Chapter 7
A Novel Web-Based Decision Support System for Aggregate Production Planning Problem

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ABSTRACT

The aggregate production planning model aims to match the supply with demand while minimizing the manufacturing or production activity costs. There are many methods in the mathematical programming theory to solve the aggregate production planning problem. This chapter develops a novel decision support system for the aggregate production planning model using the linear programming approach. The aggregate production problem modeled by the linear programming has been coded in R computer programming language, and a novel web application has been developed using Shiny to serve the needs of the production managers. The novel application is adjustable for any production setting and planning horizon for firms in global transitioning.

INTRODUCTION

Globalization has accelerated the speed of digitalization. Although there are many arguments on whether globalization increases sustainability and creates wealth through digital transformation, the concept of Industry 4.0 has shifted the paradigm, just as the previous industrial revolutions did. Nowadays, the operational practice and the global industry transition is towards digitalizing the production processes.

Production planning activities constitute a great portion of contemporary economical concepts, since the act of producing is a central function in all economic units. Scientific literature on production classifies these activities in many ways while explaining the means of their implementation for sustainability and profitability. For instance, the division of labor, an idea pioneered by the renowned economist Adam Smith, creates an appalling impact on productivity (Thornton, 2014). Nevertheless, the task of selecting and implementing an appropriate production planning and control tool requires the use of mathematics.

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Operations transform the physical material or abstract thinking into finished goods or completed products or services. Although the scope of an operation is limited to an activity on the product, implementing a production planning and control tool into the organization is challenging and demands a multidimensional perspective. Findings from the disciplines of operations management and operations research present a wide range of opportunities to entrepreneurs for improving their businesses. The distinction between these two fields is that while the practitioners and scholars of operations management focus on the design, creation, technology, production, development, procurement, delivery or coordination of the products or services, operational researchers apply quantitative methods for solving operational problems (Omor, 2020).

The planning activities should generate robust links to match the customer demand with the supply capacity of the enterprise. Cachon and Terwiesch (2012) emphasize the importance of operations management by equalizing it to matching supply with demand, and state that "*organizations that take the design of their operations seriously and aggressively implement the tools of operations management will enjoy a significant performance advantage over their competitors*". Digitalizing the operations is a way to achieve this performance edge and depends heavily on the data that the organizations harbor.

This chapter equips the reader with the knowledge on the implementation of a decision support system for aggregate production planning using the R programming language and its application development package, namely Shiny. The aim of the chapter is to present the development of a state-of-the-art aggregate production planning model and convert it into a web-based application utilized for the production departments of the enterprises. The fundamental research question of this design and calculation task is to examine whether the conversion of the mathematical knowledge into a practical application is feasible.

Matching supply with demand by the help of modern mathematical optimization techniques might significantly contribute to businesses. Efforts for developing a useful web-based application also provides a profitable business opportunity as more companies realize the ever-increasing importance of digitally transforming their production planning activities. Therefore, an organic byproduct of this study is the outline for a profitable business opportunity. Digitalizing the manufacturing environments need productivity applications, and a web-based application whose domain is the aggregate production planning might satisfy this type of demand.

The structure of the chapter is as follows: The background section provides a literature review on the domain of decision support systems of aggregate production planning and control. The next section provides methodological details on the aggregate production planning model based on linear programming approach. The chapter then provides further details on developing the novel application using R programming language. Finally, the chapter ends with future research directions, a discussion of the overall coverage and concluding remarks.

BACKGROUND

In economics, the concept of planning refers to the state intervention and the debate around how it intertwines with the global economy has been going on since decades (Kazgan, 2000). In management science, planning refers to the production planning and control activities of a company. This background section aims to explain the definitions of production planning and control along with decision support systems as well as presenting the recent developments in the reviewed scientific literature.