Chapter 8
Sustainable Development in Manufacturing Systems

Farnaz Ghazi Nezami
Kettering University, USA

Ali Ghazinezami
Wichita State University, USA

Krishna K. Krishnan
Wichita State University, USA

ABSTRACT
This chapter discusses sustainable development (SD) planning in manufacturing facilities. The industrial sector uses half of the world’s energy, and manufacturing, as the core of this sector, contributes significantly to energy consumption and environmental footprints. In this chapter, in the first step, energy consumption, as one of the main factors influencing SD in manufacturing, is analyzed from different perspectives, and its impact on SD is studied. Thereafter, several energy-aware operations management approaches are proposed. These approaches integrate energy consumption into classic production planning and scheduling decisions. In the second step, a generic sustainability-based decision-making framework is proposed for maintenance strategy selection problem, considering three pillars of sustainability. For this purpose, various indicators are proposed for each sustainability factor that has an impact on maintenance planning decisions. The maintenance strategy alternatives are evaluated for each indicator and the best alternative is selected using a decision-making method.

DOI: 10.4018/978-1-5225-2081-8.ch008

Copyright ©2017, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.
INTRODUCTION

This chapter studies sustainable development planning in manufacturing systems from different perspectives. Brundtland et al. (1987) defines a sustainable development (SD) plan as one that satisfies the needs of the current generation without compromising the needs of future. Today, human/corporation activities have an extensive impact on the environment, and these influences are mostly long term. Sustainable development planning places more responsibility on corporations for the effects of their activities on the society and environment. A general misconception occurs when sustainability is considered solely as a set of environmental factors. However, environmental issues constitute one dimension of the sustainability framework. A sustainable development plan is based on three “P”s of People, Planet, and Profit, and a balance must be attained among them. Efforts to preserve the environment must yield benefits from economic and societal perspectives as well to ensure the achievement of sustainability goals (Jayal et al., 2010).

Manufacturing can contribute to SD by designing products and establishing processes which are more environmentally-friendly and are accompanied by social interest and support (Jasiulewicz-Kaczmarek & Drozyner, 2011). Energy as a catalyst of development (Mohamed & Lee, 2006) is an indispensable factor in sustainable development of societies and manufacturing facilities. In addition, energy consumption is one of the key criteria in life-cycle assessment (LCA) studies. Usually, there is not enough information about energy usage during the manufacturing phase in the LCA studies, and various assumptions must be made (Seow & Rahimifard, 2011). This fact, along with the scarcity of natural non-renewable resources, environmental concerns, new restrictive regulations, the increasing price of energy and the growth of society’s awareness about environmentally friendly products, persuade manufacturing facilities to monitor their material and energy consumption and seek sustainable solutions. Financial savings and societal benefits associated with green policies are the other motivations for sustainability-based efforts in most organizations.

In spite of technological advancement, the global need for energy will grow by 37% in 2040 (International Energy Agency a), in line with the growth of the population. Therefore, analyzing energy consumption, and integrating sustainability criteria into various level decision-making problems for sustainable development purposes is critical. This chapter studies these concerns in manufacturing systems.

BACKGROUND: SUSTAINABLE MANUFACTURING SYSTEMS

The industrial sector, consuming approximately half of the world’s energy, is the largest consumer of energy (U.S. Energy Information Administartion). Energy con-
Strategic Management of Innovation Focusing on Confluence of Continuity and Change
[www.igi-global.com/article/strategic-management-innovation-focusing-confluence/61378?camid=4v1a](www.igi-global.com/article/strategic-management-innovation-focusing-confluence/61378?camid=4v1a)

Productive Use of Renewable Energy (PURE) for Economic Development in Developing Countries
[www.igi-global.com/chapter/productive-use-of-renewable-energy-pure-for-economic-development-in-developing-countries/94937?camid=4v1a](www.igi-global.com/chapter/productive-use-of-renewable-energy-pure-for-economic-development-in-developing-countries/94937?camid=4v1a)