Chapter 10
Diffusion and Adoption of Innovations for Sustainability

Helen E. Muga
University of Mount Union, USA

Ken D. Thomas
Auburn University, USA

ABSTRACT

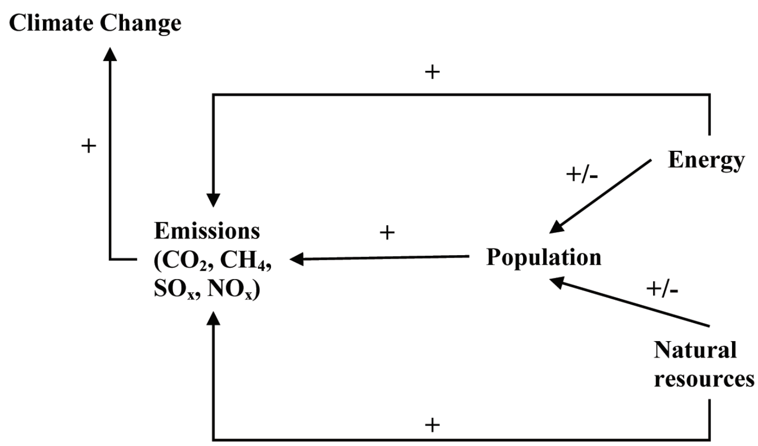
The primary focus of this chapter is on the theory and concepts of sustainability and why they are important to innovation and vice-versa. Key reductionist approaches to assessing sustainability such life cycle assessment (LCA), life cycle cost analysis (LCCA), and sustainability indicators are discussed in detail and applied to an engineering infrastructure scenario. The integrated sustainability methods of life cycle assessment and life cycle cost analysis enable a business to assess alternative products or processes at the planning and design stages. They may also be used during the production stages to assess whether a business needs to use a different raw material to make their products. The role of management, social network analysis, and mental models of individuals in the diffusion and adoption of innovations are also explored.

INTRODUCTION

Over the centuries, energy consumption has increased from 10 quadrillion BTU (10.055 x 10^{18} joules) in year 1800 to 500 quadrillion BTU (5000 x 10^{18} joules) in year 2000 (UN Environment Programme, 2007). Population, carbon dioxide emissions, water use, amounted of domesticated land, loss of tropical rain forest and woodland, and nitrogen flux to coastal zones have also increased over time. Population increased from 600 million in year 1750 to 6 billion in year 2000. Carbon dioxide emissions increased from 250 ppmv in year 1800 to 360 ppmv in year 2000. Water use increased from 200 km^3/year in 1900 to 5000 km^3/yr in 2000 and nitrogen fluxes increased from 0.25x10^{12} moles/year in year 1850 to 9x10^{12} moles/year in 2000 (Crutzen, 2005). Unsustainable practices such as excess consumption, unsustainable management practices exacerbate current global problems.

DOI: 10.4018/978-1-4666-4852-4.ch010

Figure 1. Linkages between population, resources, consumption, emissions, and climate change. Population growth requires significant amount of natural resources and energy to sustain and support, with positive and negative impacts. An increase in population, leads to an increase in energy and natural resources (+). This subsequently contributes to increase in emissions (+) which in turn contribute to climate change (+). A decrease in population leads to a decrease in energy and resource consumption (-). The adoption of sustainable practices by the public and in the energy sector also contributes to a decrease in energy consumption (-).



These global challenges/issues are intricately linked to one another. Figure 1 shows the interaction between population, natural resources and services, energy, emissions, and climate change.

The introduction, and the diffusion and adoption of sustainability concepts and theory to a large extent attempts to address current global challenges that society and future generations face by reducing excess consumption, promoting efficient management and use of natural resources, and reducing consumption of energy sources that contribute to climate change The term "sustainability" has different meanings to different people. One of the definitions of sustainability is that it is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). At the business level, sustainability is defined as, "meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc), without compromising its ability to meet the needs of future stakeholders as well" (Dyllick & Hockerts, 2002).

In this chapter, we focus on the theory and concepts of sustainability (life cycle assessment, life cycle cost analysis, and indicators) and their application to the built environment. In this chapter, we focus on the theory and concepts of sustainability (life cycle assessment, life cycle cost analysis, and indicators) and their application to the built environment. The built environment includes "all of the physical structures engineered and built by people—the places where we live, work, and play. These edifices include homes, workplaces, schools, parks, and transit arrangements" (Dearry, 2004). They also include roads, power generation facilities, harbors, treatment plants, bike paths, and storm-water management systems. These engineered structures sustain and support human activity and continuity. The built environment is one of the largest consumers of raw materials and energy. Over three billion tons per year of global raw materials (40%) are consumed in the United States (U.S. Green Building Council, 2005). Commercial and residential buildings consume around 36% of energy and over 65% of electricity