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Discrete Optimization

Improving activity-based costing heuristics by higher-level cost drivers

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Abstract

Activity-based costing (ABC) tries to allocate overhead costs to cost objects more accurately than traditional cost systems. However, since ABC proportionalizes overhead costs it is a heuristic. The paper uses simulations and mixed-integer programming to analyze the extent of the sub-optimality incurred by ABC-heuristics. While previous research has focused on ABC systems with a simple set of cost drivers, thereby restricting the potential of ABC as a heuristic, the paper analyzes the effects of establishing a cost driver corresponding to a higher cost level. Specifically, a portfolio-based cost driver captures the demand heterogeneity triggered by the portfolio. This heterogeneity driver is then used to proportionalize all costs due to inflexible overhead resources. One of the main findings is that such a heterogeneity driver improves the quality of ABC-heuristics significantly.
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1. Introduction

Activity-based costing (ABC) tries to assign overhead costs to cost objects more accurately than traditional cost systems. Therefore it is often argued that ABC can support medium- and long-term decisions, such as make-or-buy, pricing and special orders decisions, or product portfolio decisions. ABC is even considered as a strategic cost system (see, e.g., Cooper and Kaplan, 1988). So far, however, it is not at all clear whether ABC is really an adequate instrument for decision making. Also it is an open question how the quality of decisions supported by ABC depends on the cost drivers of the underlying ABC system. These are the questions that the paper wants to address.

Our paper contributes to a recent strand of literature analyzing cost-based decision rules for planning purposes (see Balakrishnan and Sivaramakrishnan (2002) for a recent overview). Within this strand there are several publications which analyze the problems of using ABC for decision making. Noreen (1991) and Christensen and Demski (1995) investigate the general conditions under which ABC provides accurate cost information for decision making. Their main result is that costs must be separable into cost pools each of which corresponding to a single cost driver.

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Furthermore, the cost of a cost pool must be proportional to the volume of the relevant cost driver resulting in a linear cost function for each cost pool. This linear behavior of overhead costs is often not fulfilled in real-world applications. A paper providing empirical evidence against proportionality is Noreen and Soderstrom (1994). They test for the proportionality of overhead costs to activity using hospital data and reject proportionality. The reason for this result is obvious. When overhead resources are not perfectly flexible, under or over capacities as well as costs for adjusting capacities will result. Since these factors are not taken into account precisely, ABC has to be viewed as a heuristic, generally yielding sub-optimal decisions.

Several papers provide special situations for which ABC yields acceptable or even optimal results. For instance, Banker and Hughes (1994) provide a setting in which ABC supports optimal pricing decisions. The reason for their ABC decision rule to be optimal is that their model is based on a single period of time and soft capacity constraints only. If necessary, resource capacity can be extended to any desired level in the short-run.

An other paper analyzing cost-based heuristics is Hansen and Magee (1993) who find out that the use of sunk capacity costs to evaluate product profitability tends to be justified when the number of possible products is large. Banker and Hansen (2000) show that cost-based heuristics yield a surprisingly good performance when being applied for a situation involving multi-period capacity adjustments with soft capacity constraints. One important reason for this is that due to the soft capacity constraints the overall problem is separable into a sequence of periodic sub-problems.

In contrast, Balakrishnan and Sivaramakrishnan (1996) analyze the consequences of proportionalizing capacity costs when hard capacity constraints apply. Using a simple example with two periods the authors illustrate that proportionalizing capacity costs as it is done in ABC generally results in sub-optimal production decisions. Balachandran et al. (1997) use simulations to analyze the performance of several cost-based heuristics for capacity planning, one of which can be interpreted as ABC. The authors show that the performance of the various cost-based decision rules within their simulation study depends on the extent to which products interact. Schneeweiß (1998) also uses simulations to investigate the quality of ABC as a decision rule and finds out that ABC may lead to a considerable economic loss which increases with the inflexibility of overhead resources.

Like Balachandran, Balakrishnan, Sivaramakrishnan and Schneeweiß the following investigation uses simulations to analyze the extent of the sub-optimality incurred by applying ABC for decision making. The quality of ABC will be compared with the optimal solution to a mixed-integer program which takes precisely into account the dynamic adjustments of capacities. In light of the complexity required to formulate and solve such a model, ABC can be justified as a simple heuristic. Previous research has focused on ABC systems using only a simple set of cost drivers, thereby restricting the potential of ABC. In contrast, the paper analyzes the effects of establishing a cost driver corresponding to a higher cost level. A higher level cost driver does not apply to single cost objects but to the portfolio of cost objects. Hence, such a cost driver is used to allocate those overhead costs for which there are no cause-and-effect relationships with respect to single cost objects. For instance, one can think of the opportunity cost due to excess or idle capacity that cannot be traced to single products but only to the product portfolio as a whole. Another example is given by the firm's suppliers. Here a higher level cost driver might measure the heterogeneity of the suppliers' electronic order systems. If the firm's suppliers differ substantially in there software standards the firm is likely to bear high software costs not traceable to just a single supplier.

More specifically, the investigation focusses on a portfolio-based cost driver that captures the demand heterogeneity triggered by the portfolio as a whole. Typically demand heterogeneity cannot be assigned to single cost objects. This heterogeneity driver is then used to proportionalize all costs due to inflexible overhead resources. Using simulations the performance of this extended decision rule is evaluated in comparison to the benchmark as well as to ABC with simple drivers.

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