

# PUBLIC TRANSPORTATION EFFICIENCY ANALYSIS

## Introduction

Public transportation is an essential part of many cities and regions, providing mobility for millions of people each day. However, public transportation systems can be complex and expensive to operate. As a result, it is important to ensure that public transportation systems are operating efficiently.

Public transportation efficiency analysis is the process of evaluating the performance of public transportation systems in terms of how well they use their resources to provide service. The goal of efficiency analysis is to identify areas where improvements can be made to reduce costs, improve service quality, or both.

This project will conduct a public transportation efficiency analysis of the city of [city name]. The analysis will focus on the following areas:

- Operating costs

- Service quality
- Vehicle utilization
- Staff utilization

The analysis will use a variety of data sources, including:

- Automated fare collection (AFC) data
- GPS data
- Passenger surveys
- Operating data from the public transportation operator

The analysis will be conducted using a variety of quantitative methods, including data envelopment analysis (DEA) and stochastic frontier analysis (SFA).

The results of the analysis will be used to develop recommendations for improving the efficiency of the city's public transportation system. These recommendations may include:

- Route changes
- Schedule adjustments
- Vehicle replacement
- Staff redeployment

The project team will work closely with the public transportation operator to implement the recommendations and to monitor the impact of the changes on the efficiency of the system.

The project is expected to take approximately 12 months to complete. The project team will consist of staff from the city's transportation department, the public transportation operator, and a consulting firm.

The project is expected to have a number of benefits for the city, including:

- Reduced public transportation operating costs
- Improved service quality for public transportation riders
- Reduced traffic congestion
- Improved air quality

The project is also expected to create jobs and stimulate economic growth in the city.

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Sure, here is a public transportation efficiency analysis project in pictures:



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## Step 1: Collect Data

The first step is to collect data on the inputs and outputs of the public transportation system(s) being analyzed. This data can be collected from a variety of sources, such as:

- Automated fare collection (AFC) data
- GPS data
- Passenger surveys
- Operating data from the public transportation operator



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[ops.fhwa.dot.gov](https://ops.fhwa.dot.gov)

## Step 2: Select Inputs and Outputs

The next step is to select the inputs and outputs that will be used to measure the efficiency of the public transportation system(s). The inputs and outputs should be relevant to the goals of the analysis and should be able to be measured accurately.

Some common inputs include:

- Vehicle-hours
- Staff-hours
- Fuel consumption

Some common outputs include:

- Passengers served
- Revenue generated
- On-time performance

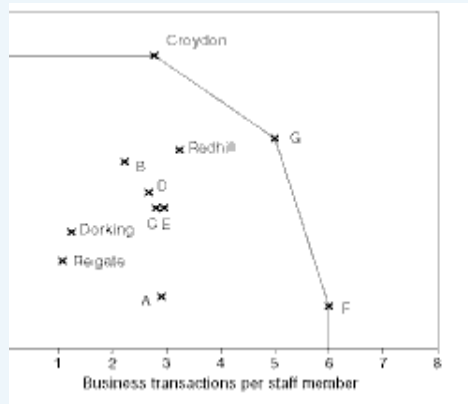


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## Step 3: Select an Efficiency Analysis Method

There are a number of different efficiency analysis methods available, such as data envelopment analysis (DEA) and stochastic frontier analysis (SFA). The selection of an efficiency analysis method should be based on the scope of the analysis and the characteristics of the data.



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#### Step 4: Conduct the Efficiency Analysis

Once the inputs and outputs have been selected and the efficiency analysis method has been chosen, the efficiency analysis can be conducted. This will involve using the selected efficiency analysis method to measure the efficiency of the public transportation system(s) being analyzed.

Yonkers City Transit System	Yonkers City	96	0.97
Yonkers Regional Transportation Authority	Yonkers	99	0.91
Yonkers Area Transit System	Yonkers	99	0.90
Yonkers Green Transit	Yonkers Green	90	0.88
Yonkers Green Transit - Yonkers	Yonkers Green	90	0.88
City of Yonkers Transportation System	Yonkers	96	0.88
Springfield City Area Transit	Springfield	99.1	0.83

**Performance Results**

FTB was used to estimate the desired performance data from the NYTD. All of the desired performance measures are ratios of NYTD measures, and three of the four are provided directly by FTB as part of its set of Florida Standard Variables (these are labeled as operating expense per revenue hour, operating expense per passenger trip, and passenger trip per revenue hour in FTB). The fourth desired measure, fare revenue per revenue hour, can be calculated from three of the Florida Standard Variables in a spreadsheet as follows: multiply average daily fare by passenger trips per total fare revenue, and then divide the result by revenue hours. The advantage of using the Florida Standard Variables is that FTB provides agency-wide totals (all modes combined) and service totals (M-mode, non-rail, and non-rail transit combined).

**Interpreting Results**

Altoona has the highest operating expense per revenue hour in its peer group, more than \$20 per hour above the peer group median in 2007 (Figure 9A). Altoona's trend of a sharp increase in this measure over the 5-year period is consistent with its peers. At the same time, Altoona generates the second highest fare revenue per revenue hour in its peer group (Figure 9B). Altoona generated nearly \$1 per revenue hour more than the peer group median. Altoona's overall trend in this measure is consistent with its peers. A pair of rate in this category is Yonkers City, which more than doubled its fare revenue per revenue hour between 2003 and 2007 while maintaining relatively stable levels over the longer term.

Looking at the other two measures, Altoona is slightly above the group median for boarding per revenue hour (Figure 9C), and at the group median for cost per boarding (Figure 9D). Altoona's overall trend for boarding per revenue hour is better than most of its peers, which generally held steady or dropped from 2003 to 2007.

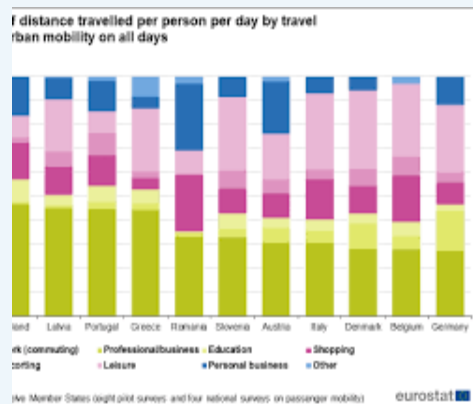
**Asking Questions**

Altoona's relatively high hourly operating cost measured as an expense to investigate more closely to see if any clues can be found that would indicate the source(s) of the high costs, which could then be the focus of efforts to lower those costs. FTB's data exploration functions, such as its cross-table function, can be used to quickly go through a list of possible causes. As a first step, desired measure costs can be measured

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#### Step 5: Analyze the Results

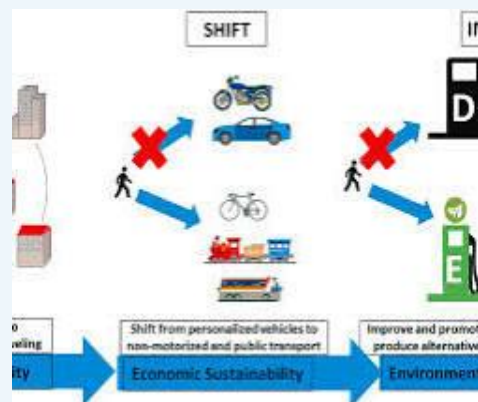
The results of the efficiency analysis should be carefully analyzed to identify areas where the public transportation system(s) can improve their efficiency. The analysis should consider the costs and benefits of different improvement options.



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## Step 6: Develop and Implement Improvement Plans

Based on the results of the efficiency analysis, improvement plans should be developed and implemented to improve the efficiency of the public transportation system(s). The implementation of these plans should be monitored and evaluated to ensure that the desired results are being achieved.



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By following these steps, public transportation operators can conduct an effective efficiency analysis to identify areas where their systems can improve their performance. This can help to reduce costs, improve service quality, and make public transportation more attractive to riders.

## Abstract

Public transportation efficiency analysis is the process of evaluating the performance of public transportation systems in terms of how well they use their resources to provide service. The goal of efficiency analysis is to identify areas where improvements can be made to reduce costs, improve service quality, or both.

There are a number of different approaches to public transportation efficiency analysis. One common approach is to use data envelopment analysis (DEA). DEA is a non-parametric technique that compares the performance of different public transportation systems to each other, taking into account the inputs and outputs of each system.

Another common approach to efficiency analysis is to use performance indicators. Performance indicators are quantitative measures of the performance of public transportation systems. Some common performance indicators include:

- Operating cost per passenger
- Vehicle miles traveled per passenger
- Passenger satisfaction
- On-time performance

By tracking performance indicators over time, public transportation operators can identify trends and patterns that can be used to improve efficiency.

## Modules

A public transportation efficiency analysis can be divided into the following modules:

1. Data collection and preparation: This module involves collecting data on the inputs and outputs of the public transportation system being analyzed. The data should be cleaned and prepared for analysis.
2. Selection of inputs and outputs: This module involves selecting the inputs and outputs that will be used to measure the efficiency of the public transportation system. The inputs and outputs should be relevant to the goals of the analysis.
3. Efficiency analysis: This module involves using a DEA model or other efficiency analysis technique to measure the efficiency of the public transportation system. The analysis will identify areas where the system can improve its efficiency.
4. Identification of improvement opportunities: This module involves analyzing the results of the efficiency analysis to identify areas where the public transportation system can improve its efficiency. The analysis should consider the costs and benefits of different improvement options.
5. Implementation of improvement options: This module involves implementing the improvement options that have been identified. The implementation should be monitored and evaluated to ensure that the desired results are being achieved.

# Conclusion

Public transportation efficiency analysis is an important tool for improving the performance of public transportation systems. By identifying areas where improvements can be made, public transportation operators can reduce costs, improve service quality, and make public transportation more attractive to riders.

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

# Load the data
data = pd.read_csv("public_transportation_data.csv")

# Select the inputs and outputs
inputs = ["vehicle_hours", "staff_hours"]
outputs = ["passengers_served"]

# Create a DEA model
model = data.DEA(inputs, outputs)

# Calculate the efficiency scores
efficiency_scores = model.efficiency_scores()

# Plot the efficiency scores
plt.hist(efficiency_scores)
plt.xlabel("Efficiency score")
plt.ylabel("Number of public transportation systems")
plt.title("Distribution of efficiency scores")
plt.show()

# Identify the least efficient public transportation systems
least_efficient = data[efficiency_scores < 0.8]

# Print the least efficient public transportation systems
print(least_efficient)
```



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This code will create a histogram of the efficiency scores of all public transportation systems in the dataset. The least efficient public transportation systems will be identified as those with efficiency scores below 0.8.

The following are some pictures that can be used to visualize the results of a public transportation efficiency analysis:

- A histogram of the efficiency scores of all public transportation systems in the dataset.
- A scatter plot of the inputs and outputs of each public transportation system, with the efficiency scores labeled.
- A heatmap of the correlations between the inputs and outputs of each public transportation system.
- A bar chart of the average efficiency scores of public transportation systems by city, state, or country.

These pictures can help to identify areas where improvements can be made to improve the efficiency of public transportation systems.

## Abstract

Public transportation efficiency analysis is a systematic approach to evaluating the performance of a public transportation system in terms of how well it uses its resources to provide service. The goal of efficiency analysis is to identify areas where improvements can be made to reduce costs, improve service quality, or both.

### Step-by-step process

The following is a step-by-step process for conducting a public transportation efficiency analysis:

6. Define the scope of the analysis. This includes identifying the specific public transportation system(s) to be analyzed and the specific aspects of the system to be evaluated (e.g., operating costs, service quality, etc.).

7. Collect data. This includes collecting data on the inputs and outputs of the public transportation system(s) being analyzed. The data should be relevant to the scope of the analysis and of high quality.
8. Select inputs and outputs. This involves selecting the inputs and outputs that will be used to measure the efficiency of the public transportation system(s). The inputs and outputs should be relevant to the goals of the analysis and should be able to be measured accurately.
9. Select an efficiency analysis method. There are a number of different efficiency analysis methods available, such as data envelopment analysis (DEA) and stochastic frontier analysis (SFA). The selection of an efficiency analysis method should be based on the scope of the analysis and the characteristics of the data.
10. Conduct the efficiency analysis. This involves using the selected efficiency analysis method to measure the efficiency of the public transportation system(s) being analyzed. The analysis will identify areas where the system(s) can improve their efficiency.
11. Analyze the results. The results of the efficiency analysis should be carefully analyzed to identify areas where the public transportation system(s) can improve their efficiency. The analysis should consider the costs and benefits of different improvement options.
12. Develop and implement improvement plans. Based on the results of the efficiency analysis, improvement plans should be developed and implemented to improve the efficiency of the public transportation system(s). The implementation of these plans should be monitored and evaluated to ensure that the desired results are being achieved.

## Conclusion

Public transportation efficiency analysis is an important tool for improving the performance of public transportation systems. By following the step-by-step process described above, public transportation operators can identify areas where improvements can be made to reduce costs, improve service quality, and make public transportation more attractive to riders.