Chapter 15
Effective Applications of Optimization Methods in the Manufacturing Environment in Turkey

Omer Faruk Yılmaz
Istanbul Technical University, Turkey

Hikmet Erbiyik
Yalova University, Turkey

ABSTRACT

In today’s manufacturing environment both used equipment and worker resources have become more crucial. Both resource must be used in an effective and appropriate way. Therefore, studies in conjunction with manufacturing environment are actualized under dual resource constrained (DRC). In the extant literature, DRC manufacturing environments place importance on certain dimensions which are surveyed in detail in this study. This literature research is conducted for manufacturing environments where worker planning and product scheduling topics are studied frequently. Our observations reveal that the systems of single conducted do not reflect the real manufacturing environment; hence, hybrid manufacturing systems which consist of functional layout and cells are investigated. The efficiency of hybrid manufacturing systems in the DRC environment are revealed by searching through literature. Therefore, the more effective way of usage of optimization methods are proposed by examining the studies regarding hybrid manufacturing system in terms of usage of optimization methods.

INTRODUCTION

Today the role of manufacturing is increasingly vital in developing economies such as Turkey’s. In particular, the manufacturing of products associated with high added value has a reasonably high effect on the development of the national economy and the rise in global competition. Due to the virtual shortness of the product life cycle in high-added value products (primarily technological products), the effective-
ness of manufacturing methods hold great importance. Additionally, the time spent for a product being manufactured and the exposed costs associated with the manufacturing cycle must be reduced. At this point, the manufacturing processes as well as the product development stage in the pre-manufacturing period are one of the issues that must be handled carefully. Since this subject is beyond the scope of the study, interested readers may refer to Morgan and Liker’s (2006), *The Toyota Product Development System: Integrating People, Process and Technology*.

Although integration of the product design, development, and manufacturing stages are the prime subjects to be considered, we will attempt to also consider the issues relevant solely to product manufacturing; additionally, some generalizations will also be made regarding these issues. Because the nature of transforming manufacturing into an effective manner is a major undertaking, researchers investigate it by dividing it into sub-divisions. For example, product sequencing and scheduling is being implemented to realize some certain objectives (e.g., makespan, tardiness, flow-time). However, there are certain classes for each manufacturing system (e.g., job-shop, flow-shop, cellular system), and even these classes are divided into sub-groups (e.g., deterministic, stochastic). Therefore, the subject has gained widespread interest.

As previously mentioned, this study shall highlight the issues directly related to manufacturing in a specific field and relevant conclusions will be obtained. As a result, we will provide general results from these conclusions and explain how to use the most effective optimization methods urgently needed by developing countries such as Turkey to improve the effectiveness of the production processes in industrial organizations. When we consider the production process, we will encounter studies in the extant literature evaluating certain systems in terms of either single- or multi-objective. For example, when considering sequencing and scheduling studies, we frequently observe issues such as makespan, tardiness, earliness, and flow time. When we analyze such studies, we observe that implementations of single machine, parallel machine, flow-shop, job-shop, flow-shop type cell, and job-shop type cell are conducted separately.

However, our observations in the manufacturing environment reveal that single-conducted systems do not reflect the actual manufacturing environment. For example, even when we intend to make a design to construct a cellular manufacturing system, the partition of the whole machines into independent cells will not be possible. In this case, we will either permit exceptional operations or a Hybrid Manufacturing System (HMS) consisting of both cell and functional areas which must be designed. Generally, most manufacturing systems are designed to specialize as per the manufacturing type and in the form of a hybrid system. For this reason, it is correct to argue that an HMS reflects the manufacturing environment in a more genuine state.

Observations made in the real manufacturing environments in an in-vehicle safety components plant in Istanbul, a furniture plant in Inegol, an office furniture plant in Bursa, and a vehicle spare parts plant in Trabzon show that HMS studies are more representative to deal with as real manufacturing plants. For example, furniture manufacturing is made in manufacturing cells but needs speciality expertise in some part of the manufacturing process, especially in the last stage of manufacturing. As such, a functional layout is used. If this manufacturing system is handled to improve in terms of optimization methods, it should be handled as an HMS.

As another example, in-vehicle safety components manufacturing is also made also in manufacturing cells, but some raw materials are made in a functional layout which has a job-shop type layout – this situation causes an HMS and hybrid layout structure of the manufacturing plant. As in furniture manufacturing to improve the effectiveness of a system using optimization methods, this manufacturing system...