

OPTIMAL PROJECT SEQUENCING WITH RECOURSE AT A SCARCE RESOURCE*

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We develop a dynamic prioritization policy to optimally allocate a scarce resource among K projects, only one of which can be worked on at a time. When the projects' delay costs differ, the problem (a "restless bandit") has not been solved in general. We consider the policy of working on the project with the highest expected delay loss *as if* the other project was completely finished first (although recourse is allowed). This policy is optimal if: (1) the delay cost increases with the delay regardless of the performance state, (2) costs are not discounted (or, discounting is dominated by delay costs), (3) projects are not abandoned based on their performance state during processing at the scarce resource, and (4) there are no stochastic delays. These assumptions are often fulfilled for processing at specialized resources, such as tests or one-off analyses.

(PROJECT PRIORITIZATION; PORTFOLIO SELECTION; PRODUCT DEVELOPMENT; RESOURCE ALLOCATION; DYNAMIC PROGRAMMING)

1. Introduction

It is common practice for new product development (NPD) organizations to pursue many projects in parallel in order to achieve broader product lines (mass customization) and higher market share (e.g., Reinertsen 1997; Ulrich and Eppinger 2000; Cusumano and Nobeoka 1998). In multiproject environments, it happens commonly that projects compete for access to a scarce resource. The processing time is much shorter than the projects' total duration. Examples for such scarce resources are equipment (such as an acoustic analyzer or wind channel in automotive design) or uniquely specialized areas of expertise, such as a critical department (e.g., a testing lab), or individuals (e.g., an engineer mastering a highly specialized procedure). Such scarce resources, although representing only a small part of the project's total duration, can become bottlenecks, and resource allocation is a critical factor for profitability (Adler et al. 1995).

How should such a scarce resource be allocated among on-going projects, or, how should projects be awarded priority for the short execution time there, in order to maximize the portfolio value? Conflicts among project managers over access to the resource are common in project organizations. Rather than solving such conflicts via giving priority to the project manager "who screams the loudest," senior managers need robust prioritization criteria. Some previous literature has recommended to work on the project with the highest ratio of

* Received January 2003; revision received August 2003; accepted October 2003.