



Appendix 1.10 Capital Cost Methodology

PREPARED FOR:

NY Metropolitan Transportation Authority

PREPARED BY:

The AECOM Team

NOVEMBER 2022



Contents

1. INTRODUCTION	1
2. ESTIMATE DEVELOPMENT	2
2.1 Overall Scope Review	2
2.1.1 Reports and Analyses Review	2
2.1.2 Drawings Review	2
2.1.3 Questions	2
2.1.4 Quotations	3
2.1.5 Ground Rules and Assumptions	3
2.1.6 Develop a Work Breakdown Structure	3
2.1.7 Agency Support	3
2.1.8 Technical Standards	3
2.2 Estimating	3
2.2.1 Gather Data/Takeoff	3
2.2.2 Compile Data	4
2.2.3 Pricing	4
2.2.4 Unit Costs, Hard Costs and Soft Costs	4
2.3 Final Review	5
2.3.1 Historical Estimates and Data	5
2.3.2 Quality Control and Quality Assurance	5
2.4 Prepare Final Submission	5
2.4.1 Basis of Estimate Page	6
2.4.2 Estimate Summary	6
2.4.3 Final Quality Control Checks	6
3. WORK BREAKDOWN STRUCTURE	7



1. INTRODUCTION

This Technical Memorandum is part of the work of Task 10.3 for the Interborough Express Study being prepared by AECOM. In response to the RFP the AECOM Team will develop preliminary, order-of-magnitude (OOM) estimates (with +/- 20% confidence) for capital (construction) costs. The computation of each alternative's capital cost include unit prices for all major items of work and estimated quantities for those items, including rolling stock and support equipment.

According to the Association for Advancement of Cost Engineering, cost estimating is the process used to quantify, cost, and price the resources required for the scope of a project. The cost estimate is the most probable cost for a project based upon its scope. The cost estimate is important in that it is the backbone, utilized by stakeholders, to generate a project budget. The cost estimate is derived by utilizing a variety of means and methods outlined in this report. Eventually the cost estimate will be refined as more detailed specifications are developed. A good cost estimate is necessary for the success of a project.

2. ESTIMATE DEVELOPMENT

2.1 Overall Scope Review

Prior to performing any work all team members will convene and review the scope documents to gain an understanding of the overall scope, its design, goals, details, approach, and deadlines etc. The review will provide team members with a general understanding of the individual components of a project as well as provide any required coordination if any.

In concurrence with the project RFP, the estimate will address the State of Good Repair needs of existing Bay Ridge Branch and Fremont Secondary infrastructure as well as highway and rail bridges and the East New York tunnel. Potential sources for the OOM capital construction costs will include:

- Statistical data compiled from previous construction projects having items of work that are similar in nature;
- Local/regional area cost data;
- Vendor information; and
- Industry publications

Unit prices will be based upon current (i.e. 2019) dollars, and escalated to the midpoint of the project. Quantity takeoffs will be primarily based upon information shown on the functional feasibility study drawings. Quantity estimates will be on an aggregate level, with similar levels of precision among alternatives to ensure valid comparisons. Order-of-magnitude estimates of construction contingency, LIRR or NYCT labor (as appropriate), construction supervision and design will be included.

Property acquisition and relocation costs will be based on information to be provided by the MTA Real Estate Department. Capital cost estimates will also include construction contingency, MTA labor, construction supervision and design. The rail alternatives shall include capital cost estimates for single and double track operating segments and any necessary terminal storage and bypass tracks, based on LIRR and NYCT operating specifications.

2.1.1 Reports and Analyses Review

At this time the Team will not be developing technical specifications, but will be preparing various reports and analyses to guide the Feasibility Study that will give the Team a general understanding of a project. Those reports and analyses may contain details regarding phasing, general conditions etc. as well as pertinent information that will be considered in the development of the OOM estimate.

2.1.2 Drawings Review

Estimating team members will review the set of conceptual-level drawings, if any, to further understand and develop the estimates of the alternatives. Those drawings, typical sections and sketches will also be reviewed and used to establish the basis of comparison of the alternatives.

2.1.3 Questions

During the review the estimators will also note down any important questions. Questions regarding scope should be compiled during the beginning and submitted for answers as early on as possible.

2.1.4 Quotations

While going through the overall review the team may come across some items that are either “large ticket” items or unknown items. With either case it may be necessary to reach out to a manufacturer, vendor, or distributor to acquire a material quote. Quotes will be requested as early as possible to allow ample time for vendors to respond.

2.1.5 Ground Rules and Assumptions

During the review, the Team should also make note of any ground rules and assumptions that may be required. These rules are important so that the estimate can be accurate as possible. For example: “The estimate includes items x,y,z.”, and/or “Estimate does not include scope x,y,z. Ground rules can also include how fast the project needs to be completed, constraints, travel costs, etc.

2.1.6 Develop a Work Breakdown Structure

Once the scope of the work has been understood, the team will create a detailed work breakdown structure (WBS). The Work Breakdown Structure (WBS) will provides a means for defining the project scope will be used to define the estimate’s organization so it needs to be reviewed by all team members including the design team to make sure it is appropriate. How an estimate is organized will change depending on the required requests from the client on organization.

2.1.7 Agency Support

The Team should identify early on what scope in the project requires agency intervention. The team should review such costs and request further data from the agency. An example of agency support would be the cost to perform “Force Account” work. The “Force Account” scope is a cost that is usually provided by the agency and then factored in accordingly to the budget.

2.1.8 Technical Standards

The following standards will be referenced and followed to guarantee the estimate adheres to industry standards:

- Association for Advancement of Cost Engineering (AACE International)
- Federal Transit Administration (FTA) Project and Construction Management Guidelines
- New York State Metropolitan Transportation Authority (MTA) Capital Projects Cost Estimation Guidelines
- R. S. Means Construction Cost Estimating Manual

2.2 Estimating

Different portions of the project scope will be estimated by the estimating team members. It is estimators’ role to execute the steps mentions in section 2.1 Overall Scope Review. The estimators will use unit quantities taken from the drawings and sketches developed by the planning and engineering staff to establish the order of magnitude costs. Once completed they can move on to the following steps in order to complete their portion of the estimate.

2.2.1 Gather Data/Takeoff

Data may be gathered from the drawings or from the specifications or various

other sources. One way that estimators can gather data is by performing takeoffs. Takeoffs are essential for a correct estimate. Takeoffs provide the quantities to which unit prices are applied in the estimate.

2.2.2 Compile Data

A proper estimate is one that is easy for project stakeholders to decipher and understand. Therefore, it is important that the data be adapted to the framework of the estimates work breakdown structure.

2.2.3 Pricing

Every item in the estimate will have a direct cost associated with it. These costs are typically split up by labor, materials, & equipment.

- Labor – the cost of the required manpower to install an item. Labor costs can be calculated as the [Average Hourly Wage] x [Productivity Rate].
 - Average Hourly Wage rates can vary from project to project depending on the requirements, Open Shop, Union, Prevailing Wage, Project Labor Agreements. These requirements need to be determined before pricing can begin. If not provided a clear assumption will be provided.
 - The average hourly wage rate often can be further divided into “labor” and “non-labor” costs
 - Labor costs are the costs associated directly the salary and benefits that the contractor incurs for each worker per hour.
 - Non-labor costs are portions of the wage rate that are not directly related to salary and benefits. These include things such as hardware and software, training and, in some instances, travel expenses to and from the site.
- Productivity Rates will be determined from historical precedent and adjusted to depending on the specific site conditions
- Material – the cost of purchasing materials to be installed. Material unit cost is simply \$/unit.
- Equipment – the cost of the required equipment to install an item. Equipment cost can be calculated as the (Hourly Cost of equipment) x (Productivity Rate).

At this point any quotations that are obtained should also be incorporated into the estimates. Always note in the estimate who provided the estimate and what date it was obtained.

2.2.4 Unit Costs, Hard Costs and Soft Costs

The estimates at this level of the project development is often developed in terms of a unit price cost, rather than the actual line-by-line estimate of the costs. The cost may use, for example, a cost per square foot of bridge rather than a detailed description of the individual components of the construction of a bridge (excavation, formwork, concrete, reinforcing steel, etc.).

In addition, the estimate will include both hard costs and soft costs. Hard costs will address the tactile elements of the work: concrete, steel, vehicles and labor.

Soft costs, on the other hand, are not necessarily visible at the completion of the work. The soft costs, often estimated in terms of percentage of the hard costs include items such as architectural and engineering design, insurance, permits and construction management. These are usually included in Category 80 (“Professional Services”) of the FTA’s SCC structure.

In the early phase of a project development, a large portion of soft costs may be associated with the Environmental Impact Statement (EIS) of the project, which may be required by the National Environmental Policy Act (NEPA) for projects seeking Federal funding. A discussion of both soft costs and how the EIS affect the estimate is provided in detail in the Transportation Research Board’s *TCRP Report 138: Estimating Soft Costs for Major Public Transportation Fixed Guideway Projects*.¹

2.3 Final Review

Prior to submitting an estimate, a formal review process must be undertaken. This step is crucial so that key elements in the estimate are not missed and that a thorough review can

2.3.1 Historical Estimates and Data

Part of the review process involves looking into past historical data. Historical data can be obtained from a variety of sources. These sources may include the agency, prior estimates, and prior bids. Prior to being finalized the estimate should be checked to see if it falls within the range of historical data. If it does not the team needs to reevaluate why it does not. Scope and/or market conditions may have changed. Once each individual estimate is complete the team should review the prior data to see if it matches.

2.3.2 Quality Control and Quality Assurance

Each estimator team member will develop individual elements of the project so that an independent estimate can be reviewed by other members of the estimating team. Each estimate undergoes a thorough and rigorous quality control and quality assurance check prior to final submission.

The following are examples of some quality control checks utilized prior to final submission:

- Math checks – All estimators will check that formulas and math are performed accurately in the estimate.
- Spell Check
- High/Low Check - look for any item that has an extremely high or low unit cost. Potentially errant unit costs were reviewed by an independent member of the estimating team with the estimator and estimated costs will be verified or modified accordingly.

2.4 Prepare Final Submission

Once the pre-final version of the estimate is completed, the estimating team will convene and, together with members of the planning and/or engineering team, will verify and compile the final estimate. Each individual estimate should be combined into the overall work breakdown structure. Once compiled the following sections will be developed:

¹ <http://www.trb.org/Publications/Blurbs/163381.aspx>



Basis of Estimate and Estimate Summary. After that the final quality control checks will be completed.

2.4.1 Basis of Estimate Page

The basis of estimate page will include the information on the cover page as well as any Estimate Exclusions/qualifications and/or clarifications. Examples of some clarifications may include overhead and profit percentages, escalation percentages, assumed construction duration etc. Exclusions will include all items that are not covered under the estimate. Examples may be general order shutdowns, loose furniture and other work usually performed by the agency

2.4.2 Estimate Summary

The estimate summary will have a price to each work breakdown structure/trades. The summary page will also include percentages for allowances, phasing & lost time, mobilization, and escalation etc. Depending on the level of the estimate, these costs/percentages may need to be adjusted accordingly. Likewise depending on the type of estimate additional line items may need to be included (i.e. architectural fees additional design build costs etc.)

2.4.3 Final Quality Control Checks

Once all other tasks are completed, and the estimate is compiled properly a final check of the estimate needs to be done. The following are items that are once again checked after the final estimate is compiled.

- Spell Check: run a spell check on the entire file
- Math Check: run math checks on the entire estimate.
- Sanity Checks: Ensure total dollars per gross square foot checks out with historical models, ensure specific spec section dollars per gross square foot check.
- Review top 10 to 20 largest individual line items.
- Template Check: Confirm the estimate has been put together in the correct template as required by the design team / owner. Borders, fonts, etc. also need to be checked during this stage.



3. WORK BREAKDOWN STRUCTURE

The order of magnitude estimate for the project alternative(s) will be established using the FTA Standard Cost Categories to facilitate consistency in the review of the potential costs for various project alternatives. In 2005, FTA implemented the Standard Cost Categories (SCC) to establish a consistent format for the reporting, estimating, and managing of capital costs for New Starts projects. Information gathered from projects across the country has been developed into a database called the Capital Cost Database, a cost-estimating resource useful to FTA and the transit industry as a whole². By using this format will allow the MTA to use a common baseline from which to view the project in the same fashion used in similar projects of this nature.

The following Work Breakdown Structure (WBS) is very similar to the SCC categories, but sub-elements have been used that will both provide project-specific information and then allow those sub-element estimates to “roll up” to the standard SCC categories. The following WBS will be used to track the direct costs for all Design Options.

10 GUIDEWAY & TRACK ELEMENTS

- 10.01 Guideway: At-grade exclusive right-of-way
Any guideway, rail-based or BRT
- 10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)
LRT or BRT alternatives
- 10.03 Guideway: At-grade in mixed traffic
LRT or BRT alternatives
- 10.04 Guideway: Aerial structure
Any guideway, rail-based or BRT
- 10.05 Guideway: Built-up fill
Any guideway, rail-based or BRT
- 10.06 Guideway: Underground cut & cover
Any guideway, rail-based or BRT
- 10.07 Guideway: Underground tunnel
Any guideway, rail-based or BRT
- 10.08 Guideway: Retained cut or fill
Any guideway, rail-based or BRT
- 10.09 Track: Direct fixation
Include rails, connectors.
- 10.10 Track: Embedded
Include rails, ties; ballast where applicable
- 10.11 Track: Ballasted
Include rails, ties and ballast.
- 10.12 Track: Special (switches, turnouts)
Include transitional curves.
- 10.13 Track: Vibration and noise dampening
Include upcharge for vib/noise dampening to any track condition above.

20 STATION, STOPS, TERMINALS, INTERMODAL

- 20.01 At-grade station, stop, shelter, mall, terminal, platform
Side Platform, incl. canopies and amenities
Center Platform, incl. canopies and amenities
Walk-on / Walk-off "sidewalk" platform, incl. canopies and amenities
- 20.02 Aerial station, stop, shelter, mall, terminal, platform

² From FTA's *Standard Cost Categories for Capital Projects* <https://www.transit.dot.gov/funding/grant-programs/capital-investments/standard-cost-categories-capital-projects>



- Side Platform, incl. canopies and amenities
- Center Platform, incl. canopies and amenities
- 20.03 Underground station, stop, shelter, mall, terminal, platform
 - Side Platform, incl. canopies and amenities
 - Center Platform, incl. canopies and amenities
- 20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.
 - Side platform - retained cut section, incl. canopies and amenities
 - Center platform - retained cut section, incl. canopies and amenities
- 20.07 Elevators, escalators

- 30 SUPPORT FACILITIES: YARDS, SHOP, ADMIN. BLDGS**
- 30.01 Administration Building: Office, sales, storage, revenue counting
- 30.02 Light Maintenance Facility (Include service, inspection, and storage facilities and equipment)
 - Infrastructure construction
 - Maintenance
 - Operations
- 30.03 Heavy Maintenance Facility (Include service, inspection, and storage facilities and equipment)
 - Infrastructure construction
 - Maintenance
 - Operations
- 30.04 Storage or Maintenance of Way Building
- 30.05 Yard and Yard Track (Include yard construction, guideway and track associated with yard)

- 40 SITEWORK & SPECIAL CONDITIONS**
- 40.01 Demolition, Clearing, Earthwork (Include project-wide clearing, demolition and fine grading)
- 40.02 Site Utilities, Utility Relocation (Include all site utilities: storm, sewer, water, gas, electric)
 - Electrical facilities / ductbanks
 - Water, Sewer and Pipelines
 - Fiber Optic facilities
- 40.03 Haz. mat'l, contaminated soil removal/mitigation, ground water treatments (Include underground storage tanks, fuel tanks, other hazardous materials and treatments, etc)
- 40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks (Include other environmental mitigation not listed)
- 40.05 Site structures including retaining walls, sound walls
- 40.06 Pedestrian / bike access and accommodation, landscaping (Include sidewalks, paths, plazas, functional landscaping, site and station furniture, site lighting, signage, bike facilities, permanent fencing)
- 40.07 Automobile, bus, van accessways including roads, parking lots (including all on grade paving)
- 40.08 Temporary Facilities and other indirect costs during construction

- 50 SYSTEMS**
- 50.01 Train control and signals
- 50.02 Traffic signals and crossing protection (Include signal prioritization at intersections)
 - Traffic prioritization
- 50.03 Traction power supply: substations
- 50.04 Traction power distribution: catenary and third rail
- 50.05 Communications (Include passenger information systems at stations and on vehicles [real time travel information; static maps and schedules]. Include equipment to allow communications among vehicles and with central control)
 - Pathfinder signage
 - PIDS (passenger information display system)



- 50.06 Fare collection system and equipment
 - On-board fare control (collection & maintenance cost)
 - Platform-based fare control
 - Station / mezzanine-based fare control
- 50.07 Central Control (SCADA modifications)

60 ROW, LAND, EXISTING IMPROVEMENTS

- 60.01 Purchase or lease of real estate
 - Relocation of existing households and businesses

70 VEHICLES

- 70.01 Light Rail
- 70.02 Heavy Rail
- 70.03 Commuter Rail
- 70.04 Bus
- 70.05 Automated Guideway Transit
- 70.06 Non-revenue vehicles
- 70.07 Spare parts

80 PROFESSIONAL SERVICES

- 80.01 Project Development
- 80.02 Engineering
- 80.03 Project Management for Design and Construction
- 80.04 Construction Administration & Management
- 80.05 Professional Liability and other Non-Construction Insurance
- 80.06 Legal; Permits; Review Fees by other agencies, cities, etc.
- 80.07 Surveys, Testing, Investigation, Inspection
- 80.08 Start up