



Management Science

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Communication—Caveats Concerning Efficiency/ Effectiveness Measures of Mass Transit Performance

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To cite this article:

John M. Gleason, Darold T. Barnum, (1978) Communication—Caveats Concerning Efficiency/Effectiveness Measures of Mass Transit Performance. *Management Science* 24(16):1777-1778. <https://doi.org/10.1287/mnsc.24.16.1777>

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Caveats Concerning Efficiency/Effectiveness Measures of Mass Transit Performance

In a recent article in *Management Science*, Savas [13] discusses performance measures in the provision of public services, states that it is difficult, but not impossible, to develop measures for efficiency and effectiveness, and discusses some of the measures that have been used in various industries. It should be noted, however, that in some fields the widely used efficiency and effectiveness indicators do not measure what they are intended to, and should be subject to further critical examination.

In his discussion of efficiency, Savas correctly notes that cost per passenger mile, cost per vehicle mile, and passenger trips per employee are among the efficiency measures often used in mass transit. Until recently, there has been no concerted effort devoted to the development of valid and reliable performance measures in mass transit. In the last few years, however, increased emphasis has been devoted to concerns over productivity in the field; even a special conference was devoted to the issue [11]. As a result, many of the previously accepted performance measures, including those noted by Savas, have been the subject of increased scrutiny. Efforts have been devoted to definitional problems and clarification of performance terms such as "efficiency," "effectiveness," and "productivity;" to the development of indicators of these measures [4], [2]; and to means of improving transit performance [7]. Unfortunately, many of the issues in the area of transit performance are still murky [1], [4], [9], [12]. As a result of this confusion, and due to the fact that performance measures may be used for comparative purposes in the future [2], [4], the following comments, offered as an extension of those of Savas, seem appropriate.

Two of the measures noted by Savas, cost per passenger mile and cost per vehicle mile, contain elements beyond the control of the transit system; hence, use of these measures can result in misleading conclusions about a given property's attempts to be efficient. (Furthermore, the cost per passenger mile ratio is seldom used, due to a lack of passenger mile data. This problem of lack of data can be expected to be eliminated with the implementation of the FARE system soon to be required by the Urban Mass Transportation Administration.)

The cost per vehicle mile and cost per passenger mile ratios do not account for differences in speed. Speed differentials, mostly a function of traffic congestion for buses, are not under the control of the vehicle operators, other employees, or management. Nevertheless, these speed differentials are reflected in the measures of cost per vehicle mile and cost per passenger mile. Consider the following data from the motor bus operations of the New York City Transit Authority (NYCTA) and Philadelphia's South Eastern Pennsylvania Transportation Authority (SEPTA) [3]. In New York, the total operating cost per vehicle mile was \$1.6278, almost 40 percent greater than Philadelphia's rate of \$1.1712. These figures suggest that SEPTA is much

more efficient than the NYCTA. However, there is substantially more traffic congestion in New York and buses average only 7.50 miles per hour in that city, compared to 11.04 miles per hour in Philadelphia. These speed differentials, mostly beyond the control of the individual system, can be taken into account by looking at cost per vehicle hour. The only difference between this ratio and the cost per vehicle mile ratio is that the former corrects for speed differences, since

$$(\text{cost/vehicle hour}) = (\text{cost/vehicle mile}) (\text{vehicle miles/vehicle hour}).$$

Thus, cost per vehicle hour in New York is \$12.21, about six percent less than Philadelphia's rate of \$12.93. Since most of transit's costs vary with time rather than distance [2], [4], any measure incorporating vehicle miles is likely to be misleading with respect to the system's controllable efficiency.

Measures which incorporate vehicle hours also include implicit weaknesses, discussions of which are beyond the scope of this note [2]. However, problems inherent in the measures Savas mentioned, and in other ratio measures used in mass transit, are similar to the problems with ratio measures which have been reported in earlier transit studies [2], [4] and in the systems analysis literature [5], [6], [8]. In light of these inherent weaknesses, it is important that performance measures utilized in transit be carefully analyzed, since governmental entities which provide subsidies are searching for "simple" measures of transit performance in order to control costs and allocate subsidy dollars [4], [10]; the use of inappropriate measures could result in less-than-satisfactory allocations. Several analyses of performance measures are in progress. Hopefully, the studies will result, not only in the development of sets of performance measures for transit, but also in a better understanding of valid measures of performance for public services in general.

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