

# Expert Judgments in the Cost-Efficiency Analysis of Technology Portfolios

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*Abstract:* We consider decision problems where there are alternative technologies with different performance characteristics for the completion of multiple prespecified tasks. Specifically, we consider how different combinations of technologies (i.e. portfolios) should be assigned to tasks in order to complete these tasks cost-efficiently, subject to two objectives: (i) the minimization of total costs resulting from technologies and their assignments to tasks and (ii) the maximization of the overall value resulting from the successful completion of tasks. These kinds of assignment problems are encountered, for example, in military planning where the technologies consist of alternative weapons systems and the tasks consist of envisaged military operations.

Such cost-efficiency evaluation problems often involve several challenges. First, it may be difficult to determine how important the tasks are relative to each; second, there may be uncertainties about to the extent to which the tasks can be completed with different technologies; third, some technologies may have interactions or they may be even incompatible. With the aim of addressing such challenges, we develop a modeling framework which helps determine for a range of cost levels (i) what technology portfolios are cost-efficient and (ii) to what tasks the technologies contained in them should be assigned. The results are derived from evaluation statements that are elicited from multiple experts: specifically, the expert statements are analyzed so that the results show which technology portfolios outperform others according to the statements of all experts, or which ones are inefficient based on the views of all experts. Methodologically, the framework is novel in that it accommodates incomplete information about the relative importance of tasks. It requires only relative information about the cost of assigning technologies to tasks. Although initially developed for military planning, the framework is generic and can therefore be deployed in practically most assignment problems where it is impossible or impractical to acquire deterministic information about how the alternatives contribute to the completion of tasks or how important the tasks are relative to each other.

*Keywords:* Portfolio Decision Analysis, Cost-Efficiency Analysis, Expert Judgments, Assignment Problems, Decision Support Systems.