Chapter 1
Resource Allocation through Scheduling Optimization

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ABSTRACT

Project management is especially critical when developing new information technology applications as there have been many project failures due to lost time and wasted effort (cf. e.g., Nelson, 2007). Despite a vast amount of research, this continues to be a problem. Even though Information Systems can involve leading edge technology, it seems to be lacking in its risk management abilities (Kappelman et al., 2006). Poor scheduling seems to be at the top of the causal ladder and Project Managers (PMs) often spend much of their time attending to the details of the schedule instead of dealing with the issues critical to the project that arise as the work progresses. This chapter is devoted to resource allocation, which the authors believe can be achieved through schedule optimization. The authors introduce a user-friendly program that provides an optimal schedule and takes into account the constraints imposed by having a limited number of resources.

INTRODUCTION

IT Projects are considered failures if they don’t work, don’t work correctly, are significantly over budget or are significantly late. In recent years despite extensive research and sophisticated project management software, projects continue to fail due to schedule and budget overruns (Herroelen & Leus, 2005). The Standish Group lists the average of projects to be considered as either a failure or challenged to be 68% from 2000 through 2008 (Standish Group, 2013). Such abysmal performance has prompted additional research into the reasons for both failure (cf. e.g., Kappelman, et al., 2006) and success (cf. Herroelen & Leus, 2005). Successful projects have good user involvement, support from managers, clear requirements and proper planning. There is general agreement in the literature that technical problems are almost never the cause of IT project failure (Kappelman, et al., 2006). The clear majority of unsuccessful projects occurs because of either process or people mistakes (Nelson, 2007). In fact, Nelson (2007) identified poor estimation and/or scheduling as the primary reason for failure 54% of the 99 projects in his study.
That poor scheduling ranks so highly among the causes of failure seems to be an odd result for two reasons. First, information technology development is all about creating leading edge software. One would therefore think that IT workers could apply this technology to their own discipline and use it to correct such problems with scheduling, yet there doesn’t seem to be such an ongoing effort. In defense of the IT discipline, however, project management is more than applying algorithms in a computer program, and so the fact that IT has not come up with effective solutions is not so surprising. Second, the amount of research that has been devoted to devising optimal scheduling methods has been vast and great strides have been made. The intractability of the problem seems to be what draws researchers, but on the other hand it is what continues to elude practitioners.

Assigning resources efficiently and effectively can manifest itself in one of two ways, depending on the project type. We refer to the distinction between resource leveling and resource allocation (Bandelloni, et al., 1994). Resource leveling occurs when the project duration is fixed (Son & Skibniewski, 1999) and the objective is to minimize the variation of resources throughout the life of the project (Ranjibar, 2013; He & Zhang, 2013). In this problem there are no resource limits and leveling is accomplished by shifting non-critical activities within their available float time (Bandelloni, et al. 1994). This type of problem occurs in projects that utilize non-renewable or consumable resources because it seeks to ensure that these resources are consumed evenly throughout the life of the project. Resource allocation occurs when there are limited resources and the objective is to minimize the makespan but meet the constraints imposed by having a limited number of resources. The resulting makespan should be as close to that originally planned as possible (Bandelloni, et al. 1994). In this chapter we discuss the resource allocation problem, because it is the one commonly faced in IT development in which the renewable resources can easily become over-allocated, especially in a multi-project environment.

Researchers have approached this problem in several different ways, but the objective is usually the desire to find that sequence of tasks for which a project will be completed in the shortest possible time, or minimizing the makespan. Approaches that have been developed to improve and/or optimize scheduling include bounded enumeration (e.g., Davis & Heidorn, 1971), dynamic programming (e.g., Jeng & Lin, 2004) and linear programming (e.g., Stinson, et al., 1978). More recent research has uncovered some more creative methods, such as genetic algorithms (Alcarz, et al., 2003, Debels & Vanhoucke, 2007, Afshar-Nadjafi, et al., 2013), evolutionary programming (Sebt, et al., 2013) and learning agents (Wauters, et al., 2011). While there is no clear explanation for continued high rates of failure due to scheduling, it may be that the techniques devised by researchers are not widely adopted. This may result from the fact that the more generalized approaches developed by academics are not easily applied to real world situations due to the high variability of situations faced and approaches used by practitioners.

Working closely with one large organization, we discovered that they were having problems very similar to what was just described. In attempting to solve their IT project scheduling problems, we devised a method for the project managers in this firm to take better control of the project scheduling process. The firm was having difficulty not just with scheduling, but with allocating resources as well. Project managers often found that their resources were either under- or over-allocated and as a result, much time was spent on trying to even their workload. This was considered wasted time as it took away from the real purpose of the project manager, which was, among other things, to ensure that projects were running smoothly and were completed on time.