Chapter 12
Lean and Sustainable Warehousing

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ABSTRACT

This chapter depicts a picture of sustainable warehousing from the perspective of the time-phased impact of warehouses on economic, environmental, and social dimensions of sustainability. The authors present sustainability issues in warehouses within three levels: macro, meso, and micro. In the macro level, they review the effect of warehouse location and construction on sustainability. In the meso level, they discuss how to deal with warehouse layout problem, the effects of aisle, and material handling equipment choices on sustainability. Last, they briefly present what warehouse managers can do for sustainable warehousing in a short amount of time. Hence, the authors aim to provide a holistic approach to make warehouses sustainable. Last but not the least, they also present supportive and strengthening theoretical and practical studies to resolve barriers in front of sustainable warehousing.

INTRODUCTION

Warehouses, where products are simply stored until they are required to be shipped to customers, play a critical role in managing supply chain network efficiently. Receiving, put-away, picking and shipping are the main operations in a typical warehouse. Nowadays, warehouses even involve varying activities such as kitting, labeling, customization in addition to their business-as-usual activities to provide value to their customers. Changing customer expectations and growing global economy, especially on the side of e-commerce, also start to force to reshape the new type of facilities from national and regional distribution centers to consolidation centers, e-fulfillment centers and cross-dock centers. Hence, this causes an increase not only in the total number of facilities but also the in total size of warehouses in the network. For instance, according to Bureau of Labor Statistics in the U.S., the number of warehouses in the U.S. reached to 17,000 in 2016 from 15,525 in 2011 (United States Department of Labor, 2017), and 173 distribution centers of those establishments belong to major two retail stores, Walmart and Target, with a total 125.8 million square feet (MWPL International Inc., 2016). A similar development has also

been happening in the U.K. where total warehouse space (units 100,000 sq ft +) in the country reached to 424 million sq feet in 2015 (United Kingdom Warehousing Association & Savills, n.d.). Additionally, number of transactions, especially small unit handlings, are increasing in these facilities due to increasing e-commerce. According to estimates for the holiday season in the USA in 2016, the main courier delivery companies are expected to deliver around one billion 835 million packages (Lindner, 2016). Similar developments are also observed in Europe because of increasing B2C (business-to-customer) e-commerce sales from 440 billion in 2015 to 500 billion euros in 2016 (Statista, 2017). Hence, the global supply chain network with new and larger facilities and the transactions on the network are growing day by day.

Advances in global supply chain network and increase in transportation and material handling have had a prominent impact not only on the economic growth but also on the society and environment. The world Economic Forum estimated that the effect of global logistics activities on the annual global greenhouse gas (GHG) emissions, which is accounted for the major indicator of environmental damage and cause of climate change, is around 5.5%; roughly 5% is caused by transportation and 0.5% by logistics facilities (Doherty and Hoyle, 2009). However, McKinnon et al. (2015) presented higher rates for the effect of warehousing on the UK national GHG emissions, which is around 3%. Although logistics facilities cause lower GHG emission than transportation, they cause 13% of total supply chain emissions and generate more GHG emissions than airfreight and rail freight (Fichtinger, Ries, Grosse, & Baker, 2015). Thus, the concept of sustainable warehousing has emerged in order to alleviate the environmental and social impacts of warehouses while they still lead to economic growth.

MHW Magazine (2010) reported that warehouses in the U.K. account for approximately 10 million tons of CO_2 emission in 2009, and approximately 1.9 million tons of oil equivalent energy use in 2016 (United Kingdom Department for Business, Energy and Industrial Strategy, 2017). According to Richards (2014), warehouses in the UK can easily save approximately 1.5 million tons of CO_2 emission just by implementing simple ideas. The major energy consumption areas and the major sources of CO_2 emission during daily operations in warehouses are heating, ventilating, air conditioning (HVAC), lighting, and operating fixed and mobile material handling equipment (Baker and Marchant, 2015). In addition to daily emissions caused by operations and operational support units, warehouse buildings also cause CO_2 emission because of embedded energy in materials and fixed equipment used to construct them, even if they do not operate. Moreover, this emission is assumed to occur during the life span of the building. Therefore, warehouse size, its layout, type of storage and material handling systems have an impact on medium- and long-term sustainability of warehouses because they are difficult to change when a warehouse is built once. One also should remember that warehouses build a bridge between suppliers and customers in a supply chain network. Therefore, the location of the warehouse plays a long-term and critical role in reducing the environmental impact of warehouses from the perspective of CO_2 emissions caused by inbound and outbound transportation. Therefore, this chapter aims to bring out all these short-, medium- and long-term impacts of warehouses on sustainability under three levels with respect to their time-phased impact; macro, meso, and micro levels,. According to decisions made under each level, this chapter also presents practices that could be performed to reduce CO_2 emissions and provide monetary savings. Thus, the remainder of the chapter presents detailed discussions about the sustainability in warehouses as outlined in Figure 1.

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