



July 2019

# RAIL TRANSIT

## Federal Transit Administration Could Improve Information on Estimating Project Costs

# GAO Highlights

Highlights of [GAO-19-562](#), a report to congressional committees

## Why GAO Did This Study

Rail transit projects are complex, and challenge sponsors to maximize limited resources. To help project sponsors build new or extend existing transit projects, Congress appropriated about \$2.65 billion for FTA's 2019 Capital Investment Grants program.

Congress included a provision in a committee report for GAO to evaluate factors affecting the costs to build transit projects. This report examines: (1) stakeholders' views on factors that affect rail transit project costs, (2) stakeholders' views on approaches sponsors have used to manage costs, and (3) the extent to which FTA's cost estimating information for sponsors aligns with best practices in GAO's *Cost Guide*. GAO interviewed academic, construction, and other stakeholders identified through a literature search and referrals. GAO conducted case studies of four U.S. rail transit projects that received FTA grants and that were selected to obtain variation in transit mode, location, and other characteristics, and compared their approaches to GAO-identified key project management principles. GAO also interviewed FTA officials and compared FTA's cost estimating information with GAO's best practices.

## What GAO Recommends

FTA should (1) ensure that FTA's cost estimating information is consistent with all 12 steps in GAO's *Cost Guide* for developing reliable cost estimates and (2) provide a central, accessible source of cost estimating information for project sponsors. FTA partially concurred with the first and concurred with the second recommendation. GAO believes FTA should fully implement both recommendations.

View [GAO-19-562](#). For more information, contact Susan Fleming at (202) 512-2834 or [flemings@gao.gov](mailto:flemings@gao.gov).

July 2019

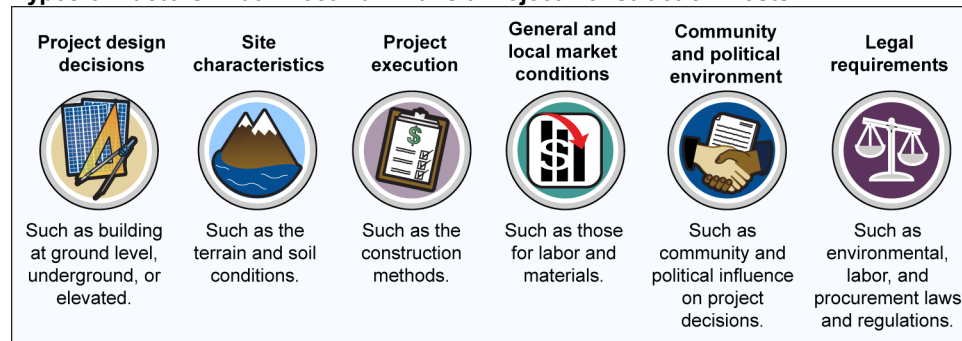
## RAIL TRANSIT

### Federal Transit Administration Could Improve Information on Estimating Project Costs

## What GAO Found

Rail transit construction project sponsors, typically state or local government entities, have a vested interest in controlling costs. Stakeholders GAO interviewed identified a variety of factors that affect a rail transit construction project's costs (see figure).

#### Types of Factors That Affect Rail Transit Project Construction Costs



Source: GAO analysis of interviews with transit project stakeholders. | GAO-19-562

Project sponsors and other stakeholders identified various approaches sponsors have used to manage a project's costs. These approaches align with key project management principles GAO identified: (1) ensuring management capability; (2) making informed procurement decisions; (3) managing risk; and (4) managing stakeholder relationships. For example, sponsor officials and a contractor's representative from one GAO case study said they managed risk by cooperating to purchase steel materials early in the project to reduce the risk of additional steel price increases.

The Federal Transit Administration's (FTA) cost estimating information for sponsors aligns with many best practices, but FTA could improve the information's usefulness. GAO found that taken together, FTA's cost estimating information substantially or fully met 7 of the 12 cost estimating steps outlined in GAO's *Cost Estimating and Assessment Guide (Cost Guide)* but did not align with 5 of the steps. For example, the documents did not discuss sensitivity analyses—an assessment of each factor's effect on cost. Doing so could help sponsors better identify which cost factors are most likely to influence a project's overall costs if assumptions change, thereby improving an estimate's reliability and better informing sponsors' decisions. In addition, sponsors may have difficulty identifying critical cost estimating information because it is distributed across 14 different documents available to sponsors, 11 of which are intended for FTA's oversight contractors. By improving the content and organization of cost estimating information, FTA would help project sponsors increase the reliability of their cost estimates and reduce the risk of cost overruns.

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## Abbreviations

AUD\$	Australian dollars
CAN\$	Canadian dollars
CIG	Capital Investment Grant
DBE	disadvantaged business enterprise
DOT	Department of Transportation
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
G-20	Group of 20
ISO	International Organization for Standardization
MARC	Maryland Area Regional Commuter
SCC	Standard Cost Categories for Capital Projects
WMATA	Washington Metropolitan Area Transit Authority

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July 22, 2019

The Honorable Susan M. Collins  
Chairman  
The Honorable Jack Reed  
Ranking Member  
Subcommittee on Transportation Housing and Urban Development  
and Related Agencies  
Committee on Appropriations  
United States Senate

The Honorable David Price  
Chairman  
The Honorable Mario Diaz-Balart  
Ranking Member  
Subcommittee on Transportation Housing and Urban Development  
and Related Agencies  
Committee on Appropriations  
House of Representatives

Rail transit projects are inherently complicated, take years to plan and construct, and can cost hundreds of millions to billions of dollars. Consequently, these projects are often the subject of interest and scrutiny from the media, stakeholders, and the public, especially if the project encounters sizeable schedule delays and cost increases. For example, media reports and academic studies of rail transit projects in New York, Hawaii, and in some foreign countries have raised concerns about the cost of completing such projects and questioned how project sponsors (sponsors)—typically state or local government agencies—could better manage transit systems and their costs.<sup>1</sup> The United States Department of Transportation (DOT) provides grants and loans to help sponsors build new transit systems or extend existing service. In fiscal year 2019, Congress appropriated over \$2.65 billion to DOT<sup>2</sup> for the Federal Transit

<sup>1</sup> Such reports and studies include: Brian Rosenthal, *The Most Expensive Mile of Subway Track on Earth: How excessive staffing, little competition, generous contracts and archaic rules dramatically inflate capital costs for transit in New York.*, New York Times (Dec. 28, 2017); Anne Davies, *Sydney's light rail chaos: who is to blame for delays and cost blowout?*, The Guardian (April 20, 2018). B. Flyvbjerg, N. Bruzelius, and B. van Wee, "Comparison of Capital Costs per Route-Kilometre in Urban Rail," *European Journal of Transport and Infrastructure Research*, vol. 8, no. 1 (2008): p. 17.

<sup>2</sup> Pub. L. No. 116-6, div. G, tit.I, 133 Stat. 13 (2019).

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Administration's (FTA) Fixed Guideway Capital Investment Grants (CIG) program, a competitive grant program that funds transportation projects, such as rail transit.<sup>3</sup> One category of CIG projects is called New Starts.<sup>4</sup> Each New Starts project is unique, and total costs for New Starts projects can range widely. For example, two recent rail transit projects of similar length and number of stations, but with very different scopes of work, ranged in cost from \$159 million to \$3 billion overall.<sup>5</sup> With federal, state, and local infrastructure investment in high demand stakeholders are interested in finding ways to better manage rail transit project costs to maximize the effective use of limited resources.

The Senate Committee report accompanying the Transportation, and Housing and Urban Development, and Related Agencies Appropriations Bill, 2018 included a provision for us to assess factors affecting the costs to build transit projects and compare standards and practices used to manage project costs in the United States to those in selected other countries.<sup>6</sup> This report discusses:

- stakeholders' views on factors that can affect the cost to build rail transit projects and on comparing project costs in the United States with selected other countries;

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<sup>3</sup> 49 U.S.C. § 5309. Fixed guideway means a public transportation facility that uses and occupies a separate right-of-way or rail line for the exclusive use of public transportation and other high-occupancy vehicles, or uses a fixed catenary system and a right-of-way usable by other forms of transportation. This includes, but is not limited to, rapid rail, light rail, commuter rail, automated guideway transit, people movers, ferry boat service, and fixed-guideway facilities for buses (such as bus rapid transit), and other high-occupancy vehicles. 49 C.F.R. § 611.105. See also 49 U.S.C. § 5302(7).

<sup>4</sup> As of 2015, New Starts projects are defined as capital investments whose sponsors request \$100 million or more CIG funding or anticipated \$300 million or more in capital costs. Fixing America's Surface Transportation Act. Pub. L. No. 114-94, 129 Stat. 1312 (2015).

<sup>5</sup> The \$159 million New Starts commuter rail project, which opened to the public in 2009, primarily refurbished existing track and bridges, installed or modified signals, and built 5 new stations. The \$3 billion heavy rail project, which opened in 2014, constructed all new track in or parallel to existing roads, a large parking facility, and 5 stations. The capital costs also included procurement of 64 rail cars and modifications to a rail yard. All dollar amounts are in nominal dollars, which are not adjusted for inflation.

<sup>6</sup> S. Rpt. 115-138 to accompany S. 1655 (115<sup>th</sup> Cong.). In this report we focused on New Starts rail transit projects because they represent a larger federal investment per project, and because, according to FTA officials, nearly all New Starts projects are rail transit modes.

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- stakeholders' views on approaches sponsors have used to manage rail transit project costs; and
  - the extent to which FTA's cost estimating information for project sponsors aligns with GAO's best practices.

To identify factors that affect the costs to build rail transit projects, we conducted a review of literature from the last 10 years on such factors and supplemented that review with additional literature referenced in the initial search results.<sup>7</sup> We also reviewed our body of work on rail transit and other reports and studies issued by various domestic and international government agencies and non-governmental organizations. To obtain stakeholders' views on these cost factors and on comparing project costs in the United States with selected other countries, we interviewed 9 academic experts on infrastructure project costs and management. We also interviewed 16 other stakeholders, including U.S. and international representatives of the construction industry, non-governmental organizations, and governmental sectors. We selected these experts and stakeholders based on the literature review, recommendations from other academic experts and stakeholders, and professional judgment. When selecting academic experts, we also reviewed publicly available information about each expert's qualifications. We examined the results of the interviews to identify individual cost factors and grouped them into categories. For purposes of this report, when describing stakeholders' views, we used the phrase "some stakeholders" to indicate that three or more stakeholders provided a particular perspective. We also used documents from the literature review and other sources to obtain more insight into cost factors and to provide examples of projects that illustrate those factors. To select these project examples, we considered projects in countries based on their membership in the "Group of 20" nations, referred to as G-20 nations in the congressional mandate directing this report.<sup>8</sup> We included examples from Australia, Canada, the United Kingdom, and the United States. We included data as reported and did not adjust any cost data for inflation.

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<sup>7</sup> In June through August 2018, we conducted searches of literature from January 1, 2008, through the dates of the searches.

<sup>8</sup> S. Rpt. 115-138 to accompany S. 1655 (115<sup>th</sup> Cong.) The projects we included as examples in this report were constructed in G-20, including European Union, countries with per-capita gross domestic products of at least \$25,000 based on 2017 United Nations data. The list of countries we considered was: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, South Korea, Spain, Sweden, the United Kingdom, and the United States.



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Our findings from the literature review and interviews provided useful insights into the factors affecting the costs of rail transit construction projects but are not generalizable.

To identify approaches that sponsors have used to manage costs, we selected four projects as case studies from among the 42 New Starts CIG rail transit projects executed in fiscal years 2003 through 2018 and interviewed stakeholders involved in these projects. These case study stakeholders included project sponsors, contractors, FTA's project management oversight contractors (oversight contractor), and FTA regional offices.<sup>9</sup> We selected two projects currently in operation—the Utah Transit Authority's Mid-Jordan light rail project and the Metropolitan Transit Authority of Harris County's Houston North Corridor light rail project; and two projects currently in construction—the Los Angeles County Metropolitan Transportation Authority's Purple Line Extension - Section 1 heavy rail project, and the Maryland Transit Administration's Purple Line light rail project. We selected these to obtain variation in terms of the rail transit mode (such as heavy or light rail), geographic location, and the extent of elevated, underground, or at-grade construction. The information from these case studies is not generalizable but provides examples of approaches stakeholders said that sponsors have employed to manage rail transit project costs. To help categorize and contextualize the identified approaches, we compared them to key standards, guidelines, and leading practices that we identified for project management, including the management of project costs. These included: GAO's *Standards for Internal Control*,<sup>10</sup> GAO's *Executive Guide on leading practices in capital decision-making*,<sup>11</sup> FTA's *Project and Construction Management Guidelines*,<sup>12</sup> the International Organization for

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<sup>9</sup> We conducted interviews with four project sponsors and four FTA regional offices. We also requested interviews with contractors from all four case studies; three contractors agreed to be interviewed and two contractors from one project did not respond to our request for interviews. Finally, we interviewed two oversight contractors; one oversight contractor oversaw two of the case study projects, and the oversight contractor for the fourth project was unavailable.

<sup>10</sup> GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

<sup>11</sup> GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-32](#) (Washington, D.C.: December 1998). For the purposes of this report we refer to this document as the *Executive Guide*.

<sup>12</sup> FTA, *Project and Construction Management Guidelines* (Washington, D.C.: March 2016).

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Standardization's *Risk Management—Guidelines*,<sup>13</sup> which are international consensus standards on risk management, and project management principles from the Project Management Institute, Inc.'s *Guide to the Project Management Body of Knowledge, PMBOK® Guide*.<sup>14</sup>

To assess the extent to which FTA's cost estimating information for project sponsors aligns with GAO's best practices, we reviewed publicly available FTA guidance, guidelines, and oversight procedures pertinent to New Starts CIG projects to identify cost estimating information and compared this information with best practices described in the *GAO Cost Estimating and Assessment Guide (Cost Guide)*.<sup>15</sup> Specifically, we reviewed FTA's (1) *Project and Construction Management Guidelines*, (2) guidance on full funding grant agreements,<sup>16</sup> (3) Standard Cost Categories for Capital Projects,<sup>17</sup> and (4) 11 separate oversight procedures that provide direction for FTA's oversight contractors and employees.<sup>18</sup> We also evaluated the extent to which FTA's documents meet GAO's *Standards for Internal Control in the Federal Government*

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<sup>13</sup> See International Organization for Standardization, *Risk Management—Guidelines*, ISO 31000:2018(E) (Geneva: February 2018). The ISO is an international, independent, non-governmental organization with a membership of 164 national standards bodies, including the American National Standards Institute. The ISO 31000 standards were developed by an ISO committee with over 50 countries participating.

<sup>14</sup> Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge, PMBOK® Guide*, Sixth Edition (2017). The Project Management Institute is a not-for-profit association that provides global standards for, among other things, project and program management.

<sup>15</sup> GAO developed the *Cost Guide* for cost estimators to assist them in preparing reliable estimates of capital program costs. See GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

<sup>16</sup> FTA, *Circular Full-Funding Grant Agreements Guidance, FTA Circular 5200.1A* (Washington, D.C.: December 2002).

<sup>17</sup> According to FTA documents, the Standard Cost Category worksheets are a project management tool for sponsors to track, evaluate, and control changes to project costs.

<sup>18</sup> The 11 FTA procedures for FTA's oversight contractors we reviewed were Oversight Procedures: (1) 33 – *Capital Cost Estimate Review*; (2) 20 – *Project Management Plan Review*; (3) 21 – *Management Capacity and Capability Review*; (4) 25 – *Recurring Oversight and Related Reports*; (5) 32A – *Project Transit Capacity Review*; (6) 32B – *NEPA and Design Document Comparison*; (7) 32C – *Project Scope Review*; (8) 32D – *Project Delivery Method Review*; (9) 34 – *Project Schedule Review*; (10) 40B – *Risk and Contingency Review (Abbreviated)*; and (11) 40C – *Risk and Contingency Review (Full)*.

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with respect to external communications.<sup>19</sup> We also interviewed FTA officials about their activities and the information they provided sponsors and oversight contractors, among other things. In some instances, interviews with stakeholders and our literature review provided contextual information about the usefulness of some of these activities, but those perspectives are not generalizable. More information on our scope and methodology can be found in appendix I.

We conducted this performance audit from May 2018 to July 2019 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 that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

Rail transit projects are typically initiated and managed by a sponsor that is responsible for determining how the project will be planned, constructed, and operated. As described in documents from FTA, the United Kingdom, and the European Commission, this process generally occurs through a series of steps:

- Typically, a sponsor begins by identifying a community's or region's transportation needs and exploring different options, or alternatives, to meet those needs. In doing so, a sponsor must make a variety of potentially interrelated decisions that shape the project as a whole, including selecting the preferred transit mode (e.g. heavy or light rail or bus); identifying available funding sources to finance the project; and, if necessary, acquiring land.
- After selecting a preferred project alternative, sponsors determine how they will form contracts for designing, building, financing, operating, and maintaining a project. In light of these determinations, sponsors select a project delivery method that defines the contractual relations, roles, and responsibilities of each party (see table 1). These contracts effectively define how project risks—which are inherent to

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<sup>19</sup> GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

such large undertakings—are assumed by each of the parties under the contract.<sup>20</sup>

- Regardless of which project delivery method a sponsor chooses the next step is to proceed with project design and preliminary engineering,<sup>21</sup> followed by a refinement of the design and further engineering and finally, initiation of construction.

**Table 1: Typical Project Delivery Method Options for Rail Transit Projects**

Project delivery method	Description
Design-bid-build	Sponsor solicits bids and contracts for the development of a project’s design, and then uses the completed design to solicit bids from construction contractors. The sponsor is responsible for the details of the design it provides to its construction contractor(s). Design-bid-build is the traditional form of project delivery method.
Design-build	Sponsor contracts for both design and construction of the project from a single legal entity referred to as the design-builder. The design-builder may be comprised of one or more firms. In contrast to design-bid-build, the design-builder takes full responsibility for the design.
Design-build-operate-maintain	In an expansion of the design-build method, the sponsor contracts with a private entity or consortium of entities for the design, construction, operation, and maintenance of the project.
Design-build-operate-maintain-finance	In a further expansion of the design-build-operate-maintain method, this includes financing responsibilities for the private sector entity delivering the project. This may also be referred to as a public-private partnership.
Construction manager/general contractor	Similar to the design-bid-build method, the sponsor contracts for and retains responsibility for the project’s design. Unlike design-bid-build, the sponsor also contracts for a construction manager to provide input on the project’s design before design is complete and to take responsibility for construction of the project. The sponsor and construction manager typically agree to a construction price once a sufficiently completed design is available.

Source: GAO analysis of Federal Transit Administration (FTA) and Transit Cooperative Research Program (TCRP) information. | GAO-19-562

Note: See TCRP, *A Guidebook for the Evaluation of Project Delivery Methods, Report 131* (Washington, D.C.: 2009)

Although the fundamentals of developing and constructing rail transit projects may be similar from one locale to another, differences in governmental systems, political authority, financing, and regulatory frameworks lead to variations in the project development process. For example, national, state and local regulations as well as political expectations may influence when and how a sponsor factors environmental considerations and public involvement into its project development process. Moreover, the type of project under consideration

<sup>20</sup> Transit Cooperative Research Program, *A Guidebook for the Evaluation of Project Delivery Methods, Report 131* (Washington, D.C.: 2009)

<sup>21</sup> During this phase, sponsors refine the design of the selected project and its estimated costs, benefits, and impacts.

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may affect the timing of different steps and legal requirements, according to FTA's *Project and Construction Management Guidelines*.<sup>22</sup>

In the United States, New Starts project sponsors must follow a statutorily defined process to be eligible for and receive federal funding through FTA's CIG program.<sup>23</sup> This process includes several phases: (1) project development; (2) engineering; (3) project rating and grant agreement; and (4) project construction and oversight. (See app. II for additional detail on this process.) FTA oversees grantees, with the help of project management oversight contractors (oversight contractor), by evaluating each project's risk, scope, cost, schedule, financial plan, and project management plan, as well as the sponsor's technical capacity and capability to complete the project.

For New Starts projects, sponsors or their contractors develop and revise cost estimates throughout project development, engineering, and construction to inform key decisions, such as determining how much funding to request from FTA. FTA and its oversight contractors review sponsors' capital cost estimates multiple times during the engineering and construction phases, as sponsors revise estimates to reflect changes and update them based on actual data. FTA provides sponsors with information on estimating project costs through numerous documents it publishes. For example, FTA requires sponsors to report, estimate, and manage cost data in a consistent format using FTA's Standard Cost Categories.<sup>24</sup> FTA also provides leading practices and other information for managing transit capital projects through FTA's *Project and Construction Management Guidelines*. We have previously reported that reliable cost estimates are critical to the success of any construction project.<sup>25</sup> For example, we found in May 2014 that reliable New Starts project cost estimates are necessary so that FTA and its oversight contractors may evaluate projects, make funding decisions, develop annual funding requests to Congress, evaluate resource requirements at

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<sup>22</sup> FTA, *Project and Construction Management Guidelines*.

<sup>23</sup> 49 U.S.C. § 5309.

<sup>24</sup> FTA's Standard Cost Categories apply to all Capital Investment Grant projects. See FTA, *Final Interim Policy Guidance Federal Transit Administration Capital Investment Grant Program* (Washington, D.C.: June 2016).

<sup>25</sup> [GAO-09-3SP](#).

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key decision points, and conduct oversight.<sup>26</sup> As noted in our previous reports, federal agencies and their grantees have experienced challenges in conducting cost estimating with some of their projects costing more than expected and delivering results that do not satisfy all requirements.<sup>27</sup>

Because FTA's New Starts grant agreements provide a fixed amount of federal funding, project cost overruns are generally assumed by the sponsor of the project and not the federal government. For example, in 2016 in New York City, the Metropolitan Transportation Authority completed construction of the first phase of the Second Avenue Subway, a 2.3 mile heavy rail project, for a total cost of \$5.57 billion. This project exceeded the estimated total cost described in the fiscal year 2008 FTA grant agreement by more than \$700 million.<sup>28</sup> On another project in Hawaii, cost estimates have risen from \$5.1 billion specified in the fiscal year 2013 construction grant agreement to over \$8 billion in fiscal year 2019 for a 20.1 mile elevated light rail project sponsored by the Honolulu Authority for Rapid Transportation. These projects and several others are discussed in greater detail in this report.

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## Stakeholders Cited

### Many Factors Affecting the Cost to Build Rail Transit Projects

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<sup>26</sup> GAO, *Public Transit: Length of Development Process, Cost Estimates, and Ridership Forecasts for Capital-Investment Grant Projects*, [GAO-14-472](#) (Washington D.C.: May 30, 2014).

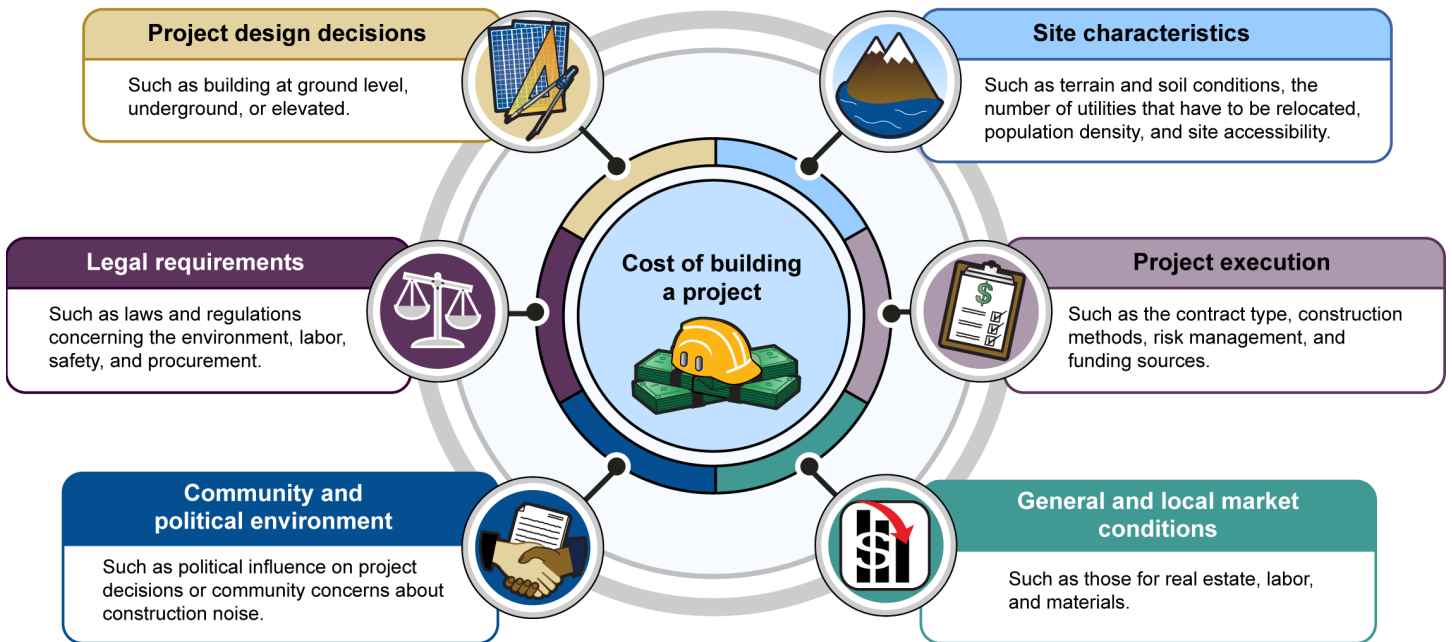
<sup>27</sup> See for example, GAO, *California High-Speed Passenger Rail: Project Estimates Could Be Improved to Better Inform Future Decisions*, [GAO-13-304](#) (Washington, D.C.: March 28, 2013) and GAO, *IRS Management: Cost Estimate for New Information Reporting System Needs to be Made More Reliable*, [GAO-12-59](#) (Washington, D.C.: January 31, 2012).

<sup>28</sup> Similarly, cost estimates for a commuter rail project in New York City, known as East Side Access, to extend the Long Island Rail Road 3.5 miles from Queens into Manhattan have risen from \$7.4 billion at the time of construction grant agreement in fiscal year 2007 to over \$11 billion.

## A Variety of Factors Affect Final Project Cost

Stakeholders we interviewed identified a variety of factors that can affect a rail transit construction project's costs and that vary from project to project, such as a sponsor's choices in designing each project.<sup>29</sup> (See fig. 1.) These factors are often interrelated, and interactions among these factors can also affect costs (see sidebar).

**Figure 1: Types of Factors Stakeholders Identified as Affecting Transit Project Construction Costs**



Source: GAO analysis of interviews with transit project stakeholders. | GAO-19-562

<sup>29</sup> For purposes of this report, we focused on construction costs and not on the potential benefits of projects or life-cycle costs, such as operations or maintenance costs.

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## Project Design Decisions

### Cost Factors Are Interrelated

Cost factors do not occur in isolation, and interactions among different factors can affect the costs of building rail transit projects. For example, according to one report, community opposition expressed during the environmental review process, a requirement under the National Environmental Policy Act of 1969, led FTA and the sponsor to revise documentation of the East Side Access project's environmental impacts in New York City. As a result, the contractor was required to conduct almost all of the project's construction activities in Manhattan underground. This requirement affected the project's execution. According to the study's authors, the limited above-ground access to the construction site required laborers to use a labor-intensive method for removing waste materials. This approach extended the project's schedule by 6 months and cost an estimated \$75 million more than if the project had employed a waste-removal method requiring greater above-ground access, according to the authors.

Source: GAO analysis of information from the Federal Transit Administration and the Regional Plan Association, *Building Rail Transit Projects Better for Less: A Report on the Costs of Delivering MTA Megaprojects* (New York City, New York: February 2018). | GAO-19-562

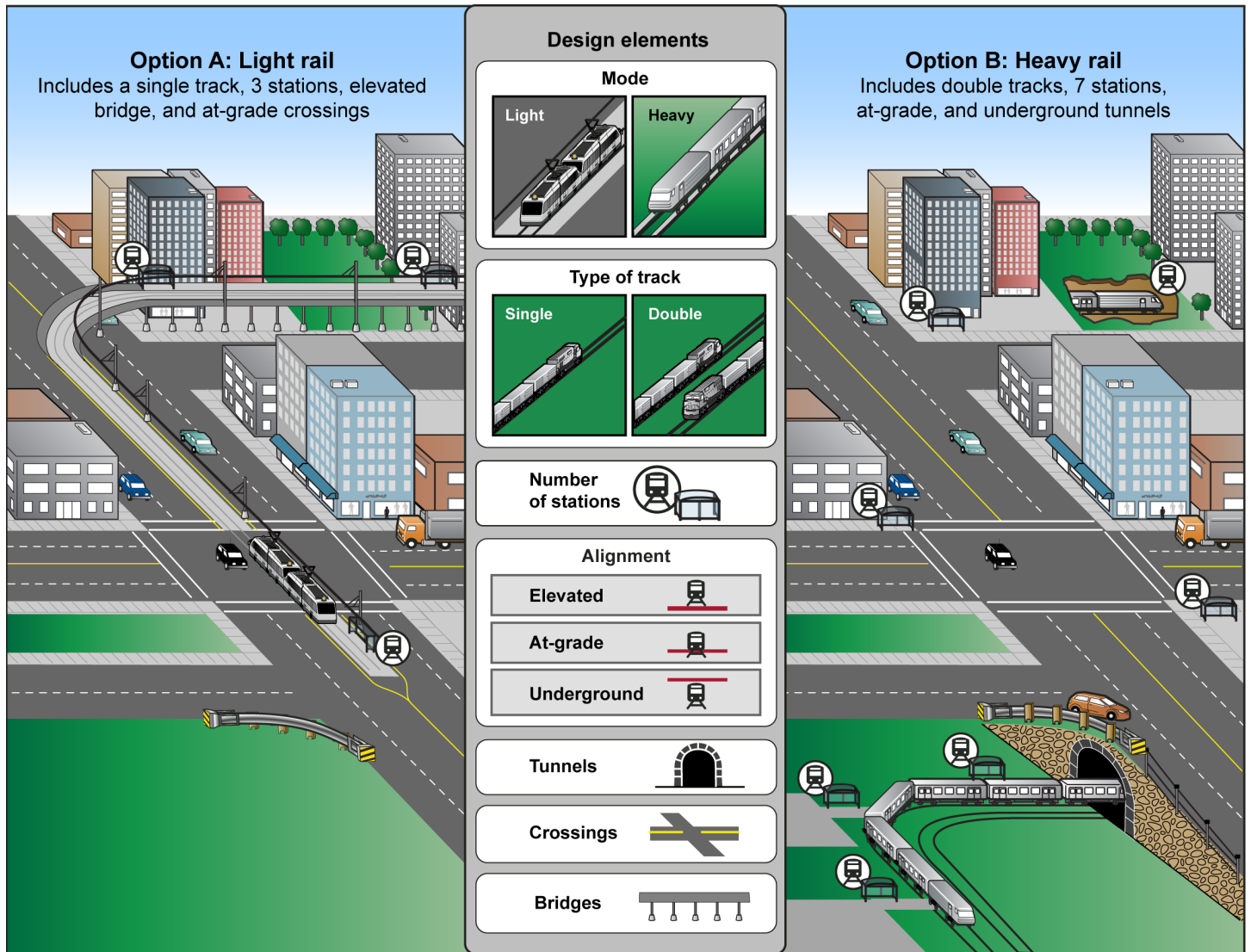
Stakeholders we interviewed identified a variety of design decisions that affect the costs of a rail transit project, including both the extent of the infrastructure built—such as the number of stations or the length of the line—and the design of that infrastructure. See fig. 2 for examples of these design decisions. These decisions, which may require deciding between options with differing benefits and costs, determine what elements the project will contain and thus directly affect the costs of the project. For example, according to some stakeholders the choice of alignment—the extent to which the project is built at-grade, underground, or elevated—affects a project's costs. According to one report, underground construction often has higher costs than elevated or at-grade construction and has higher risk for cost overruns and delays due to unforeseen soil conditions.<sup>30</sup> However, underground construction can avoid the disruption to dense urban environments that construction and operation of surface or elevated lines would cause and may promote development that leads to higher ridership and land values, according to the report. Further, some stakeholders added that design choices made to improve certain characteristics of a project, such as its safety or resiliency to environmental and other conditions, may increase its costs.

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<sup>30</sup> World Bank Group, *The Urban Rail Development Handbook* (Washington, D.C.: 2018).



**Figure 2: Examples of Design Elements That May Affect Transit Project Construction Costs**



Source: GAO analysis of interviews with transit project stakeholders. | GAO-19-562

A sponsor's use of unique design elements also affects the costs of some projects, according to some stakeholders. According to one report we reviewed, the New York Metropolitan Transportation Authority's use of custom-produced granite archway entrances for stations in the Second

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Avenue Subway project added to the cost of building the stations.<sup>31</sup> In contrast, officials with the Los Angeles County Metropolitan Transportation Authority (Los Angeles Metro) said that they use standardized modular designs for their stations to save on both construction and maintenance costs.

## Site Characteristics

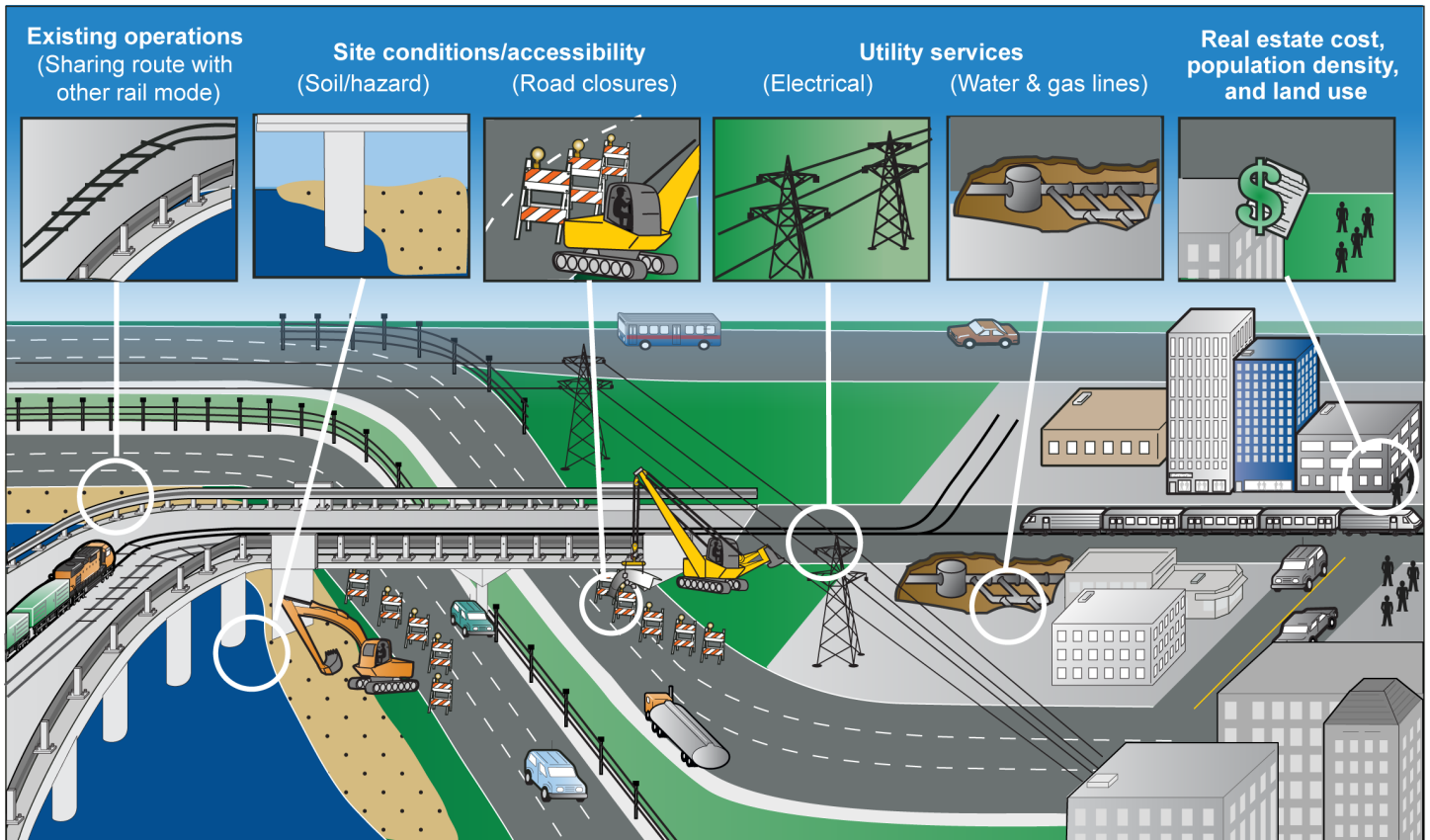
Conditions at the project's construction site, such as the types of soil and terrain encountered, may require sponsors and contractors to use construction methods that affect the project's costs, according to some stakeholders we interviewed. (See fig. 3) For example, officials with the Los Angeles Metro explained that their contractor used specialized construction methods due to subsurface gas and tar sands at a station's construction site, and that they anticipated the gas and tar sands in the original contract.<sup>32</sup>

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<sup>31</sup> Regional Plan Association, *Building Rail Transit Projects Better for Less: A Report on the Costs of Delivering MTA Megaprojects* (New York City, New York: February 2018). The Regional Plan Association is an independent, not-for-profit organization that develops and promotes ideas to improve the economic health, environmental resiliency, and quality of life of the New York metropolitan area.

<sup>32</sup> Tar sands are a mixture of sand, clay, and water that contains bitumen, a petroleum compound that resembles tar.

**Figure 3: Aspects of a Rail Transit Project's Site That May Affect Its Construction Costs**



Source: GAO analysis of interviews with transit project stakeholders. | GAO-19-562

Factors associated with construction in urban environments affect rail transit project costs, according to some stakeholders we interviewed. For example, some stakeholders said that the number of utilities—such as power lines and water mains—located in the construction site may affect a project’s costs by necessitating that the sponsor arrange for their relocation. According to one report we reviewed, relocation of utilities for the Honolulu Rail Transit Project cost \$391 million through January 2017.<sup>33</sup> Representatives of one industry organization said that contractors often must wait for utility providers to perform relocations, which can add

<sup>33</sup> In November 2018, the Honolulu Authority for Rapid Transportation estimated that the total cost of the project would be \$9.188 billion. Office of the Auditor, State of Hawai‘i, *Audit of the Honolulu Authority for Rapid Transportation: Report 1* (Honolulu, Hawaii: January 2019).

delays and costs to a project. Some stakeholders also said that the accessibility of the construction site may influence how a contractor can carry out construction activities and thus affect the project's costs. For example, representatives of a transportation association we interviewed said that building transit projects in dense urban environments can require fitting construction and staging into small physical spaces, as shown in figure 4. They also said that sponsors may face difficulties acquiring land for those purposes. The project's site may also limit working hours, including timing construction activities around community noise concerns and the schedules of other entities—such as other transit lines—operating in the area, according to the representatives.

**Figure 4: Staging and Construction Site for the Purple Line Extension in Los Angeles, California**



Source: GAO. | GAO-19-562

## Project Execution

Factors related to the sponsor's execution of a project—such as procurement decisions, funding sources, construction methods, and other factors—can affect the project's cost, according to stakeholders we

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interviewed. Examples of practices that sponsors have used to address some of the following project execution factors are discussed later in this report. Stakeholders cited factors such as:

- **Procurement decisions.** Some stakeholders said that the sponsor's management of the procurement process can affect a project's costs. For example, the extent of competition among contractors for a project may affect bid prices; when few bids are submitted, bid prices tend to be higher. A sponsor's choice of project delivery method may also affect project costs, according to some stakeholders. For example, according to one study we reviewed, the design-build delivery method can transfer the risk of cost increases caused by errors or omissions in the design from the sponsor to the contractor, who has an incentive to manage that risk.<sup>34</sup> However, under design-build potential contractors may submit higher bids on the project to account for the contractor's absorption of risk, according to some stakeholders. One academic expert noted that the contractor may be particularly likely to raise its bid if it is not able to exercise control over the relevant risks. Further, the choice of delivery method may affect the number of bidders, according to the study. For example, a design-build contract combines both design and construction in one contract with a single legal entity. The size of the bid package and the costs of preparing the bid may reduce the number of bidders, due to some contractors' capacity to deliver large projects. On the other hand, a design-bid-build project is divided into smaller, separately-bid pieces, which may result in an increased number of potential bidders and competition.<sup>35</sup>
- **Funding sources.** A sponsor's funding sources may come with additional requirements that may affect a project's costs, according to some stakeholders. For example, representatives of one industry organization said that by accepting federal funding, sponsors might incur additional costs and potential schedule delays, due to federal scheduling and procurement requirements associated with that funding. However, the representatives also said that ultimately, federal involvement generally helps sponsors reduce costs by providing oversight and ensuring timely payments. We have previously reported that FTA must strike an appropriate balance

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<sup>34</sup> Transit Cooperative Research Program, *A Guidebook for the Evaluation of Project Delivery Methods, Report 131* (Washington, D.C.: 2009).

<sup>35</sup> Transit Cooperative Research Program, *A Guidebook for the Evaluation of Project Delivery Methods*.

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between expediting project development and maintaining the rigor and accountability of the New Starts program.<sup>36</sup>

- **Construction methods.** Some stakeholders said that the construction methods used on a project, such as the tunneling method used on a project built underground, may affect the project's costs. For example, according to one study, the Second Avenue Subway in New York could have had lower labor costs if it had installed precast tunnel segments rather than relying on the "form-in-place" method for tunnel construction.<sup>37</sup>
- **Sponsor experience.** Some stakeholders said that the extent of a sponsor's experience with transit project construction may affect its success in managing costs. According to one academic expert, rail transit construction projects are often the largest construction projects ever pursued by a specific locality, and agencies' inexperience with such projects may cause them to make mistakes. For example, according to one report, a sponsor's inexperience with the design-build delivery method—including an inability to obtain funding to match the construction schedule—contributed to 16 months of schedule delays and nearly \$500 million in cost overruns for the extension of the Bay Area Rapid Transit system to San Francisco International Airport.<sup>38</sup>

## General and Local Market Conditions

Market conditions—both in the overall economy and the economy at the local level—have an effect on a project's costs. For example, stakeholders we interviewed said that during economic booms, certain resources—such as labor and materials—are in higher demand, which

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<sup>36</sup> GAO, *Public Transportation: Better Data Needed to Assess Length of New Starts Process, and Options Exist to Expedite Project Development*, [GAO-09-784](#) (Washington, D.C.: Aug. 6, 2009).

<sup>37</sup> "Form-in-place" involves first installing waterproof lining and then temporary forms to create the tunnel structure for pouring the concrete. Regional Plan Association, *Building Rail Transit Projects Better for Less*.

<sup>38</sup> World Bank Group, *The Urban Rail Development Handbook*. In prior work, we found that the Bay Area Rapid Transit District's finance plan for this project left little room for error, in part because the plan relied on cost and time savings from the use of the design-build method and required larger financial contributions over a shorter period of time. GAO, *Mass Transit: Actions Needed for the BART Airport Extension*, [GAO/RCED-96-176](#) (Washington, D.C.: May 31, 1996). In 2000, the DOT Office of Inspector General identified other factors contributing to changes in the project's cost estimates, such as changes to the project's scope. DOT, Office of Inspector General, *Final Report on the Audit of the Bay Area Rapid Transit District Extension to San Francisco International Airport*, RT-2000-085 (Washington, D.C.: Apr. 21, 2000).



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pushes up the costs of these resources. Additionally, two academic experts noted that contractors may submit lower bids during recessions. One of these experts noted that bids will likely be lower in part because labor and material costs may be lower during an economic downturn. Moreover, both experts noted that, irrespective of what happens with materials costs, bids could be lower because contractors may be willing to accept a lower profit margin during a time when they themselves face reduced demand for their services. For example, according to one report, in 2010, as a result of the global recession, construction companies submitted competitive bids that allowed the sponsor of the London, United Kingdom Crossrail project to save an estimated £500 million (\$773 million U.S.).<sup>39</sup>

Economic conditions in local markets can also influence project costs. For example, according to Los Angeles Metro officials, competition among a number of construction projects has driven up the costs of labor in the city, resulting in higher costs for its Purple Line Extension—Section 1 contractor, and in potentially higher costs to the agency for future projects. Some stakeholders also said that the extent of unionization in a city or state may affect the costs of labor for a project. For example, in the New York metropolitan area, work rules in collective bargaining agreements—such as staffing and overtime requirements—have added to the costs of projects built by the Metropolitan Transportation Authority, according to one report.<sup>40</sup> Some stakeholders also noted that the availability of labor with certain skill sets may be limited in some local markets. Representatives of one non-governmental organization noted that this is particularly true when the economy has low unemployment. A dearth of skilled labor—or the costs of providing training to improve the skill set of labor—can raise project costs. Conditions of local real estate markets also may have differential effects on the cost of transit projects across locations. In particular, according to some stakeholders, the costs of acquiring the project’s right-of-way—the area through which the train will travel—are highly correlated with the local area’s real estate and land values.<sup>41</sup>

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<sup>39</sup> National Audit Office, *Crossrail* (United Kingdom: January 24, 2014).

<sup>40</sup> Regional Plan Association, *Building Rail Transit Projects Better for Less*.

<sup>41</sup> A representative from one contractor said that sponsors may try to avoid the costs of rights-of-way in locations with high real estate costs by using an existing rail right-of-way, if available.

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## Community and Political Environment

Community and political involvement in a project may cause delays or lead to changes in the project that could affect its costs, according to stakeholders. Some stakeholders said that community views on the project—such as concerns about environmental or noise impacts—may lead sponsors to change the project’s scope, design, or schedule; all of which as discussed above may affect its costs. For example, Los Angeles Metro officials said that expanding its Purple Line into a different city required the sponsor to negotiate with that city over topics such as construction noise and work hours, and to create a \$19 million contract modification to accommodate the other city’s concerns. Further, some stakeholders said that political involvement in a project can also affect a project’s costs. For example, according to one report, external political influence caused a transportation agency in Canada to recommend construction of two additional stations with an estimated CAN\$121 million (\$91 million U.S. in 2016) in construction costs, even though the stations’ initial business cases indicated that the costs and disadvantages significantly outweighed the benefits.<sup>42</sup> Some approaches that sponsors have taken to manage stakeholder relationships are discussed later in this report.

## Legal Requirements

Legal requirements—such as laws and regulations related to the environment, labor, safety, and procurement—may introduce compliance costs, according to stakeholders. In the United States, these include federal, state, and local legal requirements. Specifically, some stakeholders said that procurement requirements, such as disadvantaged business enterprise requirements<sup>43</sup> and Buy America provisions,<sup>44</sup> can

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<sup>42</sup> Office of the Auditor General of Ontario, *Annual Report 2018* (Toronto, Canada: Fall 2018).

<sup>43</sup> Disadvantaged business enterprises (DBE) are small businesses at least 51 percent owned by, and whose management and daily business operations are at least 51 percent controlled by, individuals who are both socially and economically disadvantaged. 49 C.F.R. Part 26, Subpart A, § 26.5. FTA’s DBE program requires that recipients of FTA capital assistance which award contracts exceeding \$250,000 in FTA funds in a fiscal year must meet a variety of requirements, including setting goals for participation by DBEs. Except to the extent the Secretary of DOT has determined otherwise, at least 10 percent of authorized funds are to be expended with DBEs. However, the Secretary of DOT has determined that the 10 percent is an aspirational goal at the national level and does not authorize or require recipients to take any administrative steps if their goals are above or below 10 percent. 49 C.F.R. Part 26, Subpart C, § 26.41.

<sup>44</sup> By statute and FTA regulation, FTA, unless waived, can only obligate funds for a project if the steel, iron, and manufactured goods used in the project are produced in the United States. 49 U.S.C. §§ 5323(j)(1) and (2) and 49 C.F.R. §§ 661.5 and 661.7. This “Buy America” requirement applies to third-party procurements by FTA grant recipients.



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increase the costs of some parts, materials, and labor. For example, representatives of one industry organization noted that Buy America provisions may have a particularly noteworthy effect on the costs of rail transit projects because those projects require sophisticated electronic parts that are assembled from components manufactured in a variety of countries. Some stakeholders also said that navigating complicated environmental review processes, such as those under the National Environmental Policy Act<sup>45</sup> and other federal and state laws, can affect project costs.

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### Project Modifications and Unreliable Cost Estimates Can Contribute to Higher than Expected Costs

Some stakeholders said that the extent of and reasons for cost overruns—when project costs exceed estimates—may vary depending on the estimate chosen for the comparison. Stakeholders also cited various causes that may contribute to the cost overruns for a particular project. For example:

- **Scope and design changes.** According to some academic studies and stakeholders we interviewed, changes a sponsor makes to a project’s scope or design after it has estimated costs can result in higher than expected project costs. For example, according to an FTA study of the Norfolk, Virginia Tide light rail project, scope additions, including signaling, control, communications, and station design changes, contributed to the project’s exceeding its \$232 million estimate (at grant agreement) by \$83 million.<sup>46</sup>
- **Weaknesses in cost estimating processes.** According to some academic studies and stakeholders we interviewed, sponsors or contractors developing cost estimates may not anticipate all factors that may affect project costs. For example, one report on the construction of a public-private partnership light rail project in Sydney, Australia, attributed 94 percent of an estimated AUD\$549 million increase (\$495 million U.S. in 2014) in the cost of building the project to incorrect estimates in the initial business case for the project.<sup>47</sup> GAO’s best practices for cost estimation emphasize that budgeting a

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<sup>45</sup> National Environmental Policy Act of 1969, Pub. L. No. 91-190, 83 Stat. 852 (1970).

<sup>46</sup> Department of Transportation, Federal Transit Administration, *The Tide Light Rail Project Before-and-After Study (2015)* (Washington, D.C.: 2015).

<sup>47</sup> Audit Office of New South Wales, *CBD and South East Light Rail Project: Transport for NSW* (Sydney, Australia: November 30, 2016).

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project to a risk-adjusted estimate is critical to the project's successfully achieving its objectives.<sup>48</sup>

- **Insufficient contingencies in cost estimates.** Some stakeholders said the extent to which a cost estimate includes sufficient contingencies—estimated funding amounts set aside to address cost increases caused by potential risks—can affect whether project costs exceed earlier estimates. For example, a representative from one contractor told us that the amount of contingency in a sponsor's cost estimates is the primary factor that determines whether project costs exceed planning stage estimates, and said that sponsors are often too optimistic and set their contingencies too low. According to GAO's best practices for cost estimation, sponsors can use a risk and uncertainty analysis to determine how much contingency reserve will be required to provide the desired degree of certainty that the project is completed within the estimated cost.<sup>49</sup>
- **Bias in cost estimation.** According to some academic studies and stakeholders we interviewed, sponsors' or contractors' optimism when making preliminary cost estimates and schedules, as well as their minimization of risk factors, may create a bias toward lower cost estimates. Further, some academic experts have contended that in the early stages of gaining support for the project, estimators may underestimate costs to influence the project's approval process. For example, one frequently cited academic study asserted that "cost estimates used in public debates, media coverages, and decision making for transportation infrastructure development are highly, systematically, and significantly deceptive."<sup>50</sup>

Further, some stakeholders said that the explanation for a cost overrun on a particular project may depend on which cost estimate is used as a baseline for comparison, a situation that can also affect the perceived magnitude of the overrun. For example, the explanation for an overrun where costs are measured against an estimate produced at the initial political decision to proceed with a project may differ from the explanation for an overrun where costs are measured against an estimate produced at the contracting stage. Some stakeholders said that as projects

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<sup>48</sup> [GAO-09-SP](#).

<sup>49</sup> [GAO-09-SP](#).

<sup>50</sup> Bent Flyvbjerg, Mette Skamris Holm, and Søren Buhl, "Underestimating Costs in Public Works Projects: Error or Lie?," *Journal of the American Planning Association*, Vol. 68, No. 3 (Summer 2002).

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progress, sponsors typically have more information, identify more risks, clarify the project's scope and design, and generally produce more detailed estimates. However, the public may base its perceptions of costs on prior, publicly discussed cost estimates, according to the stakeholders.

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### Factors Including Data Limitations Limit Comparisons of Project Costs in the United States and Other Countries

The complexity of rail transit construction projects and data limitations, among other things, limits the ability to compare the costs of these projects, according to the stakeholders we interviewed. As highlighted above, each project has a unique collection of specific factors that drive its costs. According to FTA officials, each proposed transit project has its own unique characteristics, physical operating environment, and challenges. Some stakeholders said that the wide disparity in the relative effect of different cost factors renders cost comparisons between projects difficult. For example, representatives of an international transit organization said that because of the large number of elements that can affect a project's costs and the differences in what costs are included in different projects' data, projects should be compared only at a very granular level and that aggregate cost comparisons, such as between the costs per mile or costs per kilometer of different projects, are likely flawed. Some stakeholders also said that project costs should not be compared without considering the projects' contexts, such as their complexity. For example, one academic expert contended that project costs cannot be compared without considering the context of each project, and that analysis of projects should focus on leading practices and lessons learned instead.

In addition, the availability and comparability of international rail transit project cost data limits comparisons between projects. Stakeholders mentioned limitations such as sponsors' and contractors' reluctance to report cost data, differences in how sponsors and contractors categorize and report costs, and differences in what costs are included in estimates. For example, one academic expert said that the cost of acquiring the right-of-way for a project could have significant cost implications for a project, but that those costs may or may not be considered part of the project's costs. Another academic expert added that sponsors do not want to share adverse information, and that contractors do not want to publish proprietary cost data that includes their profit margins. Similarly, a European Commission official said that a study of the unit costs of European Union rail projects encountered difficulties in collecting and

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resolving differences in project cost data and in ensuring projects were comparable.<sup>51</sup>

Several efforts are underway to address these data limitations. For example, in 2017, to address the absence of international standards for categorizing and reporting construction project costs, the International Construction Measurement Standards Coalition (Standards Coalition) published a set of international standards for that purpose. However, Standards Coalition officials said that adoption of these standards is still in an early stage, and data that would allow for comparisons between projects using the standards are not yet available.<sup>52</sup> For U.S. projects, FTA's Standard Cost Categories provide a means of collecting and presenting transit project cost data in a consistent format. Further, some stakeholders have developed databases that may facilitate improved cost comparisons. For example, FTA has a database of some domestic projects available to sponsors. FTA officials said that the database is intended for benchmarking cost estimates for transit projects.

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## Sponsors Have Used a Variety of Approaches to Manage Project Costs

Sponsors and other case study stakeholders identified a variety of approaches sponsors have employed to manage rail transit project costs.<sup>53</sup> These approaches fall under a few key project management principles:

- ensuring management capability,
- making informed procurement decisions,
- managing risk, and
- managing stakeholder relationships.

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<sup>51</sup> This study covered rail infrastructure projects generally and did not include projects solely involving construction of inner-urban railway lines. European Commission, *Assessment of Unit Costs (Standard Prices) of Rail Projects (Capital Expenditure)* (Brussels, Belgium: July 13, 2018).

<sup>52</sup> The International Construction Measurement Standards Coalition is a group of professional and not-for-profit organizations that develops and implements international standards for benchmarking, measuring, and reporting construction project costs.

<sup>53</sup> As described above, we interviewed case study stakeholders—representatives of sponsors, FTA regional offices, contractors, and oversight contractors from four case study projects.

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According to key standards, guidelines, and leading practices that we identified for project management, applying these management principles can help sponsors achieve project objectives, including the management of project costs.<sup>54</sup> None of the approaches cited by case study stakeholders, in and of themselves, can assure success in managing costs. However, GAO's *Executive Guide* on capital decision-making notes that for projects to be successfully implemented they must be well managed.<sup>55</sup>

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## Ensuring Management Capability

According to key standards, guidelines, and leading practices, to manage project costs effectively, sponsors should cultivate management capability, which is the experience and skill level of project team members. For example, the United Kingdom's National Audit Office guidance states that without experienced project managers, organizations have limited control over project progress.<sup>56</sup> Examples of approaches sponsors can use to ensure management capability include:

- **Develop or augment in-house staff.** Sponsors can draw on their own or others' experience to enhance their in-house capabilities. For example, Los Angeles Metro officials told us that the agency leverages its experience in conducting several ongoing major rail transit projects by conducting monthly meetings to share information with project managers. Maryland Transit Administration officials said that they brought on contractors familiar with light rail to assist with design for the Maryland Purple Line. FTA also hosts workshops for sponsors and contractors and offers courses through Rutgers University's National Transit Institute to help sponsors better manage rail transit projects. Some sponsor officials described the workshops as helpful venues for learning about other sponsors' experiences and leading practices. As stated in FTA's *Project and Construction*

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<sup>54</sup> As previously discussed, the standards, guidelines, and leading practices we reviewed included GAO's *Standards for Internal Control in the Federal Government*, the Project Management Institute, Inc.'s *A Guide to the Program Management Body of Knowledge, PMBOK® Guide*, the International Organization for Standardization 31000 Standards for Risk Management, and FTA's *Project and Construction Management Guidelines*.

<sup>55</sup> GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-32](#) (Washington, D.C.: December 1998). For purposes of this report we refer to this document as the *Executive Guide*.

<sup>56</sup> National Audit Office, *The DECA: Understanding challenges in delivering project objectives* (November 2013).

### Los Angeles Purple Line Tunnel Segments

The Los Angeles County Metropolitan Transportation Authority is using precast tunnel segments, shown below, to line tunnels for its heavy rail Purple Line Extension-Section 1. The project will extend 3.9 miles underground from the existing Wilshire/Western station to the planned Wilshire/La Cienega station.

Source: GAO analysis of information from the Federal Transit Administration. | GAO-19-562



Source: GAO. | GAO-19-562

*Management Guidelines (Guidelines)*, sponsors must have in place their “own qualified organization to maintain overall control of the project.” In a 2016 report on a light rail project, the Auditor-General of New South Wales, Australia, reported that the project’s sponsor had “strengthened project management” by creating a dedicated project office that was not in place during planning.<sup>57</sup>

- **Conduct peer reviews and other cross-agency information sharing.** Sponsors may consult with other sponsors through formal peer reviews or informal information sharing to take advantage of lessons learned by other sponsors and gain an external perspective. For example, Los Angeles Metro officials said that the sponsor assembled a peer review panel to provide input on the project plan for the Purple Line Extension – Section 1. At the panel’s recommendation, the sponsor conducted additional exploratory work that informed and helped improve the accuracy of contractors’ bids. Further, FTA solicits lessons learned—short, high-level summaries of challenges sponsors have faced and approaches various parties employed to address them—from its oversight contractors and has published 86 such lessons learned online to help share sponsors’ experiences.<sup>58</sup>

<sup>57</sup> Audit Office of New South Wales, Australia, *CBD and South East Light Rail Project: Transport for NSW* (Sydney, New South Wales, Australia: Nov. 30, 2016).

<sup>58</sup> FTA’s *Oversight Procedure 26 – Lessons Learned* provides its oversight contractors with specific guidance on how to prepare a lessons learned report. See FTA, *Oversight Procedure 26 –Lessons Learned* (Washington, D.C.: September 2015).

## Making Informed Procurement Decisions

### Maryland Purple Line Connections

According to the Maryland Transit Administration's plan, the Purple Line will provide multiple rail connections, requiring construction stakeholders to coordinate with a variety of transit agencies. The light rail line will reach 16.2 miles from Bethesda to New Carrollton.

Source: GAO analysis of information from the Federal Transit Administration and stakeholders GAO interviewed. | GAO-19-562



Source: GAO representation of WMATA and Maryland Transit Administration information. | GAO-19-562

According to key standards, guidelines, and leading practices, to manage project costs effectively, sponsors should use project objectives in balancing costs and other factors when making procurement decisions. Such decisions include the selection of a project delivery method and the process by which proposals will be selected.<sup>59</sup> Examples of approaches sponsors can use to make informed procurement decisions include:

- Select a project delivery method based on project objectives.** Different project delivery methods may better contribute to the achievement of objectives such as lowest constructed cost, speed of construction, or the degree of control over design retained by the sponsor.<sup>60</sup> For example, Maryland Transit Administration officials said that the sponsor's selection of a design-build-operate-maintain-finance method for most design and construction activities on the Maryland Purple Line allowed the contractor to innovate in design and construction. Specifically, because the contractor was responsible for a portion of project design, it was able to propose a high-voltage power system that would require fewer substations at lower cost than lower-voltage power systems. In contrast, the Maryland Transit Administration selected a design-bid-build contract for a separate portion of this project because it was better positioned than the contractor to manage "exacting" environmental permitting requirements, according to a sponsor official and oversight contractor representatives.
- Align proposal selection factors with project objectives.** When selecting among contractors' proposals, some sponsors use a "best value" selection process in which the sponsor compares both cost and non-cost factors to select the most advantageous proposal overall. In contrast, under the lowest-bid selection process, sponsors select the lowest-priced proposal that meets minimum technical requirements. According to FTA guidance, a sponsor using a best value process

<sup>59</sup> According to FTA's *Project and Construction Management Guidelines*, project sponsors should determine how state and local laws and regulations apply to procurement decisions.

<sup>60</sup> The Transit Cooperative Research Program, a forum sponsored by FTA for transit agencies to research issues of common concern to the transit industry, reported on how sponsors can use a selection framework to evaluate the positives and negatives of some common project delivery methods. See Transit Cooperative Research Program, *A Guidebook for the Evaluation of Project Delivery Methods, Report 131* (Washington, D.C.: 2009).

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should specify and use evaluation factors that reflect its priorities.<sup>61</sup> For example, officials at one project said that the sponsor's evaluation factors included the bidders' key leadership personnel commitments and strategies for meeting disadvantaged business enterprise goals.

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## Managing Risk

### London Crossrail Risk Management

Sponsors can also act to increase the likelihood or impact of positive risk events, otherwise known as opportunities. For example, according to one expert stakeholder, Crossrail Limited, which is jointly sponsored by Transport for London and the United Kingdom's Department for Transport, implemented an innovation strategy starting in 2011 to improve the efficiency and innovation of the 73-mile Crossrail rail project across London, England. As part of the strategy, Crossrail Limited created a common fund with project contractors to invest in innovative ideas. According to the stakeholder, one innovation on the project was the introduction of mobile technology to access information on-site, a technology that had not been anticipated at project initiation.

Source: GAO analysis of information from literature and an academic stakeholder GAO interviewed. | GAO-19-562

According to key standards, guidelines, and leading practices, sponsors should manage risk to address the potential for negative events that could contribute to schedule delays and increase costs. Through risk identification and analysis, sponsors should characterize the likelihood of various events and their potential impact, should they occur, in terms of cost or other consequences.<sup>62</sup> Sponsors should take steps to mitigate risk relative to the cost of implementing that approach.<sup>63</sup> Examples of approaches sponsors can use to manage risk include:

- **Obtain additional information or mitigate uncertainty to reduce risk.** Some case study stakeholders provided examples of how sponsors took action to reduce the likelihood or consequences of a given negative event. For example, representatives of a contractor explained that Los Angeles Metro mitigated risk by contracting for the relocation of underground utilities, the exact locations of which were unknown, prior to construction of the Purple Line Extension. The construction contractor was able to begin work more quickly than if the location of utilities had remained unknown. Further, FTA's *Guidelines* emphasize the importance of sponsors identifying what additional information would increase the contractor's certainty over project risks and reduce the risk premiums charged by the contractor to assume responsibility for such risks. According to oversight contractor officials we interviewed, bidders respond to unknown risks with higher prices.

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<sup>61</sup> FTA Circular 4220.1F provides contracting guidance for recipients of federal assistance awarded by the FTA when using that assistance to finance procurements. See Federal Transit Administration, *Third Party Contracting Guidance*, FTA Circular 4220.1F, Rev. 4 (Mar. 18, 2013).

<sup>62</sup> See International Organization for Standardization, *Risk Management—Guidelines*, ISO 31000:2018(E) (Geneva: February 2018).

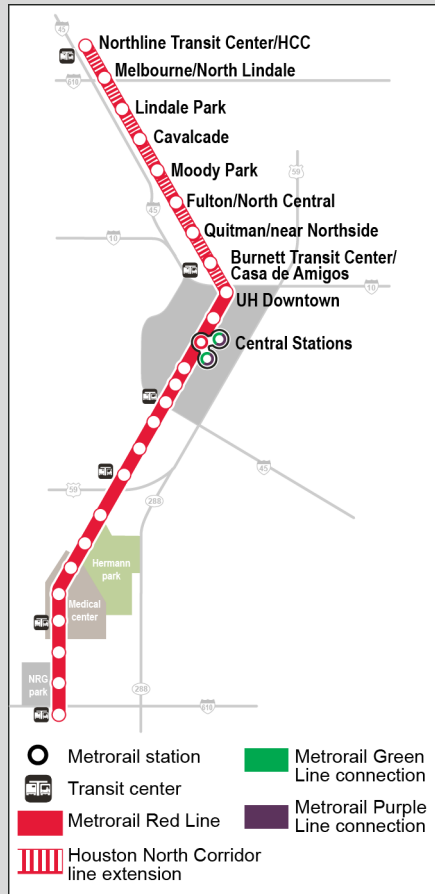
<sup>63</sup> See GAO, *Risk Management: Further Refinements Needed to Assess Risks and Prioritize Protective Measures at Ports and Other Critical Infrastructure*, [GAO-06-91](#) (Washington, D.C.: Dec. 15, 2005).



**Houston North Corridor Line Extension**

The Metropolitan Transit Authority of Harris County's North Corridor light rail project extended Houston's Red Line north from the pre-existing University of Houston-Downtown station to the Houston Community College/Northline Transit Center station. The project added 5.3 miles and eight stations to the Red Line.

Source: GAO analysis of information from the Federal Transit Administration. | GAO-19-562



Source: GAO analysis of Metropolitan Transit Authority of Harris County data. | GAO-19-562

- Assign responsibility for risks to the party most able to manage those risks.** The contract provisions between a sponsor and its contractors are a mechanism for defining each party's responsibilities, including the assumption of responsibility for managing various risks and negative events. According to FTA's *Guidelines*, sponsors can reduce risk by assigning responsibility for a given risk to the party most able to manage the risk.<sup>64</sup> For example, officials from one sponsor we interviewed said that their organization assigns responsibility to contractors for securing city design approvals on design-build projects, because such contractors are best positioned to do so.

<sup>64</sup> See FTA, *Project and Construction Management Guidelines* (Washington, D.C.: March 2016)

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## Managing Stakeholder Relationships

According to key standards, guidelines, and leading practices, to manage project costs effectively, sponsors should manage stakeholder relationships to avoid costs associated with schedule delays or unexpected cost increases incurred as a result of stakeholder decisions or input. For example, the Project Management Institute's *Guide to the Project Management Body of Knowledge, PMBOK® Guide* states that stakeholders can impact any project in a positive or negative way and describes key concepts and processes for project stakeholder management.<sup>65</sup> Examples of approaches sponsors can use to manage key relationships include:

- **Establish lines of communication with third parties.** Third parties with influence over the project's schedule or costs, such as permitting authorities, property owners, or utility companies, may have different priorities than the sponsor. Some case study stakeholders said that sponsors can communicate to prevent or reduce schedule delays that can occur when third parties act (or choose not to act) according to such differing priorities. For example, sponsors can negotiate agreements with third parties that will need to approve or perform work for a project to proceed. Specifically, prior to implementing the Houston North Corridor light rail project, the Metropolitan Transit Authority of Harris County entered an agreement with the City of Houston, which specified that a City staff position would be designated to facilitate timely coordination of public works approvals.
- **Engage the local community to understand needs and establish expectations.** Some case study stakeholders said that sponsors can work to understand and accommodate community needs and expectations to minimize disputes that could delay the project. For example, Utah Transit Authority officials said that they established a master intergovernmental agreement with all municipalities affected by the Mid-Jordan project, and created an incentive payment for their contractor contingent on the contractor's successful collaboration with a panel of community stakeholders. The panel rated the contractor based on whether the affected cities received appropriate notice for construction activities, among other factors. According to the project's stakeholders, the sponsor's approach helped to establish and manage community expectations early on, an approach that may have

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<sup>65</sup> Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge, PMBOK® Guide*, Sixth Edition (2017).

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### Utah Mid-Jordan Project Shared Freight Track

The Utah Transit Authority's 10.6 mile Mid-Jordan light rail project opened for service in 2011 at a total cost of \$510 million. The Utah Transit Authority constructed 8.3 miles of the line within a pre-existing railroad right-of-way—the area through which light rail vehicles travel. The Utah Transit Authority negotiated with a railroad company to share tracks using time-of-day restrictions, an approach that project stakeholders said helped manage construction costs.

Source: GAO analysis of information from Federal Transit Administration stakeholders GAO interviewed. | GAO-19-562



Source: Utah Transit Authority (UTA). | GAO-19-562

prevented delays due to disputes that otherwise could have occurred during construction.

- **Collaborate with contractors to manage costs and risk.** Some case study stakeholders provided examples of how sponsors collaborated with contractors to manage project costs and risk throughout the project life cycle. For example, officials from one sponsor told us that they used a two-step proposal selection process to solicit design ideas from multiple proposers before awarding the contract to a single entity, which resulted in the adoption of a cost-saving route adjustment. On the Mid-Jordan light rail project, Utah Transit Authority officials and one contractor representative said that facing escalating steel prices, they cooperated to purchase steel materials early in the construction process to mitigate price uncertainty and reduce the risk of additional steel price increases. Sponsors can use a workshop-based process called “partnering” with contractors to manage risks by developing mutual objectives to prevent disputes. Utah Transit Authority officials said that they employed partnering workshops at regular intervals to discuss risks and determine which party should assume them.

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## FTA’s Cost Estimating Information for Sponsors Aligns with Many Best Practices but Is Not Easily Accessible

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## FTA's Cost Estimating Information for Sponsors Aligns with Many Best Practices but Lacks Some Steps Needed for Developing Reliable Estimates

Reliable New Starts project cost estimates are necessary so that FTA and its oversight contractors may evaluate and effectively oversee New Starts projects, among other things, as we found in May 2014.<sup>66</sup> Moreover, as discussed earlier in this report, weaknesses in cost estimation processes for a particular project may contribute to cost overruns, according to some academic studies and stakeholders we interviewed. GAO's *Cost Guide* outlines best practices for cost estimating and presents 12 steps to create high-quality estimates.<sup>67</sup> These steps are generally applicable in a variety of circumstances and application of these principles should result in reliable and valid cost estimates that management can use to make informed decisions.

In our review of FTA's publicly available documents containing cost estimating information for sponsors, we found that, taken together, several of FTA's documents provided cost estimating information that either *substantially* or *fully meets* 7 of the 12 cost estimating steps, as shown in figure 5.<sup>68</sup> (See app. III for more detail on our findings and on how we assessed FTA's information.) Specifically, FTA's cost estimating information *fully met* two of the cost estimating steps—defining the program's characteristics, and determining the estimating structure. For example, the third step outlined in the *Cost Guide* states that a key to developing a credible estimate is having an adequate understanding of a project's characteristics—usually by describing the project and its requirements, among other things—in a technical baseline. In particular, FTA requires sponsors to use standardized worksheets—known as Standard Cost Categories—to track and evaluate changes to project costs. These worksheets include detailed technical, project, and schedule descriptions that, along with other documents, fully met best practices outlined in this step of the *Cost Guide*. Furthermore, the fourth step outlined in the *Cost Guide* states that sponsors should determine the cost estimating structure by developing a work breakdown structure to define, in detail, the work necessary to accomplish a project's objectives. Among other things, the work breakdown structure is a valuable communication tool among systems engineering, project management, and other

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<sup>66</sup> [GAO-14-472](#).

<sup>67</sup> [GAO-09-3SP](#).

<sup>68</sup> Cost estimating information that *substantially* or *fully meets* the 12 steps may contribute to high-quality cost estimates. If any of the characteristics are *not met*, *minimally met*, or *partially met*, then the information does not fully reflect the steps necessary for high-quality cost estimates.

functional organizations because it provides a clear picture of what needs to be accomplished and how the work will be done. We found that FTA’s cost estimating information, including its Standard Cost Category worksheets *fully met* best practices for determining the estimating structure by establishing a consistent format for the reporting, estimating, and managing of capital costs for New Starts projects.

**Figure 5: Assessment of FTA’s Cost Estimating Information for Project Sponsors Compared to GAO’s Cost Estimating Best Practices**

GAO’s 12 Step Cost Estimating Process		Assessment of FTA’s guidelines and guidance
Phase	Step	
Initiation and Research	1. Define the estimate’s purpose	● Substantially met
	2. Define the estimating plan	● Substantially met
Assessment	3. Define the program’s characteristics	● Fully met
	4. Determine the estimating structure	● Fully met
	5. Identify ground rules and assumptions	◐ Partially met
	6. Obtain the data	◐ Partially met
	7. Develop the point estimate and compare to an independent cost estimate	● Substantially met
Analysis	8. Conduct a sensitivity analysis	○ Not met
	9. Conduct a risk and uncertainty analysis	◐ Minimally met
	10. Document the estimate	● Substantially met
Presentation	11. Present estimate to management	◐ Partially Met
	12. Update the estimate	● Substantially met

Source: GAO analysis of Federal Transit Administration (FTA) documents. | GAO-19-562

Note: Our assessments of this guidance in comparison with the GAO Cost Estimating and Assessment Guide fall in the following categories: *Fully met*: FTA provided complete evidence that satisfies the elements of the step; *Substantially met*: FTA provided evidence that satisfies a large portion of the elements of the step; *Partially met*: FTA provided evidence that satisfies about half of the elements of the step; *Minimally met*: FTA provided evidence that satisfies a small portion of the elements of the step; and *Not met*: FTA provided no evidence that satisfies any of the elements of the step.

Additionally, we found that FTA’s cost estimating information *substantially met* 5 of the 12 cost estimating steps. For example, the twelfth step outlined in the *Cost Guide* states that sponsors should update cost estimates whenever project requirements change and that they should reconcile the revised cost estimate with the baseline estimate. Such updates provide sponsors with accurate cost information and help illustrate how a project’s costs have changed over time. We found that

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FTA's cost estimating information acknowledges the importance of updates to the cost estimates. In addition to this information, FTA and its oversight contractors review sponsors' capital cost estimates multiple times during the project development and construction process, as sponsors revise estimates to reflect changes and update them based on actual data. However, to *fully meet* the twelfth step, FTA could be more specific about the reasons that might prompt a sponsor to re-estimate project costs.

Although FTA has *substantially* or *fully met* 7 of the 12 best practices, FTA's cost estimating information does not align with GAO's best practices in five areas: (1) risk and uncertainty analysis; (2) sensitivity analysis; (3) identifying ground rules and assumptions; (4) obtaining the data; and (5) presenting cost estimates to management.

## Risk and Uncertainty Analysis

Although FTA's cost estimating information aligns with many of the *Cost Guide's* best practices, we found that this information only *minimally met* the best practice regarding risk and uncertainty analysis. As previously noted, managing risk is a key management principle that can help sponsors achieve project objectives such as managing costs. Specifically, FTA ensures that project sponsors produce a cost estimate from which risk—the probability that an unfavorable event will occur—can be assessed through its Standard Cost Categories reporting requirement. However, FTA's documents do not discuss how sponsors should evaluate and incorporate risk and uncertainty into the cost estimates they provide to FTA. Cost estimates are associated with risk and uncertainty for several reasons, some of which we've previously discussed: (1) there is always a chance that the actual cost will differ from the estimate, (2) there is always the possibility of error as a result of historical data inconsistencies, assumptions, cost estimating equations, and factors typically used to develop an estimate, and (3) cognitive or motivational biases. Given this uncertainty, making good predictions about how much funding a project needs for success is difficult. According to the *Cost Guide*, using a quantitative risk and uncertainty analysis specific to the project's cost estimate provides a way for sponsors to assess the variability in their cost estimates, accounting for effects from the factors discussed above, and to inform good management decisions.

According to FTA officials, FTA requires sponsors to identify and manage risks at the project level through a risk register in which sponsors describe the potential risks, evaluate potential consequences from negative

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events, and estimate the likelihood that a risk will occur.<sup>69</sup> FTA and its oversight contractors engage sponsors in discussions of risk throughout the development and construction process using this risk register, according to FTA officials, oversight contractors, and project sponsors we interviewed. In addition, FTA and its oversight contractors conduct their own risk assessment for each project, which they use to evaluate project-wide risk and to monitor the project, according to FTA officials.

While assessing risk at the project level may be practical for sponsors and FTA to manage project-wide risks, this approach does not provide reasonable assurance that sponsors have evaluated risk and uncertainty by each cost element.<sup>70</sup> According to GAO's *Cost Guide*, to ensure a high quality risk and uncertainty analysis, cost estimators should not only quantify the effect of risks in the risk register but should also evaluate each cost element's uncertainty based on data availability, reliability, and variability. Such an analysis could capture the uncertainty of changing economic conditions, a topic that we have previously discussed. If a sponsor knew to conduct a risk analysis the sponsor would capture such uncertainties pertaining to each cost element which would not necessarily be reflected in the risk register.

## Sensitivity Analysis

In addition, we found that FTA's documents *did not* meet the best practice for sensitivity analysis—the assessment of the effect of each factor on cost. In particular, sensitivity analysis includes changing the value of a single cost element and recalculating the cost, then comparing the original estimate with the recalculated estimate to understand how sensitive the estimate is to a particular change. Specifically, the FTA documents we reviewed did not include guidelines or other information about how a sponsor should conduct a sensitivity analysis. According to the *Cost Guide*, all cost estimates should include sensitivity analyses, because they examine the effects of changing assumptions and ground rules by analyzing the effect of changing one assumption or cost driver at a time, while holding all other variables constant. Unlike an uncertainty analysis, which captures the cumulative effects of additional risks, sensitivity analysis evaluates how sensitive the most likely cost estimate is to various factors that affect a project's costs. If one of a sponsor's assumptions changes, it can potentially alter the cost estimate. For

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<sup>69</sup> FTA, *Oversight Procedure 40C- Risk and Contingency Review*.

<sup>70</sup> A cost estimate is usually composed of many lower-level work breakdown structure elements, each of which comes with its own source of error.

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instance, even a small change in one factor, such as utility relocation costs, could have a large effect on the total cost estimate. Sponsors may also use the results of a sensitivity analysis to inform the project risk register by conducting “what if” scenarios.

According to FTA officials, FTA does not provide information on conducting a sensitivity analysis because FTA requires sponsors to identify and manage risk at the project level. Moreover, FTA officials said that a sensitivity analysis would not help FTA understand how project costs may increase overall. However, sensitivity analyses may help sponsors counteract some of the reasons a project’s costs can exceed estimates, a situation that we have previously discussed. In particular, such analyses may help sponsors anticipate additional risk factors and determine how much to allot for contingencies. In addition, sensitivity analyses allow sponsors to know which risk factors have the greatest impact on cost estimates and to analyze trade-offs in mitigating those risks. Moreover, by focusing on individual risks, sensitivity analyses may serve to reveal sponsors’ critical assumptions. Such information could increase the reliability of cost estimates by helping counteract sponsors’ and contractors’ potential biases that academic studies and stakeholders note may contribute to the cost overruns. Without additional information from FTA about conducting sensitivity analyses, sponsors may overlook an important tool to identify which cost elements represent the most risk to the reliability and accuracy of their cost estimates.

## Ground Rules and Assumptions and Other Steps

We also found that FTA’s information *partially met* the best practices for three other steps—identifying the ground rules and assumptions, obtaining the data, and presenting cost estimates to management. For example, with regard to ground rules and assumptions, GAO’s *Cost Guide* states that it is imperative that sponsors document assumptions so management understands the conditions upon which the estimate is based, because many assumptions profoundly influence cost. Such documentation and analysis provide management with an invaluable perspective on project decisions. Additionally, sponsors must ensure that assumptions are not arbitrary and that they are founded on expert judgments rendered by experienced project and technical personnel. FTA’s cost estimating information discusses two cost assumptions, contingency<sup>71</sup> and escalation—the projected increase in the cost of each

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<sup>71</sup> As previously discussed, contingencies are estimated funding amounts set aside to address cost increases caused by potential risks and the extent to which a cost estimate includes contingencies can affect whether a project’s costs exceed estimates, according to some stakeholders.



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line item in a cost estimate. Also, the information includes placeholders for sponsors to document project-specific assumptions in the Standard Cost Categories workbook.

According to FTA officials, FTA and its oversight contractors ensure that sponsors follow sound practices for developing cost estimates and submit a document describing the basis of project cost estimates, including some information about sponsors' assumptions. However, FTA does not provide sponsors information about the value of documenting a complete set of cost, technical, and schedule assumptions specific to the sponsors' cost estimate. Such information would better ensure sponsors' estimates are accurate and reflect a consistent understanding of the project's parameters. Unless cost estimating ground rules and assumptions are clearly documented, the cost estimate will not have a basis for areas of potential risk to be resolved. A complete set of cost, technical, and schedule assumptions, combined with a sensitivity analysis to test those assumptions, would further improve the accuracy of sponsors' estimates and provide greater assurance that the estimates reflect a consistent understanding of the project baseline. For additional information comparing FTA's documentation on obtaining data and presenting cost estimates to management with GAO's best practices, see appendix III.

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### Cost Estimating Information for Sponsors Is Distributed across Multiple FTA Documents

We found that FTA does not provide sponsors with a centralized, authoritative source that integrates cost estimating best practices. As previously discussed, FTA's publicly available documentation provides overarching cost estimating information, but that information is dispersed across 14 documents, many of which are characterized as procedures for FTA's oversight contractors, not for sponsors. By contrast, the Federal Railroad Administration (FRA), another of DOT's modal administrations that distributes funding via grants and loans for intercity passenger rail projects and other purposes, developed consolidated cost estimating guidance for its sponsors, to help sponsors improve an estimate's reliability and ensure successful project delivery. FRA published the guidance on its website and refers applicants to the guidance in its Notices of Funding Availability/Opportunity and in its grant and loan agreements.<sup>72</sup> According to federal standards of internal control, FTA

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<sup>72</sup> Federal Railroad Administration, *Capital Cost Estimating: Guidance for Project Sponsors* (Washington, D.C.: August 2016).

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should communicate quality information externally so that external parties, such as sponsors, can help achieve the project's objectives.

According to FTA officials, they expect grantee organizations—the project sponsors—to have sufficient expertise to develop a cost estimate in accordance with industry leading practices. Those officials said that sponsors may enroll in the training courses on transit project management offered by FTA through the National Transit Institute and that sponsors usually hire consultants to help them with their cost estimates, although some sponsors may employ staff with that expertise. In addition, FTA officials said that they do not expect sponsors to use FTA's oversight procedures as cost estimating guidance, but some sponsors review them to know what the oversight contractors will be looking for in their reviews. However, as previously discussed, a sponsor may not have prior experience building rail transit projects and may not know that FTA's oversight procedures provide useful information for sponsors' cost estimation. Moreover, an overreliance on contractors' expertise can present problems as well. For example, FTA and its oversight contractors expressed concern with the Honolulu Authority for Rapid Transportation's overreliance on its contractors, in 2014, 2016, and 2018—and urged the transit agency to transition key management positions to its own employees to improve the agency's ownership and strengthen its control of the project.

In addition, without a centralized, authoritative source of cost estimating information that clearly indicates that sponsors are the intended audience, there is potential for a sponsor to overlook vital information. Weaknesses in early cost estimates may necessitate greater FTA and oversight contractor involvement later on to address unidentified risks and manage uncertainty. Providing a centralized location to share existing FTA documentation with sponsors, and ensuring that the documentation incorporates best practices from GAO's *Cost Guide*, such as sensitivity analyses, could improve the reliability of sponsors' cost estimates and could reduce the risk of cost overruns for CIG New Starts applicants and grantees.<sup>73</sup> FTA officials said that providing cost estimating information in a centralized location and expanding their guidelines to include more cost estimating information would probably be helpful to sponsors in addition to the information FTA provides in its training courses on transit project management.

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<sup>73</sup> [GAO-14-704G](#)

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## Conclusions

Managing rail transit projects, which are often large, complex multi-year efforts requiring substantial investment, is challenging. To ensure the effective use of limited resources at the federal, state, and local level, it is critical for project sponsors to develop high-quality, reliable cost estimates that account for the variety of interrelated factors that affect the cost to build these projects. Although FTA documents provide sponsors with some useful information to develop their cost estimates, because FTA's cost estimating information does not align with all of GAO's cost estimating best practices, FTA lacks reasonable assurance that sponsors have developed and communicated high-quality cost estimates, consistent with best practices in GAO's *Cost Guide*. Furthermore, because cost estimating information is distributed across numerous FTA documents and not easily accessible to project sponsors, the sponsors may omit key elements of cost estimation and produce weak estimates that require additional attention from FTA's oversight contractors. By incorporating all the steps needed for developing reliable cost estimates into its documentation for project sponsors, and by organizing this information into a central and easily accessible source, FTA would have increased confidence that sponsors' cost estimates are based on sound procedures and are reliable. In addition, Congress would have enhanced confidence that the cost estimate information used by FTA to develop its annual funding requests is also reliable so that limited federal funding can be efficiently allocated to grantees.

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## Recommendations for Executive Action

We are making the following two recommendations to FTA:

- The FTA administrator should ensure that FTA's cost estimating information for project sponsors is consistent with all 12 steps found in GAO's *Cost Estimating and Assessment Guide* and needed for developing reliable cost estimates. [Recommendation 1]
- The FTA Administrator should provide a central, easily accessible source with all of FTA's cost estimating information to help project sponsors improve the reliability of their cost estimates. [Recommendation 2]

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## Agency Comments

We provided a draft of this product to the Department of Transportation (DOT) for review and comment. In comments, reproduced in appendix IV, DOT stated that FTA is committed to providing effective oversight of federal funds invested in major capital public transportation projects across the country, and that FTA's oversight program is designed to

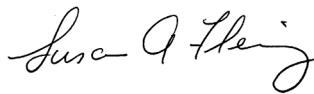
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ensure project sponsors have plans and procedures to effectively deliver projects. FTA partially concurred with our first recommendation that the FTA Administrator ensure FTA's cost estimating information for project sponsors is consistent with all 12 steps in GAO's *Cost Guide*. FTA did not specify a reason for not fully agreeing with the recommendation. However, the agency stated that it would post GAO's *Cost Guide* to its website and encourage project sponsors to follow industry best practices. We continue to believe it is important for FTA to implement this recommendation to provide increased confidence that sponsors develop and communicate high-quality cost estimates. FTA concurred with our second recommendation that the FTA Administrator provide a central and easily accessible source with all of FTA's cost estimating information for project sponsors. FTA also provided technical comments, which we incorporated as appropriate.

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

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or [flemings@gao.gov](mailto:flemings@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.



Susan Fleming  
Director, Physical Infrastructure Issues

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# Appendix I: Objectives, Scope, and Methodology

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This report describes stakeholders' views on factors that affect the costs to build rail transit projects and on comparing project costs in the United States with selected other countries, stakeholders' views on approaches sponsors have used to manage rail transit project costs, and the extent to which FTA's cost estimating information for project sponsors aligns with GAO's best practices for cost estimating.

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## Literature Review

To obtain information regarding factors that affect the costs of building rail transit projects and approaches sponsors have employed to manage those costs, we conducted a review of English-language literature published between January 1, 2008 and August 7, 2018 that related to those costs. We conducted searches in the ProQuest Academic, ProQuest Dialog, and Scopus databases. We reviewed the results and excluded papers that focused on countries other than "Group of 20" nations, referred to as G-20 nations in the congressional mandate directing this report.<sup>1</sup> We also excluded papers that focused on aspects of projects other than construction costs, including papers focused on operations costs or potential benefits of transit projects, such as reducing pollution or congestion. We also reviewed: (1) selected literature referenced in the papers identified by our literature search, including some literature that was published prior to January 1, 2008; (2) prior GAO reports on rail transit; (3) reports and studies issued by various domestic and international government agencies, such as the Department of Transportation Office of Inspector General, the Congressional Research Service, and the European Commission; and (4) reports and studies issued by non-governmental organizations, such as the World Bank, the Regional Plan Association, and the Organisation for Economic Co-operation and Development. To select project examples to illustrate cost factors and approaches to manage costs, we considered projects in countries based on their membership in the G-20 and their per capita gross domestic products. We included examples from Australia, Canada,

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<sup>1</sup> S. Rpt. 115-138 to accompany S. 1655 (115<sup>th</sup> Cong.). The members of the G-20 nations are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States, and the European Union.

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the United Kingdom, and the United States.<sup>2</sup> We included data as reported and did not adjust any cost data for inflation.

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## Stakeholder Interviews

To identify factors that affect the costs of building rail transit projects, and to obtain stakeholders' views: (1) on approaches sponsors have employed to manage those costs and (2) on comparing project costs in the United States with selected other countries, we interviewed selected academic experts and other stakeholders. Our selection of stakeholders to interview represented academia, the construction industry, non-governmental organizations, and governmental sectors. Specifically, we selected nine academic experts on infrastructure project costs and management to interview based on the literature review, references from other academic experts and stakeholders, and a review of publicly available information about each expert's qualifications. We selected 15 other U.S. and international stakeholders based on the literature review, recommendations from academic experts and other stakeholders, and professional judgment. To identify factors that affect the costs of building rail transit projects, we examined each interview summary for specific factors and grouped them into six categories of factors commonly identified by the stakeholders. For purposes of this report, when describing stakeholders' views, we used the phrase "some stakeholders" to indicate that three or more stakeholders provided a particular perspective. In addition, we interviewed representatives of a stakeholder in a New York rail transit project discussed in a Regional Plan Association report.<sup>3</sup> See table 2 for the list of academic experts and other stakeholders we interviewed. Our findings from the literature review and interviews provided useful insights into the factors affecting the costs of rail transit construction projects, but are not generalizable.

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<sup>2</sup> The projects we included as examples in this report were constructed in G-20, including European Union, countries with per capita gross domestic products of at least \$25,000 based on 2017 United Nations data. The list of countries we considered was: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, South Korea, Spain, Sweden, United Kingdom, and United States.

<sup>3</sup> Regional Plan Association, *Building Rail Transit Projects Better for Less: A Report on the Costs of Delivering MTA Megaprojects* (New York City, New York: February 2018).

**Table 2: Stakeholders Interviewed**

<b>Academic experts</b>
Dr. Alexander Budzier, Saïd Business School, University of Oxford, United Kingdom
Dr. Andrew Davies, The Bartlett School of Construction and Project Management, University College London, United Kingdom
Dr. Harry Dimitriou, The Bartlett School of Planning, University College London, United Kingdom
Dr. Peter Love, Faculty of Science and Engineering, Curtin University, Australia
Dr. Keith Molenaar, College of Engineering and Applied Science, University of Colorado Boulder, United States
Dr. Don Pickrell, Volpe National Transportation Systems Center, United States
Dr. Ali Touran, College of Engineering, Northeastern University, United States
Dr. Bert van Wee, Faculty of Technology, Policy and Management, Delft University of Technology, The Netherlands
Dr. Martin Wachs, Luskin School of Public Affairs, University of California Los Angeles (emeritus), United States
<b>Construction industry representatives</b>
American Road and Transportation Builders Association
American Society of Civil Engineers
Associated General Contractors of America
Bechtel Corporation
Related Companies
WSP Global Inc.
<b>Foreign government representatives</b>
European Commission, European Union
Japan Transport and Tourism Research Institute, Japan <sup>a</sup>
Ministry of Land, Infrastructure, Transport, and Tourism, Japan <sup>a</sup>
<b>Non-governmental organization representatives</b>
American Association of State Highway and Transportation Officials
American Public Transportation Association
International Construction Measurement Standards Coalition
Organisation for Economic Co-operation and Development
Railway and Transport Strategy Centre, Imperial College London
Regional Plan Association
The World Bank

Source: GAO. | GAO-19-562

<sup>a</sup>We received written responses from the Japan Transport and Tourism Research Institute and the Ministry of Land, Infrastructure, Transport, and Tourism in lieu of an interview.

## Case Study Interviews

To identify approaches that project sponsors have used to manage costs, we selected a non-generalizable sample of four rail transit projects that executed New Starts CIG full-funding grant agreements with FTA in fiscal years 2003 through 2018 as case studies. We selected these projects

from a list of 42 projects provided by FTA; the list included information about project location; rail transit mode; the extent of elevated, underground, or at-grade construction; delivery method; estimated total project cost at the time of grant agreement; actual total project cost (when available); and opening date (when available). We also reviewed project-specific documents, such as FTA's Capital Investment Program Project Profiles and Before and After Studies. Our four selected projects represented light and heavy rail, had total capital costs higher than \$300 million, and varied in terms of: location in the US, the extent of above-, below-, or at-grade construction, and project delivery method. We selected two projects that had begun operation for transit service and two projects that had not yet begun operation. The projects we selected were: (1) the Utah Transit Authority's Mid-Jordan light rail project, which began operating in 2011; (2) the Metropolitan Transit Authority of Harris County's Houston North Corridor light rail project, which began operating in 2013; (3) the Maryland Transit Administration's Purple Line light rail project; and (4) the Los Angeles County Metropolitan Transportation Authority's Purple Line Extension - Section 1 heavy rail project.

We then interviewed stakeholders from the selected projects, whom we refer to as case study stakeholders throughout this report, to learn about the factors that affected each project's costs and the approaches the sponsor employed to manage a project's costs. (See table 3 below.) To inform our interviews, we reviewed the Full Funding Grant Agreements executed between the FTA and the project sponsor for each project. We requested and conducted interviews with all four project sponsors. We also requested interviews with contractors from all four case studies; three contractors agreed to be interviewed and two contractors from one project did not respond to our requests for interviews.<sup>4</sup> In addition, we requested and conducted interviews with two oversight contractors; one oversight contractor oversaw two of the case study projects and the oversight contractor for the fourth project was unavailable.<sup>5</sup> Finally, we requested and conducted interviews with four FTA regional offices, each with responsibility for one of the selected projects.

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<sup>4</sup> Two key contractors in the Houston Rapid Transit joint venture did not respond to our requests for interviews.

<sup>5</sup> According to FTA officials, they could not provide a contact for one of the project management oversight contractors due to company restructuring.



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**Table 3: Case Study Stakeholders Interviewed**

<b>Project sponsor representatives</b>
Utah Transit Authority
Metropolitan Transit Authority of Harris County, Texas
Los Angeles County Metropolitan Transportation Authority, California
Maryland Transit Administration
<b>FTA regional office representatives</b>
Region 8 Office, Denver, Colorado
Region 6 Office, Fort Worth, Texas
Region 9 Office, Los Angeles Metropolitan Office, Los Angeles, California
Region 3 Office, Philadelphia, Pennsylvania
<b>Project management oversight contractor representatives</b>
APTIM <sup>a</sup>
Urban Engineers
Contractors
Kiewit
Skanska
Purple Line Transit Partners

Source: GAO. | GAO-19-562

<sup>a</sup>We interviewed representatives of APTIM over two interviews to discuss two case study projects.

To analyze the responses provided in the case study interviews, we examined each interview summary for approaches sponsors used to manage rail transit project costs. To help categorize and contextualize the approaches identified in the case study interviews, we compared them to key standards, guidelines, and leading practices that we identified for project management, including management of the project's costs, and a second analyst reviewed the work for accuracy. For example, we referred to GAO's *Standards for Internal Control*, which identifies principles of internal control for achieving organizational objectives.<sup>6</sup> We reviewed GAO's *Executive Guide* on leading practices in capital decision-making, which identified leading capital decision-making practices implemented by

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<sup>6</sup> GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

public and private sector organizations recognized for outstanding capital decision-making practices.<sup>7</sup>

We reviewed FTA's *Project and Construction Management Guidelines*, which describe general project management principles and the application of those principles in the transit capital project process, as well as its *Construction Project Management Handbook*, which provides guidelines to sponsors undertaking construction projects.<sup>8</sup> We also reviewed FTA guidance such as its *Third Party Contracting Guidance* (Circular 4220.1F).<sup>9</sup> We also reviewed the United Kingdom's National Audit Office's *Delivery Environment Complexity Analytic*, which provides guidance on how project sponsors can assess the challenges to implementing major projects based on the National Audit Office's analysis of factors that are key influences of success or failure in achieving a project's objectives.<sup>10</sup> We reviewed the International Organization for Standardization's *Risk Management—Guidelines*, which constitutes an international consensus standard on risk management.<sup>11</sup> We also reviewed prior GAO work on risk management.<sup>12</sup> We reviewed project management principles from the Project Management Institute, Inc.'s

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<sup>7</sup> GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-32](#) (Washington, D.C.: Dec. 1998). For purposes of this report we refer to this document as the *Executive Guide*.

<sup>8</sup> FTA, *Project and Construction Management Guidelines* (Washington, D.C.: March 2016) and FTA, *Construction Project Management Handbook* (Washington, D.C.: February 2016).

<sup>9</sup> Federal Transit Administration, *Third Party Contracting Guidance*, FTA Circular 4220.1F, Rev. 4 (Mar. 18, 2013). FTA Circular 4220.1F provides contracting guidance for recipients of federal assistance awarded by the FTA when using that assistance to finance procurements.

<sup>10</sup> National Audit Office, *The DECA: Understanding challenges in delivering project objectives* (November 2013). For the purposes of this report, we refer to this document as the *Delivery Environment Complexity Analytic*.

<sup>11</sup> International Organization for Standardization, *Risk Management—Guidelines*, ISO 31000:2018(E) (Geneva: February 2018). The ISO is an international, independent, non-governmental organization with a membership of 164 national standards bodies, including the American National Standards Institute. The ISO 31000 standards were developed by an ISO committee with over 50 countries participating.

<sup>12</sup> See GAO, *Risk Management: Further Refinements Needed to Assess Risks and Prioritize Protective Measures at Ports and Other Critical Infrastructure*, [GAO-06-91](#) (Washington, D.C.: Dec. 15, 2005) and GAO, *Enterprise Risk Management: Selected Agencies' Experiences Illustrate Good Practices in Managing Risk*, [GAO-17-63](#) (Washington, D.C.: Dec. 1, 2016).

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*Guide to the Project Management Body of Knowledge, PMBOK® Guide*.<sup>13</sup> These standards are utilized worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios. We also reviewed the Transit Cooperative Research Program's *Report 131*.<sup>14</sup> This report provides a framework for sponsors to use to evaluate the positives and negatives of project delivery methods, including in the context of project management considerations such as management capability and risk management.

We also interviewed FTA officials about their activities and the information they provide sponsors and oversight contractors, among other things. In some instances, interviews with case study stakeholders provided contextual information about the usefulness of some of these activities, but those perspectives are not generalizable.

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## Review of FTA's Cost Estimating Information for Project Sponsors

To assess the extent to which FTA's cost estimating information for New Starts CIG project sponsors aligns with GAO's best practices for cost estimating, we compared FTA documents with 12 best practices described in the *GAO Cost Estimating and Assessment Guide (Cost Guide)*.<sup>15</sup> GAO designed the *Cost Guide* to be used by federal agencies to assist them in developing reliable cost estimates and also as an evaluation tool for existing cost estimates. To develop the *Cost Guide*, GAO's cost experts assessed measures applied by cost estimating organizations throughout the federal government and industry and considered best practices for the development of reliable cost estimates.

We reviewed FTA guidance, guidelines, and oversight procedures and interviewed FTA officials to identify publicly available cost estimating information pertinent to New Starts projects. We compared the above best practices with FTA documents including: (1) the *Project and Construction Management Guidelines*, (2) guidance on full funding grant

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<sup>13</sup> Project Management Institute, Inc., *A Guide to the Project Management Body of Knowledge, PMBOK® Guide*, Sixth Edition (2017). The Project Management Institute is a not-for-profit association that provides global standards for, among other things, project and program management.

<sup>14</sup> Transit Cooperative Research Program, *A Guidebook for the Evaluation of Project Delivery Methods, Report 131* (Washington, D.C.: 2009).

<sup>15</sup> GAO developed the *Cost Guide* for cost estimators to assist them in preparing reliable estimates of capital program costs. See [GAO-09-3SP](#).

agreements,<sup>16</sup> (3) Standard Cost Categories for Capital Projects, and (4) 11 separate oversight procedures that provide direction for FTA's oversight contractors.<sup>17</sup> The oversight procedures are strictly directed at their intended audience—FTA's oversight contractors. However, we took the procedures into consideration because they are publicly available on FTA's website and contain information sponsors would find useful to understand the way they will be assessed.

After a review of FTA's cost estimating information for New Starts CIG project sponsors, we assessed the extent to which these documents aligned with GAO's *Cost Guide* best practices on a five point scale:

- **Fully met.** FTA provided complete evidence that satisfies the elements of the step;
- **Substantially met.** FTA provided evidence that satisfies a large portion of the elements of the step;
- **Partially met.** FTA provided evidence that satisfies about half of the elements of the step;
- **Minimally met.** FTA provided evidence that satisfies a small portion of the elements of the step; and
- **Not met.** FTA provided no evidence that satisfies any of the elements of the step.

We have summarized our findings for each of the *Cost Guide*'s 12 steps in appendix III of this report. We also evaluated the extent to which FTA's publicly available information meets GAO's *Standards for Internal Control in the Federal Government* with respect to external communications.<sup>18</sup>

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<sup>16</sup> FTA, *Circular Full-Funding Grant Agreements Guidance, FTA Circular 5200.1A* (Washington, D.C.: December 2002).

<sup>17</sup> The 11 FTA procedures for FTA's oversight contractors we reviewed were Oversight Procedures: (1) 33 – *Capital Cost Estimate Review*, (2) 20 – *Project Management Plan Review*, (3) 21 – *Management Capacity and Capability Review*, (4) 25 – *Recurring Oversight and Related Reports*, (5) 32A – *Project Transit Capacity Review*, (6) 32B – *NEPA and Design Document Comparison*, (7) 32C – *Project Scope Review*, (8) 32D – *Project Delivery Method Review* (9) 34 – *Project Schedule Review*, (10) 40B – *Risk and Contingency Review (Abbreviated)*, and (11) 40C – *Risk and Contingency Review (Full)*.

<sup>18</sup> GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

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We conducted this performance audit from May 2018 to July 2019 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 that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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# Appendix II: Summary of the Development and Construction Process for New Starts Projects in FTA's Capital Investment Grant Program

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In the United States, project sponsors (sponsors) must follow a statutorily defined process to be eligible for and receive federal funding through the Federal Transit Administration's (FTA) Capital Investment Grant (CIG) program.<sup>1</sup> For New Starts projects,<sup>2</sup> this multi-phase process includes:

- **Project Development.** During this phase sponsors must, among other things, complete an environmental review process, as outlined in the National Environmental Policy Act of 1969,<sup>3</sup> and develop sufficient information to demonstrate that the project is justified and has secured the required local financial commitment.<sup>4</sup> Unless granted an extension, New Starts projects must complete the statutorily required activities to obtain a project rating by FTA within 2 years from the day on which they enter into the Project Development phase.<sup>5</sup> As such, sponsors may begin project development work prior to applying for a New Starts CIG.<sup>6</sup>
- **Engineering.** The sponsor's request to enter the Engineering Phase is FTA's first opportunity to evaluate and rate a project, and is the point at which FTA determines the maximum amount of federal funding the project may receive.<sup>7</sup> The sponsor must comply with a number of requirements in this phase including developing a reliable cost, scope, and schedule for the project and obtaining all non-CIG program funding commitments.

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<sup>1</sup> 49 U.S.C. § 5309.

<sup>2</sup> As of 2015, New Starts projects are defined as capital investments whose sponsors request \$100 million or more CIG funding or anticipated \$300 million or more in capital costs. Fixing America's Surface Transportation Act. Pub. L. No. 114-94, 129 Stat. 1312 (2015).

<sup>3</sup> 49 U.S.C. § 5309(d)(1)(A)(i)(II).

<sup>4</sup> 49 U.S.C. § 5309(d)(1)(B).

<sup>5</sup> 49 U.S.C. § 5309(d)(1)(C)(i). To complete this phase, project sponsors must select a locally preferred alternative as required under the National Environmental Policy Act of 1969 and the project must be adopted into the metropolitan transportation plan. 49 U.S.C. § 5309(d)(2)(A).

<sup>6</sup> FTA's policy guidance encourages project sponsors to perform whatever work they feel is necessary prior to submitting a request to FTA to enter into the Project Development phase to enable them to complete this phase within 2 years.

<sup>7</sup> Before FTA can recommend a project to Congress for funding, it is required by law to rate the project by using a number of criteria designed to provide important information about the project's merit.

- **Project rating and grant agreement.** Before FTA can recommend a project to Congress for funding, it is required by law to rate the project by using a number of criteria<sup>8</sup> designed to provide important information about a project's merit.<sup>9</sup> If, after congressional notification, FTA enters into a construction grant agreement for a New Starts project, the sponsor receives federal funding to proceed with project construction.
- **Project construction and oversight.** After the construction grant agreement, FTA continues to oversee grantees, with the help of project management oversight contractors (oversight contractor), evaluating each project's risk, scope, cost, schedule, financial plan, and project management plan, as well as the sponsor's technical capacity and capability to complete the project. For example, FTA and its oversight contractors review sponsors' capital cost estimates multiple times during the engineering and construction phases, as sponsors revise estimates to reflect changes and update them based on new information and actual costs.<sup>10</sup> As we reported in 2010, FTA sets expectations for its project management oversight contractors through contracts, task orders,<sup>11</sup> and written guidance—called oversight procedures.

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<sup>8</sup> Currently, New Starts project justification criteria are: mobility improvements, environmental benefits, cost-effectiveness, economic development, land use, and congestion relief. 49 U.S.C. 5309(d)(2)(A)(iii). Cost-effectiveness is calculated using capital and operations and maintenance cost estimates, and ridership forecasts.

<sup>9</sup> 49 U.S.C. § 5309(g)(1),(2). We previously reported on how FTA's evaluation and rating process enables it to verify that statutory requirements are met before recommending a New Starts project for funding. See GAO, *Public Transit: Observations on Recent Changes to the Capital Investment Grant Program*, [GAO-16-495](#) (Washington, D.C.: Apr. 28, 2016).

<sup>10</sup> FTA is statutorily required to evaluate and rate projects to assess their merit based in part on capital cost estimates, and such estimates are part of the agency's support when recommending a project for funding to Congress.

<sup>11</sup> Pursuant to the Federal Acquisition Regulation, a task order means an order for services placed against an established contract or with government sources. Individual orders must clearly describe all services to be performed by the contractor. FAR §§2.101 and 16.505(a)(2).

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# Appendix III: Summary of GAO's Assessment of FTA's Cost Estimating Information for Project Sponsors

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GAO's *Cost Guide* outlines best practices pertaining to cost estimation principles, presenting 12 steps to create high-quality estimates.<sup>1</sup> These steps are generally applicable in a variety of circumstances and range from defining the purpose of the estimate to obtaining data to presenting the estimate to management for approval. Application of these principles should result in reliable and valid cost estimates that management can use to make informed decisions. To assess the extent to which FTA's cost estimating information aligns with these best practices, we compared FTA's information to the *Cost Guide*. Specifically, we reviewed FTA documents containing cost estimating information pertinent to New Starts projects including FTA's: (1) *Project and Construction Management Guidelines*, (2) guidance on full funding grant agreements, (3) Standard Cost Categories for Capital Projects (SCC),<sup>2</sup> and (4) 11 separate oversight procedures that provide direction for FTA's oversight contractors.<sup>3</sup>

Taken together, several of FTA's documents provided cost estimating information that either *substantially* or *fully* meets 7 of the 12 cost estimating steps. Furthermore, the information *partially met* 3 of the 12 steps, *minimally met* 1 of the 12 steps, and *did not meet* 1 of the 12 steps. Table 4 summarizes GAO's assessment of the extent to which FTA's information aligns with GAO's best practices.

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<sup>1</sup> [GAO-09-3SP](#).

<sup>2</sup> FTA's Standard Cost Categories apply to all Capital Investment Grant projects, and provide a consistent format for the reporting, estimating, and managing of capital costs.

<sup>3</sup> The 11 FTA procedures for FTA's oversight contractors we reviewed were Oversight Procedures: (1) 33 – *Capital Cost Estimate Review*, (2) 20 – *Project Management Plan Review*, (3) 21 – *Management Capacity and Capability Review*, (4) 25 – *Recurring Oversight and Related Reports*, (5) 32A – *Project Transit Capacity Review*, (6) 32B – *NEPA and Design Document Comparison*, (7) 32C – *Project Scope Review*, (8) 32D – *Project Delivery Method Review* (9) 34 – *Project Schedule Review*, (10) 40B – *Risk and Contingency Review (Abbreviated)*, and (11) 40C – *Risk and Contingency Review (Full)*.



**Appendix III: Summary of GAO's Assessment  
of FTA's Cost Estimating Information for  
Project Sponsors**

**Table 4: Summary Assessment of FTA's Cost Estimating Information for Project Sponsors in Its Guidance and Guidelines Compared to Best Practices**

GAO's 12 step cost estimating process	FTA's guidelines and guidance compared to GAO's <i>Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs</i> <sup>a</sup>	Assessment of FTA's publicly available information
1: Define estimate's purpose	<p>The purpose of a cost estimate is determined by its intended use and its intended use determines its scope and detail. To determine an estimate's scope, cost analysts must identify the customer's needs.</p> <p>FTA documents provide substantial information about identifying the cost estimate's purpose. In particular, the documents address both scope and schedule, including providing a template for the Baseline Cost Estimate, and specifying the points in time when project justification and financing documentation are required. By providing additional clarity regarding how the project justification and financing process relates to a project's full life-cycle cost estimate, encompassing all past (or sunk), present, and future costs, regardless of funding source, FTA would ensure the sponsor understands the estimate's purpose, and can provide a complete estimate to support that purpose.</p>	Substantially Met
2: Develop the estimating plan	<p>An analytic approach to cost estimates typically entails a written estimating plan detailing a master schedule of specific tasks, responsible parties, and time frames. Enough time should be scheduled to collect data, including visits to contractor sites to further understand the strengths and limitations of the data that have been collected. If there is not enough time, then the schedule constraint should be clearly identified in the ground rules and assumptions, so that management understands the effect on the estimate's quality and confidence.</p> <p>FTA's cost estimating information addresses estimating team's qualifications, where the participation of a cost engineer(s) throughout the life of the project is prudent. However, FTA's documentation does not address how sponsors might identify the estimate timeline and understand schedule risks based on data collection and analysis.</p>	Substantially Met
3: Define the project's characteristics	<p>The key to developing a credible estimate is having an adequate understanding of the project that usually takes form in a technical baseline. A technical baseline should include a description of the project, define the requirements, and document the underlying technical and project assumptions necessary to develop a cost estimate and update changes as they occur.</p> <p>FTA's cost estimating information addresses the development and documentation of project characteristics to define the technical baseline. In particular, the Standard Cost Categories (SCC) workbook, the format for consistent reporting of estimates, provides placeholders for technical baseline documentation for the sponsor to provide a common definition of the project—including a detailed technical, project, and schedule description of the system—from which all life-cycle cost estimates will be derived. In addition, FTA requires comprehensive acquisition and technical documentation underlying the sponsor cost estimate.</p>	Fully Met
4: Determine the estimating structure	<p>A work breakdown structure<sup>b</sup> is the cornerstone of every project because it defines in detail the work necessary to accomplish a project's objectives. For example, a typical "work breakdown structure" reflects the requirements and what must be accomplished to develop a project, details common elements, and provides a basis for identifying resources and tasks for developing a project cost estimate.</p> <p>Within its publicly accessible documents, FTA's SCC establishes a consistent format for sponsors to report, estimate, and manage capital costs for New Starts projects.</p>	Fully Met

**Appendix III: Summary of GAO's Assessment  
of FTA's Cost Estimating Information for  
Project Sponsors**

GAO's 12 step cost estimating process	FTA's guidelines and guidance compared to GAO's <i>Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs</i> <sup>a</sup>	Assessment of FTA's publicly available information
5: Identify ground rules and assumptions	<p>Cost estimates are typically based on limited information and therefore need to be bound by the constraints that make estimating possible. These constraints are usually made in the form of assumptions. It is imperative that cost estimators document all assumptions well and test them for risk to portray the effects of any assumptions changing, so that management fully understands the conditions the estimate was based on. Such documentation and analysis provides management with an invaluable perspective on its decision. Additionally, cost estimators must ensure that assumptions are not arbitrary and that they are founded on expert judgments rendered by experienced project and technical personnel.</p> <p>FTA's cost estimating information discusses two cost assumptions, contingency and escalation. Also, the information includes placeholders for sponsors to document project-specific assumptions in the SCC workbook. However, FTA does not provide information to the sponsors recommending documentation for a complete set of cost, technical, and schedule assumptions specific to the sponsors' cost estimate. Such information would better ensure sponsors' estimates are accurate and reflect a consistent understanding of the baseline. Unless cost estimating ground rules and assumptions are clearly documented, the cost estimate will not have a basis for areas of potential risk to be resolved.</p>	Partially Met
6: Obtain the data	<p>Credible cost estimates are rooted in historical data. Estimators usually develop estimates for new projects by relying on data from existing projects and adjusting for any differences. Thus, collecting valid and useful historical data is a key step in developing a sound cost estimate. One way of ensuring that the data are applicable is to perform checks of reasonableness to see if the results are similar.</p> <p>FTA's cost estimating information references the Capital Cost Database and other industry standard data sources such as the RSMeans construction cost estimating manual.<sup>c</sup> However, FTA's documentation offers little information about what constitutes good historical data, or how sponsors might address data normalization to adjust the data to make them applicable to a particular project.</p> <p>Without sufficient background knowledge about the source and reliability of the data, sponsors cannot know with any confidence whether sponsors can use the collected data directly or if they need to modify them. Since sponsors can gather data from a variety of sources, the data are often in many different forms and need to be adjusted before sponsors can use them.</p>	Partially Met
7: Develop the point estimate and compare to an independent cost estimate	<p>This step pulls all the information together to develop the point estimate—the best guess at the estimate given the underlying data. This estimate includes the estimate's methodology, and its validation process.</p> <p>All the FTA documents containing cost estimating information that we reviewed address sponsors' development of the point estimate. FTA could improve its information for sponsors in the areas of defining and documenting the methodology and its traceability to the estimate. Additionally, FTA's documentation does not clearly outline the importance of sponsors applying verification and validation checks of the estimate.</p>	Substantially Met

**Appendix III: Summary of GAO's Assessment  
of FTA's Cost Estimating Information for  
Project Sponsors**

GAO's 12 step cost estimating process	FTA's guidelines and guidance compared to GAO's <i>Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs</i> <sup>a</sup>	Assessment of FTA's publicly available information
8: Conduct a sensitivity analysis	<p>A sensitivity analysis should be included in all cost estimates because it examines the effects of changing single assumptions. Without sensitivity analysis, the cost estimator will not fully understand which variable most affects the cost estimate.</p> <p>FTA's cost estimating information does not provide direction for sponsors as to the value of a sensitivity analysis and how to perform it. A sensitivity analysis entails changing the value of a single cost input parameter, recalculating the cost, and comparing the original estimate with the recalculated estimate to understand how sensitive the estimate is to a particular change. Without conducting a sensitivity analysis that reveals how the cost estimate is affected by a change in a single assumption, cost estimators will not fully understand which variable most affects the cost estimate.</p>	Not Met
9: Conduct a risk and uncertainty analysis	<p>Quantitative risk and uncertainty analysis provides a way to assess the variability in the point estimate. Having a range of costs around a point estimate is more useful to decision makers because it conveys the level of confidence in achieving the most likely cost and also informs them on cost, schedule, and technical risks.</p> <p>Multiple FTA documents containing cost estimating information speak to project risk and support for the risk register. However, none of FTA's documents address how the sponsor should evaluate and incorporate risk in its cost estimate. Additionally, FTA's cost estimating information does not provide sponsors information on developing a level of confidence for the project's cost estimate. For the sponsor's management to make good decisions, the project's cost estimate must reflect the degree of uncertainty, so that a confidence level can be provided for the estimate. Having a range of costs around a point estimate is more useful to decision makers because it conveys the level of confidence in achieving the most likely cost and also informs them on cost, schedule, and technical risks. If sponsors do not conduct complete risk and uncertainty analyses, their estimates will lose credibility. Management decisions will not be informed by an understanding of the ranges in the cost estimate based on assumed risk and uncertainty.</p>	Minimally Met
10: Document the estimate	<p>Documentation provides total recall of the estimate's detail so that the estimate can be replicated by someone other than those who prepared it. Documentation also serves as a reference to support future estimates. Documenting the cost estimate makes available a written justification showing how it was developed and aids in updating it as key assumptions change and more information becomes available. According to the <i>Cost Guide</i>, estimates should be documented to show all parameters, assumptions, descriptions, methods, and the calculations used to develop the cost estimate.</p> <p>FTA's documents on cost estimating information discuss sponsors' documentation of cost estimates, but it is limited. Estimates should be documented to show all parameters, assumptions, descriptions, methods, and calculations used to develop a cost estimate. Cost estimate documentation should explain why particular methods and data sets were chosen, and there should be enough detail so that the documentation serves as an audit trail of backup data, methods, and results. If sponsors follow only FTA's information, their documentation would not include enough detail so that an analyst unfamiliar with the project could recreate the analysis.</p>	Substantially Met

**Appendix III: Summary of GAO's Assessment  
of FTA's Cost Estimating Information for  
Project Sponsors**

GAO's 12 step cost estimating process	FTA's guidelines and guidance compared to GAO's <i>Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs</i> <sup>a</sup>	Assessment of FTA's publicly available information
11: Present estimate to management	<p>Briefing management about how the estimate was constructed—including the specific details about the project's technical characteristics, assumptions, cost-estimating methodologies, data, sensitivity, risk, and uncertainty— is necessary for management to have confidence that the estimate is accurate, complete, and high in quality. Furthermore, a cost estimate is not considered valid until management has approved it. The briefing should be clear and complete so that those who are unfamiliar with it can easily comprehend the competence that underlies the estimate results.</p> <p>FTA's cost estimating information addresses the oversight contractor's review of the sponsor's cost estimate, but does not discuss the relationship between the oversight contractor's review and FTA's review/approval of the estimate. In addition, FTA's information does not provide information for how and when FTA or the oversight contractor reviews sponsors' cost estimates, and who validates and approves sponsors' cost estimates.</p> <p>A cost estimate is not considered valid until the sponsor's management has approved it. Thus, it is imperative that management understands how sponsors developed the estimate, including the risks associated with the underlying data and methods. For FTA to gain confidence that sponsors' estimates are accurate, complete, and high quality, it is necessary for sponsors to brief their management and FTA about how the estimate was constructed—including the specific details about the project's technical characteristics, assumptions, cost estimating methodologies, data, sensitivity, risk and uncertainty.</p>	Partially Met
12: Update the estimate	<p>Cost estimates must be updated whenever requirements change and the results should be reconciled and recorded against the old estimate baseline. The documented comparison between the current estimate (updated with actual costs) and the old estimate allows the cost estimator to determine the level of variance between the two estimates. In other words, it allows estimators to see how well they are estimating and how the project is changing over time.</p> <p>FTA's cost estimating information acknowledges the importance of updates to the cost estimate. However, the information FTA provides sponsors is vague concerning reasons for re-estimation. Unless properly updated on a regular basis, the cost estimate cannot provide decision makers with accurate information about the cost associated with the project as it changes over time.</p>	Substantially Met

Source: GAO analysis of Federal Transit Administration documents | GAO-19-562

Note: Our assessments of this guidance in comparison with the *GAO Cost Estimating and Assessment Guide* fall in the following categories: *Fully met*: FTA provided complete evidence that satisfies the elements of the step; *Substantially met*: FTA provided evidence that satisfies a large portion of the elements of the step; *Partially met*: FTA provided evidence that satisfies about half of the elements of the step; *Minimally met*: FTA provided evidence that satisfies a small portion of the elements of the step; and *Not met*: FTA provided no evidence that satisfies any of the elements of the step.

<sup>a</sup> GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, GAO-09-3SP, (Washington, D.C.: March, 2009).

<sup>b</sup> "Work breakdown structure" defines in detail the work necessary to accomplish a project's objectives.

<sup>c</sup> RSMMeans is a database of current construction cost estimates.

# Appendix IV: Comments from the Department of Transportation



U.S. Department of  
Transportation  
Office of the Secretary  
of Transportation

Assistant Secretary  
for Administration

1200 New Jersey Avenue, SE  
Washington, DC 20590

JUL 03 2019

Susan A. Fleming  
Director, Physical Infrastructure Issues  
U.S. Government Accountability Office (GAO)  
441 G Street NW  
Washington, DC 20548

Dear Ms. Fleming:

The Federal Transit Administration (FTA) is committed to continuing to provide effective oversight of Federal funds invested in major capital public transportation projects across the country. As the GAO noted in its draft report, FTA's cost estimating information for project sponsors aligns with many best practices. Eighty-five percent of transit projects opened since 2004 were completed under budget or within 10 percent of the estimated capital cost. FTA's project management oversight program is designed to ensure project sponsors have plans and procedures in place to effectively complete and deliver projects. Further, FTA has taken additional steps to ensure realistic project sponsor cost estimates by developing standard cost categories, implementing the capital cost database, sharing best practices and lessons learned, and implementing further improvements to the risk assessment process.

Upon review of the GAO's draft report, FTA partially concurs with Recommendation 1 to ensure that FTA's cost estimating information is consistent with all 12 steps in GAO's *Cost Estimating and Assessment Guide (Cost Guide)* for developing reliable cost estimates. FTA agrees to post GAO's *Cost Guide* to its website, and FTA encourages project sponsors to follow industry best practices. FTA concurs with Recommendation 2 to provide a central, accessible source of cost estimating information for project sponsors. We will provide a detailed response for each recommendation within 180 days of the final report's issuance.

We appreciate the opportunity to respond to the GAO draft report. Please contact Madeline M. Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if you would like to obtain additional details.

Sincerely,

Keith Washington  
Deputy Assistant Secretary for Administration

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# Appendix V: GAO Contact and Staff Acknowledgments

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## GAO Contact

Susan Fleming, (202) 512-2834, or [flemings@gao.gov](mailto:flemings@gao.gov)

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## Staff Acknowledgments

In addition to the contact named above, Matt Barranca (Assistant Director), Jaclyn Mullen (Analyst in Charge), Amy Abramowitz, Melissa Bodeau, Jennifer Echard, Tobias Gillett, Anna Irvine, Hannah Laufe, Jason Lee, Serena Lo, Cheryl Peterson, Malika Rice, Pamela Snedden, and Shane Spencer made key contributions to this report.

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