Chapter 8

MULTIOBJECTIVE COMBINATORIAL OPTIMIZATION – THEORY, METHODOLOGY, AND APPLICATIONS

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Abstract This chapter provides an annotated bibliography of multiple objective combinatorial optimization, MOCO. We present a general formulation of MOCO problems, describe their main characteristics, and review the main properties and theoretical results. One section is devoted to a brief description of the available solution methodology, both exact and heuristic. The main part of the chapter consists of an annotation of the existing literature in the field organized by problem. We conclude the chapter by stating open questions and areas of future research. The list of references comprises more than 400 entries.

Keywords: Combinatorial optimization, multiple objectives, metaheuristics, exact methods, bibliography
1. Introduction

Combinatorial Optimization is a field extensively studied by many researchers. Due to its potential for application in real world problems it has prospered over the last few decades. A good survey of the state of the art is provided by [74]. But as far as real world decision making is concerned, it is also well known, that decision makers have to deal with several – usually conflicting – objectives. The growth in the interest in theory and methodology of multicriteria decision making (MCDM) over the last thirty years as documented by the chapters in this volume, the survey of the activities in the field [366] and a bibliography of MCDM applications [421] is witness of this fact.

Thus it is somewhat surprising that a combination of both, i.e. multicriteria or multiobjective combinatorial optimization (MOCO) has not been studied widely. A few papers in the area have been published in the seventies, then the classical problems have been investigated in the eighties. Only in recent years – approximately since 1990 – a profound interest in the topic is evident. Since then several PhD theses have been written, specific methodologies have been developed, and the number of research papers in the field has grown considerably.

In this chapter we intend to give an overview over the literature in the field of multiobjective combinatorial optimization. In the following sections, we first present a brief introduction to the field, including a general problem formulation, description of several types of MOCO problems, and the most important theoretical properties of these problems (Sections 2 and 3). In Section 5 we explain the classification of literature that we used. This consists first of a classification of the problem treated and secondly of the methodology applied to solve it. Then we review existing methods to solve MOCO problems in Section 4. The main part of the chapter is devoted to the annotation of the literature (Section 6). The chapter is concluded by a brief discussion of open questions and areas of future research (Section 7).

Let us now describe the focus of this chapter. We compiled the literature on multiobjective combinatorial optimization accessible to us. We mainly consider papers that deal specifically with MOCO problems, thus our bibliography is certainly not complete on 0-1 programming with multiple objectives, and exclude most of the literature on general multiobjective integer programming. A similar statement can be made with respect to scheduling. Scheduling problems are specific problems with their own theory and methodology, which we will not describe in detail, but refer to Chapter 7.3. We should also mention, that there exist earlier survey papers related to MOCO, one general [398], and two specifically