

# Chapter 6

## Optimization in Military Planning: Resource Allocation Problems

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### ABSTRACT

*In recent years, advancing technology has introduced a wide range of resources for military forces. This rapid improvement in the number and types of military resources also led to difficulties in the management of resource allocation issues in combat missions. The general resource allocation problem can be defined as determining the optimal sequence of resource usage allocations while maximizing the kills on the enemy's forces or minimizing casualties. In this chapter, the authors investigate the resource allocation problems and solution approaches observed in planning military missions. Theoretical background information and some examples based on real-time data are provided to illustrate the chosen problem types.*

### INTRODUCTION

Today, the conflicts and the precariousness which the countries have been faced are more complex than compared to the past. Nowadays, asymmetrical threats and terrorist activities have become more an issue than the conventional wars. Therefore, the counter-measures against these situations are substantially different.

The technology advances quickly, and as a result, both the offensive and defensive systems have been evolved. With these rapid advances in military systems technologies, more capabilities are available to the armed forces and planners. All these capabilities and the various types of threats bring out many different types of problems as well. One of the most important problem types among those is the optimization and allocation of the force resources.

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In this chapter we will focus on the general resource allocation problem and its applications in the military context. For this reason we first provide a background on the studies related to resource allocation problems. Then, we discuss on specific types of problems observed in military organizations. Next, we discuss both analytic and heuristic methodologies developed to solve those problems, and finally conclude.

## **BACKGROUND**

Force deployment and optimal resource allocation have been an area of considerable research interest in conventional warfare for a long time (Danshin, 1967; Shubik, 1983; Colegrave, & Hyde, 1993; Bracken, Kress, & Rosenthal, 1995; Cruz, Simaan, Gacic, Jiang, Leitellier, Li, & Liu, 2001; Krichman, Ghose, Speyer, & Shamma, 2001; Ghose, Speyer, & Shamma, 2002; Ghose, Krichman, Speyer, & Shamma, 2002).

Due to the complexities of the situations which the operation planners encounter, especially the human lives are in question, planning and optimizing the resources rapidly, in a cost-effective manner and with minimum mistake is vital. Because the slightest mistake that the planner might do may cause many lives in the operational theatre. Many real-world decision problems in the operational theatre exhibit the presence of different, contrary objectives in process of evaluating alternatives, as well as the necessity for making adjustments or trade-offs concerning the outcomes of changing the course of action (Karatas, 2017; Karatas, 2018; Karatas & Yakici, 2018; Razi & Karatas, 2016; Razi, Karatas, & Gunal, 2016). Further, most of these same resource allocation decision problems are encountered under inherent, concealed uncertainties.

In our era, with rapid and significant advances in communication and computation technologies, sophisticated decision-making in these situations has become feasible. And also these improvements have generated renewed interest in formulating decision-making problems in these areas and seeking optimal solutions. (Sheeba, & Ghose, 2005)

Resources are limited and time is short. The resources must be utilized in the most effective way in order to encounter the threats. To address these problems, Operations Research methods, a sub-level research topic of Industrial Engineering, has been used since World War II. Operations Research's foundations invented to address the strategical and tactical problems in air / naval defense and many different algorithms have been invented up today. Resource allocation and optimization problems are one of these research areas.

One of the main problems of combat planning is resource allocation problem, which defines the operations against enemy targets and aims to optimize the resource allocation efficiency and effectivity. Research on this problem types emerged with the adoption of scientific approach in the organization management field. While dealing strategic and tactical problems of military operations in World War II, need for academic study and scientific support raised and Operations Research (OR) activity officially began with created military OR teams. (Hillier, & Lieberman, 2004)

## **RESOURCE ALLOCATION PROBLEM**

In general; resource allocation problems involve the process of assigning and managing valuable assets in a way that supports an organization's strategic missions. They manages the assignment of resources to the most promising solution among the competitive ones for minimizing total costs or maximizing

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