

Project portfolio selection with scheduling: an evolutionary approach

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Abstract. This paper addresses the project portfolio selection problem enriched with scheduling. The factors considered for project scheduling are: the planning time horizon and the negative impact of the project completion time on the total profit. The objective is to select a subset of projects which maximizes the discounted total gain by late completion time, respecting resource constraints and without exceeding the time horizon. A mixed integer linear programming model was formulated and compared to two recent models addressing the same problem. To show the potential of the model on the large scale we used a metaheuristic based on the genetic algorithm Non-dominated Sorting Genetic Algorithm II. We show experimentally the benefits of our proposal and leave open the possibility of its study applied on a larger scale in future works.

Keywords: Project portfolio selection with scheduling; mixed integer linear programming; genetic algorithm; non-dominated sorting genetic algorithm II.

1 Introduction

In organizations of different turns, there is a common problem, the selection of a project portfolio, whose quality in its solution interferes a lesser or greater degree in their profits, another factor that directly influences these benefits is the completion time of the projects. "In the United States of America, only 26% of information technology projects are carried out on time and within the budget" [1]. As important is the proper selection of projects that integrate the portfolio, as is the efficient timing of such projects. The project portfolio selection problem has been extensively studied, however, the incorporation of temporary dependencies has been little discussed in the specialized literature [2].

This paper addresses the project portfolio selection problem with scheduling. It proposes a linear mathematical model that maximizes the profit and minimizes the time of completion of the projects that integrate the portfolio. We evaluate the quality of our model by contrasting its solutions with those obtained by other models of state of the art. With the purpose of showing the potential of the proposal in large scale, the model was solved with the Non-dominated Sorting Genetic Algorithm II (NSGA-II) metaheuristic.

2 Background

In this section, we describe some basic definitions of the project portfolio selection and scheduling problems, the piecewise linearization method used to improve the solution methodology, and finally a brief description of the NSGA-II algorithm.

2.1 Project portfolio selection problem with scheduling

One of the main tasks of managers in public sector organizations, such as foundations, research centers and companies conducting research and development, is to evaluate a set of projects that compete for financial support, to select those that contribute the maximum benefit to the organization. This subset of projects is a project portfolio [3].