

Chapter 3

Applications of Operations Research in Production and Distribution Management of Pharmaceutical Products

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ABSTRACT

Pharmaceutical industry is considered as a global industry because of its effects on the human life. Many researchers used optimization tools to manage the pharmaceutical supply chain (PSC) efficiently. A supply chain may be defined as an integrated process where several business entities work together to produce goods and/or services and deliver them to the end customer. The issue of PSC which includes strategic, tactical and operational decisions, is still a quite hot issue. The intended mission of this chapter is to introduce and discuss the recent developments of procurement, production and distribution management of pharmaceutical products in order to pave the way for the readers who are interested in this area of research. Notably, the focus of the chapter is on quantitative OR-based models which enable the decision makers to appropriately coordinate and manage the whole pharmaceutical industry.

INTRODUCTION

Pharmaceutical industry is a system which consists of processes, operations and organizations involved in the discovery, development, production and distribution of drugs and medications (Shah, 2004). Economically, medicine is the second profitable industry after crude oil. Pharmaceutical supply chain aims to deliver safe and high quality pharmaceutical products at the right time and place to final consumers. Namely, (1) discovery, (2) development, (3) production and (4) distribution are the main stages needed for a drug to reach the market successfully. The efficient management of the product flow through these

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four stages plays an important role in the competitiveness of pharmaceutical supply chains. Accordingly, integrated planning of procurement, production and distribution processes can lead to cost saving and more amount of profit. One significant issue which should be considered by decision makers and managers is the risk of failure within the mentioned four stages. Notably, the rate of success is less than 1 per 1000 and 1 per 5 in discovery and development stages, respectively (Tollman et al., 2011). Moreover, the production and distribution stages also include operational and environmental uncertainties which may disrupt the drug flow from pharmaceutical companies to market.

Pharmaceutical products have some special features which differentiate them from the other products. One of these features goes back to perishable nature of pharmaceutical products. Perishable products such as drugs have a maximum allowable usage time (Sazvar et al., 2013); therefore, they should stock carefully in wholesalers and retailers to prevent any waste product and/or possible damage to consumers.

The aim of this chapter is to introduce and discuss the recent developments of procurement, production and distribution management of pharmaceutical products in order to pave the way for the readers who are interested in this area of research. Accordingly, a systemic review on the relevant models is provided and a several mathematical models as well as a case study are described and analyzed in this chapter.

Importance and Drivers

The importance of modern pharmaceutical industry is declared because three of the eight main goals set by the United Nations for development in the millennium are related to pharmaceutical industry (Narayana et al., 2012). (1) Decreasing child's death, (2) improving mother's health and (3) fighting with AIDS, Malaria and other diseases are depending on the access to medications. Notably, one of the millennium development goals includes the cooperation with pharmaceutical companies in order to achieve affordable access to essential medicines in developing countries.

One of the key factors related to this goal is the effective and efficient management of pharmaceutical supply chain (Susarla & Karimi, 2012). In addition, irreversible globalization, increasing environmental rules and new scientific progress may lead to renewed operational organization in sketch of drugs and medicines, business, pharmaceutical industry, production, stock, distribution, products checking mechanism and medications delivery. To face these challenges and remaining competitive in the market, companies are looking for integrated tools for managing operations and control resources. The objectives are to minimize the operational and development costs and maximizing profits in accordance with environmental rules.

Nowadays, the importance of inventory control is one of the vital issues in all parts of supply chain management and pharmaceutical industry. Surveying business reports shows that, total investment in inventory in the United States is more than 1.3 trillion dollars (Nahmias, 2011). Therefore, it is obvious that the use of appropriate and efficient methods for inventory control can decrease costs and smooth the flow of materials, goods and services from suppliers to end-customers. Accordingly, many researchers made effort to develop decision-making tools to manage inventory through the pharmaceutical supply chain. However, most of these researches assumed that, products have unlimited life and their quality and application do not change during the time. In fact, pharmaceutical products are categorized in the class of perishable products. The perishability of pharmaceutical products is an important issue which should be taken into account while making different supply chain planning decisions such as inventory decisions (Goyal & Giri, 2001).

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