



July 2013

TRANSIT ASSET MANAGEMENT

Additional Research
on Capital Investment
Effects Could Help
Transit Agencies
Optimize Funding

GAO Highlights

Highlights of [GAO-13-571](#), a report to the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Why GAO Did This Study

Many of the nearly 700 public transit agencies in the United States struggle to maintain their bus and rail assets in good repair. Assets that are not in an acceptable condition and not rehabilitated or replaced can reduce safety, on-time service, and ridership. Asset management practices can help agencies prioritize their capital investments to help optimize limited funding.

This report examines (1) the extent to which selected transit agencies follow leading asset management practices to prioritize capital investments, and challenges in using these practices; (2) the extent to which these agencies measure the effects of capital investments; and (3) FTA initiatives to support transit agencies' use of leading practices. GAO reviewed federal legislation and analyzed reports on leading asset management practices; reviewed the asset management practices of 18 transit agencies through a site visit or literature search; and interviewed federal officials and others. Site visit agencies were selected to represent a range of sizes based on annual ridership and the number of vehicles available. The findings from the 18 agencies cannot be generalized.

What GAO Recommends

GAO recommends that FTA conduct additional research to help transit agencies measure the effects of capital investments, including future ridership effects, to help agencies optimize limited funding. DOT did not agree or disagree with the recommendation.

View [GAO-13-571](#) or key components. For more information, contact David J. Wise at (202) 512-2834 or wised@gao.gov.

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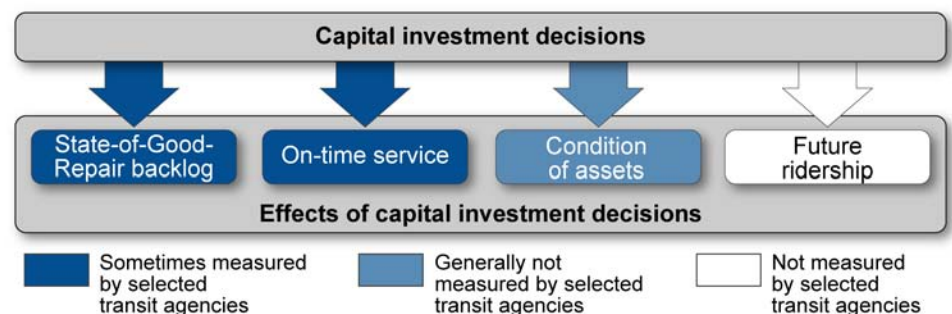
Additional Research on Capital Investment Effects Could Help Transit Agencies Optimize Funding

What GAO Found

To prioritize capital investments, selected transit agencies we reviewed follow some leading practices in the areas of planning, information and data systems, and ranking capital projects. For example, several agencies have developed asset inventories that provide accessible, consistent, and comprehensive information about their assets. One agency also incorporated asset condition data into its asset replacement models, resulting in more accurate and cost-effective replacement investments. However, transit agencies face challenges in implementing these leading practices. For example, several agencies we visited reported challenges collecting data or monitoring or analyzing assets' condition and performance.

As part of efforts to prioritize investments, some of the transit agencies we reviewed can estimate the effect capital investment decisions have on their state-of-good-repair backlog and on-time service to customers. In particular, the Federal Transit Administration's (FTA) Transit Economic Requirements Model (TERM) and TERM Lite models—tools to estimate capital investment needs—recently helped some agencies determine effects on their state-of-good-repair backlog. However, of transit agencies we visited, only two measured the effects on the condition of certain assets. Further, none of the agencies measured effects on future ridership, in part because they lacked tools to determine these effects. Not understanding the effects of capital investment decisions on future ridership may limit transit agencies' ability to effectively prioritize their capital investments.

Extent to Which Selected Transit Agencies Measure Effects of Capital Investments on State-of-Good-Repair Backlog, On-Time Service, Asset Condition, and Future Ridership



Source: GAO.

FTA has supported transit agencies' use of leading asset management practices through several initiatives. For example, FTA developed a guide to help transit agencies implement these leading practices. Also, FTA is modifying its TERM Lite model to help transit agencies better estimate capital investment needs and prioritize investments. However, FTA could assist transit agencies by conducting further research that examines effects of capital investments, including those effects on future ridership. Understanding these effects would help transit agencies optimize their use of limited transit funding.

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
CTAA	Community Transportation Association of America
DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
MAP-21	Moving Ahead for Progress in the 21st Century Act
MARAD	Maritime Administration
PRIIA	Passenger Rail Investment and Improvement Act of 2008
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users
TCRP	Transit Cooperative Research Program
TERM	Transit Economic Requirements Model
TIGER	Transportation Investment Generating Economic Recovery

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July 11, 2013

The Honorable Tim Johnson
Chairman
The Honorable Mike Crapo
Ranking Member
Committee on Banking, Housing, and Urban Affairs
United States Senate

Transit agencies in the United States face an enormous task as they seek to preserve their existing transit assets. Many of the 694 public transit agencies have a wide variety of assets to maintain—such as buses, rail cars, escalators, and elevators—and many of these assets have reached or exceeded their recommended useful lives. The Federal Transit Administration (FTA) estimates that roughly \$78 billion (in 2009 dollars) would be necessary to cover the costs of rehabilitating or replacing the nation's transit assets and bring them to a “state of good repair.” Aging assets in less than acceptable condition that are not rehabilitated or replaced can lead to increased operating costs, declines in safety and on-time service, and, ultimately, reduced ridership. However, in an age of declining resources and fiscal uncertainties, transit agencies face challenges allocating sufficient resources to maintain these assets.

Asset management is an approach that can help transit agencies decide how best to prioritize their capital investments to strategically allocate their limited resources to manage their existing assets and plan appropriately for rehabilitation and replacement. Moreover, asset management can ultimately help transit agencies optimize limited funding so that they receive the “biggest bang for their buck” when rehabilitating and replacing their assets. Such practices can include assessing the effects of capital investment decisions, including effects on their state-of-good-repair backlog and ridership, to help set spending priorities. For example, certain capital investments may yield increased ridership and better return on investment. New York City's Metropolitan Transportation Authority invested an estimated \$74 billion from the early 1980s to the end of 2008 into its transit assets, an investment that helped increase ridership 58 percent from 1982 to 2007. Ensuring that transit infrastructure is in a state of good repair is essential for sustaining and increasing transit ridership. The Moving Ahead for Progress in the 21st

Century (MAP-21) Act¹ reauthorizes surface transportation programs through 2014 and contains provisions and requirements that are designed to help transit agencies bring systems to a state of good repair by implementing asset management practices.²

You asked us to examine how transit agencies invest federal and other funding sources in aging assets—i.e., make capital investment decisions—as well as how these investments affect the quality of transit services and the likelihood that people will use them.³ This report provides information on (1) the extent selected transit agencies follow leading practices in asset management to prioritize capital investment decisions, and related challenges agencies face; (2) the extent selected transit agencies measure the effects of capital investment decisions on their state-of-good-repair backlog, condition of assets, on-time service, and ridership; and (3) FTA’s initiatives to support transit agencies’ use of leading practices, and what additional actions, if any, could be taken.

To address these objectives, we defined “capital investment decisions” to refer only to those decisions related to rehabilitating or replacing a transit agency’s existing assets, even though agencies can use capital funding

¹On July 6, 2012, President Obama signed the Moving Ahead for Progress in the 21st Century (MAP-21) Act, Pub. L. No. 112-141, 126 Stat. 405 (July 6, 2012), reauthorizing surface transportation programs through fiscal year 2014. Surface Transportation reauthorizations generally authorize funding from the Highway Trust Fund and authorize new or amend existing federal transit and highway provisions codified at titles 49 and 23 of the United States Code.

²MAP-21 requires transit agencies that receive federal funding to develop transit asset management plans. These plans must include, at a minimum, capital asset inventories, condition assessments, and investment prioritization. Each transit agency that receives funding will be required to report on the condition of its system, any change in condition since the last report, targets set through performance measures, and progress toward meeting those targets. This requirement will not be a condition for receiving FTA grant funds until FTA issues a rulemaking. Through a rulemaking, FTA will establish requirements for a capital asset inventory, condition assessments, decision support tools, and prioritization of capital investments, all of which must be included in an asset management plan. Once the asset management rulemaking is issued, grantees apportioned funds under the new State of Good Repair Formula Program will be required to include all FTA State of Good Repair formula program-funded projects in their own asset management plan. Pub. L. No. 112-141 § 20019, 126 Stat. 405, 707 (July 6, 2012); 77 Fed. Reg. 63677 (October 16, 2012).

³We have previously reported on the effect of capital investment decisions on safety. GAO, *RAIL TRANSIT: FTA Programs Are Helping Address Transit Agencies’ Safety Challenges, but Improved Performance Goals and Measures Could Better Focus Efforts*, [GAO-11-199](#) (Washington, D.C.: Jan. 31, 2011).

for new transit infrastructure or expansion projects such as a transit line extension. We reviewed pertinent federal legislation and FTA notices pertaining to state-of-good-repair requirements and funding including: MAP-21; the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU); and the American Recovery and Reinvestment Act of 2009 (Recovery Act).⁴ We also interviewed officials from nine multimodal and bus-only transit agencies⁵ that we visited, as follows:

- Detroit Department of Transportation (Detroit, Michigan);
- Gwinnett County Department of Transportation (greater Atlanta, Georgia area);
- Long Beach Transit (Long Beach, California);
- Los Angeles County Metropolitan Transportation Authority (Los Angeles, California);
- Massachusetts Bay Transportation Authority (Boston, Massachusetts);
- Metropolitan Atlanta Rapid Transit Authority (Atlanta, Georgia);
- Southern California Regional Rail Authority, operator of Metrolink Commuter Rail Service (Metrolink) (greater Los Angeles, California area);
- Suburban Mobility Authority for Regional Transportation (Detroit, Michigan); and
- Washington Metropolitan Area Transit Authority (Washington, District of Columbia)

We used data on annual ridership and the number of bus and/or rail vehicles available at each agency to select this range of various transit agencies. While the information obtained from these transit agencies cannot be generalized to all transit agencies, it provides insights into a range of experiences related to how agencies make capital investment decisions, the practices they follow, and the challenges they face. Throughout this report, we refer to these nine transit agencies as agencies we “visited.”

⁴Pub. L. No. 109-59, 119 Stat. 1144 (Aug. 10, 2005); Pub. L. No. 111-5, 123 Stat. 115 (Feb. 17, 2009).

⁵While some agencies we visited operate secondary modes of transit, such as water taxis, we did not address asset management for those other modes of transit, and so for the purposes of this report, we refer to these agencies as “bus-only.”

We also conducted a literature review to select, review, and analyze reports containing current examples of transit agencies and other entities that use asset management practices and measure the effects of capital investment decisions. Our literature review identified two key reports that we deemed sufficiently reliable to use as criteria for our report:

- *FTA's Asset Management Guide: Focusing on the Management of Our Transit Investments*,⁶ and
- *Transit Cooperative Research Program (TCRP) Report 157, State of Good Repair: Prioritizing the Rehabilitation and Replacement of Existing Capital Assets and Evaluating the Implications for Transit* (Sponsored by FTA).

We analyzed leading practices from these two reports and synthesized the practices into three broad categories based on previous GAO work:⁷ (1) "Planning," which relates to how agencies plan capital investments; (2) "Information and Data Systems," which relates to how agencies collect asset condition and performance data; and (3) "Ranking Capital Projects Based on Established Criteria," which relates to how agencies prioritize capital investment projects for funding (see app. I for a more detailed explanation of this synthesis).

We also reviewed the two reports for examples of transit agencies and other entities cited for using leading asset management practices in the three categories above and selected examples to include in our report. We did not visit these agencies or interview officials from them. The nine agencies whose practices we reviewed were:

- Amtrak,⁸
- Bay Area Rapid Transit,

⁶Federal Transit Administration, *Asset Management Guide: Focusing on the Management of Our Transit Investments* (Washington, D.C.: October 2012).

⁷GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-32](#) (Washington, D.C.: December 1998).

⁸Amtrak, although federally established and unable to operate without substantial federal subsidies to remain solvent, is not a government agency, but rather a private, for-profit corporation. GAO, *Amtrak Management: Systemic Problems Require Actions to Improve Efficiency, Effectiveness, and Accountability*, [GAO-06-145](#) (Washington, D.C.: October 2005).

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- Chicago Transit Authority,
 - King County Metro Transit,
 - London Underground,
 - New York City's Metropolitan Transportation Authority,
 - San Francisco Bay Area's Metropolitan Transportation Commission,
 - Santa Clara Valley Transportation Authority, and
 - Regional Transportation Authority of Northeastern Illinois.

Throughout this report, we refer to these nine agencies, plus the agencies we visited, as agencies we "reviewed."

In addition, we interviewed officials from FTA and other U.S. Department of Transportation (DOT) modal administrations, including Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and Maritime Administration (MARAD). We also interviewed industry stakeholders, including representatives from the American Public Transportation Association (APTA), the Community Transportation Association of America (CTAA), the Transportation Research Board (TRB), the Transportation Asset Management Expert Task Group, and asset management consultants.

We conducted this performance audit from July 2012 to July 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Federal, state, and local investment in transit has grown over the years, resulting in the expansion of the nation's public transit systems. FTA works in partnership with states and local grant recipients, such as transit agencies, to administer federal transit programs, and provide financial, technical, and other assistance. FTA administers federal grant programs that transit agencies can use to rehabilitate and replace assets to help meet ridership demand by, for example, modernizing rail systems and purchasing buses. (For a description of FTA's transit program funding for capital reinvestment projects, see app. II.) State and local governments are ultimately responsible for executing most federal transit programs by matching and distributing federal funding and by planning, selecting, and supervising infrastructure projects in accordance with federal

requirements. Transit agencies also rely on a variety of other funding sources to help provide service, including assistance from state and local entities, and other sources such as passenger fares. Using these different revenue streams, transit agencies make investment decisions for operating and capital projects, including rehabilitation and replacement projects.

Congress has directed FTA to undertake increasing responsibilities for transit asset management. In 2007, a conference report accompanying an appropriations bill directed FTA to assess the condition of the nation's commuter rail infrastructure and the estimated cost of bringing it up to a state of good repair.⁹ The Consolidated Appropriations Act for fiscal year 2010 made \$5 million of research funding available to develop standards for asset management plans, provide technical assistance, improve data collection, and conduct a pilot program designed to identify the best practices of asset management.¹⁰ Using these funds, FTA, for example, awarded funding to six transit agencies for transit asset management pilot projects intended to demonstrate effective transit asset management systems and practices to improve asset management. In 2012, MAP-21 required FTA to develop a decision support tool for transit agencies to estimate their capital needs and to develop additional asset management requirements and technical assistance.

As demand for public transit continues to grow, transit agencies face a range of financial challenges in maintaining their assets in a state of good repair. According to the U.S. Census Bureau, the number of people who commute to work using public transit grew by about 1 million from 2005 to 2008 to reach approximately 7.21 million persons. Annual federal, state, and local investment in transit grew nearly 97 percent between 1999 and 2008 to total almost \$39 billion. With demand for transit service increasing, the federal investment in transit needs to be accompanied by strong performance accountability to ensure that funds are being used efficiently and effectively. As transit agencies attempt to manage their aging assets, a variety of factors make the current financial environment challenging:

⁹H. R. Rep. No. 110-446, at 130 (2007). The bill was ultimately enacted in the Consolidated Appropriations Act, 2008, Pub. L. No. 110-161 (2007).

¹⁰Pub. L. No. 111-117, div. A, title I, 123 Stat. 3034, 3062.

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- *Ridership is increasing, but fiscal uncertainties and costs are rising.* Population growth and other factors are likely to increase future ridership demand, but cost increases and fiscal uncertainties could limit transit agencies' ability to meet this demand. Future costs for transit agencies will increase because agencies must continue to support system expansions and add capacity to accommodate increases in ridership demand, as well as address expenses associated with maintaining a state of good repair for aging infrastructure. In addition, transit agencies' finances have been strained since 2008, as fuel prices have risen while state and local funding has decreased with the economic downturn. Furthermore, many local governments are facing financial pressure from the lingering effects of the financial crisis and economic downturn.¹¹ According to the American Public Transportation Association (APTA), a leading industry organization, these economic pressures have contributed to flat or reduced funding for many transit agencies, as well as service cuts and higher fares.¹²
 - *Funding shortfalls typically lead to maintenance backlogs.* According to a National Transportation Policy Project's report, transit agencies faced with funding shortfalls typically delay capital investments—even those investments designed to maintain the system in a state of good repair—because delaying such investments is easier than cutting service or raising fares. However, the report found such delays have hidden costs: they not only increase the cost of future maintenance, they are also likely to create operating problems as equipment breakdowns begin to increase. Furthermore, over time, the authors noted that the practice of deferring maintenance could lead to higher breakdown rates and lower service levels.¹³

Transit agencies in the U.S. and abroad have established a number of definitions for “state of good repair.” While no consensus on a universal definition exists, a state of good repair generally refers to the point at which all of a transit agency's assets are in good condition. However, as

¹¹GAO, *Public Transit: Funding for New Starts and Small Starts Projects, October 2004 through June 2012*, [GAO-13-40](#) (Washington, D.C.: Nov. 14, 2012).

¹²American Public Transportation Association, *Impacts of the Recession on Public Transportation Agencies, 2011 Update: Survey Results* (Washington, D.C.: August 2011).

¹³National Transportation Policy Project, *The Consequences of Reduced Federal Transportation Investment* (Washington, D.C.: September 2012).

assets age and deteriorate, a transit agency will always have some assets in need of rehabilitation and replacement. (For a description of the types of transit assets and equipment, see app. III). In reports to Congress on transit investment needs, FTA defines state of good repair based on a numeric system for evaluating transit asset conditions: 5 (excellent), 4 (good), 3 (adequate), 2 (marginal), 1 (poor). According to this definition, an asset is in good repair if its condition rating is 2.5 or greater.¹⁴ Conceptually, replacement at condition 2.5 implies that assets remain in service for a short time period after they have exceeded their useful life. For example, under this assumption, a bus with an expected minimum useful life of 12 years would be replaced at an average age of roughly 14 years.

The “state-of-good-repair backlog” is a measure to indicate the amount required to rehabilitate and replace all assets with estimated condition ratings that are less than 2.5. FTA has estimated this backlog to be about \$78 billion (in 2009 dollars). In other words, an investment of this amount would be required for the immediate replacement of all of the nation’s transit assets that currently exceed their useful lives and to complete all outstanding station rehabilitations. The largest category of the backlog is for heavy rail, which according to FTA, reflects high investment levels in heavy rail combined with a large proportion of over-age assets (see fig. 1).¹⁵ Once the backlog has been addressed, FTA found an annual average of \$14.4 billion would be required to keep that backlog from getting larger. By comparison, MAP-21 authorized approximately \$8.5 billion in FTA formula grants for fiscal year 2013 that support transit agencies’ reinvestment needs and other purposes.¹⁶ Moreover, according to the *State of Good Repair Initiative Report to Congress*, transit agencies that received Recovery Act funding used roughly \$3.9 billion in funds to repair, rehabilitate, and replace existing transit vehicles (mostly buses), stations, maintenance facilities, control systems, track, and structures

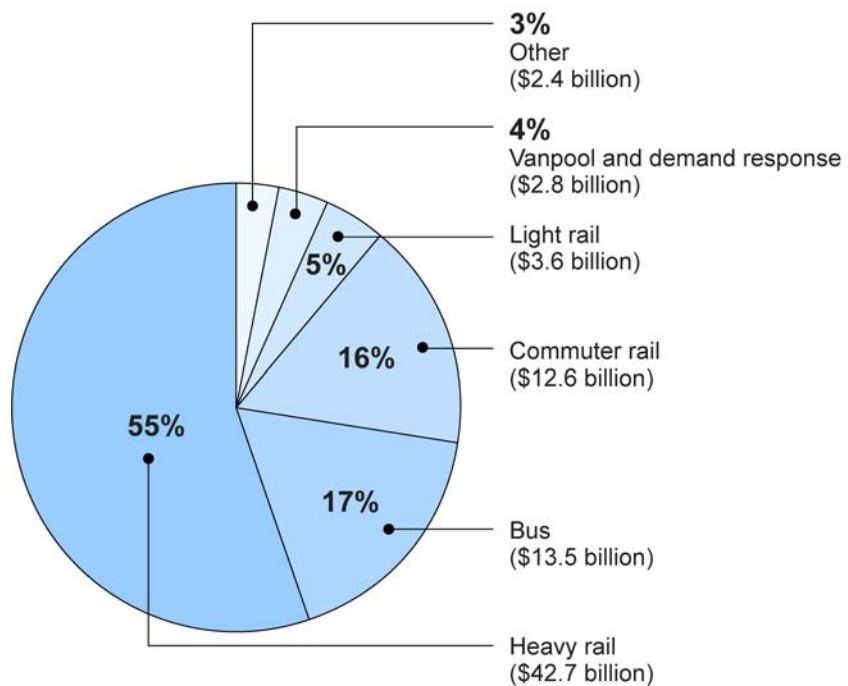
¹⁴Federal Transit Administration, *National State of Good Repair Assessment* (June 2010).

¹⁵Transit rail is composed of heavy and light rail systems. Heavy rail is an electric railway that can carry a heavy volume of traffic, and is characterized by high speed and rapid acceleration, passenger rail cars operating singly or in multi-car trains on fixed rails, separate rights-of-way from which all other vehicular and foot traffic is excluded, sophisticated signaling, and high-platform loading. Most subway systems are considered heavy rail. GAO, *Passenger Rail Security: Consistent Incident Reporting and Analysis Needed to Achieve Program Objectives*, [GAO-13-20](#) (Washington, D.C.: Dec. 19, 2012).

¹⁶Other purposes include operating expenses, capital projects other than for reinvestment, and planning.

with deferred investment needs.¹⁷ According to FTA estimates, the \$3.9 billion in Recovery Act funding applied to rehabilitate and replace existing transit assets yielded a roughly equal reduction in the existing backlog.¹⁸

Figure 1: FTA Estimate of the Backlog of State-of-Good-Repair Needs, 2010
(shown in billions of 2009 dollars)



Source: FTA.

¹⁷Transit agencies that were recipients of Recovery Act funding were required to obligate the funds by September 30, 2010.

¹⁸According to FTA's *State of Good Repair Initiative Report to Congress*, most of the reduction in the nation's backlog is estimated to be concentrated in non-rail modes yielding a roughly \$2.5 billion reduction in the state-of-good-repair backlog. The remaining funds yield a \$1.4 billion reduction in the rail state-of-good-repair backlog, with the largest share of these funds going to heavy rail (which also has the largest share of the total transit capital investment backlog).

Transit agencies can use capital funding either for new transit infrastructure or expansion projects—such as a transit line extension—or for rehabilitation and replacement investments for existing assets.¹⁹ (Figure 2 provides illustrative images of rail and bus assets being repaired at two agencies we visited). As transit agencies attempt to meet their systems' service demand, they aim for a state of good repair for their assets by using available resources to make sound capital investment decisions that optimize limited transit funding, including rehabilitation and replacement actions. Capital investment decisions that maintain or improve the condition of a transit asset can improve the performance of the asset, which can then improve the performance of an overall transit system.

Figure 2: Los Angeles County Metropolitan Transportation Authority Rail and Gwinnett County Transit Bus Assets under Repair



Source: GAO.

FTA and transit research organizations recommend leading asset management practices that transit agencies can use to manage investments. We used previous GAO work on capital project decision-making to synthesize these practices into three broad categories: (1)

¹⁹For this report, capital investment decisions include only those decisions related to rehabilitating or replacing a transit agency's existing assets.

Planning, (2) Information and Data Systems, and (3) Ranking Projects Based on Established Criteria.

FTA's Transit Economic Requirements Model (TERM) is an analysis tool designed to estimate transit capital investment needs by examining an asset's age and projected condition over time. TERM can also estimate the level of capital investment required to attain a state of good repair (or other investment objectives) and can also assess how variations in capital funding availability will likely affect the future condition and performance of transit infrastructure. FTA uses TERM to support its preparation of DOT's biennial *Report to Congress on the Condition and Performance of the Nation's Highways, Bridges and Transit*. FTA has developed a version of TERM called TERM Lite for local transit agency capital planning staff to use. TERM Lite can also calculate the state-of-good-repair backlog and normal replacement needs. According to FTA officials, four transit agencies have used TERM Lite and several others have received TERM Lite training from FTA.

Agencies Follow Several Leading Practices but Face Challenges Related to Planning, Information and Data Systems, and Ranking Capital Projects

Selected Agencies We Reviewed Follow Several Asset Management Leading Practices

Some of the selected agencies we reviewed follow several leading practices across the three leading practice categories—Planning, Information and Data Systems, and Ranking Capital Projects Based on Established Criteria.

Leading Practice: Planning

Some agencies are developing systems and reports that follow the planning leading practice, which links capital investments to strategic objectives to help plan and prioritize replacement and rehabilitation projects, for example:

-
- London Underground has developed a system for measuring asset performance that helps to prioritize investments by directing capital and operating funds to the assets and associated projects that have the greatest impact on its strategic objectives, such as customer service. Every 4 weeks the agency reviews asset performance and measures how assets are contributing to key system performance measures, such as in-service failures and lost customer hours.
 - Seattle’s King County Metro Transit uses an asset management plan to plan and communicate the agency’s asset management goals, how they are measured, and how asset data feed into the capital program. The plan specifies actions that are necessary, within a 6-year window, for the agency to maintain its fixed assets in a state of good repair. For example, the plan calls for assets it contains to be inspected annually at the component and subcomponent levels.
 - Santa Clara Valley Transportation Authority, in California, uses a commercial software package that helps the agency better prioritize its asset management projects considering agency goals and objectives, in a documented, repeatable process. This “decision-making” software uses flexible models that can produce new outputs as agency project priorities and budgets change, and the agency is using the software to develop its capital plan for fiscal year 2014-15.

Leading Practice: Information and Data Systems

Some agencies have developed information and data systems that can help prioritize capital investments.

Asset Inventories can provide accessible, consistent, and comprehensive information about each asset class and more broadly across all asset classes to support business processes, including capital programming and operations and maintenance budgeting. A strong data collection system and an accurate asset inventory are critical to asset management. The following agencies follow leading practices to collect data and develop inventories to help manage assets:

- Long Beach Transit is concluding work on an asset inventory and expects to obtain data on condition and develop a measure of “criticality” for each of its vehicles and fixed assets. Officials said the asset criticality measure is determined based on an asset’s estimated likelihood of failure (using data on percentage of useful life consumed) and the severity of failure (measured in terms of

impact to people, environment, costs, and operations). The agency uses the asset criticality measure to help prioritize capital investments.

- Metropolitan Atlanta Rapid Transit Authority has established an agency-wide asset management program that includes an inventory that staff updates through routine inspection and maintenance procedures. The inventory contains detailed information on more than 53,000 assets across 16 categories, which is stored in an electronic information system that the agency intends to use to integrate all relevant data electronically into its capital improvement planning process.
- Massachusetts Bay Transportation Authority has developed a state-of-good-repair database with an inventory that department managers can use to prioritize rehabilitation and replacement projects for the agency's Capital Investment Program. Agency officials reported that they use the database to analyze individual capital asset records and, based on projected useful life information, estimate the overall replacement or renewal costs for its backlog.

Condition Assessment and Performance Monitoring takes into account requirements for asset condition inspection and monitoring across different asset classes and improves asset reliability by improving an agency's ability to predict failure, address the root causes of failure, and plan for the capital investments required to maintain good performance. As agencies improve their asset data collection systems, they can use condition tracking information to improve maintenance timing and cost-effectiveness, as well as capital planning. The following agencies monitor asset condition and performance in ways that align with leading practices:

- Metropolitan Atlanta Rapid Transit Authority uses "condition based monitoring" to determine the optimum time to replace assets. For example, officials said that by maintaining and routinely testing generator performance, they have been able to defer replacing some generators, which they said has allowed them to reprioritize "several million dollars" of capital funds—originally intended for such replacements—to other, more urgent needs.
- While Amtrak is not a transit agency, its railroad condition assessment program was cited by the TCRP for its comprehensive treatment of rail tracks. The program includes a variety of data collection methods, such as periodic

measurements using railcars that measure track surface conditions, ground-penetrating radar to identify subgrade conditions, and remote-sensing equipment to identify the condition of drainage ditches.

Life-cycle Management Planning documents the costs, performance, and risks associated with an asset class throughout its life. This information can be used to ensure an asset's performance expectations match an agency's broader goals and performance objectives. FTA's asset management guide includes a 100-page supplement dedicated to providing information and guidance on the principles of life-cycle management for each asset class, including leading practice examples that FTA believes will help transit agencies develop life-cycle management plans. These agencies follow leading practices in life-cycle management planning:

- Metropolitan Atlanta Rapid Transit Authority has developed the Lifecycle Asset Reliability Enhancement program, which details the maintenance actions to be performed over the entire lifecycle of a rail car for each of its 11 different car systems. This leading practice separates rail car assets into their component parts, allowing for more accurate repair and replacement decisions.²⁰
- Long Beach Transit has begun incorporating life-cycle cost analysis into its procurement process for capital investment decisions, allowing the agency to follow the leading practice of reviewing a vehicle's design to improve its maintainability and reduce total life-cycle cost. For example, as the agency began considering bids from two vendors for 10 new all-electric buses, officials said they contracted with a university to perform a life-cycle cost analysis to compare the different long-term operating costs resulting from the two different charging systems proposed by the vendors. The analysis allowed Long Beach Transit to estimate cost differences resulting from the two different charging systems over the 12-year life of the buses.

²⁰For complex assets, it is important that the asset be represented at the element or component level, both to accurately characterize asset life and to more realistically reflect what rehabilitation or replacement actions are needed at any given time. However, this practice can entail substantial added effort expended on data acquisition and maintenance.

Leading Practice: Ranking Capital Projects Based on Established Criteria

To help rank projects, some agencies use project-scoring criteria that can help them achieve a variety of objectives including reducing costs, reducing asset breakdowns or failures, improving safety, increasing mobility, and reducing travel time. TCRP *Report 157* describes a leading practice to rank capital projects for funding by using scoring criteria that weight a small set of key factors and apply a formula to calculate scores for a set of projects to program from a list of viable candidates.²¹ The report found transit agencies use a variety of ranking methods, primarily to prioritize potential expansion projects rather than for rehabilitation and replacement investments. In addition, FTA's guide states that generally, transit agencies' capital planning and programming processes should include simple, quantifiable, agreed-upon prioritization criteria that link capital investments to agency outcomes. However, FTA officials told us FTA does not specifically prescribe how transit agencies should use weighted scoring criteria, nor does it offer detailed guidance to agencies on how to do so. Officials from several agencies reported using a variety of such project-scoring criteria, including the following:

- Long Beach Transit prioritizes projects using its asset criticality measure. Officials assign projects a "criticality code" based on an asset's likelihood and severity of failure. Managers then rank and prioritize funding for all capital projects based on the code.
- Los Angeles County Metropolitan Transportation Authority uses eight categories, with the most important category—"Is project mission critical?"—counting for 20 percent.
- Massachusetts Bay Transportation Authority's top four categories are all worth 20 percent each, and include "Cost/benefit," "Legal commitment," "Operations impact," and "state of good repair."

(For a detailed breakdown of whether and how each of the transit agencies we visited use scoring criteria to prioritize investments, see app. IV.)

²¹Transit Cooperative Research Program, *State of Good Repair: Prioritizing the Rehabilitation and Replacement of Existing Capital Assets and Evaluating the Implications for Transit, Report 157* (Washington, D.C.: August 2012). The FTA sponsored this report. For more on our use of this and other reports, see appendix I.

Agencies We Visited Face Challenges Implementing Leading Practices across All Categories

Officials at transit agencies we visited told us they face challenges following leading practices across all three leading practice categories—Planning, Information and Data Systems, and Ranking Capital Projects Based on Established Criteria. Some of the agencies have taken, or are taking, steps to overcome these challenges.

Challenges: Planning

- *Lack of funding and inconsistent funding.* All nine of the transit agencies identified a lack of sufficient funding to meet their state-of-good-repair needs as a challenge. For example, according to Washington Metropolitan Area Transit Authority officials, the agency has a sizable state-of-good-repair backlog because a history of insufficient funding, combined with constraints on system design, has severely limited the agency's ability to conduct delayed and ongoing needed repairs and maintenance while still delivering service. In addition, two agencies named inconsistent funding as a challenge.
- *Staff resources or managing change.* Seven of the nine agencies named either human capital shortages or organizational or cultural change as a challenge. For example, one transit agency's General Manager told us the agency's lack of funding for state-of-good-repair needs is compounded by staff shortages due to the declining financial situation at his agency. Another agency reported that as senior mechanics retire, the agency's capability to perform maintenance has been diminished by a lack of institutional knowledge. In addition, FTA found that improving current agency asset management practices requires considerable organizational and cultural change, and officials from three transit agencies said achieving such organizational change is challenging. For example, Metropolitan Atlanta Rapid Transit Authority officials told us the agency had to invest considerable time and effort to change the way it conducts its operations when implementing its Lifecycle Asset Reliability Enhancement system. They said it was a major challenge for the agency to convince its accounting department to expend the resources necessary to implement a new financial system that tracks assets at the component level.

Challenges: Information and Data Systems

- *Gathering and using reliable condition and performance data.* We found that the transit agencies we visited use a range of methods to collect data on the condition of their assets and that they

generally face gaps between their current and desired data capabilities. Further, it can be costly for agencies to improve their data collection systems.²² For example, Massachusetts Bay Transportation Authority officials said different departments have in the past submitted asset condition data to a centralized collection point for manual entry into a state-of-good-repair database, which has resulted in disparities in the quality and reliability of the data. However, agency officials told us they are using about half of a \$950,000 FTA asset management pilot program grant to update the existing data, improve the level of detail of the data collected in the future, and link one of the new data fields more closely to the capital program prioritization process. They also said that, while the quality of the data still varies by department, a new, more automated process will allow individual departments to enter their own asset data, eliminating the need for a centralized collection and manual entry process. In addition, Washington Metropolitan Area Transit Authority officials said that while they currently rely mainly on asset age and expected useful life, they are implementing a new asset management program to better collect and analyze asset condition data, including a pilot program using handheld mobile devices to capture and transmit asset condition data.

- *General technology challenges.* Officials at five of the nine agencies reported general technological challenges related to asset management, and at three of those, officials reported specific challenges collecting asset condition and performance data or monitoring or analyzing asset condition and performance. For example, Washington Metropolitan Area Transit Authority officials told us it is challenging when an asset's expected useful life differs from its condition in the field. They added that it is especially challenging to create a comprehensive asset score when monitoring condition, because no algorithm exists that incorporates data on an asset's unique characteristics; usage under real-world conditions; or life-cycle management status. In addition, they said having incomplete performance information makes it difficult to understand system-wide service reliability.

²²In its guide, FTA reported that the *International Infrastructure Management Manual* states that data collection is the largest workload component of an asset management program, often constituting 80 to 95 percent of the setup costs.

Challenges: Ranking Capital Projects Based on Established Criteria

According to officials at agencies we visited, transit researchers we spoke to, and information from key reports, ranking capital projects can have beneficial results, but the process can be challenging. TCRP *Report 157* states that the process of ranking capital projects for funding is not at all straightforward, despite the fact that it is well understood and appears deceptively simple to the casual observer. According to the report, given the many complicating factors, transit agencies that use systematic approaches tend to make simplifications and approximations to keep the process manageable. For example, as previously mentioned, Los Angeles County Metropolitan Transportation Authority and Massachusetts Bay Transportation Authority use such simplified ranking criteria. In addition, officials at three of the agencies we visited reported challenges related to either their capital investment prioritization process or their method of ranking projects for funding using criteria. Challenges using criteria to rank projects include:

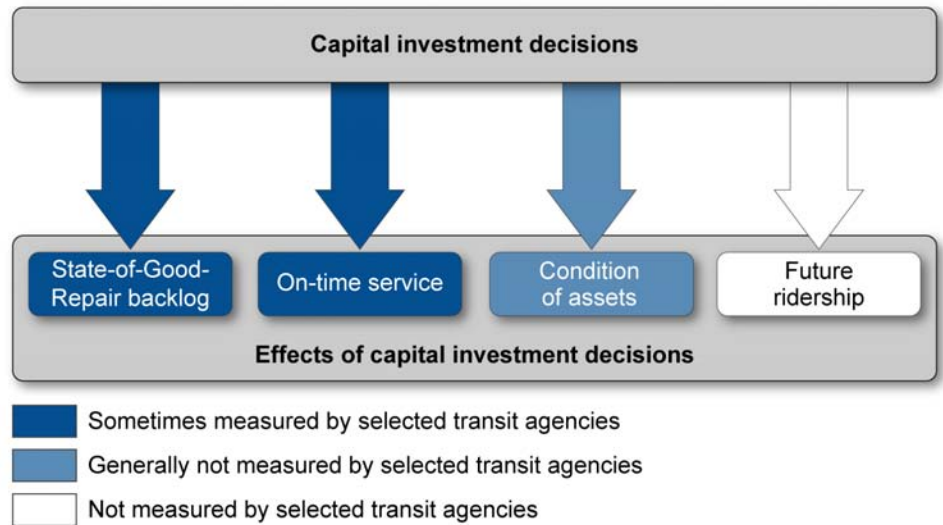
- *Project-Scoring Formulas Are Subjective and Not Absolute.* Establishing project-scoring formulas or a set of weights on evaluation factors can be challenging, because applying weights to the various factors is highly subjective. For example, Massachusetts Bay Transportation Authority officials told us the agency's project-scoring criteria contain subjective elements. In addition, they said regardless of a project's score, other factors may result in projects with the highest-ranking scores not receiving funding. For example, the officials said that projects enhancing safety are always funded, and certain policy concerns or funding constraints can result in projects with lower scores receiving funding over projects with higher scores.
- *System-Wide Objectivity Is Difficult to Maintain.* An official at one transit agency we visited said the biggest challenge in the project prioritization process is attempting to maintain objectivity amid competing departmental priorities. The official said that as managers self-rate projects, they can try to "game the system" by inflating scores used for ranking projects. To counter that, the official said an executive committee composed of senior staff could adjust a project's ratings downward as they try to attain a fair balance of projects across the agency.
- *Scoring Formulas Can Emphasize New Infrastructure over Maintenance.* Weighted project prioritization criteria are designed to emphasize projects that attain certain agency strategic goals over others that do so to a lesser extent. However, because it is challenging to design project-scoring methods that accurately rank

projects based on how well they align with agency strategic goals, transit agencies' ranking methodologies can shift funding away from projects that align with strategic goals. For example, Metrolink officials told us using the "Growth" prioritization criteria category, worth 21 percent of the overall score, elevated new capital projects over state-of-good-repair projects, even though "Service Reliability," at 28 percent, was the most heavily weighted of five criteria categories. As a result, new capital projects were often ranked higher than asset rehabilitation projects. In an attempt to counter this outcome, Metrolink stopped using scoring criteria and now separates capital investment projects submitted for funding into Rehabilitation and New Capital categories so they can be ranked separately.

Agencies' Efforts to Measure Effects of Capital Investment Decisions Vary

In prioritizing investments, the extent to which agencies we reviewed measure the effects of capital investment decisions varies (see fig. 3). Both the TCRP *Report 157* and FTA's asset management guide state that transit agencies should identify the effects and consequences of their capital investments to help make more informed decisions and to prove the value of their investments. Some of the agencies measure how their capital investment decisions affect their state-of-good-repair backlog and on-time service to customers. However, the nine transit agencies we visited generally did not measure how capital investment decisions affect the condition of their assets. Further, none of them measured the effects of capital investment decisions on future ridership, in part because they lacked tools that can assess the sophisticated and indirect relationship between capital investments and future ridership.

Figure 3: Extent to Which Selected Transit Agencies Measure the Effects of Capital Investment Decisions on State-of-Good-Repair Backlog, On-Time Service, the Condition of Assets, and Future Ridership



Source: GAO.

Some of the Agencies We Reviewed Measure How Capital Investment Decisions Affect State-of-Good-Repair Backlog and On-Time Service

As part of efforts to prioritize investments, some of the transit agencies we reviewed can estimate the effect capital investment decisions have on their state-of-good-repair backlog. In particular, FTA's TERM and TERM Lite models have recently helped some transit agencies estimate the effect different levels of capital investment have on their state-of-good-repair backlog. As previously mentioned, the TERM Lite model can measure and predict how variations in capital funding availability will likely affect their state-of-good-repair backlog.

- Metropolitan Atlanta Rapid Transit Authority, for example, has used the TERM Lite model to predict consequences of certain funding levels on their state-of-good-repair backlog. According to agency officials, TERM Lite has helped them assess how much state-of-good-repair backlog is remaining or unaddressed over certain periods of time (for example, a 10-year or 20-year period). With a current state-of-good-repair backlog equaling \$3.3 billion, TERM Lite calculated effects on the backlog and determined that investing the budget-constrained amount of \$245 million per year would increase the backlog to \$6.6 billion after 10 years and \$13 billion after 20 years.

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- San Francisco Bay Area's Metropolitan Transportation Commission—the transportation planning, coordinating, and financing agency for the nine-county San Francisco Bay area—has also used FTA's TERM model to evaluate the effects of different funding levels on its state-of-good-repair backlog. With a current backlog of \$6.3 billion, Metropolitan Transportation Commission applied its asset data to the TERM model and determined that it would need to invest \$1.3 billion annually until 2040 to maintain its current state-of-good-repair scenario. The Commission also determined that it would need to invest \$1.8 billion annually for the next 10 years to attain a state-of-good-repair and get rid of its backlog.

Besides TERM Lite, transit agencies use in-house assessment tools to estimate the effect of capital investment decisions on their state-of-good-repair backlogs. According to the agencies, these tools have allowed them to more accurately articulate state-of-good-repair needs and also to make a stronger case for additional funding from state and local decision-makers.

- According to officials, Massachusetts Bay Transportation Authority uses its state-of-good-repair database to forecast asset renewal and replacement needs over time and determine state-of-good-repair backlog implications based on different funding scenarios. According to the 2006 Massachusetts Bay Transportation Authority State of Good Repair Report, the state-of-good-repair backlog was estimated at \$2.7 billion. The agency used its state-of-good-repair database to determine that investing \$410 million per year would increase the backlog to \$4 billion in 2024; investing \$470 million annually would maintain the backlog at \$2.7 billion; and investing \$620 million per year would eliminate the backlog by 2024. Massachusetts Bay Transportation Authority officials noted that assessing the effects of various funding scenarios on their state-of-good-repair backlog has helped the agency convey its funding needs to the Massachusetts legislature and has led to favorable funding outcomes. For example, it has helped the agency to focus its capital spending almost exclusively on achieving a state of good repair as opposed to expansion projects, which are now funded by the state.
- In addition to TERM Lite, Metropolitan Atlanta Rapid Transit Authority uses Expert Choice—a decision-support software tool that prioritizes rehabilitation and replacement projects based on various factors and priorities—to determine state-of-good-repair

backlog “benefit scores” for various investment scenarios. According to officials, estimating the effects of various funding levels on their state-of-good-repair backlog has allowed the agency to more accurately articulate state-of-good-repair needs to state policymakers and make a stronger case for additional funding. Agency officials also noted that they have provided their board and executive management team anticipated asset backlog estimates over the next 10 years and the investment level required to keep the system viable. As a result, Metropolitan Atlanta Rapid Transit Authority officials told us they currently allocate approximately 85 to 90 percent of capital expenditures to address state-of-good-repair needs.

- Using a number of in-house assessment tools, including its Capital Asset Condition Assessment, Chicago’s Regional Transportation Authority of Northeastern Illinois recently projected that \$24.6 billion dollars would be required over a 10-year period to address its state-of-good-repair backlog and fulfill normal rehabilitation and replacement needs. Based on these calculations, the authority also estimated that there was a \$19.9 billion dollar discrepancy over a 10-year period between projected available funding and the funding that would be required to bring all assets to a state of good repair. Estimating the effects of various funding levels on its state-of-good-repair backlog has also allowed Chicago’s Regional Transportation Authority of Northeastern Illinois to make a more compelling case for state-of-good-repair capital investments.

Similarly, some of the transit agencies we reviewed measure how capital investment decisions affect on-time service to customers. For example, Metropolitan Atlanta Rapid Transit Authority, Washington Metropolitan Area Transit Authority, Bay Area Rapid Transit, and Detroit’s Suburban Mobility Authority for Regional Transportation use performance measures that help determine and track how capital investment decisions affect on-time service, including delays.

- Metropolitan Atlanta Rapid Transit Authority employs key performance indicators to determine how its capital investment decisions affect customers, such as on-time service, according to officials. The agency’s key performance indicators that measure effects on customers include: on-time performance, mean distance between failures, and mean distance between service interruptions. Agency officials said mean distance between service interruptions, in particular, is a good metric in that it focuses on

service to the customer and helps ascertain whether the capital investment improved service. Metropolitan Atlanta Rapid Transit Authority specifically measured mean distance between service interruptions before and after rail-car rehabilitation investments to determine the effects of the capital investment on on-time service to customers.

- Washington Metropolitan Area Transit Authority evaluates the effect of capital investment decisions on a monthly basis by analyzing ten key performance indicators such as bus service delivery. For example, the agency has examined how a capital investment affects the mean distance between failures of its bus fleet. Specifically, Washington Metropolitan Area Transit Authority assesses how the mean distance between failures of buses that were rehabilitated at their mid-life overhaul (and the service they provide) has stabilized and or improved reliability of their bus fleet and lowered operating costs as a result of that investment. Officials also told us that the agency has measured the effects of capital investments on escalators' and elevators' availability to see whether their availability has increased or decreased as a result of a capital investment.
- Bay Area Rapid Transit has also developed an advanced transit system performance review process that reports on key performance indicators such as on-time service, service speeds, crowdedness, and delay time per passenger. The agency not only tracks and reports on these key performance indicators but also forecasts how different levels of capital investment will affect on-time service to passengers. For example, Bay Area Rapid Transit examined the effects of investing only 30 percent of the amount needed to maintain a state of good repair and concluded that by 2032, the resulting deterioration would cause the percentage of customers who are not on time to increase from 4 to 9 percent. As the effects of underinvestment compound, by 2042, one-third of the agency's customers would be delayed.
- Suburban Mobility Authority for Regional Transportation, a bus-only transit provider, tracked and measured the number of road calls and service failures of its buses to determine the effects of a bus engine repowering project. The agency saw a 37 percent decrease in the number of road calls and service failures from 2002 to 2009 after the capital investment project.

Agencies We Visited Generally Do Not Estimate the Effects of Capital Investment Decisions on Asset Condition

When a transit agency makes a capital investment decision that allocates funding to rehabilitate or replace a transit asset, the rehabilitation or replacement generally maintains or improves the condition of that asset. In general, transit agencies that measure the condition of their assets before and after a capital investment can estimate the effects the capital investment decision had on the condition of the asset. Two of the agencies we visited provided examples of how they measured the effects of capital investment decisions on the condition of their assets for certain transit assets, as follows:²³

- Los Angeles County Metropolitan Transportation Authority used capital dollars to replace and rehabilitate hydraulic bus lifts—which hoist buses above ground—that were leaking hydraulic fluid and affecting bus operations performance, according to officials. Upon completion of the capital project, the agency pressure-tested the hydraulic lines to ensure they worked properly and performed in a more efficient manner.
- Metropolitan Atlanta Rapid Transit Authority also made a capital investment to rehabilitate its station and tunnel lighting. According to an agency official, the agency compared power consumption and light levels before and after the capital investment. The result was lower power consumption and increased light levels, which improved customer satisfaction.

Other transit agencies monitor condition, but do not link capital investment decisions to the condition of their assets for various reasons.

- Washington Metropolitan Area Transit Authority examines the condition of its rail and bus assets and collects asset condition information. Agency officials told us that they use “track walkers” that inspect the track twice on a weekly basis. However, the

²³Only two of the nine transit agencies we visited estimate how capital investment decisions affect the condition of their assets as part of their efforts to prioritize investments. Some transit agencies we reviewed—such as San Francisco’s Bay area’s Metropolitan Transportation Commission and New York City’s Metropolitan Transportation Authority—use certain asset age-based measures like “average age of assets as percent of their useful life” or “percent of vehicles with functioning climate control systems” as proxy measures to quantify changes in the condition of assets that can result from rehabilitation and replacement investments. However, changes in these age-based measures do not necessarily mean the actual condition of the asset changed or improved as a result of a capital investment.

agency currently is not able to determine the effect of capital investment decisions on the condition of its assets because the agency does not link changes or differences that occur as a result of capital investments.

- Massachusetts Bay Transportation Authority inspects the condition of some of its assets on a regular basis but does not measure specifically how its capital investment decisions affect the condition of its assets. For example, the agency conducts inspections of its assets regularly but does not compare the condition of the asset before and after the investment to see what changes or effects occurred as a result of that capital investment. However, agency officials told us that they intend to better assess the effects of capital investment decisions on the condition of assets over time.
- Officials from Metrolink told us they conduct routine inspections of rail assets. However, they do not specifically monitor how capital investments affect the condition of their assets because they lack the data, tools, and resources to do so.

Agencies We Visited Do Not Measure How Capital Investment Decisions Affect Future Ridership

Of the nine transit agencies that we visited, none measure or quantify the effect of capital investment decisions on future ridership. Researchers have acknowledged that understanding the effect of capital investment decisions on future ridership, in particular, is very difficult to measure because ridership depends on a number of factors other than capital investment decisions. For example, besides capital investment decisions, other factors like fares, low funding, public image of the transit system, safety, and the economy may affect ridership. FTA officials also added that assessing the impact of capital investment decisions is very difficult and requires additional research because of the number of variables involved that could also affect future ridership besides capital investment decisions. Various transit agency officials along with officials we spoke to from TRB, the Transportation Asset Management Expert Task Group, and APTA also agreed that measuring larger effects, such as future ridership, and quantifying the results of these investments is difficult for transit agencies. This is, in part, because transit agencies lack the analytical capability and necessary tools to assess the sophisticated and indirect relationship between capital investments and future ridership.

Furthermore, existing tools—such as FTA's TERM Lite model—do not predict how capital investment decisions affect future ridership. According to FTA officials, the model has an analytical feature that allows transit

agencies to assess the level of funding that would be needed to reach an estimate of future ridership.²⁴ For example, TERM Lite will tell a transit agency to add or grow the number of new vehicles by a certain number in order to meet that assigned ridership estimate. Although this feature of TERM Lite can provide transit agencies a helpful assessment of the level of investment needed to reach a ridership goal, it does not predict how capital investment decisions affect future ridership. Asset management consultants we interviewed also agreed that the TERM Lite model cannot determine the effects or consequences—positive or negative—that capital investment decisions may have on future ridership; they also noted that not knowing these effects limits transit agencies' ability to effectively prioritize capital investments in a way that optimizes limited transit funding.

Although transit agencies lack tools to measure effects on future ridership, several transit agency officials told us that capital investment decisions can affect ridership. Detroit Department of Transportation officials told us that one consequence of delaying capital investment projects that rehabilitate and replace projects is poor service reliability. The more bus breakdowns they experience the more it discourages Detroit transit users because riders do not reach their transfer point or destination on time. According to Suburban Mobility Authority for Regional Transportation officials, older assets that are beyond their useful life and are not rehabilitated or replaced require more maintenance and are prone to more frequent breakdowns despite a stringent maintenance program. Moreover, these buses are less attractive to customers, a perception that can lower ridership. Metropolitan Atlanta Rapid Transit Authority officials also told us that failure to rehabilitate or replace transit assets has a direct impact on service delivery and may decrease ridership.

The inability to quantify the effects of capital investment decisions, including those on future ridership, can limit transit agencies' efforts to prioritize among competing state-of-good-repair needs and optimize limited transit funding. More importantly, not knowing the effects of capital

²⁴According to FTA officials, none of the transit agencies that have beta-tested TERM Lite have used this ridership feature, in part, because it was not a real interest to them. To do this, a transit agency assigns a ridership estimate in the future based on expected population growth. TERM Lite will determine the amount of investment the transit agency will have to make in order to fulfill or meet that future ridership estimate. FTA used this type of ridership modeling for the 2010 *Conditions and Performance* report and it will be included in the 2012 version.

investment decisions on the condition of agencies' assets, on-time service, and future ridership has serious disadvantages. For example, Metropolitan Atlanta Rapid Transit Authority officials told us that not knowing the effects of capital investment decisions would limit their understanding of their financing needs and their ability to accurately prepare for the future; this in turn could prevent them from running a top quality transit service, thus potentially creating a decline in ridership as well as causing more pollution and congestion.

**FTA Initiatives
Support Transit
Agencies' Use of
Asset Management
Practices, but
Additional Research
Could Improve
Agencies' Ability to
Measure Effects of
Capital Investment**

**FTA Initiatives Support
Leading Practices in
Transit Asset Management**

Beginning in 2008, FTA began to highlight the need to bring the nation's aging transit assets into a state of good repair and to hold transit agencies accountable for implementing a strategic approach to managing the lifecycle of their assets, according to the FTA administrator. FTA made transit asset management a strategic focus based on four concepts:

- enhancing communication and technical assistance,
- increasing the number of transit agencies that invest in asset management systems,
- assisting transit agencies in developing asset management programs, and
- enhancing asset management techniques, data collection and analysis.

To enhance communication and technical assistance, FTA issued reports from 2008 through 2011 that described leading practices in transit asset management, reported the limited extent to which transit agencies had implemented leading asset management practices, and focused on the need for asset management by highlighting the state-of-good-repair backlog—roughly \$78 billion (in 2009 dollars). (For more information on FTA’s transit asset management reports, see app. V.) In addition, beginning in 2008, FTA supported annual meetings for transit industry experts to share approaches and solutions to state-of-good-repair problems. As previously mentioned, FTA developed an asset management guide which it completed in 2012. This report provides guidance on how transit agencies can implement leading practices in asset management. FTA also created an asset management course available through the National Transit Institute. Following the enactment of MAP-21, FTA reached out to transit agencies and others for comments on how it might best implement the asset management requirements introduced in MAP-21. According to FTA officials, more than 700 users registered on FTA’s website where they posted ideas and comments, and FTA used results of this online dialogue to inform its preparation of forthcoming rules to implement the transit asset management requirements of MAP-21.

To increase the number of transit agencies investing in asset management systems, starting in fiscal year 2010, FTA awarded funds from the Bus and Bus Facilities Program on a discretionary basis under a new State of Good Repair Bus Initiative. For example, in fiscal year 2010, it awarded \$36.2 million in grants to 17 agencies specifically for asset management systems. Three agencies we visited received fiscal year 2010 grants for asset management systems: Long Beach Transit (\$1.1 million), Washington Metropolitan Area Transit Authority (\$2.4 million), and Metropolitan Atlanta Rapid Transit Authority (\$1.4 million). The agencies used these grants to help improve their long-term planning and prioritization processes through investments that included upgrading asset management software and hardware, improving asset condition monitoring practices and data collection, and using maintenance data to inform their long-term asset decisions.

To assist transit agencies in developing asset management programs, FTA awarded \$4 million in 2011 to six transit agencies for transit asset management pilot projects intended to demonstrate effective asset management systems and practices to improve asset management. (See appendix II for the pilot project recipients and the funding each received.) Massachusetts Bay Transportation Authority received \$950,000 for a pilot project. Objectives of the pilot included improving the agency’s state-of-

good-repair database, using asset data to project asset conditions over time for alternative-funding scenarios, improving the agency's current project prioritization process, and using asset management system outputs to articulate a compelling argument for funding more state-of-good-repair infrastructure projects. Results of these pilot projects are expected to be available in 2013, according to FTA officials.

To enhance transit asset management techniques, data collection, and analysis, FTA developed a decision support tool, TERM Lite, for use by transit agencies. TERM Lite can help transit agencies better estimate capital investment needs and prioritize investments. FTA is modifying the model to meet agency planning needs by having two transit agencies—Chicago's Regional Transportation Authority of Northeastern Illinois and the Los Angeles County Metropolitan Transportation Authority—test the software. FTA also engaged the Transportation Research Board to review FTA's transit asset model; this review was completed in 2013.

Other DOT modal administrations have recognized the importance of implementing leading practices in asset management. We contacted the FRA, MARAD, and FHWA and officials at each agency indicated that they require asset management approaches for certain programs. For example, AMTRAK, as an FRA grantee, is required to develop a comprehensive asset management process, according to an FRA official. MARAD uses an automated commercial program to manage the maintenance of its Ready Reserve Force vessels that are used to support rapid federal responses to national emergencies. FHWA has been a long-time proponent of leading asset management practices, according to agency officials. FHWA supports state and local agency use of American Association of State Highway and Transportation Officials' (AASHTO) 2011 asset management guide for transportation agencies. Furthermore, FHWA created a suite of economic analysis tools to help highway agencies rank and select projects based on established criteria. FHWA also provides technical assistance on asset management to highway agencies by providing studies, training, a task group of outside experts that promotes the use of leading asset management practices and a series of asset management webinars for interested stakeholders. FTA officials said they looked to FHWA as an agency with experience promoting asset management. For example, FTA officials said they got the idea of developing TERM Lite from a similar tool developed at FHWA. FTA's asset management guide also cites the asset management guide developed for highway agencies by AASHTO as a significant source of asset management knowledge.

Additional Research Could Help Transit Agencies Better Measure the Effects of Capital Investments

While TERM Lite projects asset investment backlogs and funding needed for a transit system to reach a state of good repair, it does not measure some important effects of capital investment. An asset management consultant specializing in highway and transit modeling told us that measuring the effects of capital investment decisions on ridership would be difficult, but not impossible. A limited number of case studies have been conducted in the past and more recently that examine the difficult-to-estimate effect of capital investment decisions on on-time service and ridership.

- In 2009, several researchers studied how capital investment decisions to rehabilitate New York City's transit aging assets led to an improvement in ridership. From the early 1980s through the end of 2008, New York City's Metropolitan Transportation Authority invested an estimated \$74 billion in New York City Transit and other Metropolitan Transportation Authority properties. For New York City Transit, this translated into the rehabilitation or replacement of approximately 6,000 rail cars, 700 miles of track, and 200 stations. Among other positive effects from these capital investments, Metropolitan Transportation Authority increased its ridership 58 percent from 1982 to 2007 for all properties, in contrast to a 17 percent reduction in the 1970s.

Researchers have also examined the effects of capital investment decisions on ridership in the Chicago area.

- In 2005, researchers examined the negative effects of deferring investments in aging assets. For example, Chicago Transit Authority experienced a decline in ridership when it decided to defer rehabilitation and replacement investments to the Douglas Branch of its Blue Line (now the Pink Line). This branch was originally built in 1896, but by the late 1990s, the physical conditions of the branch had deteriorated, causing trip times to increase from 25 to 45 minutes and ridership to drop by 50 percent.
- Some academics at the Chaddick Institute for Metropolitan Development have suggested that minimal capital investment in a transit agency's backlog decreases reliability of service, which should result in ridership losses of at least 15 to 20 percent relative to today's levels. Moreover, these researchers determined that every \$1 invested to help bring the Chicago area transit system into a state of good repair generated a return of between \$1.30 and \$1.90.

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- A 2011 study conducted by the University of Illinois-Chicago explored the effects of “slow zones” on the Chicago Transit Authority rail lines. The study concluded that delays have a significant effect on ridership. Moreover, the study concluded that the deterioration of the transit system will impose costs on existing highway and transit users of more than \$500 million annually, primarily as a result of higher travel times and congestion. This equates to at least \$175 per household within the region annually.

TCRP has taken important steps to support transit agencies in their efforts to determine the effect of capital investment decisions. As previously mentioned, TCRP has developed an initial framework for prioritizing capital investment decisions and models that transit agencies can use to determine the effect of capital investment decisions on on-time service, such as delays.²⁵ For example, the *TCRP Report 157* describes a vehicle model for buses and rail cars that links accumulated vehicle mileage to breakdowns and failures to predict passenger delay.²⁶ This model assumes a certain passenger volume plus passengers’ waiting at upcoming stops and then asks how much delay these passengers would face if a vehicle failure occurred. According to two asset management consultants whom we interviewed, *TCRP Report 157* models that determine some effects of capital investment decisions on on-time service, such as passenger delays, could be incorporated into TERM Lite model for buses and rail cars. However, the consultants also indicated that the models in the report would require further testing. Thus, further research and testing could be helpful.

FTA has also recognized the importance of determining the effects of capital investment decisions and has undertaken various initiatives to help transit agencies assess these effects. For example, according to FTA’s asset management guide, predicting the effects of capital

²⁵According to *TCRP Report 157*, these models provide guidance on when to perform rehabilitation and replacement actions, calculate the economic benefits of rehabilitation and replacement, and calculate a prioritization index that is used to select the set of capital investment decisions that maximize benefits.

²⁶The vehicle model uses information on a bus or rail vehicle fleet to estimate the cost-minimizing point at which to replace a vehicle, as well as to predict the priority for replacing the vehicles in a fleet as a function of age. The model considers transit agency rehabilitation costs, energy or fuel costs, user costs of delay resulting from road calls for buses or failures for rail, and potential savings a transit agency may obtain from new vehicles.

investment decisions through modeling tools would allow transit agencies to prioritize their capital investment projects more effectively. The guide also delineates initial steps and key implementation principles a transit agency can take. Further, the asset management guide also promotes developing criteria that demonstrate the link between capital investments and overall transit system outcomes and asserts that doing so provides internal and external stakeholders clear justification for capital investment decisions. Further, FTA officials told us that they will require transit agencies that have completed a state-of-good-repair project to report some of the effects of the federal grants they have received, including ridership effects. In addition, FTA officials said they are open to further developing ways to assess the effects of capital investment decisions, including ridership effects.

While FTA has acknowledged the importance of examining effects of capital investment decisions and has delineated some key steps to take, additional research would help agencies understand more thoroughly the effects of investment decisions. For example, a potential analysis that measures the effect on ridership would incorporate various factors including: fares, average travel times, and average travel time variability. Although predicting the effects of capital investments may take some time for FTA to develop, understanding these effects is an important part of helping transit agencies prioritize capital investment decisions. Without fully understanding the effects of capital investments, including those on ridership, transit agencies may limit their ability to prioritize capital investment decisions in a way that ensures they ultimately optimize limited transit funding.

Conclusions

Improved transit asset management is important because of the 1) large backlog of transit assets that are already beyond their useful lives, 2) increasing demand for transit services, and 3) financial strains due to rising fuel prices and decreased state and local funding. Moreover, transit agencies that measure and quantify the effects of their capital investment decisions are likely to make a stronger case for additional state-of-good-repair funding from state and local decision-makers. However, transit agencies vary regarding the extent to which they have implemented leading practices in asset management. Some transit agencies use scoring criteria to help rank capital projects and prioritize funding, while others face challenges collecting asset condition and performance data or monitoring or analyzing asset condition and performance. Others have developed sophisticated data systems and analysis techniques to monitor their current asset conditions and estimate future capital investment needs. Transit agencies also vary in the extent to which they measure the

effects of investment on state-of-good-repair backlog, on-time service, and asset conditions. However, according to various transit officials, transit agencies do not measure the effects of investments on ridership because of the lack of tools that address the complicated relationship between investment decisions and ridership.

MAP-21 directed FTA to develop certain asset management requirements for all recipients of federal transit program funds. These requirements include a transit asset management plan, minimum transit inventory data, and annual condition assessments. FTA has been developing guidance to help transit agencies implement leading practices in asset management and a decision support tool to project investment needs and prioritize investments. As FTA completes these endeavors, transit agencies may be better equipped to implement current leading practices in asset management and comply with future transit asset management requirements envisioned by MAP-21.

Ensuring that transit infrastructure is in a state of good repair is essential for sustaining and increasing transit ridership. While tools exist that help some transit agencies identify their asset investment backlog, transit agencies could better prioritize their capital investment decisions knowing how their investments relate to future ridership. This capability would require new research to account for other variables besides capital investment decisions that also affect future ridership. This research, if successful, could support the development of a tool that would help transit agencies better prioritize their capital investment decisions and optimize their use of limited transit funding.

Recommendation for Executive Action

To equip transit agencies with the ability to make more effective capital investment decisions that optimize the use of limited transit funding, we recommend that the Secretary of the Department of Transportation direct the Administrator of the Federal Transit Administration to conduct additional research to help transit agencies measure the effects of capital investments, including future ridership effects.

Agency Comments

We provided copies of a draft of this report to U.S. Department of Transportation (DOT) for its review and comment. DOT did not agree or disagree with the recommendation.

We are sending copies of this report to interested congressional committees and the Secretary of the Department of Transportation. In addition, this report will be available at no charge on GAO's website at <http://www.gao.gov>.

If you or your staff have any questions or would like to discuss this work, please contact me at (202) 512-2834 or wised@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Individuals making key contributions to this report are listed in appendix VI.

A handwritten signature in black ink that reads "David J. Wise". The signature is written in a cursive, flowing style.

Dave J. Wise
Director
Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

This report provides information on (1) the extent selected transit agencies follow leading practices in asset management to prioritize capital investment decisions, and related challenges they face; (2) the extent selected transit agencies measure the effects of capital investment decisions on their state-of-good-repair backlog, condition of assets, on-time service, and ridership; and (3) Federal Transit Administration (FTA) initiatives to support transit agencies' use of leading practices, and what additional actions, if any, could be taken. To address these objectives, we defined "capital investment decisions" to refer only to those decisions related to rehabilitating or replacing a transit agency's existing assets even though agencies can use capital funding for new transit infrastructure or expansion projects such as a transit line extension.

To determine the extent selected transit agencies follow leading practices in asset management to prioritize capital investment decisions, and the challenges they face, we reviewed agencies by conducting site visits and interviews, examining documents, and consulting relevant literature. We selected agencies for review in two ways: 1) using a selection process described below for transit- agency site visits, and 2) reviewing transit agency case studies included in two key reports we identified through a comprehensive literature review. In our report, we refer to both types of agencies we selected for review as agencies we "reviewed."

The site selection process we used was intended to yield a range of transit agencies of various sizes managing a variety of transit modes. We selected nine transit agencies using FTA data, including the transit mode(s) offered by the agencies and their size, based on annual ridership and the number of bus and/or rail vehicles available at each agency. We also considered the transit agencies' experience with asset management practices as reflected in a literature review and interviews with industry stakeholders, and—because the extent of each agency's state-of-good-repair backlog is not reported by FTA—the average age of vehicle fleets as reflected by FTA data. While the information obtained from these transit agencies cannot be generalized to all transit agencies, it provides insights into a range of experiences related to how agencies make capital investment decisions, the practices they follow, and the challenges they face. Throughout this report, we refer to these nine transit agencies as agencies we "visited." For each site visit, we conducted, summarized, and

analyzed in-depth interviews with officials from the nine multimodal and bus-only transit agencies¹ that we visited, as follows:

- Detroit Department of Transportation (Detroit, Michigan);
- Gwinnett County Department of Transportation (greater Atlanta, Georgia area);
- Long Beach Transit (Long Beach, California);
- Los Angeles County Metropolitan Transportation Authority (Los Angeles, California);
- Massachusetts Bay Transportation Authority (Boston, Massachusetts);
- Metropolitan Atlanta Rapid Transit Authority (Atlanta, Georgia);
- Southern California Regional Rail Authority, operator of Metrolink Commuter Rail Service (Metrolink) (greater Los Angeles, California area);
- Suburban Mobility Authority for Regional Transportation (Detroit, Michigan); and
- Washington Metropolitan Area Transit Authority (Washington, District of Columbia)

We also conducted a literature review and to select, review, and analyze reports that contained current examples of transit agencies and other entities that use asset management leading practices and measure the effects of capital investment decisions. Our literature review identified two key reports that we deemed sufficiently reliable to use as criteria for our report:

- *FTA's Asset Management Guide: Focusing on the Management of Our Transit Investments*. The guide combines knowledge and standards of practice from existing asset management guides, leading practices at transit agencies, and ideas from the transit industry on addressing common asset management challenges.
- *Transit Cooperative Research Program (TCRP) Report 157, State of Good Repair: Prioritizing the Rehabilitation and Replacement of Existing Capital Assets and Evaluating the Implications for Transit* (Sponsored by FTA). The report combines a review of state-of-

¹While some agencies we visited operate secondary modes of transit, such as water taxis, we did not address asset management for those other modes of transit, and so for the purposes of this report, we refer to these agencies as "bus-only."

good-repair practices, a framework containing a set of steps for transit agencies to follow, and an analytical approach and set of spreadsheet tools designed to support the framework.

We analyzed leading practices from these two reports and synthesized the practices into three broad categories based on previous GAO work:² (1) Planning, (2) Information and Data Systems, and (3) Ranking Capital Projects Based on Established Criteria. (See table 1, below, for a chart of this synthesis.) For comparison, we also summarized the key requirements related to these leading practices from the Moving Ahead for Progress in the 21st Century (MAP-21) legislation. In addition, we conducted a high-level content analysis of the interviews we conducted to categorize the challenges, faced by transit agencies we visited, in following asset management leading practices and quantified their frequency.

Table 1: Leading Practices for Prioritizing Transit Capital Investment Decisions, by Category, Based on Administrative, Industry, and Legislative Sources

Leading practice category	Planning	Information and data systems	Ranking capital projects based on established criteria
Administrative FTA Asset Management Guide Framework: Necessary Business Processes	Establish: - Policy - Strategy - Planning	- Manage asset data in an inventory - Monitor asset condition and performance - Develop life-cycle management plans	Establish a capital planning and programming process that includes simple, quantifiable, agreed-upon prioritization criteria that link capital investments to agency outcomes
Industry TCRP Report 157: <i>Process for Evaluating and Prioritizing Transit Asset Rehabilitation and Replacement</i>	Develop capital investment plan reflecting transit agency priorities	- Collect data - Analyze asset condition and performance	- Generate rehabilitation and replacement alternatives - Define investment scenarios - Prioritize projects
Legislative MAP-21 Requirements in Public Law 112-141 (Sec. 20019. Transit Asset Management)	As part of a national transit asset management system, FTA will require recipients and subrecipients of federal financial assistance to develop transit asset management plans for their public transportation systems	As part of a national transit asset management system, FTA will require designated recipients of federal financial assistance to report on the condition of their public transportation systems and describe any changes in those conditions	As part of a national transit asset management system, FTA will develop an analytical process or decision support tool for use by public transportation systems that allows for the estimation of capital investment needs over time and assists with asset investment prioritization

Source: GAO analysis.

²GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-31](#) (Washington, D.C., December 1998).

After synthesizing the leading practices, we reviewed the two reports for examples of transit agencies and other entities cited for using leading asset management practices in the three categories above and selected examples to include in our report. We did not visit these agencies or interview officials from them. The nine agencies whose practices we reviewed were:

- Amtrak,³
- Bay Area Rapid Transit,
- Chicago Transit Authority,
- King County Metro Transit,
- London Underground,
- New York City's Metropolitan Transportation Authority,
- San Francisco Bay Area's Metropolitan Transportation Commission,
- Santa Clara Valley Transportation Authority, and
- Regional Transportation Authority of Northeastern Illinois.

Throughout this report we refer to these nine agencies, plus the agencies we visited, as agencies we “reviewed.”

To determine the extent selected transit agencies measure the effects of capital investment decisions on their state-of-good-repair backlog, condition of their assets, on-time service, and ridership, we used the methods described above, and we reviewed other reports and presentations that we determined were sufficiently reliable for our purposes. We also interviewed officials from FTA and other U.S. Department of Transportation (DOT) modal administrations including the Federal Highway Administration (FHWA), the Federal Railroad Administration (FRA), and the Maritime Administration (MARAD). In addition, we interviewed industry stakeholders, including representatives from the American Public Transportation Association (APTA), the Community Transportation Association of America (CTAA), the Transportation Research Board (TRB), the Transportation Asset Management Expert Task Group, and asset management consultants.

³Amtrak, although federally established and unable to operate without substantial federal subsidies to remain solvent, is not a government agency, but rather a private, for-profit corporation. GAO, *Amtrak Management: Systemic Problems Require Actions to Improve Efficiency, Effectiveness, and Accountability*, [GAO-06-145](#) (Washington, D.C.: October 2005).

To determine FTA initiatives to support transit agencies' use of leading practices, and what additional actions, if any, could be taken, we interviewed officials at FTA, FHWA, FRA, and MARAD. We reviewed FTA reports, testimonies, and presentations regarding transit asset management. We also reviewed FTA's guidance and regulations regarding transit asset management, and we reviewed pertinent federal legislation and notices pertaining to state of good repair and transit asset management requirements and funding including: MAP-21; the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU); and the American Recovery and Reinvestment Act (Recovery Act).

Appendix II: FTA's Transit Program Funding for Capital Reinvestment Projects

Funding for transit capital reinvestment, such as repair, rehabilitation, and replacement of assets was authorized through surface transportation reauthorization acts, as well as made available through other sources. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) and subsequent extensions to SAFETEA-LU authorized funds for transit-related grant programs from fiscal year 2005 through fiscal year 2012, and the Moving Ahead for Progress in the 21st Century Act (MAP-21) authorized funds for transit-related grant programs for fiscal year 2013 and fiscal year 2014. In addition, the Passenger Rail Investment and Improvement Act of 2008 (PRIIA) authorized funds for transit capital investment, and the American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated funds for discretionary multi-modal grants as well as funds that were distributed under rules governing existing transit-related formula grant programs.

FTA Apportionments for Transit Formula Grant Programs

SAFETEA-LU and extensions to SAFETEA-LU authorized funds for transit-related formula grant programs from fiscal year 2005 through fiscal year 2012. The Recovery Act also appropriated funds that could be used for transit capital investment, which were distributed under rules governing existing grant programs. From fiscal year 2005 through fiscal year 2012, approximately \$59.6 billion was apportioned from these two sources that could potentially be used for capital reinvestment. Table 2 shows these FTA apportionments for transit formula grants that could be used for transit capital reinvestment projects.

Table 2: FTA Apportionments between Fiscal Year 2005 and 2012 that Could Be Used for Capital Reinvestment (Dollars in Millions)

FTA Grant Program	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Total
Urbanized Area Formula Grants 49 U.S.C. § 5307	\$3,575	\$3,414	\$3,584	\$3,891	\$9,538 ^a	\$4,126	\$4,530	\$4,541	\$37,199
Other than Urbanized Area Formula Program 49 U.S.C. § 5311	250	367	386	416	1,098 ^a	438	513	514	3,982
Growing States and High Density States Formula 49 U.S.C. § 5340		\$384	\$404	\$438	\$1,140 ^a	\$464			2,830
Fixed Guideway Modernization	\$1,193	\$1,317	\$1,434	\$1,555	\$2,393 ^a	\$1,647	\$1,650	\$1,656	12,843

**Appendix II: FTA's Transit Program Funding
for Capital Reinvestment Projects**

FTA Grant Program	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Total
Formula Grants for Special Needs of Elderly Individuals and Individuals with Disabilities 49 U.S.C. § 5310	95	110	117	127	136	134	133	133	986
Job Access and Reverse Commute Formula Grants ^b 49 U.S.C. § 5316		137	144	156	183	175	175	176	1,146
New Freedom Program ^b 49 U.S.C. § 5317		77	81	87	101	99	99	101	646
Total	<u>\$5,112</u>	<u>\$5,806</u>	<u>\$6,149</u>	<u>\$6,669</u>	<u>\$14,588</u>	<u>\$7,083</u>	<u>\$7,101</u>	<u>\$7,121</u>	<u>\$59,630</u>

Source: FTA.

^aThis number includes 2009 Recovery Act apportionments.

^bThis program repealed by MAP-21.

Urbanized Area Formula Grants and the Other Than Urbanized Area Formula Program: Two grant programs that transit agencies could use for capital projects, including recapitalization of existing assets, were the Urbanized Area and Other than Urbanized Area formula programs. These funds could be used for transit system expansion projects as well as reinvestment in existing transit agency assets. From fiscal year 2005 through fiscal year 2012, apportionments for these programs provided over \$35.1 billion for transit programs (\$31.8 billion from the Urbanized Area program plus \$3.3 billion from the Other than Urbanized Area program). In addition, in 2009, Recovery Act apportionments provided \$5.4 billion through the Urban Area Formula Program and \$660 million through the Other than Urbanized Area Formula program to support transit projects. Both programs were also supplemented by the Growing States and High Density States Formula program. Apportionments for this program totaled \$2.8 billion, including Recovery Act apportionments of \$675 million.

Fixed Guideway Modernization: This program provided funds that transit agencies could use for capital projects to modernize or improve existing fixed guideway systems, including purchase and rehabilitation of rolling stock, track, line equipment, structures, signals and communications, power equipment and substations, passenger stations and terminals, security equipment and systems, and maintenance facilities and equipment. From fiscal year 2005 through fiscal year 2012, apportionments for this program totaled \$12.8 billion (including Recovery Act apportionments of \$743 million).

Specialized Transit Programs: Three grant programs were designed to improve mobility and job access for welfare recipients and low income persons, and provide transportation options for senior citizens and individuals with disabilities. These were the Formula Grants for Special Needs of Elderly Individuals and Individuals with Disabilities, the Job Access and Reverse Commute Formula Grants, and the New Freedom Program. Funds from these programs could be used for capital expenses. Altogether, apportionments for these three programs from fiscal year 2005 through fiscal year 2012 totaled \$2.8 billion.

**FTA's Discretionary
Funding for Transit
between Fiscal Year 2005
and Fiscal Year 2012 That
Could Be Used for Capital
Reinvestment**

Bus and Bus Related Equipment and Facilities Program: The Bus and Bus Related Equipment and Facilities program provided capital assistance for new and replacement buses, related equipment, and facilities. It was a discretionary program to supplement formula funding in both urbanized and rural areas. From fiscal year 2005 through fiscal year 2012, a total of \$7 billion was allocated for this program.

Public Transportation on Indian Reservations: This program provided funding to federally recognized tribes for supporting tribal public transportation in rural areas. Tribes could use the funding for capital operating, planning and administrative expenses. From fiscal year 2006 through fiscal year 2012, \$108 million was made available for this program from the Formula Grants for Other Than Urbanized Areas program.

Transit Asset Management Pilot Program: The Consolidated Appropriations Act for fiscal year 2010 made \$5 million of research funding available to develop standards for asset management plans, provide technical assistance, improve data collection, and conduct a pilot program designed to identify the best practices of asset management.¹ In 2011, FTA awarded \$4 million for six transit asset management pilot projects. Recipients of these funds were:

- Peninsula Corridor Joint Powers Board (Caltrain), \$750,000;
- Valley Regional Transit (Ada and Canyon counties, Idaho), \$300,000;

¹Pub. L. No. 111-117, div. A, title I, 123 Stat. 3034, 3062.

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- Regional Transportation Authority of Northeastern Illinois (Chicago), \$800,000;
 - Massachusetts Bay Transportation Authority, \$950,000;
 - Utah Transit Authority, \$500,000; and
 - Virginia Department of Rail and Public Transportation, \$700,000.²

Grants to the Washington
Metropolitan Area Transit
Authority

PRIIA authorized funds for capital and preventive maintenance projects at the Washington Metropolitan Area Transit Authority —\$1.5 billion over 10 years.³ The first appropriation for this program—\$150 million—was provided by the Consolidated Appropriations Act for fiscal year 2010.⁴

Department of
Transportation (DOT)
Discretionary Grants
under the Recovery Act

The Recovery Act provided \$1.5 billion for the DOT's Transportation Investment Generating Economic Recovery (TIGER) discretionary grants. Projects eligible for TIGER grants included, but were not limited to, road, rail, transit and port projects. Each project was multi-modal, multi-jurisdictional or otherwise challenging to fund through existing programs, according to DOT. Beginning with fiscal year 2010, subsequent annual appropriations acts continued funding for the TIGER grant program, though at a reduced level. The appropriation acts for fiscal year 2010 through 2012 provided \$1.6 billion for TIGER grants. Among the 40 to 50 TIGER grants that DOT awarded each year from fiscal year 2009 through fiscal year 2012 were projects that involved transit. For example, in 2012, the Chicago Transit Authority received a \$20 million TIGER grant for infrastructure updates and repairs to a major rail and bus station.

Moving Ahead for Progress
in the 21st Century Act
(MAP-21)

MAP-21 authorized \$8.5 billion for fiscal year 2013 and \$8.6 billion from the Mass Transit Account of the Highway Trust Fund for transit-related formula grants. FTA apportionments for transit programs that were potentially available for transit capital reinvestment totaled \$8.2 billion for

²Virginia Department of Rail and Public Transportation has yet to execute its grant.

³Pub. L. No. 110-432, div. B, title VI, §601(f), 122 Stat. 4848, 4970 (Oct. 16, 2008).

⁴Pub. L. No. 111-117, div. A, title I, 123 Stat. 3034, 3063 (Dec. 16, 2009).

fiscal year 2013. The fiscal year 2013 authorization total excludes the emergency relief for transit systems affected by Hurricane Sandy.⁵

⁵The Disaster Relief Appropriations Act, 2013, Pub. Law 113-2, div.A, 127 Stat. 4, 35 (Jan. 29, 2013), provided \$10.9 billion for FTA's Public Transportation Emergency Relief Program for recovery and relief efforts in the areas most affected by Hurricane Sandy. However, as a result of the Budget Control Act of 2011 (Pub. L. No. 112-25), 5 percent of the \$10.9 billion made available under the Appropriations Act (\$545,000,000) is subject to the significant spending cuts known as sequestration and is unavailable for Hurricane Sandy Disaster Relief. See 78 Fed. Reg. 19357 (Mar. 29, 2013).

Appendix III: Description of Transit Assets

Transit assets can refer to fixed long-life physical assets (including, for example, station structures, tunnels, and facilities) and equipment such as bus and rail vehicles (see table 3).

Table 3: Transit Asset Categories and Types

Asset category	Asset type	Asset category	Asset type
Vehicles	Buses	Facilities	Administration
	Cars		Maintenance
	Trucks		Storage
	Vans		Maintenance equipment
	Heavy rail cars	Systems	Train control
	Light rail vehicles		Electrification
	Locomotives		Communications
	Commuter rail cars		Revenue collection
	Cable cars		Utilities
	Ferries		Drainage
			Ventilation
Fixed Guideway	Track	Stations	Station structures
	Special track work		Bus shelters
	Third rail		Elevators/escalators
	Catenary		Parking garages/lots
	Tunnels		Pedestrian walkways
	Elevated structures		Platforms
	Right-of-way		Signage and graphics

Source: Transit Cooperative Research Program's *Report 157*.

Appendix IV: Do Selected Transit Agency Capital Programs Contain Capital Investment Project-Scoring Criteria?

In each site visit to nine transit agencies, GAO gathered information on whether and how each agency uses project-scoring criteria to inform their capital investment decision processes. The following table summarizes which of the nine agencies use criteria, the criteria used, and further information on why other criteria are not used. Eight of the nine agencies we visited named safety as the most important project selection criteria, regardless of whether safety was included as a scoring category or not, and said projects deemed important to safety took immediate priority over all others.

Table 4: Do Selected Transit Agency Capital Programs Contain Capital Investment Project-Scoring Criteria?

Transit agency capital program	Does program contain project-scoring criteria for investment prioritization?	If yes, description of project scoring criteria category and weight of score for each category If no, agency descriptions of capital program processes
Multimodal agencies		
Los Angeles County Metropolitan Transportation Authority Capital Budget Process	Yes	- Is project mission critical? – 20% - Is project a safety enhancement? – 15% - Does project fulfill a legal mandate or board resolution? – 15% - Does project demonstrate readiness to utilize funds as scheduled? – 15% - Does project support or further strategic plan? – 15% Does project provide a replacement of an existing asset? – 10% - Is project justified by a cost benefit analysis? – 5% - Has scope of work been adequately understood? – 5%
Massachusetts Bay Transportation Authority Capital Investment Program	Yes	- Cost/Benefit – 20% - Legal commitment – 20% - Operations impact – 20% State of good repair – 20% - Health – 10% - Environment – 10%

Appendix IV: Do Selected Transit Agency
Capital Programs Contain Capital Investment
Project-Scoring Criteria?

Transit agency capital program	Does program contain project-scoring criteria for investment prioritization?	If yes, description of project scoring criteria category and weight of score for each category
		If no, agency descriptions of capital program processes
		Category GAO determined is most directly related to "state of good repair" is in bold
Metropolitan Atlanta Rapid Transit Authority Capital Improvement Program Decision Model	Yes	Agency officials reported that they assign asset condition codes on a 5-point scale and asset priority codes on a 7-point scale, which they use to help them rank and prioritize projects for the annual capital budget process. In 2012, they acquired and began using a decision-making software tool that uses the following criteria: • Sustaining assets – 35% • Continuous improvement to customer service – 20% • Funding optimization – 15% • Financial impact – 10% • Project deliverability – 10% • Environmental stewardship and sustainability – 5% • Regional and other collaboration opportunities – 5%
Washington Metropolitan Area Transportation Authority Capital Needs Inventory	No	Agency does not currently link its four agency strategic goals to project scoring criteria, but has plans to develop weighted scoring criteria for the following strategic goals: • Build and maintain a premier safety culture and system • Meet or exceed customer expectations by consistently delivering quality service • Improve regional mobility and connect communities • Ensure financial stability and invest in our people and assets Agency officials said that in the past they have used project-scoring criteria based on agency goals to prioritize capital needs and demonstrate potential impacts.

Appendix IV: Do Selected Transit Agency
Capital Programs Contain Capital Investment
Project-Scoring Criteria?

Transit agency capital program	Does program contain project-scoring criteria for investment prioritization?	If yes, description of project scoring criteria category and weight of score for each category
		If no, agency descriptions of capital program processes
		Category GAO determined is most directly related to "state of good repair" is in bold
Bus agencies		
Detroit Department of Transportation Transportation Improvement Plan	No	Agency uses "Asset Works" software to help prioritize investment decisions. Officials said they would like to have a system where they can assign factors to help them weigh different potential capital projects against each other; however, they do not have that capability currently. Rather, management currently examines the trade-offs between different capital projects and makes prioritization decisions.
Gwinnett County Transit Annual Budget Process	No	Agency considers itself relatively small and its maintenance needs fairly straightforward. In general, maintenance schedules dictate repair and replacement activities.
Long Beach Transit ^a Capital Call for Projects	Yes	Long Beach Transit uses project-scoring criteria, but the categories are not included in this chart for space reasons. The agency takes into account the potential impacts of an asset's failure when prioritizing projects through the concept of "asset criticality." The agency calculates asset criticality codes ranging from 1 to 25, with 25 being the most critical, and most in need of repair or replacement. Officials assign a value between 1 and 5 for an asset's likelihood of failure, with 5 being the most likely to fail, and multiply that number by a similar value between 1 and 5 for an asset's severity of failure, with 5 being the most severe impact an asset's failure would have on the agency's operation, people, or finances, or on the environment in which the agency operates. Managers then rank and prioritize funding for all capital projects based on the code.

**Appendix IV: Do Selected Transit Agency
Capital Programs Contain Capital Investment
Project-Scoring Criteria?**

Transit agency capital program	Does program contain project-scoring criteria for investment prioritization?	If yes, description of project scoring criteria category and weight of score for each category
		If no, agency descriptions of capital program processes
		Category GAO determined is most directly related to “state of good repair” is in bold
Suburban Mobility Authority for Regional Transportation Capital Budget Program	No	Agency coordinates capital project priorities when preparing for the agency’s State DOT application for upcoming federal projects and priorities, and prepares a capital budget program, which it presents to its Board for approval. Agency’s top factor for prioritizing the replacement of revenue vehicles is mileage, due to the sound correlation of that factor to maintenance costs and downtime.
Commuter rail agencies		
Metrolink (operated by Southern California Regional Rail Authority) Strategic Capital Planning Process	No	Individual Metrolink departments determine their annual rehabilitation and replacement needs, develop scope and budget for each project, and prioritize those projects. Metrolink’s Strategy and Capital Planning Group then creates a master priority list and matches available funds to the list. The final list of projects to be activated is then reviewed by Member Agencies and the Metrolink Board. Note: Metrolink stopped using the following scoring criteria for its master priority list in 2012 (for an explanation of the reason, see the “Challenges” section of this report): • Service Reliability – 28% • Efficiency – 27% • Growth (Capacity) – 21% • Safety – 17% • Environmental – 7%

Source: GAO analysis.

^aTransit agency also provides other types of transit services, but our site visit focused on the type of transit service indicated.

Appendix V: FTA Reports on Transit Assets, 2008 through 2011

FTA issued a series of reports on transit asset management from 2008 through 2011. These reports identified leading transit asset management practices, including goal setting for strategic planning; collecting and analyzing good data on asset performance, conditions, and costs; and, ranking investment projects based on established criteria. These reports, as shown in table 5, showed significant backlogs of needed transit improvements and limited use of leading asset management practices by transit agencies.

Table 5: Federal Transit Administration's Reports on Transit Asset Conditions and the State of Transit Asset Management Practices, 2008 to 2011

Report	Asset backlog	Transit agencies' limited use of leading practices
<i>Transit State of Good Repair: Beginning the Dialogue</i> (October 2008)	Roughly one-quarter of the nation's bus and rail assets are in marginal or poor condition.	Most U.S. transit agencies utilize a maintenance management system to track and schedule maintenance activities for transit assets. While these systems are designed for all asset types, most agencies only enter asset inventory data for their revenue vehicle fleets, repair equipment and maintenance facility components. Few agencies use these systems for other asset types such as stations, traction power and train control systems, or track work.
<i>Rail Modernization Study: Report to Congress</i> (April 2009)	Estimated \$50 billion (\$2008) state-of-good-repair backlog at the largest seven rail transit agencies.	Agencies tend to rely on prioritization processes that are both informal (i.e., the process is not well-defined) and implicit (the agencies' investment goals and objectives are not explicitly stated or defined). Decision support tools are not yet widely used by transit operators.
<i>Transit Asset Management Practices-A National and International Review</i> (June 2010).		U.S transit agencies generally can improve asset management practice in terms of aligning policy goals and objectives with achieving a state of good repair, establishing condition and performance measures that communicate asset conditions, and developing the systems and processes that can best optimize scarce agency funds for preservation and improvement of transit assets.
<i>National State of Good Repair Assessment</i> (June 2010)	\$77.7 billion national transit state-of-good-repair backlog	None of the 16 sampled agencies possesses fully developed capital planning asset inventories. Only 1 of the 23 agencies contacted for the Rail Modernization and National State of Good Repair Assessment studies currently maintains a decision support tool permitting these types of analyses.
<i>State of Good Repair Initiative: Report to Congress</i> (December 2011)	A significant portion of the nation's public transportation assets are in need of capital reinvestment due to the historically inadequate level of financial resources from all sources available for maintenance and asset replacement	Many transit agencies lack the technical ability to set appropriate recapitalization priorities. Most transit agencies also lack effective asset condition assessment tools and systems.

Source: FTA.

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

Dave J. Wise, (202) 512-2834 or wised@gao.gov

Staff Acknowledgments

In addition to the contact named above, Cathy Colwell and Sara Vermillion (Assistant Directors), Richard Calhoon, Kathy Gilhooly, Gary Guggolz, DuEwa Kamara, Hannah Lafe, Amanda Miller, Tina Paek, and Amy Rosewarne made key contributions to this report.

Related GAO Products

Public Transportation: Washington Metro Could Benefit from Clarified Board Roles and Responsibilities, Improved Strategic Planning. [GAO-11-660](#). Washington, D.C.: June 30, 2011.

Rail Transit: FTA Programs Are Helping Address Transit Agencies' Safety Challenges, but Improved Performance Goals and Measures Could Better Focus Efforts. [GAO-11-199](#). Washington, D.C.: January 31, 2011.

Public Transportation: Transit Agencies' Actions to Address Increased Ridership Demand and Options to Help Meet Future Demand, [GAO-11-94](#). Washington, D.C.: November 30, 2010.

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