proposals based on the proposed cycle (Hernández, Ramírez & Carvajal, 2010). Sustainability is achieved through a permanent cycle of observation of the designed systems within a process of constant adjustment (Carvajal, Ramírez, & Hernández, 2010; Carvajal, Ramírez, Torres, & Arias, 2010). After several years of research, and obtaining pragmatic innovation results from student teams, a group of researchers proposed the introduction of an additional initial phase of observation into the CDIO framework (Steiner, Ramírez, Hernández, & Plazas, 2008).

These researchers believe that a person (or a group of people) trying to develop an initiative for the purpose of innovation in any context must observe his/her context in order to attempt to

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