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An Application of the Balanced Scorecard to Public Transit System Performance Assessment

Abstract

Public transit systems, like all public entities, are being subjected to ever-increasing scrutiny due to public concerns over increased taxation as well as budget shortfalls at all levels of government. Public transit firms exist primarily to support a mission composed of three distinct components: efficiency, effectiveness, and impact. This article focuses on adapting the balanced scorecard, originally developed for use in the private sector, for use in the public sector—specifically, for the appraisal of public transit system performance. This article also develops the first comprehensive "shopping list" of transit system performance constructs/goals and their corresponding transit performance measures via a comprehensive analysis of both the transit goal and performance measurement literature.

In an era of increasing concern over taxation and public disillusionment with government, the performance of government entities is being subjected to ever-increasing scrutiny. But how exactly should one assess the performance of government entities? While private firms exist primarily to make money for their shareholders, owners, and employees, public organizations exist primarily to support a particular mission. This mission, while not always clear, always encompasses much more than simply profitability.

This lack of clarity regarding purpose and the resulting conflicting goals may make the use of the balanced scorecard advocated by Kaplan and Norton in their 1992 *Harvard Business Review* article of interest to government entities in general and transit system managers in particular. The balanced scorecard, while originally developed for the use of "for-profit" organizations, can also be modified for use in the public sector.

This article has three primary purposes:

1. To explore the concept of the balanced scorecard advocated by Kaplan and Norton (1992) and its applicability to public transit system performance assessment,
2. To provide a comprehensive list of performance constructs and measures specifically for public transit assessment, and
3. To develop a "shopping list" of performance measures for managers to select from while developing balanced scorecards for public transit systems.

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Introduction to the Balanced Scorecard Approach

Over the past few decades, many different conceptual frameworks and measurement classification schemes have been advocated by various authors to match business activities to strategy. In 1992, Dr. Robert Kaplan of the Harvard Business School and David Norton of Nolan, Norton, & Company (a private consulting firm) developed a performance framework and management philosophy they coined the "balanced scorecard." The balanced scorecard framework has been of considerable interest to managers since that time (see, for example, Liberatore and Miller 1998; Thomas, Gable, and Dickinson 1999; Lipe and Salterio 2000; Brewer and Speh 2000).

As Kaplan and Norton assert in their article, "What you measure is what you get." Recognizing that because of this truism, no single measure could provide an acceptable performance target or adequately focus management's

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attention on critical areas of the business, they developed a "balanced scorecard" composed of a set of measures to give managers a fast but comprehensive view of their business. Specifically, the balanced scorecard allows an organization's managers to look at its business from those perspectives most important for the success of the firm and to establish tangible objectives and measures that relate to the organization's mission, vision, and strategy.

The framework was used exclusively by the private sector until the mid-1990s, when the city of Charlotte, North Carolina became the first public sector entity to use the framework (Syfert, Elliot, and Schumacher 1998). But adoption by the public sector requires some adjustments to the "metrics" of the balanced scorecard.

Originally, Kaplan and Norton (1992) recommended that managers use the following four metrics for private sector organizations:

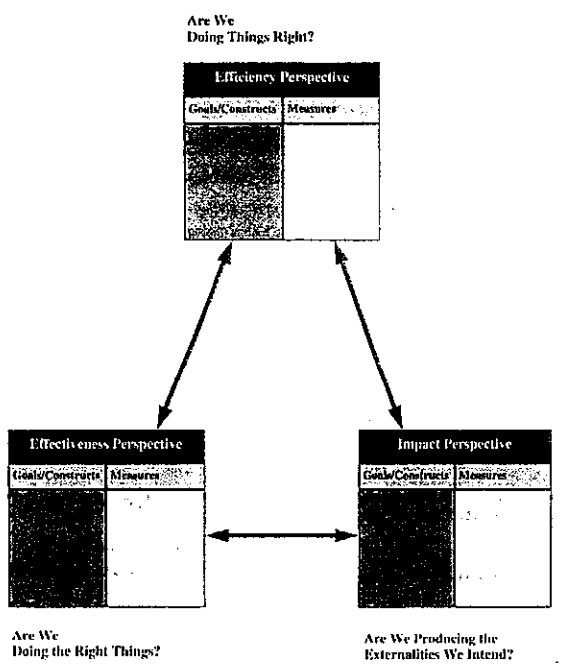
1. The Financial Perspective,
2. The Internal Business Perspective,
3. The Customer Perspective, and
4. The Innovation and Learning Perspective.

But, for public sector organizations, these metrics must be changed because public sector organizations generally only pursue mission effectiveness and efficiency. That is, they want to accomplish their mission as efficiently as possible (Arveson 1998).

Further, in his essay on applying the balanced scorecard to government entities, Arveson (2003) suggests that the metrics of efficiency and effectiveness be used in place of the four original metrics advocated by Kaplan and Norton (1992) for use in the private sector. This, in turn, is entirely consistent with past research on assessing public transit system performance in which these metrics have been settled upon as the proper categories for transit performance measures. However, due to the macro effects of public transit on society, this article also utilizes a third metric, "impact," that is based upon the work of Dajani and Gilbert (1979).

Thus, the metrics used for public transit firms should parallel the categories of performance measurement that have been advocated by transit performance researchers for decades: efficiency, effectiveness, and impact (See Figure 1 for an overview of these perspectives).

Figure 1. The Balanced Scorecard for Public Transit Systems



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The Metrics of Public Transit

"Efficiency" indicates the extent to which the government produces a given output with the least possible use of resources. Efficiency indicators rate the processes by which transit services are produced, particularly through the relationship of inputs to outputs. That is, efficiency is concerned with "doing things right."

"Effectiveness" has been defined as the comparison of produced output (provided service) to intended output or objectives. That is, measures of effectiveness are concerned with the extent to which the service is provided--in terms of quantity, location, and character--and corresponds to the goals and objectives established for the transit system by government and the needs of citizens. Thus, effectiveness is concerned with "doing the right things."

The third category, impact, describes the macro effects of public transit and reflects the efficiency and effectiveness of transit, as well as external and indirect effects on social well-being, economic development, and environmental quality. That is, impact includes externalities and indirect effects both beneficial and adverse, intended and unintended (Dajani and Gilbert 1979).

Rationale for Categorizing Transit Performance Measures

Categorization of transit performance measures has been advocated in the literature because of the fundamental difference between efficiency and effectiveness. For example, one early work on transit performance insisted that measures of efficiency in the use of resources be separated from measures of effectiveness (Tomazinis 1974). Drawing on the work of Tomazinis (1974), further research distinguished between "efficiency" measures and "effectiveness" measures, stating that it is methodologically incorrect to mix these measures conceptually, and inferring that many previous studies have incorrectly mixed the two measures. It determined that this improper mixing of terms confuses the issue of what is being evaluated and concluded that efficiency measures are better able to indicate relative performance between transit systems, while effectiveness measures relate more to the relative performance of one system over time in its own environment (Fielding and Glauthier 1976).

The categorization of performance measures to a third distinct category, impact, allows the effect of public transit on social well-being, economic improvement, and environmental quality to also be assessed (Dajani and Gilbert 1978).

Methodology Used for Categorizing Transit Performance Measures

In order to develop a comprehensive list of constructs that relate to transit performance, two areas of transit performance research were examined in depth.

First, research that advocated "measurement sets" was examined because the act of advocating sets of measures to obtain a comprehensive assessment of transit performance implies that the measurement sets used were comprehensive (at least from the perspective of the author advocating a given set.) Therefore, a comprehensive analysis of the literature on performance measures was undertaken and constructs distilled in one of two ways. If the author of the research explicitly categorized the performance measures advocated or used another researcher's set of categorized performance measures, that categorization was adapted to the present research's comprehensive construct list. If, however, the author of the research simply presented a list of performance measures with definitions but did not categorize them (or categorized them in general terms such as efficiency or effectiveness), the measures were categorized by this author using the more elaborate categorizations as a guide. Then, after eliminating duplicate constructs, a list of constructs based on the performance measurement research to date was created.

In addition, the literature on transit goals and objectives was examined and a set of constructs distilled. This set of constructs was then compared with the construct set developed from the performance measurement research and duplicate constructs were eliminated. In the following sections, the constructs advocated by the transit performance measurement literature and transit goal and objective literature are examined. Together, these sections represent a comprehensive list of constructs that relate to transit performance as developed from a

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review of the literature in business, transportation, political science, and other social sciences.

As the constructs of transit performance have not, to date, been explicitly investigated in literature, the constructs were developed by inference from the measures, goals, and objectives of public transit which are discussed in the literature. Given the cursory examination these constructs have received in the past when compared to the detailed study of their measurement, the literature provides only a brief discussion for each construct. In order to help managers create balanced scorecards, applicable performance measures are provided for each construct derived from the performance measurement literature. However, if a construct was recommended solely by the transit goal and objective research or is based on a single piece of transit performance measurement research, only the applicable citations are provided.

It should also be noted that the constructs were assigned to the three categories of performance measurement (i.e., efficiency, effectiveness, and impact) on the basis of the literature to date. After all of the constructs were categorized, the assignment of performance measures to each construct was made on the basis of the recommendations contained in the literature. As a result, some performance measures may appear in more than one category of performance measurement due to the recommendations of past researchers.

Constructs of the Definition of Public Transit Performance: Efficiency

The constructs of efficiency can be divided into input constructs and output constructs. For a "shopping list" of relevant performance measures relating to the following efficiency goals/constructs, see Table 1.

Input constructs of efficiency refer to the ability of transit systems to use their resources, or factors of production, for transit service. The factors of production for transit service include labor, equipment, capital, and energy.

Labor Efficiency: Because labor costs represent such a large proportion of transit system costs, the efficient use of labor in supplying transit service is a critical component of the performance of any transit system. In fact, labor-related expenses have been estimated to account for over 80 percent of public transit operating costs (Sale and Green 1979). "Labor efficiency" (also termed "labor productivity" or "labor utilization") refers to the efficient use of the labor factor of transit production.

Vehicle Efficiency: Vehicle efficiency (also termed in the literature as "vehicle utilization" or "vehicle productivity") is important because of the sizable, and usually public, investment required to purchase public transit vehicles. As a result, the effective use of such equipment is of concern (Anderson and Fielding 1982).

Capital Efficiency: Developed from transit performance measures (also termed "revenue generation per expense" or "self-sufficiency"), this construct is assessed via two sub-constructs: profit maximization/loss minimization and self-sufficiency.

- Profit Maximization / Loss Minimization: This construct assesses the desire of the transit system to operate like a private firm. That is, it represents the aspect of performance that desires to maximize profit or, given that transit firms generally run a deficit, to minimize the deficit or loss. Therefore, because both transit profit maximization and transit loss minimization are determined by dividing revenues by cost, a transit system can achieve this construct in several ways. All things being constant, a transit system that values this construct can maximize its attainment of it by either maximizing profit or minimizing cost.
- Self-Sufficiency: This construct is similar to the profit maximization/loss minimization construct because it also measures a transit system's similarity to a private business concern. However, self-sufficiency also encompasses revenue not generated as a result of the farebox. Specifically, self-sufficiency assesses the public's willingness to pay for a particular operator's provided service both directly in terms of fares paid and indirectly in terms of non-mandated (voluntary) local governmental contributions (Keck and Schneider 1979).

Energy/Fuel Efficiency: The cost of fuel or its equivalent for transit vehicles is a major cost component of public transit systems. Obviously, transit systems desire to maximize the fuel efficiency of their fleets. Although fuel costs are a significant cost component in the provision of public transit, this construct was

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advocated in a number of studies of transit performance measurement and goals as a direct result of the oil embargoes of the mid 1970s.

Maintenance Efficiency: Maintenance efficiency refers to how efficiently the transit system maintains its vehicles with regard to cost. For example, total maintenance efficiency would be higher, all things being equal, if vehicle breakdowns while in service where minimized. A breakdown in the field would cause a transit system to bear both additional monetary costs (due to, for example, towing or moving personnel and equipment to the location of the breakdown) as well as customer satisfaction costs (due to delays, etc.). As a result, proper maintenance of the fleet while minimizing maintenance costs is a key component of transit system performance.

Public Transit Efficiency: Output Constructs: Output constructs of efficiency refer to the ability of transit systems to maximize their output given their resources, or factors of production, for transit service. Public transit is not constrained and influenced by the same forces that govern private enterprise. Due to transit's ability to make use of government subsidy to cover some of its losses, the service it provides may or may not reflect the desires and needs of society. That is, the distinction between quantity and quality is important because more (or less) transit does not necessarily imply better (or worse) transit. Allen and DiCesare (1976), in their early work on transit service evaluation, felt that this distinction was important enough to advocate the categorization of the level of transit service into the following three groups:

1. Quantity of service (the supply or how much transit service exists),
2. Quality of service (how good is the service?), and
3. Cost/revenue (to deal with economic factors that must be evaluated separately).

While cost/revenue is a component of the capital efficiency constructs, quantity and quality of service are addressed with the constructs of maximization of produced output per dollar of cost and maximization of consumed output per dollar of cost (respectively).

As a result, it is necessary to examine the efficiency of transit in producing output as well as its efficiency in having its output consumed. To assess the importance of produced versus consumed output, two additional constructs of efficiency are used: (1) maximization of produced output per dollar of cost and (2) maximization of consumed output per dollar of cost. It should be noted that these constructs are interrelated because the act of producing transit output in no way assures that that output is desired and will be consumed. Thus, the cost per consumed output will always be greater than or equal to the cost per produced output (and sometimes substantially greater).

- Maximization of Produced Output per Dollar of Cost: A major goal of public transit providers is to maximize the amount of service provided to society (often measured in terms of vehicle hours or vehicle miles provided). This construct simply assesses the desire of a given stakeholder to maximize the amount of service provided by the transit system. It does not assess whether or not that output is desired by society.
- Maximization of Consumed Output per Dollar of Cost: Transit systems, in order to be truly efficient, must provide transit service that is desired by society. This construct (also termed in the literature as "service consumption per expense," "consumed output per dollar of cost," "passenger unit cost," or "mobility impacts") represents the cost and deficit associated with carrying one passenger a given distance.

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Table 1. Efficiency Perspective

Goals / Constructs	Measure	Source
Labor Efficiency	Annual Bus Miles per Operator	Allen & Zapalac (1982)
	Annual Passengers per Employee	Miller (1980)
	Annual Vehicle-Hours per Annual Employee-Hour	Miller (1980)
	Annual Vehicle-Hours per Employee	Miller (1980)
	Capacity Hours of Rev Service per Employee Hour	Keck, Zerrillo, & Schneider (1980)
	Capacity Miles of Rev Service per Employee Hour	Keck, Zerrillo, & Schneider (1980)
	Passenger Miles per Employee Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Passengers per Driver Pay Hour	Bhandari & Sinha (1979)
	Passengers per Employee Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980), Miller (1980)
	Peak Vehicles per Exec, Prof, & Super Employee	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Peak Vehicles per Main, Support, & Serv Personnel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Peak Vehicles per Operating Employee	Fielding, Babitsky, & Brenner (1985)
	Peak Vehicles per Operating Personnel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Capacity Hours per Employee Hour	Zerrillo, Keck, & Schneider (1981)
	Rev Capacity Miles per Employee Hour	Zerrillo, Keck, & Schneider (1981)
	Rev Passengers per Employee Hour	Zerrillo, Keck, & Schneider (1981)
	Rev Passenger-Miles per Employee Hour	Zerrillo, Keck, & Schneider (1981)
	Rev Vehicle Hours per Employee	Fielding, Glauthier, & Lave (1978), Fielding, et.al. (1978), Giuliano (1981)
	Rev Vehicle Hours per Operating Employee	de la Rocha, Brenner, & Fielding (1984)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Labor Efficiency (cont.)	Rev Vehicle Hours per Operating Employee Hour	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Vehicle Miles per Employee	Fielding, Glauthier, & Lave (1978)
	Total Vehicle Hours per Employee	Anderson (1980)
	Total Veh Hours per Total Employees	de la Rocha, Brenner, & Fielding (1984), Fielding, Brenner, & Faust (1985)
	Total Vehicle Miles per Employee	Anderson (1980), Fielding, Glauthier, & Lave (1978)
	Transit Property Employees per Passenger	Brosdal (1977)
	Vehicle Hours of Rev Service per Employee Hour	Keck & Schneider (1979)
	Vehicle-Hours per Driver	Sinha & Dobry (1978a)
	Vehicle-Hours per Driver-Hour	Sinha & Dobry (1978a)
	Vehicle Hours per Employee	Anderson & Fielding (1982), Fielding (1992), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984), Kern & Weiss (1983), Sinha & Jukins (1978b)
	Vehicle-Miles per Driver-Hour	Sinha & Dobry (1978a)
	Vehicle Miles per Driver Pay Hour	Bhandari & Sinha (1979)
	Vehicle Miles per Employee	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984), Sinha & Jukins (1978b)
	Vehicle Miles per Employee-Hour	Sinha & Jukins (1978b)
	Vehicle Miles of Rev Service per Employee Hour	Keck & Schneider (1979)
	Vehicle Service Hours per Employee	Fielding (1992)
Vehicle Efficiency	% Vehicles Operating at Peak	Sinha & Jukins (1978b)
	Annual Passengers Per Vehicle	Bhandari & Sinha (1979)
	Annual Vehicle Hours of Service Per Rev Vehicle	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1979)
	Annual Vehicle Miles of Service Per Vehicle	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1979)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Vehicle Efficiency (cont.)	Annual Vehicle Miles Per Vehicle	Bhandari & Sinha (1979), Guenthner & Sinha (1981), Miller (1980)
	Annual Vehicle Hours Per Vehicle	Miller (1980)
	Revenue Capacity Miles Per Vehicle Mile	Anderson & Fielding (1982)
	Revenue Vehicle Hours Per Maximum Vehicle Hours	Giuliano (1981)
	Revenue Vehicle Hours Per Vehicle	Fielding, Glauthier, & Lave (1978), Fielding, et.al. (1978), Zerrillo, Keck, & Schneider (1981)
	Revenue Vehicle Miles Per Vehicle	Fielding, Glauthier, & Lave (1978), Zerrillo, Keck, & Schneider (1981)
	Revenue Vehicle Miles Per Vehicle Miles	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Seat-Miles Per Vehicle	Sinha & Jukins (1978b)
	System-Wide Revenue Hours Per Vehicle	Drosdat (1977)
	System-Wide Revenue Miles Per Vehicle Mile	Drosdat (1977)
	Total Vehicle Hours Per Bus	Anderson (1980)
	Total Vehicle Hours Per Peak Vehicle	Anderson (1980)
	Total Vehicle Miles Per Bus	Anderson & Fielding (1982), de la Rocha, Brenner, & Fielding (1984), Fielding, Babitsky, & Brenner (1983), Fielding, Brenner, & Faust (1985)
	Total Vehicle Miles Per Vehicle	Fielding, Glauthier, & Lave (1978)
	Vehicle Hours Per Active Vehicle	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Vehicle Efficiency (cont.)	Vehicle Hours Per Peak Vehicle Requirement	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Vehicle Hours Per Vehicle	Sinha & Jukins (1978b)
	Vehicle Miles Per Active Vehicle	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Vehicle Miles Per Peak Vehicle	Fielding, Babitsky, & Brenner (1985)
	Vehicle Miles Per Peak Vehicle Requirement	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Vehicle Miles Per Vehicle	Kern & Weiss (1983), Sinha & Jukins (1978b)
	Vehicle-km Per Vehicle	Koushki (1984)
Profit Maximization / Loss Minimization	Average Cost Per Vehicle Hour	OECD (1980)
	Average Daily Operating Cost Per Passenger Trip	Koushki (1984)
	Average Daily Operating Cost Per Vehicle	Koushki (1984)
	Average Operation Cost Per Passenger Trip	Koushki, Yaseen, & Ali (1999)
	Average Operation Cost Per Revenue Vehicle-km	Koushki, Yaseen, & Ali (1999)
	Cost Per Trip	Winnie & Hatry (1973)
	Operating Cost Per Capacity Hour of Service	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Operating Cost Per Capacity Mile of Service	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Operating Cost Per Hour	Miller (1980)
	Operating Cost Per Mile	Kern & Weiss (1983), Kosdrosky & Ankeny (2001)
	Operating Cost Per Passenger	Fielding (1992)
	Operating Cost Per Revenue Vehicle Service Hour	Fielding (1992)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Profit Maximization / Loss Minimization (cont.)	Operating Cost Per Vehicle Service Hour	Fielding (1992)
	Operating Costs and Capital Investment vs. Budget	OECD (1980)
	Operating Expense Per Vehicle Mile	Allen & Zapalac (1982)
	Operating Revenue Per Operating Cost	Fielding (1992), Fielding, Brenner, & Faust (1985), Zerrillo, Keck, & Schneider (1981)
	Operating Revenue Per Operating Expense	Allen & Zapalac (1982), de la Rocha, Brenner, & Fielding (1984), Drosdat (1977), Kern & Weiss (1983)
	Operating Revenue Per Operating Subsidy	de la Rocha, Brenner, & Fielding (1984)
	Operator Cost Per Passenger	Bhandari & Sinha (1979)
	Operator Cost Per Passenger Mile	Bhandari & Sinha (1979)
	Operator Cost Per Vehicle Hour	Bhandari & Sinha (1979), Guenthner & Sinha (1981)
	Operator Cost Per Vehicle Mile	Bhandari & Sinha (1979), Guenthner & Sinha (1981)
	Output Per $ Cost	Fielding, Brenner. & Faust (1985)
	Passenger Revenue Per Operating Expense	Anderson & Fielding (1982)
	Ratio Operating Revenue to Operating Expense	Allen & Zapalac (1982), Anderson & Fielding (1982), Fielding (1992), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984), Guenthner & Sinha (1981), Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980), Koushki (1984), Miller (1980)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Profit Maximization / Loss Minimization (cont.)	Ratio Total Revenue To Total Expense	Anderson & Fielding (1982), Fielding (1992), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Veh Hours Per Operation Labor & Fringe Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Veh Hours Per Veh Maint Labor & Fringe Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Vehicle Hours Per Admin Labor & Fringe Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Rev Vehicle Hours Per Total Labor & Fringe Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Revenue Vehicle Hours Per Dollar Operating Expense	Anderson & Fielding (1982), Fielding (1992), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Revenue Vehicle Hours Per Operating Expense	de la Rocha, Brenner, & Fielding (1984)
	Revenue per Driver per Day	Koushki, Yaseen, & Ali (1999)
	Revenue per Revenue Vehicle km	Koushki, Yaseen, & Ali (1999)
	Revenue Vehicles Per km	Koushki (1984)
	Revenue/Cost Ratio	Koushki (1984), OECD (1980)
	Revenue/Operation Cost Ratio	Koushki, Yaseen, & Ali (1999)
	Running Cost (Fuel, Oil, Tires) / Vehicle Hour Cost	OECD (1980)
	Running Cost (Fuel, Oil, Tires) / Vehicle km Cost	OECD (1980)
	Total Cost Per Passenger	Bhandari & Sinha (1979)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Profit Maximization / Loss Minimization (cont.)	Total Cost Per Passenger Mile	Bhandari & Sinha (1979)
	Total Cost Per Vehicle Hour	Bhandari & Sinha (1979), Guenthner & Sinha (1981)
	Total Cost Per Vehicle Mile	Bhandari & Sinha (1979), Guenthner & Sinha (1981)
	Total Vehicle Hours Per Dollar Operating Expense	Anderson (1980)
	Total Vehicle Miles Per Operating Expense	de la Rocha, Brenner, & Fielding (1984)
	Unit Costs Per Vehicle	OECD (1980)
	Unit Costs Per Vehicle Hour	OECD (1980)
	Unit Costs Per Vehicle km	OECD (1980)
	Vehicle Miles Per Operating Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
Self-Sufficiency	Operating Rev & Excess Local Assist Per Pass Mile	Zerrillo, Keck, & Schneider (1981)
	Operating Rev Plus Excess Local Assist Per Pass Mile	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1979)
	Operating Revenue Per Operating Cost	Fielding (1992), Fielding, Brenner, & Faust (1985), Zerrillo, Keck, & Schneider (1981)
	Operating Revenue Per Operating Expense	Allen & Zapalac (1982), de la Rocha, Brenner, & Fielding (1984), Drosdat (1977), Kern & Weiss (1983)
	Operating Revenue Per Operating Subsidy	de la Rocha, Brenner, & Fielding (1984)
	Operating Revenue To Operating Expense	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1979)
	Pass Rev Per Total Operating & Capital Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding et.al. (1984)
	Pass Rev Per Total Operating Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Self-Sufficiency (cont.)	Passengers Per Local Operating Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Passengers Per Total Operating & Capital Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Passengers Per Total Operating Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Rev Veh Hours Per Local Capital & Oper Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Rev Veh Hours Per State Capital & Oper Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Rev Veh Hours Per Total Capital & Oper Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Rev Veh Hours Per Total Oper Assistance	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding,et.al. (1984)
	Revenue To Subsidy	Kern & Weiss (1983)
	Subsidy Per Passenger	Fielding (1992)
	Urban Area Pop Per Total Capital & Operating Assist	Anderson & Fielding (1982)
	Urban Area Population Per Total Operating Assistance	Anderson & Fielding (1982)
Energy / Fuel Efficiency	Energy Consumption Per Revenue Vehicle Hour	Fielding, Glauthier, & Lave (1978)
	Energy Consumption Per Revenue Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Energy Consumption Per Total Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Fuel Cost ($) Per Vehicle-Mile	Koushki (1984)
	Fuel Cost (SR) Per Vehicle-km	Koushki (1984), Koushki, Yaseen, & Ali (1999)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Energy / Fuel Efficiency (cont.)	Gallons of Fuel Consumed Per Mile	Koushki (1984)
	Gallons of Fuel Per Passenger	Drosdat (1977)
	Litres of Fuel Consumed Per km	Koushki (1984), Koushki, Yaseen, & Ali (1999)
	Passenger-km Per Litre	Koushki (1984), Koushki, Yaseen, & Ali (1999)
	Passenger-Miles Per Gallon	Koushki (1984)
	Revenue Vehicle Miles Per Gallon Diesel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Total Vehicle Miles Per Gallons of Fuel Consumed	Anderson & Fielding (1982)
	Vehicle Capacity Miles (Bus) Per Gallon Diesel	Anderson & Fielding (1982)
	Vehicle Miles (Bus) Per Gallon Diesel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
Maintenance Efficiency	1,000,000 Vehicle Miles Per Roadcall	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1985), Fielding, et.al. (1984)
	Annual Bus Miles Per Roadcall	Allen & Zapalac (1982)
	Lost Vehicle-Miles Per Breakdown	Sinha & Jukins (1978b)
	Maintenance Cost Per Maintenance Man-Hours	Sinha & Jukins (1978b)
	Maintenance Cost Per Passenger-Mile	Sinha & Jukins (1978b)
	Maintenance Cost Per Seat Mile	Sinha & Jukins (1978b)
	Maintenance Cost Per Vehicle	Sinha & Jukins (1978b)
	Maintenance Cost Per Vehicle-Mile	Sinha & Jukins (1978b)
	Mean Time To Repair Per Breakdown	Sinha & Jukins (1978b)
	Number of Peak Vehicles Per Maintenance Employee	de la Rocha, Brenner, & Fielding (1984)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Maintenance Efficiency (cont.)	Total Vehicle Miles Per Maintenance Employee	Anderson & Fielding (1982), de la Rocha, Brenner, & Fielding (1984), Fielding, Babitsky, & Brenner (1983), Fielding, Brenner, & Faust (1985)
	Total Vehicle Miles Per Maintenance Expense	Fielding, Babitsky, & Brenner (1985)
	Total Vehicles Per Maintenance Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Vehicle Miles Per Dollar Maintenance Expense	Fielding (1992)
	Vehicle Miles Per Maintenance Employee	Anderson & Fielding (1982), Fielding (1992), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
Maximization of Produced Output Per Dollar of Cost	Cost Per Unit Revenue	Sinha & Jukins (1978b)
	Labor Cost Per Seat-Mile	Sinha & Jukins (1978b)
	Labor Cost Per Vehicle Mile	Sinha & Jukins (1978b)
	Managerial Cost Per Seat-Mile	Sinha & Jukins (1978b)
	Managerial Cost Per Vehicle Mile	Sinha & Jukins (1978b)
	Operating Cost Per Revenue-Hour	Sinha & Jukins (1978b)
	Operating Cost Per Seat-Mile	Sinha & Jukins (1978b)
	Operating Cost Per Vehicle	Sinha & Jukins (1978b)
	Operating Cost Per Vehicle-Hour	Sinha & Jukins (1978b)
	Operating Cost Per Vehicle-Mile	Sinha & Jukins (1978b)
	Operating Expense Per Revenue Vehicle Hour	Fielding, Glauthier, & Lave (1978), Giuliano (1981)
	Operating Expense Per Revenue Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Operating Expense Per Seat Mile	Fielding, Glauthier, & Lave (1978)
	Operating Expense Per Total Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Revenue Per Man-Hour	Sinha & Jukins (1978b)
	Revenue per Seat-km	Koushki, Yaseen. & Ali (1999)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Maximization of Produced Output Per Dollar of Cost (cont.)	Revenue Per Unit Cost	Sinha & Jukins (1978b)
	Revenue Per Vehicle	Sinha & Jukins (1978b)
	Revenue Per Vehicle-Hour	Sinha & Jukins (1978b)
	Revenue Per Vehicle-km	Koushki, Yaseen, & Ali (1999)
	Revenue Per Vehicle-Mile	Sinha & Jukins (1978b)
	Seat Miles of Service / Annual Operating Expense	Anderson (1980)
	Total Annual Veh Miles Per $ of Annual Op Expense	Anderson (1980)
	Total Annual Veh Miles To Total Annual Wages	Anderson (1980)
	Total Annual Veh Miles To Total Annual Wages	Anderson (1980)
	Total Vehicle Hours Per Dollar of Operating Expense	Anderson (1980)
Maximization of Consumed Output Per Dollar of Cost	Annual Rev Passengers Per Annual Operating Expense	Anderson (1980)
	Annual Revenue Passengers Per Annual Vehicle Mile	Anderson (1980)
	Cost Per Dollar of User Benefit	Miller & Kirby (1984)
	Cost Per Passenger	Kern & Weiss (1983)
	Cost Per Passenger Trip	Miller & Kirby (1984)
	Cost Per Passenger Trip Mile	Miller & Kirby (1984)
	Deficit Per Passenger	Guenthner & Sinha (1981)
	Deficit Per Revenue Passenger Mile	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Labor Cost Per Passenger	Sinha & Jukins (1978b)
	Managerial Cost Per Passenger	Sinha & Jukins (1978b)
	Managerial Cost Per Passenger-Mile	Sinha & Jukins (1978b)
	Net Deficit Per Revenue Passenger	Allen & Zapalac (1982)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Maximization of Consumed Output Per Dollar of Cost (cont.)	Operating Cost Per Passenger	Sinha & Jukins (1978b)
	Operating Cost Per Passenger Mile	Sinha & Jukins (1978b)
	Operating Cost Per Revenue Passenger Mile	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Operating Expense Per Passenger Mile	Fielding, Glauthier, & Lave (1978)
	Operating Expense Per Revenue Passenger	Fielding, Glauthier, & Lave (1978)
	Operating Expense Per Total Passengers	Fielding, Glauthier, & Lave (1978)
	Operator Cost Per Passenger	Guenthner & Sinha (1981)
	Operator Cost Per Passenger Mile	Guenthner & Sinha (1981)
	Passenger Miles Per Operating Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passenger Miles Per Total Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passengers Per Dollar of Operating Expense	Guenthner & Sinha (1981)
	Passengers Per Gallon Diesel Fuel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passengers Per Operating Expense	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passengers Per Total Labor & Fringe Benefits	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Revenue Passengers Per Dollar Operating Expense	Anderson (1980)
	Revenue Passengers Per Dollar Operating Expense	Anderson (1980)
	Revenue Per Passenger	Sinha & Jukins (1978b)

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Table 1. Efficiency Perspective (cont.)

Goals / Constructs	Measure	Source
Maximization of Consumed Output Per Dollar of Cost (cont.)	Revenue per Passenger-km	Koushki, Yaseen, & Ali (1999)
	Revenue Per Passenger-Mile	Sinha & Jukins (1978b)
	Total Annual Passengers / Annual Operating Expense	Anderson (1980)
	Total Annual Passengers / Annual Seat Miles	Anderson (1980)
	Total Annual Passengers / Annual Wages Paid	Anderson (1980)
	Total Annual Passengers / Employee	Anderson (1980)
	Total Annual Passengers / Size of Bus Fleet	Anderson (1980)
	Total Annual Passengers / Total Vehicle Hours	Anderson (1980)
	Total Cost Per Passenger	Guenthner & Sinha (1981)

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Constructs of the Definition of Public Transit Performance: Effectiveness

"Effectiveness" has been defined as the comparison of produced output (provided service) to intended output or objectives. That is, constructs of effectiveness are concerned with the extent to which the service provided--in terms of quantity, location, and character--corresponds to the goals and objectives established for it by government and the needs of citizens. That is, effectiveness is concerned with "doing the right things." For a "shopping list" of relevant performance measures relating to the following effectiveness goals/constructs, see Table 2.

Utilization of Service: Utilization of service (also referred to in the literature as "service utilization" and "usage levels") refers to how many passengers actually use the transit service. A principal objective of public transit is to move people, and the level of success of a system in accomplishing this should be considered in any measure of performance (Keck and Schneider 1979).

Security: The safety of passengers from crime incidents on transit vehicles and in transit facilities affects public mobility. The apprehension of the public with regard to using public transit may result in the selection of alternate modes of travel. Winnie and Hatry (1973) advocate the collection of statistics (especially at the neighborhood level) on the number of reported robberies and physical attacks on transit users and personnel at bus stops, transit stations, or in transit. In order to measure this performance construct, they advocate a single measure: number of crime incidents related to transportation.

Accessibility: Accessibility refers to "the ability of persons to reach important community destinations such as work, shopping or recreational opportunities from their place of residence with reasonable expenditures of time and effort" (Winnie and Hatry 1973, 17). This construct is "macro" in that it is concerned with the accessibility and convenience of all users and potential users of a particular transit system. As transportation for the transit-dependent is a social goal of transit, the provision of transit for the transit-dependent is assessed via the construct entitled "Accessibility of the Transit-Dependent (elderly, disabled, low income, etc.)."

Operating Safety: Physical injury to users and non-users of the transportation system and property damage are important community concerns (Winnie and Hatry 1973). As a result, the assessment of a transit system's safety record is important.

Passenger Convenience: This construct can be defined as either "the effort required in traveling to desired destinations" (Winnie and Hatry 1973, 22) or how easily transit patrons can use a particular transit system. This construct is closely related to the following transit performance constructs: accessibility, frequency of service, reliability of service, speed of service, and service quality. Specifically, it involves factors such as proximity of transit stops to home or destinations, frequency of transit service, number of transfers required to reach destinations, transit information availability and understandability, and availability of parking. Winnie and Hatry (1973) advocate "citizen perception of travel convenience" as the relevant performance measure for this construct (see also Altshuler 1979).

Frequency of Service: This construct refers to how often transit service is available to patrons (e.g., "a bus comes by every fifteen minutes"). Obviously, the frequency with which transit riders can use a given transit system affects their appraisal of that transit system's performance (i.e., the more often service is available, the better the transit user's experience). This construct is closely related to the passenger convenience construct advocated by Winnie and Hatry (1973) and could be assessed by the "frequency of performance" measure advocated by Anderson and Fielding (1982).

Reliability of Service: This construct refers to the ability of a transit system to provide service to its patrons as promised.

Speed of Service: The length of time required to travel between two points is argued by Winnie and Hatry (1973) as being one of the most important tests of a transportation system's effectiveness. Potential measures of this construct include "operating speed" (Allen and Zapalac 1982) or "time required to travel between major origin and destination

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points" (Winnie and Hatry 1973) (see also Altshuler 1979).

Service Quality: This construct refers to how well transit service is provided and includes factors (Miller 1980) such as transfer opportunities per route mile, vehicle cleanliness and condition, driver performance, and headway.

Passenger Comfort: This construct is composed of those elements of the transit experience that affect choice of mode and frequency of travel. Winnie and Hatry (1973) state that the following are some of the factors relevant to transit passenger comfort:

1. Crowdedness of the vehicle (and privacy),
2. Noise level within the vehicle,
3. Temperature and odors within the vehicle,
4. Jerkiness of the ride (including the frequency of stops and starts),
5. Forced exposure to inclement weather, and
6. Internal cleanliness of vehicles.

Accordingly, they advocate assessing passenger comfort through the measurement of an "index to road surface quality" and "citizen perception of travel comfort" (see also Altshuler 1979).

General Public Satisfaction: This construct refers to the satisfaction of the public (both transit users and non-users) with regard to the transit service provided in a given area. The literature advocates collection of data about general public satisfaction with public transit through the use of surveys. Accordingly, one potential measure of this construct is "citizen perception of overall adequacy of transportation services" (Winnie and Hatry 1973).

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Table 2. Effective Perspective

Goals / Constructs	Measure	Source
Utilization of Service	Load Factor	Allen & Zapalac (1982)
	Passenger Miles Per Employee Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Passenger Miles Per Passenger	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passenger Miles Per Vehicle Capacity Mile	Anderson & Fielding (1982)
	Passenger Miles Per Vehicle Mile	Sinha & Jukins (1978b)
	Passenger Trips Per Passenger	Fielding, Babitsky, & Brenner (1983)
	Passenger Trips Per Peak Vehicle	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passenger Trips Per Population Served	Sinha & Jukins (1978b)
	Passenger Trips Per Revenue Vehicle Hour	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), 9, Fielding, et.al. (1984)
	Passenger Trips Per Revenue Vehicle Mile	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Passenger Trips Per Route Mile	Sinha & Jukins (1978b)
	Passenger Trips Per Seat Mile	Sinha & Jukins (1978b)
	Passenger Trips Per Unit Service Area	Sinha & Jukins (1978b)
	Passenger Trips Per Vehicle	Sinha & Jukins (1978b)
	Passenger Trips Per Vehicle Hour	Sinha & Jukins (1978b)
	Passenger Trips Per Vehicle Mile	Sinha & Jukins (1978b)
	Passengers Per Employee Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Passengers Per Mile	Kern & Weiss (1983)
	Passengers Per Service Area Population	Miller (1980)

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Table 2. Effective Perspective (cont.)

Goals / Constructs	Measure	Source
Utilization of Service (cont.)	Passengers Per Vehicle	Drosdat (1977)
	Passengers Per Vehicle Hour	Miller (1980)
	Passengers Per Vehicle Service Hour	Fielding (1992)
	Revenue Passenger Miles Per Capacity Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Revenue Passenger Miles Per Revenue Capacity Mile	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980), Zerrillo, Keck, & Schneider (1981)
	Revenue Passenger Miles Per Revenue Capacity Hour	Zerrillo, Keck, & Schneider (1981)
	Revenue Passengers Per Capacity Hour	Keck & Schneider (1979), Keck, Zerrillo, & Schneider (1980)
	Revenue Passengers Per Revenue Capacity Hour	Zerrillo, Keck, & Schneider (1981)
	Revenue Passengers Per Revenue Vehicle Hour	Fielding, Glauthier, & Lave (1978)
	Revenue Passengers Per Revenue Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Revenue Passengers Per Service Area Population	Fielding, Glauthier, & Lave (1978), Fielding, et.al. (1978)
	Revenue Passengers Per Vehicle Hour	Fielding, et.al. (1978)
	Revenue Per Vehicle Hour	Miller (1980)
	Total Annual Passengers / Autoless Pop of Service Area	Anderson (1980)
	Total Annual Passengers / Elderly Pop of Service Area	Anderson (1980)
	Total Annual Passengers / Service Area Population	Anderson (1980)
	Total Passengers Per Revenue Vehicle Hour	Fielding, Babitsky, & Brenner (1983)
	Total Passengers Per Revenue Vehicle Mile	Fielding, Babitsky, & Brenner (1983)
	Total Passengers Per Service Area Population Served	Anderson (1980)
	Total Passengers Per Vehicle	Fielding, Glauthier, & Lave (1978), Fielding, et.al. (1978)
	Total Ridership Per Vehicle Hour	Miller (1980)

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Table 2. Effective Perspective (cont.)

Goals / Constructs	Measure	Source
Utilization of Service (cont.)	Unlinked Passenger Trips Per Revenue Vehicle Hour	Fielding, Babitsky, & Brenner (1985), Fielding, Brenner, & Faust (1985)
	Utilized Capacity Per Available Capacity	Sinha & Jukins (1978b)
Security	Number of Crime Incidents Related to Transportation	Winnie & Hatry (1973)
Accessibility	% of Residents More Than 1 Hr From Key Destinations	Winnie & Hatry (1973)
	% of Residents Not Within "X" Min of Pub Transit Service	Winnie & Hatry (1973)
	Percent Employment Served	Miller (1980), Sinha & Jukins (1978b)
	Percent of Population Served	Fielding, Glauthier, & Lave (1978)
	Percent Population Served	Fielding, Glauthier, & Lave (1978), Fielding, et.al. (1978), Miller (1980), Sinha & Jukins (1978b)
	Percent Transit Dependent Served	Miller (1980)
Operating Safety	1,000,000 Vehicle Miles Per Accident	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Accidents/Incidents Per x,000 Vehicle-km Cat By Type	OECD (1980)
	Number of Accidents Per Vehicle Mile	Sinha & Jukins (1978b)
	Number of Injuries Per Vehicle Mile	Sinha & Jukins (1978b)
	Rate of Transit-Related Accidents	Winnie & Hatry (1973)
	Revenue Vehicle Hours Per Accident	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Revenue Vehicle Hours Per Accident	de la Rocha, Brenner, & Fielding (1984)
	Total Revenue Miles Per Accident	de la Rocha, Brenner, & Fielding (1984), Fielding, Brenner, & Faust (1985)
	Vehicle Miles Per Accident	Fielding, Babitsky, & Brenner (1985)

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Table 2. Effective Perspective (cont.)

Goals / Constructs	Measure	Source
Operating Safety (cont.)	Vehicle Miles Per Collision Accident	Fielding (1992)
Passenger Convenience	Citizen Perception of Travel Convenience	Winnie & Hatry (1973)
Frequency of Service	Frequency of Performance	Winnie & Hatry (1973)
Reliability of Service	Deviation From Schedule / Ave. Passenger Waiting Time	OECD (1980)
	Letters of Complaint	OECD (1980)
	Lost Vehicle kms	OECD (1980)
	On-Time Performance	Allen & Zapalac (1982)
	Proportion of Veh Beg. Duty More Than x Min Late	OECD (1980)
Speed of Service	Operating Speed	Allen & Zapalac (1982)
	Time Required to Travel Between Major Origin & Destination Points	Winnie & Hatry (1973)
Service Quality	% On-Time Arrivals	Sinha & Jukins (1978b)
	% Transfers	Sinha & Jukins (1978b)
	Average Bus Age	Allen & Zapalac (1982), Kosdrosky & Ankeny (2001)
	Base Period Vehicle Oper Per Capita	Sinha & Jukins (1978b)
	Base Period Vehicle Oper Per Route-Mile	Sinha & Jukins (1978b)
	Base Period Vehicle Oper Per Vehicle-Hour	Sinha & Jukins (1978b)
	Base Period Vehicles Oper Per Unit Service Area	Sinha & Jukins (1978b)
	Load Factor	Allen & Zapalac (1982)
	Number of Vehicles Per Route-Mile	Sinha & Jukins (1978b)
	Percent Trips Missed	Miller (1980)
	Seat-Hours Per Capita	Miller (1980)
	Seat-Miles Per Capita	Sinha & Jukins (1978b)
	Seat-Miles Per Route-Mile	Sinha & Jukins (1978b)

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Table 2. Effective Perspective (cont.)

Goals / Constructs	Measure	Source
Service Quality (cont.)	Speed	Allen & Zapalac (1982)
Passenger Comfort	Index to Road Surface Quality	Winnie & Hatry (1973)
	Citizen Perception of Travel Comfort	Winnie & Hatry (1973)
General Public Satisfaction	Citizen Perception of Overall Adequacy of Transportation Services	Winnie & Hatry (1973)

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Constructs of the Definition of Public Transit Performance: Impact

Impact constructs describe the macro effects of public transit and reflect the efficiency and effectiveness of transit, as well as external and indirect effects on social well-being, economic development, and environmental quality. That is, impact constructs include externalities and indirect effects both beneficial and adverse, intended and unintended (Dajani and Gilbert 1979). For a "shopping list" of relevant performance measures relating to the following impact goals/constructs, see Table 3.

Accessibility of the Transit-Dependent (elderly, disabled, low-income, etc.): The provision of transit services for the transit-dependent is an important element of public transit performance advocated not by transit system providers but instead by society via government directives.

Urban Development/Revitalization: The direction of urban development and revitalization of urban areas became an important element of public transit performance due to the desires of society and the government. Controlling urban development and revitalizing declining areas is a common goal of federal, state, and local governments (Cervero and Brunk 1983; Potter 1979).

Attraction and Retention of Commuter Traffic: The attraction and retention of commuter traffic is an important element of transit system performance because of its positive impact on both transit revenues and those individuals who do not use public transit. Commuters provide a steady revenue source for transit providers (through such programs as employer-subsidized monthly passes) and thus allow transit providers to plan more effectively. Commuters also contribute to the reduction of congestion and pollution in urban areas, which results from their decision to not use their automobiles for transportation to and from work (see Public Technology Inc. 1978).

Pollution Reduction (air, water, noise, etc.): Pollution (air, water, noise, etc.) caused by transit vehicles and machines used in the construction or repair of transit infrastructure provide a negative externality for the individuals living and working along transit corridors.

The noise produced by the various modes of transportation negatively impact pedestrians, workers, and residents along transportation corridors. For air pollution, "emissions from internal combustion engines in automobiles and some other transportation modes can be a serious health hazard to inhabitants of urbanized areas. Transportation vehicles are the chief source of carbon monoxide, lead and hydrocarbon air pollution, and about one-half of nitrogen oxide pollution in metropolitan areas, nationwide." (Winnie and Hatry 1973, 21.)

Reduction of Congestion: The reduction of traffic congestion in a community is a major social goal and is often an argument used by advocates of the subsidization of public transit. Congestion can be measured in terms of frequency, duration, and/or intensity (Altshuler 1979).

Reduction of Energy Consumption: The vehicles used by transit firms are more energy-efficient than the private automobile on a per-passenger basis. This construct assesses the importance of energy conservation.

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Table 3. Impact Perspective

Goals / Constructs	Measure	Source
Accessibility of the Transit-Dependent (elderly, disabled, low income, etc.)	% Elderly and Handicapped Served	Sinha & Jukins (1978b)
	% Route Miles in Low Income Area	Sinha & Jukins (1978b)
	Passengers Per Autoless Population	Anderson & Fielding (1982)
	Passengers Per Elderly Population	Anderson & Fielding (1982)
	Percent Transit Dependent Served	Miller (1980)
	Percentage of Riders 65 Years Old or Older	Allen & Zapalac (1982)
	Total Veh Hours Per Elderly Service Area Population	Anderson (1980)
Attraction and Retention of Commuter Traffic	None Recommended	Public Technology Inc. (1978)
Pollution Reduction	Air Pollution Attributable To Transportation Sources	Winnie & Hatry (1973)
	Cost Per Vehicle Mile of Travel Reduced	Miller & Kirby (1984)
	No of Persons Poss Affected By Transit Air Poll Levels	Winnie & Hatry (1973)
	No of Persons Poss Affected By Transit Noise Levels	Winnie & Hatry (1973)
	Noise Levels Along Transportation Corridors	Winnie & Hatry (1973)
Reduction of Congestion	None Recommended	Altshuler (1979)
Reduction of Energy Consumption	Energy Consumption Per Revenue Vehicle Hour	Fielding, Glauthier, & Lave (1978)
	Energy Consumption Per Revenue Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Energy Consumption Per Total Vehicle Mile	Fielding, Glauthier, & Lave (1978)
	Fuel Cost ($) Per Vehicle-Mile	Koushki (1984)
	Fuel Cost (SR) Per Vehicle-km	Koushki (1984)
	Gallons of Fuel Consumed Per Mile	Koushki (1984)
	Gallons of Fuel Per Passenger	Drosdat (1977)
	Litres of FuelConsumed Per km	Koushki (1984)
	Passenger-km Per Litre	Koushki (1984)

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Table 3. Impact Perspective (cont.)

Goals / Constructs	Measure	Source
Reduction of Energy Consumption (cont.)	Passenger-Miles Per Gallon	Koushki (1984)
	Revenue Vehicle Miles Per Gallon Diesel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)
	Total Vehicle Miles Per Gallons of Fuel Consumed	Anderson & Fielding (1982)
	Vehicle Capacity Miles (Bus) Per Gallon Diesel	Anderson & Fielding (1982)
	Vehicle Miles (Bus) Per Gallon Diesel	Anderson & Fielding (1982), Fielding, Babitsky, & Brenner (1985), Fielding, Babitsky, & Brenner (1983), Fielding, et.al. (1984)

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Conclusion

The evaluation of public transit is an ongoing challenge for transit system managers and their stakeholders. This article explored the balanced scorecard approach and how it can be applied to the assessment of public transit system performance by using the metrics of efficiency, effectiveness, and impact in place of the metrics advocated for use in the private sector.

This article also developed a "shopping list" of performance measures for managers to select from when developing balanced scorecards for public transit systems. It gathered together, for the first time, a comprehensive list of public transit constructs/goals and their corresponding performance measures in order to help public transit managers develop a balanced scorecard or any other type of performance assessment framework in a more efficient manner. This comprehensive list of transit system goals and performance measures may also benefit the conducting of future research concerned with transit system goals and performance measurement.

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