OLO Report 2013-8 July 30, 2013

Managing the Design and Construction of Public Facilities: A Comparative Review

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OLO Office of Legislative Oversight

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EXECUTIVE SUMMARY

This OLO report responds to the County Council's request to enhance its understanding of the design and construction of public facilities. To do so, this report reviews the management practices used within Montgomery County Government and provides comparative information on the practices used in other jurisdictions or public agencies.

Summary of Oversight and Management Practices

Designing and constructing a public facility is a complex and detailed process. OLO found that the County's Department of General Services has established several key oversight structures for each phase of the process. These key structures do not vary substantially from the structures or models used by the other jurisdictions and agencies surveyed. Instead, OLO found several common elements when comparing management structures:

Other Jurisdictions/Agencies Surveyed

- Fairfax County, VA
- Prince George's County, MD
- Montgomery County Public Schools
- District of Columbia
- State of Maryland
- Maryland Stadium Authority
- Arlington County, VA
- Loudoun County, VA
- City of Austin, TX
- Miami-Dade County, FL
- New York City, NY
- Santa Clara County, CA
- Ventura County, CA

- **Use of a formal project management structure** to manage and coordinate a project's design and construction phases, typically with oversight from an internal Project Manager. In addition, some jurisdictions regularly engage a Construction Manager to assist with project oversight.
- **Development of written procedures and guidelines**, with a particular focus on design process.
- **Multiple types and formats of standardized design review**, with internal staff design reviews, constructability reviews, and value engineering reviews consistent features among those surveyed. More unique review types (and less prevalent as a standard procedure) include independent peer reviews and Building Information Modeling.
- **Requiring formal quality control plans** in both the construction and design phases to ensure that contractors perform activities in conformance with project specifications.
- **Standardized monitoring and reporting during construction**, including regular progress meetings; daily, weekly, and/or monthly written reports; and routine site-visits.
- **Multiple layers of inspections, tests, and approvals.** Most of the jurisdictions reviewed use independent, third-party contract inspectors for formal inspections not conducted by a permitting authority, while a few jurisdictions use internal staff to conduct some inspections.

Next Steps: OLO Report on Construction Project Change Orders in FY14

Based on the information compiled for this study, OLO finds that the structures and practices used by Montgomery County Government to oversee the design and construction of public facilities largely align with the models and practices used by other jurisdictions and with the "best practices" literature.

A logical next step in the Council's oversight of public facility design and construction is to examine the County Government's performance in implementing these structures in practice. Along those lines, OLO's FY14 Work Program includes a project to review the process and results of "change orders" for County Government construction contracts, including case studies of recent facility projects. Some jurisdictions and agencies use change order data as a performance measure to assess the design and construction process.

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MANAGING THE DESIGN AND CONSTRUCTION OF PUBLIC FACILITIES: A COMPARATIVE REVIEW

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Chapter I. Authority, Scope, and Organization of Report

A. Authority

Council Resolution 17-714, *Resolution to Amend Resolution 15-517 to Revise the FY13 Work Program of the Office of Legislative Oversight: Design and Construction of Public Buildings,* adopted April 9, 2013.

B. Purpose and Scope of Report

In March 2013, the County Executive released a report detailing a series of design and construction failures that have left the Silver Spring Transit Center (SSTC) unsafe. After review, the County Council stated that the report "makes clear that there were pervasive problems in the design, construction, and inspection of the Transit Center which have resulted in a structure that does not meet the County's safety and durability requirements."[1] While calling on the SSTC project design firm, general contractor, inspector, and the Executive Branch to remedy these errors as quickly as possible, the Council also noted that it would work to ensure that issues like these do not happen in the future.

The purpose of this report is to enhance the Council's understanding of the design and construction of public buildings and facilities by reviewing Montgomery County's management practices as well as models used in other jurisdictions. Specifically, this report:

- Reviews general research, standards, guidelines, and best practices for public facility design and construction;
- Summarizes the processes and procedures used by Montgomery County Government to oversee the design and construction of public facilities; and
- Describes the public facility design and construction management and oversight practices used in other jurisdictions and public agencies.

This report does not analyze or review any particular Montgomery County facility project, nor does it review the performance of Montgomery County or any other jurisdiction in implementing or applying its management and oversight structures in practice.

C. Organization of Report

Chapter II, Recommended Management Practices for Public Facility Design and Construction, summarizes the information reviewed by OLO and identifies common practices, structures, and processes used to effectively manage and oversee public facility construction projects.

Chapter III, Public Facility Design and Construction Management in Montgomery County, details the Department of General Services' management and oversight procedures during the public facility design and construction process, and describes the Department of Permitting Services' regulatory role in reviewing a project as part of the permit approval process ensuring that construction plans comply with adopted codes and standards.

[1] Montgomery County Council Statement on Newly Released Report on Silver Spring Transit Center, March 20, 2013. http://www6.montgomerycountymd.gov/Apps/Council/PressRelease/PR_details.asp?PrID=9298.

Chapter IV, Management Practices in Other Jurisdictions and Public Agencies, provides comparative information on the public facility design and construction models used in thirteen other jurisdictions and public agencies.

Chapter V contains **Agency Comments** received from Montgomery County Government's Chief Administrative Officer on the final draft of this report.

D. Methodology

Office of Legislative Oversight (OLO) staff members Craig Howard and Kristen Latham conducted this study. OLO gathered information through document reviews and interviews with staff from the County Government's Department of General Services and Department of Permitting Services; telephone interviews with staff representatives from other jurisdictions and/or public agencies involved with public facility design and construction; a review of documents provided by each jurisdiction or available on their websites; and a general literature and document search.

E. Acknowledgements

OLO received a high level of cooperation from County Government staff involved in this study. OLO appreciates the time commitment, the information shared, and the insights provided by all staff who participated. In particular, OLO acknowledges the following staff for their assistance: Fariba Kassiri, Assistant Chief Administrative Officer; David Dise, Ernie Lunsford, and Don Scheuerman from the Department of General Service; and Diane Jones, Hadi Mansouri, and Gail Lucas from the Department of Permitting Services.

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- City of Austin, TX – Howard Lazarus, Roxanne Cook, Mike Boyle, and Gail Hamrick-Pigg;
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- Fairfax County, VA – Carey Needham and Madgi Imbabi;
- Loudoun County, VA – Paul Brown;
- State of Maryland – Bart Thomas, Larry Bricker, and Tim Case;
- Maryland Stadium Authority – Gary McGuigan;
- Miami-Dade County, FL – Patrick Brown;
- Montgomery County Public Schools – James Song;
- Prince George's County, MD – Jack Sloan;
- Santa Clara County, CA – Siva Darbhamulla; and
- Ventura County, CA – Jeff Pratt and Herbert Schwind.

Chapter II. Recommended Management Practices for Public Facility Design and Construction

Public facility construction can be a lengthy, complex, and rigorous process. To gain a better understanding of how governmental institutions successfully navigate this process, OLO reviewed relevant research literature, standards and guidelines developed by construction trade and industry associations, and best practice documents from other jurisdictions.

This chapter summarizes common practices, structures, and processes used to effectively manage and oversee public facility construction projects, and is organized as follows:

- **Part A** identifies challenges a jurisdiction must overcome in constructing public facilities; and
- **Part B** reviews recommended practices for successfully managing the construction and design of public facilities.

A. Challenges of Public Facility Construction

In order to build a high-quality facility that meets organizational needs, a jurisdiction must successfully manage the planning, design, and construction processes. As described by the Construction Management Association of America: "Construction is inherently a complex endeavor. An owner embarking on a construction project or program faces a variety of challenges, such as time and cost constraints, program and quality goals, project team creation and integration, and internal organizational requirements."[2]

Some of these inherent complexities are exacerbated in a public setting, as "public sector construction projects typically face more difficult problems and obstacles than private sector projects. The formality of the budgeting process renders cost overruns unusually troublesome, and the realities of public administration of the projects often result in delays and claims."[3] The State of Washington's Office of Financial Management summarized several common factors and events that can negatively impact public facility projects based on a review of case studies. Notable factors include:

- Poorly defined or unrealistic scope, budget or schedule at the beginning of the project;
- Changes in project scope and budget;
- Lack of attention to project relationships among stakeholders;
- Design errors and omissions;
- Failure of contractors to coordinate and manage construction;
- Lack of a firm schedule and absence of ongoing monitoring;
- Conflicting interpretations of contract document requirements; and
- Lengthy resolution of issues.[4]

As a result, jurisdictions employ numerous management practices and concepts to help ensure high quality public facility projects that meet user needs while efficiently utilizing public tax dollars.

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[2] Construction Management Association of America (CMAA), *An Owner's Guide to Construction and Program Management*, 2011. pg. 1.
[3] Friedlander, Mark C. and Ruth E. Krugly, "A New Solution for Public Construction Projects: Sequential Designer Led Design-Build," www.schiffhardin.com/binary/friedlander-krugly_design-build.pdf. Originally published in the *Journal of Construction Accounting and Taxation*, March-April 2007.
[4] State of Washington, Office of Financial Management, *Best Management Practices for Capital Projects*, January 2008. http://www.ofm.wa.gov/budget/capital/best_management_practices_report.pdf.

B. Recommended Practices

While many best practice documents related to facility construction contain detailed technical standards and specifications, there are several commonly-cited recommended practices for overcoming the challenges detailed above.

1. Project Management Structures and Protocols

A detailed project management structure can turn the "planning, design and construction process into one which maximizes the owner's control over the project's scope, quality, time, and cost, and adds predictability of the outcome from the start of programming to completion of construction."[5] The project management process begins with identification of the owner's requirements, project limitations/needs, and the establishment of realistic objectives for delivery. Jurisdictions should develop project management protocols to establish how a project is executed, and monitored.

The overall project management structure can be either centralized or decentralized and can include government employees, consultants, and contractors; however, roles and responsibilities must be clearly delineated. As stated by the Massachusetts Municipal Association, "clear and concise definitions of roles and responsibilities should be communicated early in the project to avoid unnecessary disputes and overlaps. Constant and clear communication with the project team should clarify misunderstandings quickly."[6] Two practices cited as beneficial in successfully implementing project management are described below.

Appoint an expert project manager (in-house or contractor). Successful projects tend to have an experienced project manager and an adequate number of staff to oversee the design and construction of public facilities. While the project manager can either be an employee or a hired consultant, there should always be an in-house employee assigned final authority. One model is to hire a Construction Manager, who acts as the jurisdiction's representative with the contractors, manages the construction site, and oversees and inspects work completed.

Use technology to enhance project management. With changing technology, jurisdictions can use specialized software programs to assist project managers with project planning and administration, cost estimating, scheduling, document control, data management, performance evaluation, and forecasting.

2. Design Review

Design review is integral to the oversight of public facility construction. Design reviews are structured analyses of design plans to assure compliance with design standards, environmental and site constraints, and operational needs. In general, design reviews aim to identify errors and omission and ensure:

- Compliance with relevant codes and laws;
- Adherence to cost projections and cost effectiveness;
- Ability to meet operational needs; and
- Overall quality project delivery.

[5] CMAA 2011, pg. 11.
[6] Massachusetts Municipal Association, *Recommended Practices for Hiring Owner's Project Managers: A Guide for Municipal Construction Project, Edition 1*, 2006, pg. 16.

There are many types of design reviews; peer review, value engineering, and constructability reviews were highlighted in several publications as recommended practices, while building information modeling is a newer practice that is becoming more common.

Independent Peer Review. A peer review occurs when an independent team reviews plans for local building code compliance, adherence to standards of design practice/criteria, and design conflicts. Peer review is an important tool for Quality Control/Quality Assurance, and is "an effective way to incorporate lessons learned from other projects and to identify best practices to carry forward into the Final Design phase of the project."[7]

Value Engineering. Value engineering (VE) is a specialized interdisciplinary project review aimed at reduction of costs, increased productivity, and improved quality. VE analyzes the functions of a project to determine its "best value," or relationship between worth and cost. Specifically, VE aims to balance the required functions, performance, quality, and safety of a project with the cost and other operating resources necessary to meet those requirements.

Constructability Review. A constructability review determines whether a project is buildable, biddable, maintainable, and cost-effective. It consists of reviewing the draft plans, draft technical specifications and the proposed bid schedule to ensure that the work requirements are clear, the documents are coordinated, and that there are not any errors, omissions, or conflicts. Constructability reviews can enhance early planning, minimize scope changes, reduce design related change orders, develop construction friendly specifications, enhance quality, reduce delays, meet schedules, reduce disputes and claims, and decrease construction and maintenance costs.[8]

Building Information Modeling (BIM). BIM is a process that utilizes software programs to virtually construct a three-dimensional model of a project and help "architects, engineers and constructors to visualize what is to be built in simulated environment and to identify potential design, construction or operational problems."[9] BIM is emerging as "an innovative way to manage projects. Building performance and predictability of outcomes are greatly improved by adopting BIM."[10]

3. Project Monitoring

The owner of a project is ultimately accountable for the proper delivery of the project, even if the design and construction are contracted out. The purpose of project monitoring is to ensure that contractors comply with contract terms, performance expectations are achieved, and any problems are identified and resolved. During the initial stages of a project, jurisdictions should develop an oversight plan that outlines the key project oversight roles and requirements, including:

- Appoint a contract manager with authority, expertise, and time to monitor the project;
- Track costs and compare them to budget;
- Ensure deliverables are completed on time;
- Conduct material testing to verify quality and compliance;
- Evaluate the contractor's performance against outlined performance measures; and
- Document all monitoring activities.

[7] Federal Transit Administration, *Project and Construction Management Guidelines*, 2011, pg. 2-50.
[8] AASHTO Subcommittee on Construction, *Constructability Review Best Practices Guide*, 2000, pg. 21.
[9] Azhar, Salman, Michael Hein and Blake Sketo, "Building Informatiom Modeling (BIM):Benefits, Risks, and Challenges," http://ascpro.ascweb.org/chair/paper/CPGT182002008.pdf.
[10] Ibid.

Project Schedule. Once the project's scope is defined, the project management team should create a more specific schedule for: 1) construction of each component of the project; 2) review meetings and progress reports; 3) procurement requirements; and 4) inspections and testing. In addition, "project managers should perform reviews of the project schedule on a regular basis to identify developing trends and to point out potentially significant problems in the schedule forecast."[11]

Consistent Recordkeeping and Reporting Requirements. Jurisdictions should create a centralized information management system to monitor the project and keep all project team members informed of project status. Progress reports should be completed on a weekly basis and include:

- Status of the project
- Budgeted vs. actual cost
- Budgeted vs. actual time
- Changes and modifications
- Performance measures
- Scope changes and related potential costs
- Trends and trend forecasts
- Any anticipated problems

Procedures for Changes and Modifications. During the course of construction, unanticipated work may arise and there should be a process in place to review the situation and issue necessary change orders. Accordingly, "the most effective approach to controlling the cost of changes is a management culture that resolves contractor requests for changes in a timely, decisive, and equitable manner."[12]

Performance Requirements for Contractors. It is necessary to hold the contractor accountable for the delivery of quality services and a final product. Performance requirements should include: 1) clear and measurable performance outcomes; 2) evaluation procedures and standards; and 3) positive or negative performance incentives.

4. Quality Control and Inspections

Another recommended practice is that jurisdictions emphasize the development of quality control plans and processes throughout the design and construction of a facility. In general, quality control refers to procedures to ensure that design and construction activities are performed in compliance with project specifications. Quality control "became important not just to ensure that pieces fit together, but also to ensure the safety of the final product."[13]

Inspections. An important component of project oversight, often conducted as part of or in concert with quality control measures, is a system of tests and inspections. These inspections are typically in addition to any inspections required as part of a permit, and can be conducted by in-house staff or contractors. All inspectors, in-house or contracted, should have the appropriate experience and/or certifications. Recommended testing and inspections components include:

- A detailed plan of the amount and types of inspections required;
- A schedule for the required tests and inspections, including what inspections must be completed before certain construction activities can proceed;
- Delineation of responsibilities for who is conducting which inspections; and
- Reporting procedures to ensure that the appropriate parties are receiving and reviewing the test and inspection results.

[11] Federal Transit Administration 2011, pg. 3-31.
[12] Federal Transit Administration, *Construction Project Management Handbook*, 2009, pg. 6-8.
[13] Federal Transit Administration, *Quality Assurance and Quality Control Guidelines*, February 2002, pg. I-5.

Chapter III. Public Facility Design and Construction Management in Montgomery County

There are three primary phases of public facility construction in Montgomery County: facility planning, design, and construction. This chapter provides an overview of the processes and structures established by Montgomery County Government to oversee public facility projects during the design and construction phases. More specifically, the processes reviewed in this chapter are for projects that have a completed Project Description Form and have been approved with a funding allocation as part of the adopted Capital Improvements Program (CIP).

Chapter Highlights

The Department of General Services (DGS) is responsible for managing the design and construction of public facilities, and typically contracts with an architectural/engineering (A/E) firm to design a facility and a General Contractor to build it. The County has established several management and oversight structures for facility design and construction, summarized below, that largely align with the recommended practices described in Chapter II.

Oversight of Project Design and Permit Approval

- A project management protocol to establish roles, responsibilities, and authorities for the project participants and stakeholders.
- Development of formal design quality control plans and procedures.
- Multiple internal and external design review structures.
- Regulatory review of final construction plans by applicable authorities.

Oversight of Project Construction

- A project management structure to establish roles, responsibilities, and authorities for the project participants and stakeholders.
- Development of formal project schedules and quality control plans prior to construction.
- Standard project meetings throughout construction to review and assess progress.
- Establishment of documentation and reporting standards.
- Requirements and processes for all necessary tests, inspections, and approvals.

The chapter is organized as follows:

- **Part A** details the Department of General Services' (DGS) management and oversight procedures during the public facility design process, and describes the Department of Permitting Services' (DPS) role in reviewing a project's design as part of the permit approval process; and
- **Part B** reviews DGS' management and oversight procedures during public facility construction to ensure projects are constructed as intended, and DPS' regulatory practices to ensure that construction complies with permit requirements and adopted codes.

A. Oversight of Project Design Process and Permit Approval

This section highlights several components of the County's oversight structure during the design phase. It reviews the roles and responsibilities of County and consultant staff involved in the design process and describes various ongoing or point-in-time oversight mechanisms. DGS is the "owner" of County facilities and is responsible for managing and overseeing all facets of facility design, including hiring design and other consultants in accordance with County procurement laws and regulations. DPS' role as a regulatory agency, to review construction plans submitted for permit application for compliance with codes, begins after DGS' design process is complete.

The table below briefly summarizes the roles and responsibilities of key participants that are typically involved in the design and permit approval of County facilities.

Selected Roles and Responsibilities – Design Phase and Permit Approval

- **DGS Project Manager** – County staff member responsible for managing, coordinating, and overseeing a project through the entire design phase. Coordinates the work of other DGS staff members and external consultants/contractors on a project that are hired by DGS.
- **Architect/Engineer (A/E)** – An outside consultant hired by DGS to design the facility for construction. The Design Manual notes that "the end result of any contract with the A/E must be documents that provide a complete and fully functional facility." The A/E is responsible for overseeing the work of any sub-contractors it uses on a project.
- **Commissioning Agent** – An outside consultant, required under LEED standards for green buildings, hired by DGS to assist the A/E in designing a "Commissioning Plan" for the installation of the electrical, plumbing, and mechanical systems.
- **Building Envelope Consultant** – An outside consultant hired by DGS to review all design features on a project related to the building envelope (e.g., roofs, exterior walls, windows/doors, weatherproofing).
- **Americans with Disabilities Act (ADA) Consultant** – An outside consultant hired by DGS to review the facility design and ensure it complies with ADA requirements.
- **Other Agency Staff** – If a particular project requires formal coordination with another governmental agency, staff from that agency may be required to review and/or approve all or some of the design.
- **DPS Permit Review Staff** – In connection with an application from DGS for a building or other permit, DPS staff across multiple disciplines review the permit application and plans submitted for compliance with the applicable International Building Codes (as adopted by Montgomery County) and applicable regulations and permitting requirements.

Process and/or procedure documents. For DGS' project design process, many of the responsibilities, oversight structures, and standards are described in the *Montgomery County Manual for Planning, Design, and Construction of Sustainable Buildings, Version 2010.7* (hereinafter "Design Manual"). The Design Manual is an 800+ page document, originally published in 1996 and periodically updated by DGS, that provides a framework for public facility projects in Montgomery County as follows:

> Montgomery County has a great interest in the highest quality buildings for the comfort of its occupants and those who visit them for business. As a public developer we are very interested in the best practices to sustain the environment through energy efficiency, pollution prevention, revitalizing communities, and establishing standards and policies that will enhance life in the county. One of the documents that provide us with the requirements and standards to achieve these goals is the building design manual…The purpose of this manual is to provide guidelines to architects and engineers designing new and renovating existing facilities for Montgomery County, Maryland. This manual is intended to summarize information on what is expected by the County, either by choice or by the specialized nature of the facility, and to avoid historical problems with planning, design, and construction, and with subsequent operations and maintenance. (Introduction, pg. 1-2)

While the Design Manual provides a framework for design expectations, the specific contract agreements with consultants or contractors govern each individual project. Additionally, like all private projects, County facilities must be designed in accordance with all applicable building codes that have been adopted via the County Code and/or Executive Regulation and permitting requirements.

1. Project Management Structure

Once a project receives formal approval by the County Council, DGS assigns the project to the Building Design and Construction Division or the Office of Special Projects.[14] The DGS Division/Office managing a project assigns a Project Manager who is responsible for managing, coordinating, and overseeing a project through each stage of the design process. DGS' staff of Project Managers includes engineers, architects, and individuals with certification as a Project Management Professional.

The assignment of a Project Manager to lead and manage the day-to-day business of the project is part of DGS' project management protocol established in the Design Manual. The protocol outlines the hierarchy, major responsibilities, and lines of authority within a project as it relates to DGS' management of the design process and submission of permit applications. For the design process, the DGS Project Manager's general responsibilities as detailed in the Design Manual include:

- Management of the design process;
- Chairing of project progress meetings;
- Coordination with the user agency, Department of Technology Service, Division of Facilities Management, and the Real Estate Office;
- Submission of applicable permit applications and development approval requests to M-NCPPC and the Department of Permitting Services, State Highway Administration, and other approving agencies as applicable;
- Coordination with and management of the A/E and other consultants;
- Preparation and distribution of meeting reports and related documents to the team; and
- Coordination of document review and comments.

DGS reports that it typically assigns one Project Manager to each project, but a large or complex project can have more. In those cases, responsibilities are divided up but one Project Manager is designated as the lead. DGS reports that they occasionally contract out some or all Project Management responsibilities, and in these cases that contract position is referred to a Construction Manager (even if the work starts during the design phase). DGS notes that the decision to hire a Construction Manager often results from a need for specialty expertise in a particular area (e.g., a specific type of structural engineering expertise). Examples of County projects that have utilized a Construction Manager include the Silver Spring Library, Strathmore, and the Detention Center.

2. Design Framework and Quality Control Procedures

DGS requires the A/E complete two documents in the design phase of a County project – a quality control plan and a commissioning guide – that help to ensure that the construction documents are high quality and meet the County's operational needs.

Quality Control Plan. DGS' Design Manual details the design quality control process and deliverables required for County building projects. The project A/E must provide the County with a formal design quality control (DQC) plan within two weeks of receiving a notice-to-proceed from DGS. As part of the plan, the consultant must identify the personnel that will be assigned quality control functions on the project, including the firm's DQC Manager. The quality control plan requires the A/E to develop several documents and procedures that are used to review, track, and monitor progress. Some examples detailed in the Design Manual include:

[14] DGS staff report that the Office of Special Projects manages projects within the Rockville Core and any Smart Growth projects. All other projects are assigned to the Building Design and Construction Division.

- **Submittal Tracking Plan** – a checklist that identifies all the required document and/or information submittals, submittal type and format, comment and revision processes, and dates for both initial submittal and final approval from DGS and/or the appropriate regulatory agency.
- **Scope Tracking System** – a system for tracking any scope changes during the design, including the impact of such changes on other aspects such as schedule and cost.
- **Coordination Plan** – a checklist or matrix that identifies design elements requiring coordination by phase, consultants responsible for coordination sign-off, coordination issues, check dates, follow-up, and final resolution.
- **Decision Log** – a mechanism to centrally record all important and incremental decisions that are made during the design process. The log must identify the approving party for each decision and any affected disciplines for coordination.
- **Project Schedule** – a detailed schedule of all project activities so the County can follow the design production and assure that all activities are happening within the required timeframe.
- **Schedule Log** – a mechanism to record all important and incremental events and decisions that change the project schedule during the design process. The log must identify the approving party for each decision and any affected disciplines for coordination.
- **Design Document Progress Log** – a mechanism to record and keep track of progress for all disciplines and design documents at each submission phase, including but not limited to, drawings, specifications, and any other documents.
- **Life Cycle Cost Analysis** – a decision-making tool that analyzes at least three different system alternatives so the building owners can select the best system for the building.
- **Construction Cost Change Log** – a mechanism to monitor the design and its conformance to the established construction cost budget.

Commissioning Plan. The Design Manual defines commissioning as the "process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the user's operational needs, the installation is adequately documented and that the operators are adequately trained."[15] Building systems refer to the mechanical, electrical, and plumbing systems within a facility.

DGS contracts with an outside consulting firm to be the Commissioning Agent on each County project. This consultant works with the A/E in developing a Commissioning Plan and is responsible for all associated coordination during the design process. The specific commissioning steps DGS requires during the design phase include:

- Initial meeting with the County to establish the project requirements and protocols;
- Development of a formal Commissioning Plan by the Commissioning Agent;
- Review, format, and supplement the design documents at each stage; and
- Finalize the Commissioning Plan and specifications to include information for the construction phase and to include generic testing procedures.

[15] DGS Design Manual, Part 1-Section C, pg. 2 of 55.

3. Design Review Process

DGS' design review process includes multiple steps intended to reduce or eliminate errors, omissions, or problems before a design is finalized for construction. DGS utilizes a web-based, interactive system throughout the review process that tracks the design status and allows all the user parties to see the comments, concerns, suggestions or required changes, etc. from each participant. This type of system is intended to reduce the potential for errors resulting from poorly coordinated documents. Overall, DGS staff note that they have a detailed and extensive process of submission and review during the design process. Staff report that this detailed review process can increase the project's time-frame on the front-end, but that it can save time later in the project by helping to prevent issues or problems.

Progress Review Meetings. Throughout the design process, DGS requires the A/E team (including any sub-consultants) to attend bi-weekly meetings to review, coordinate, and monitor project progress. The A/E must record and distribute minutes of these meetings and note any specific actions or changes that result from the meeting. DGS also requires that the A/E participate in informal progress reviews throughout the process to ensure that communication and understanding exist between County staff and the consultants. As noted in the Design Manual: "This process is to assure that the County's needs are understood, accommodated, and that each new facility is designed with maintenance and operation requirements fully recognized."[16]

Design Quality Control Review Team. DGS establishes an internal quality control staff group for each project to review and comment on the design at each stage in the design submittal process. This staff group includes a mechanical engineer, structural engineer, civil/site engineer, architect, Project Manager, and Construction Representative. The DGS team reviews each set of documents against discipline-based checklists as well as any other requirements or standards established at that point. The DGS team will provide a consolidated set of comments for revision and/or correction to the documents. The A/E team must formally respond in writing to each comment from the DGS review team.

Value Management. Value management is a more recent oversight practice that DGS utilizes for large and/or complex building projects. It involves using an independent, third-party design consultant to review the project during the design phase and offer suggestions or options for improving quality while potentially saving time and/or money. DGS' value management process encompasses principles of both "value engineering" (looking for ways to provide the same design features or services at a lower cost) and "quality management" (looking for ways to enhance design features or services for the same or a slightly higher cost).

The first County project that used Value Management as part of the formal design process was the Silver Spring library in 2012. DGS staff note that it is important to initiate the value management process at the right time in the project, i.e. when the design is complete enough for the review to be of value but when there is still time to make suggested changes without negatively impacting the other phases of the project.

Building Information Modeling (BIM). BIM is another project management tool recently implemented by DGS. BIM is a process where all the design elements of a structure are inputted into a software program that creates a three-dimensional, "virtual" model of the proposed building, allowing for DGS and the A/E to identify potential physical design errors and/or oversights before the project reaches the construction phase. DGS utilizes BIM by taking the two-dimensional datasets from the various design components (architectural, mechanical, and electrical) and having a consultant convert the information into a single three-dimensional schematic.

[16] DGS Design Manual, Part 1-Section D, pg. 17 of 78.

Once the design information is incorporated into the BIM, DGS and the consultants conduct a "clash analysis" to find any design problems, conflicts, or omissions that would occur if the building were constructed as designed. For example, the model would show if a structure as designed has a water pipe that is running through duct work. DGS staff then work with the architect to eliminate any clashes and add any missing pieces identified through the modeling.

DGS first used BIM on the Silver Spring Library project in 2012. Other County projects that are currently under construction and have undergone the BIM process include the Travilah Fire Station, the 3rd District Police Station, and the animal shelter.

Other Agency Design Review. If a particular project requires coordination with another governmental entity (e.g., WMATA, State of Maryland, one of the County's municipalities, etc.) related to the ultimate operation and/or ownership of the facility, DGS reports that they typically develop a written agreement with the other agency or jurisdiction involved in the project. The written agreement will characterize the relationship between DGS and the other agency/jurisdiction, and detail whether or not (and in what ways) staff from the other agency will participate in the design review process.

4. Permit Review and Approval

County facility projects, whether new construction, renovations, or additions/alterations, are classified as commercial buildings from a permitting perspective and must undergo the same standardized DPS permit review and approval process as any non-governmental entity. As a result, DGS submits all the final plan design and construction documents for approval as part of a building permit application before proceeding onto the construction phase of the project. This includes both land development and building construction reviews.

For land development, DGS submits permit applications for sediment control, stormwater, flood plain, right-of-way, grading and paving approval as applicable. For building construction, DPS has a multi-step review process that includes a separate, specialized review for each construction discipline (such as zoning, architectural, structural, electrical, mechanical, life safety, drainage, etc.) relevant to a given project. If DPS staff find any aspects of the design that do not comply with code standards or requirements, it presents those issues to DGS and the A/E for correction and re-submittal before the review proceeds. Plans submitted in connection with special inspection projects (described below) are required to be signed and sealed by an appropriate design professional licensed in the state of Maryland.

All projects are required to be submitted to M-NCPPC for "mandatory referral" review, typically occurring at 30% design completion. Depending on the type of project, it may also require review and/or approval from other entities such as M-NCPPC for forest conservation, WSSC, or Historic Preservation. DPS automatically submits all building permit application materials to M-NCPPC for review, while DGS must submit the required application materials to the other entities.

Determination of Special Inspections/Complex Projects. As part of the plan review process, DPS staff also determine if the facility qualifies as a "simple" or "complex" structure. This distinction is significant for the inspection process during the construction phase of the project; DPS Inspectors perform all permit-required building inspections for simple structures, while a third-party contractor performs all permit-required inspections for complex structures under DPS' Special Inspections program.

The factors that qualify a building as a complex structure are primarily established within the International Building Code, although the County can designate additional parameters. In Montgomery County, buildings qualify as complex structures if they are:

1) At least three stories in height; or
2) Less than three stories in height but meet at least one of the following conditions:
   - Require the use of caisson's drilled down into the soil.
   - Require post-tension reinforcement.
   - Utilize precast concrete.
   - Are determined to be "complicated" construction.

For all complex structures, DPS requires submission of a Statement of Special Inspections as part of the permit application. The statement must include a list of materials requiring special inspections, the inspections to be performed, and a list of the individuals, approved agencies and firms intended to be retained for conducting such inspections.

B. Oversight of Project Construction

This section highlights several components of the County's oversight structure during the construction phase. It reviews the roles and responsibilities of County and consultant staff involved in the construction process (summarized below) and describes various ongoing or point-it-time oversight mechanisms.

Selected Roles and Responsibilities – Construction Phase

- **DGS Project Manager** – County staff member responsible for managing, coordinating, and overseeing a project through the entire construction phase. Coordinates the work of other DGS staff members and external consultants/contractors.
- **DGS Construction Representative** – County staff member responsible for overseeing day-to-day operations at the project site and coordinating the on-site activities of contractors hired by DGS with the activities of the General Contractor.
- **Architect/Engineer (A/E)** – The same consultant that designed the facility remains involved throughout the construction process to help ensure the facility is constructed in accordance with the A/E's design.
- **General Contractor** – An outside firm responsible for all facets of the facility construction in accordance with the project design. The General Contractor selects and manages any sub-contractors it uses on a project (including any sub-contractors required as part of the County's procurement process, such as a qualified MFD firm). The General Contractor's key personnel required on a project include a Superintendent (responsible for day-to-day construction operations on-site) and a Quality Control Manager.
- **DPS Inspectors** – County staff members that conduct required building inspections for "simple" structures and review reports submitted by approved third-party contractors that conduct required building inspections for "complex" structures under the County's Special Inspections Program.
- **Testing and Inspections Consultant** – An outside consultant hired by DGS that conducts a variety of material and construction tests and inspections for all projects (simple and complex structures) as required by DGS and/or the A/E, and, if qualified, conducts the DPS required inspections for complex structures under the County's Special Inspections Program.
- **Commissioning, Building Envelope, and ADA Consultant** – The same consulting firms from the design phase monitor and review the construction activities within their specialty.
- **Other Agency Staff** – If a particular project requires coordination with another agency, staff from that agency may be required to participate in the construction administration.

Process and/or procedure documents. Many of the responsibilities, oversight structures, standards, and expectations during construction are detailed in the General Conditions of Construction Document (hereinafter "Construction Contract"). The Construction Contract is the written agreement between the County and a general contractor for the actual facility construction. Additionally, the contract incorporates the final, approved set of construction documents developed during the design phase.

Another document outlining requirements during the construction phase for qualifying projects is DPS' written *Special Inspections Program* manual.[17] This manual outlines the administration of the Special Inspections program, including roles and responsibilities of relevant parties, inspection procedures to be followed, and the various inspection documents that must be completed by the contract inspector.

1. Project Management Structure

Similar to the design process, DGS maintains a formal project management structure that outlines the hierarchy, major responsibilities, and lines of authority within the construction process. A DGS Project Manager is responsible for managing, coordinating, and overseeing the construction activities. DGS typically maintains the same Project Manager through both the design and construction processes. The Project Manager is assisted during the construction phase by a Construction Representative who represents DGS at the project site each day. The Construction Contract establishes the DGS Project Manager and Construction Representative as responsible for overall construction administration.

As noted in the previous section summarizing the design phase, sometimes DGS will assign multiple Project Managers and/or Construction Representatives for a large or complex project. In addition, DGS on occasion contracts out some or all project management duties to a contract Construction Manager. DGS notes that the decision to hire a Construction Manager often results from a need for specialty expertise in a particular area (e.g., a specific type of structural engineering expertise). Examples of County projects that have utilized a Construction Manager include the Silver Spring library, Strathmore, and the Detention Center.

The A/E remains part of the project team during construction, with a role that includes assisting DGS with administering and overseeing the contract and the construction work, reviewing and providing notes on work plans and schedules, participating in required progress meetings, reviewing submittals, and providing clarification as needed on the design documents. The Construction Contract requires the General Contractor to have a Superintendent on-site at all times during performance of any work and a Quality Control Manager located at the site during all construction activities.

Other Agency Participation. If a project requires coordination with another governmental entity, the written agreement with DGS will characterize that agency's role (if any) in the project management structure during the construction phase.

2. Schedules and Quality Control Procedures

After selection, a general contractor must provide three different planning documents to DGS before receiving a formal notice-to-proceed with construction activities. These documents help both DGS and the General Contractor manage and oversee the construction process.

[17] http://permittingservices.montgomerycountymd.gov/DPS/pdf/SpecialInspectionProgramManual.pdf.

Initial Critical Path Method (CPM). The CPM is the planned order and sequence that construction activities must occur in, i.e., activity A must be completed before activity B is started, etc. The general contractor must prepare and submit for approval by both DGS and the A/E a proposed initial CPM schedule for performance of the work.

Schedule of Values. The schedule of values is the general contractor's detailed breakdown of planned work with an associated schedule of payments. The general contractor follows this schedule to submit formal progress reports and request for payments as different stages of the construction are completed.

Quality Control Plan. Similar to the design process, DGS requires the general contractor to develop and implement a quality control plan for the construction work, including the work of subcontractors and suppliers, to assure delivery of work that meets requirements for performance, quality, and timeliness. Quality control refers to the methods and systems the general contractor will utilize to prepare, initiate, and verify the quality of work required by the construction documents. The general contractor cannot proceed with construction activities until DGS accepts the quality control plan.

The quality control plan must identify a qualified individual to be the contractor's Quality Control Manager. The Quality Control Manager cannot be the same individual serving as the contractor's Superintendent for the project. The contractor also must include as part of the quality control team individuals with expertise in HVAC, electrical, and building envelope. The quality control plan must also detail the general contractor's plan for complying with the requirements of the approved commissioning plan (developed during the design process).

3. Project Meetings

DGS requires a standardized series of project meetings throughout the construction phase to monitor and review progress as well as to ensure coordination of activities.

Pre-construction conference. In accordance with the building permit, DGS must schedule a pre-construction conference before starting construction activities to review the procedures and work required for the project. Representatives that must attend the pre-construction conference include DGS and DPS staff, the A/E, the General Contractor, and any additional contractors or consultants. If the project is defined as a complex structure, the specific procedures required under the Special Inspections Program must be reviewed as well.

Progress meetings. Bi-weekly progress meetings are held at the project site throughout the length of the project. Required attendees for the progress meetings include DGS staff, A/E representatives, General Contractor representatives (including the job superintendent, quality control manager, and project manager), suppliers, subcontractors, or other entities involved with the current progress or who will be involved in near-future activities at the site.

Pre-installation conferences. Separate meetings are held at the project site before the start of any construction activity that requires coordination with other construction. Required attendees include the General Contractor's superintendent and quality control manager, the DGS Construction Representative, Installer (subcontractor), representatives from the testing agencies, representatives of the manufacturers and fabricators involved or affected by the activity, and representatives of subcontractors that have preceded or will follow the activity.

Coordination meetings. Meetings are held for all parties (including subcontractors, suppliers, etc.) that are involved in the construction activities at that time. The coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

4. Documentation, Clarification, and Reporting

DGS requires the General Contractor's Superintendent to submit daily construction reports to the Construction Representative. The daily reports must include information on: which contractors and/or personnel worked at the project site, visits by third parties such as utilities or inspectors, weather conditions (including high and low temperatures), etc. Also, any "unusual event" that occurs at the project site must be described in writing via a Special Report and submitted to both DGS and the A/E. In addition, the testing and inspection process requires standardized documentation and reporting as described in the next section. The A/E also establishes document review procedures during the construction process. This includes reviewing and processing all shop drawings, catalog submissions, project reports, test reports, etc., as well as requests or changes and applications for time extensions.

Interpretation and Clarification of Drawing and Specifications. DGS has an established process for the A/E to provide information and/or clarification of the design documents during the construction phase. If the General Contractor has a specific question or needs clarification about a design feature, they must file a Request for Information (RFI) with the A/E. The A/E then responds in written or graphic form as appropriate. If the A/E cannot readily answer the question or provide the clarification (for example, an issue has arisen that requires a formal change in a design feature or document), the general contractor must file a Supplementary Information Request. With DGS' approval, the A/E will then amend the formal construction documents as needed.

5. Tests, Inspections, and Approvals

Every County facility project undergoes a series of tests, inspections, and approvals either conducted by DPS, an independent third-party inspector and/or testing agency hired by DGS, or both.

DPS Inspections. If the project qualifies as a simple construction project, DPS staff conduct all the building, mechanical, and electrical inspections required as part of the permit to ensure that the construction complies with all applicable building codes. The DGS Construction Representative schedules each inspection in accordance with the sequence of work. For commercial project inspections, DPS reports that they typically use a group of inspectors broken down by specialty (e.g., electrical, fire/life safety, building/mechanical), but that the same group of inspectors stays with a project from start to finish. DPS inspectors must have one of two possible types of certification – a state of Maryland professional engineer license or a specific trade or material certification (concrete, fire protection, etc).

DPS provides the results of each inspection to DGS, including any follow-up or re-inspection requirements if necessary, and records the inspection results in its permit database. If a permit violation is found during an inspection, DPS inspectors are authorized to issue a verbal notice, a written Notice of Violation, or a written Stop Work Order that requires taking corrective action by a specific deadline.

Third-Party Inspections – Special Inspections Program. For projects that fall under the Special Inspections Program, DGS must have a structural engineer of record, specialty engineers, an independent third-party professional inspector, and appropriate laboratory that are required to provide signed and sealed reports of inspections and testing throughout the construction process. As noted previously, a third-party inspector conducts the required inspections as part of the permit for complex structures under the Special Inspections Program instead of DPS staff.[18] In these cases the third-party inspectors must be hired by DGS, have certain certifications or expertise for approval by DPS, and the specific list and schedule of inspections is detailed in the Schedule of Special Inspections submitted and approved as part of the building permit.

[18] Except for electrical inspections, which are always conducted by DPS staff.

All such inspectors are required to execute the Special Inspections Program agreement, and DGS' general contractor is required to sign the Special Inspection Program agreement as well. The aspects of construction and materials that fall under the Special Inspection Program include: sheeting and shoring, underpinning, soils and foundation systems, super structure inspections (including concrete, post-tension concrete, and steel), and structural masonry.

During construction, the third-party inspectors conduct inspections as called for in the Special Inspections Program agreement and must submit daily reports whenever they perform activities at the project site to DPS, the DGS Project Manager and Construction Representative, the A/E, and the General Contractor. The third-party inspector must also submit a "deficiency report" for any problems it finds along with recommended corrective actions and a "final report of special inspections" upon completion indicating that the work inspected was done in conformance with approved construction documents.

While the third-party conducts the inspections, DPS assigns a staff inspector to monitor the inspection work and review the reports that are submitted. The DPS Inspector reviews the daily reports and, if necessary, will require additional information, a meeting at the site, or even issue a notice or a stop work order if construction is not proceeding properly. In addition, DPS staff report that the reviewing Inspector will inform DGS of any potential issues they notice that could be problematic but do not violate any code standards. Any corrective action or changes based on these issues are at the discretion of DGS and not required by DPS. DPS Inspectors assigned to a particular project will also periodically visit a project site to ensure that the inspections are being completed and the activities of the inspector are matching up with the daily report. During these visits, DPS does not review the quality or outcome of the inspections.

Other Third-Party Tests and Inspections. DGS hires a testing and inspections consultant for all construction projects, even if the project does not qualify as a complex structure. For each project, DGS compiles the specific tests, inspections, and approvals that it requires in addition to any permit inspection requirements. For a typical project, DGS requires independent inspections on all aspects of construction and materials (e.g., soils, footers, concrete, rebar, welding, and masonry). These tests and inspections are part of the overall quality control process to ensure the construction activities and materials align with the design specifications. For example, ensuring that the contractor is using the exact type and quality of product or material specified and that the product or material is installed correctly.

The DGS Project Manager and Construction Representative coordinate the inspection process in conjunction with the construction superintendent. As portions of the work are completed and ready for testing, the superintendent informs the Construction Representative who then coordinates the work with the inspections consultant. The consultant provides the test and inspection results to DGS staff as well as the project A/E. DGS staff and the A/E will review the work of the construction team at various points in the construction process, but only the inspections consultant conducts the formal tests and inspections on materials as called for in the construction documents and plans.

Additionally, the other specialty consultants hired by DGS conduct reviews and inspections in their respective areas as follows:

- The Commissioning Agent monitors the construction of the electrical, plumbing, and mechanical systems of the facility in accordance with the Commissioning Plan.
- The Building Envelope Consultant reviews the construction of any feature related to the building envelope such as roofs, exterior walls, windows/doors, and weatherproofing.
- The Americans with Disabilities Act (ADA) Consultant reviews the constructed facility prior to substantial completion to verify compliance with ADA requirements.

Chapter IV. Management Practices in Other Jurisdictions and Public Agencies

To better understand how other jurisdictions in the region as well as across the country manage the design and construction process for public facility projects, OLO researched policies, procedures, and models in use by other states, counties, municipalities and public agencies. This chapter provides comparative information for thirteen jurisdictions and/or public agencies, and is organized as follows:

- **Part A** summarizes common characteristics of the management practices used in the other jurisdictions and compares those practices with those of Montgomery County Government;
- **Part B** summarizes additional project management and oversight themes or topics that were discussed by staff from the other jurisdictions; and
- **Part C** provides a summary of the public facility design and construction management practices in each of the thirteen jurisdictions or agencies included in this review, listed below.

A. Summary of Practice and Structures in Other Jurisdictions

Among all the jurisdictions reviewed (including Montgomery County), OLO did not find substantial variation in the primary structures or models used to oversee public facility design and construction. Instead, most jurisdictions utilize management structures with similar components. Within those common components, however, OLO did find some variation in the specific implementation strategies used by the jurisdictions. The six common characteristics, along with some of the notable implementation features, are summarized below.

1. Use of a formal project management structure to oversee and coordinate a project's design and construction phases

All the jurisdictions reviewed have staff Project Managers that are assigned to oversee and coordinate the design and/or construction process. One difference in implementation among the jurisdictions is the use of a contract Construction Manager to either complement the internal Project Manger or to assume responsibility for many of the Project Management duties.

Some of the jurisdictions (such as the **Maryland Stadium Authority** and the **District of Columbia**) regularly or exclusively engage a Construction Manager to participate as a de facto design review consultant during the design phase and then to oversee the construction phase. Other jurisdictions (such as **Montgomery County** and **Prince George's County**) do not regularly use Construction Managers but have done so for certain large or complex projects.

While most jurisdictions OLO reviewed use the same internal Project Manager to oversee both the design and construction process, **Montgomery County Public Schools** uses a slightly different format: a Project Manger to oversee the design process and a Construction Inspection Team to oversee the construction process. The Team includes employees that specialize in different areas of construction (e.g., building, electrical, mechanical, etc.) who take a lead role in overseeing that particular facet of construction.

The **City of Austin** has a Project Management Division that requires all staff to complete an internal Project Management Academy training program. A notable practice used in **New York City** is to assign a Design Liaison (in addition to a Project Manager) to each project who focuses on ensuring that design quality principles are maintained throughout all phases of the project.

2. Development of written procedure manuals and/or guidelines, with a particular focus on the design process

Nearly all of the jurisdictions reviewed (as well as **Montgomery County**) either have or are developing written procedure/guideline documents intended to provide contractors and consultants with standard requirements and specifications that typically apply to each project up-front. Some have general procedures and guidelines, while other jurisdictions create a different process document for each component of a project. Staff from jurisdictions that have written procedure manuals note that they are particularly helpful in the early design phase of a project. **Ventura County** has an extensive collection of project management documents for internal staff and contractors. **Fairfax County** also has specialized design manuals for specific facility types – fire stations, police stations, libraries, and parking structures.

3. Multiple types and formats of design review

Each jurisdiction, in its written documents as well as during interviews, emphasized the need for a strong design review process to catch (and fix) errors and omissions as early in the process as possible. While all of the jurisdictions conduct multiple types of design reviews, the specific combinations vary. The jurisdictions and agencies typically conduct internal staff design reviews and perform some form of constructability and value engineering reviews.

OLO found less consistency among peer reviews and the use of Building Information Modeling (BIM). A peer review involves having an independent design consultant review and comment on the project A/E's design. Similar to **Montgomery County's** practice, several of the jurisdictions have either recently begun to use independent peer reviews regularly or use it on complex projects. Others, like **New York City, Santa Clara County,** and the **District of Columbia**, require peer reviews on every project.

BIM is a process that utilizes software programs to virtually construct a three-dimensional model of a project as designed and identify potential conflicts, errors, and omissions. None of the jurisdictions reviewed require BIM on every project, although many report requiring it at times, particularly for complex projects. Staff from several jurisdictions identified BIM as an emerging trend among design and construction management practices.

4. Requiring Quality Control Plans in both the construction and design phases

Most of the jurisdictions require design and construction contractors to develop Quality Control Plans intended to ensure that the contractor performs the design or construction activities in conformance with the specifications of the contract. Some jurisdictions (such as **Arlington County**, **Prince George's County**, and **MCPS**) follow the same structure as **Montgomery County** and require detailed quality control plans for each stage of a project submitted by the contractor prior to beginning work.

5. Standardized monitoring and reporting during the construction process

Common elements for monitoring and managing the construction process include standardized progress meetings; daily, weekly, and/or monthly written reports; and routine project site-visits from the project management team. While there was little variation among monitoring elements, some jurisdictions provide more hands-on staff oversight of a project with additional internal staff. **Miami-Dade County** assigns an internal Field Representative that works at the project site and monitors daily construction activities, similar to **Montgomery County's** Construction Representative. **Fairfax County** assigns a Project Engineer as the construction contract administrator, and uses internal Building Inspectors who are on-site each day to monitor and review construction activities. Jurisdictions that hire a Construction Manager, like the **Maryland Stadium Authority**, use a different model that puts day-to-day management duties on the Construction Manager with oversight from a Project Manager.

6. Multiple layers of inspections, tests, and approvals

Each jurisdiction requires multiple layers of inspections, tests, and approvals during construction to ensure building safety; check compliance with applicable codes, laws, and regulations; verify materials meet contract specifications; and ensure that the physical construction occurs in accordance with the approved design. There is variation among the jurisdictions as to who conducts the inspections. Several jurisdictions utilize independent, third-party contractors for any inspection not conducted by a permitting authority, while a few jurisdictions use internal staff to conduct inspections.

Prince George's County, Loudoun County and **Montgomery County** are examples of jurisdictions that use third-party inspectors for all formal inspections not conducted by a permitting agency. In contrast, the **City of Austin** uses internal staff to conduct all non-permit related inspections (unless the use of a third-party inspector is required under the building code). **MCPS** utilizes a hybrid approach that involves both internal and third-party inspectors for non-permit related inspections. MCPS' internal inspectors conduct ongoing inspections of each part of the construction work within their specialty area, but MCPS also hires third-party inspectors to inspect and test all critical trades and materials. In **Fairfax County**, internal Building Inspectors conduct daily construction and quality control reviews while independent, third-party inspectors conduct formal tests and inspections (including required Special Inspections).

B. Common Project Management and Oversight Themes

During the course of interviews for this project, staff from the various jurisdictions and agencies discussed practices and policies that have resulted in more effective project management. OLO identified numerous themes for the design and construction of public facilities that were common among several jurisdictions, summarized below:

- **Relationships are critical.** Staff from nearly every jurisdiction asserted that relationships among stakeholders are an important part of effective project management. The establishment of cooperative, coordinated and respectful relationships between the jurisdiction's staff, contractors, and inspectors can lead to productive and effective project management. In contrast, adversarial relationships among stakeholders can result in project delays and quality issues.

- **Having qualified and experienced staff is important, especially project managers.** Whether it is internal employees or hired consultants, staff members stressed the need for expert design teams, construction firms, and project managers to deliver a project in a timely, cost-efficient and quality manner. Experienced internal project managers were cited as particularly important.

- **Early planning and organization is key.** Staff from multiple jurisdictions reported that the earliest stages of project development are important for public facility design and construction. Major issues and problems can be avoided with proper planning and review from the onset of a project. Staff report that accurate and fair estimates of time, budget, and project requirements are critical to the successful delivery of a project.

- **Having documented and standard procedures increases efficiency, particularly for the correction of problems.** Numerous jurisdictions stated that having well-documented and standard processes and procedures resulted in a more timely completion of project tasks. Several staff also reported that mistakes are inevitable but having established correction procedures may result in a quick solution at minimum additional costs.

- **Project delivery methods that use contract Construction Mangers are becoming more prevalent.** Jurisdictions use various delivery methods for public facility construction. Several jurisdictions report that they are moving away from the more traditional Design-Bid-Build method toward Design-Build or Construction Manager at-risk methods that engage a construction management firm to participate in the design process and then lead the construction process. Jurisdictions that regularly use Construction Managers note that the efficiency (budget and schedule), quality control, improved communication, and singular responsibility of the design builder can lead to a better managed project. On the other hand, some reported negatives include potentially higher costs and a reduction in the "layers of control" a jurisdiction has over a project.

- **Balancing the "Project Management Triangle" can be difficult because of the public stakeholders in the project.** The "Project Management Triangle" is the combination of three independent constraints of construction – cost, schedule, or quality/scope. One side of the "triangle" cannot be changed without affecting the other sides. Staff from numerous jurisdictions note that there is added pressure to the constraints due to the unique nature of building for the public community.

C. Summaries of Management and Oversight Practices in Other Jurisdictions/Public Agencies

The remainder of this chapter contains individual summaries of the management and oversight practices for each of the thirteen jurisdictions and agencies included in OLO's comparative review. OLO staff obtained the comparative information through: telephone interviews with one or more representatives from each jurisdiction;[19] a review of any documents provided by each jurisdiction; and information available from each jurisdiction's website.

[19] Excluding New York City.

Fairfax County, Virginia

Organizational Structure

The Fairfax County Department of Public Works and Environmental Services, Building Design and Construction Division (BDCD) is responsible for managing the design, construction and budget for new and/or renovated County facilities.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Fairfax County contracts separately with an Architect/Engineering (A/E) firm to design the facility and a General Contractor to construct the facility via the County's procurement process. Key policies, procedures, and structures typically used to manage these processes are summarized below.

Process and/or Procedure Documents. Fairfax County has several written manuals outlining the policies and procedures for design and construction management in the County, including:

- *Guidelines for Architects and Engineers* – provides information that should be incorporated into design and construction documents;
- *Facility-Specific Design Manuals* – separate manuals that provide specific guidelines for four different facility types: fire stations, police stations, libraries, and parking structures; and
- *Project and Construction Management Manuals* – describes the County's standard project management practices and procedures for all phases of a project, including a checklist of quality control procedures.

BDCD staff report that these documents are regularly updated based on experiences and "lessons learned" that are recorded at the end of each project.

Project Management. BDCD assigns an internal Project Manager and Project Engineer to each project. The Project Manager is responsible for the overall management and oversight of a project in both the design and construction phases. Most of the County's Project Managers (~75%) are licensed engineers or architects. The Project Engineer also assists with managing the design process, and then acts as the contract administrator during the construction process. The Project Engineer also oversees the work of the County's internal Building Inspectors during construction. On large projects, the Division will sometimes assign multiple Project Managers and/or Engineers. Also, BDCD will also hire a consultant to assist with general project management responsibilities or the management of a unique or specific component on some large or complex projects.

Quality Control Plans. Fairfax County requires both the A/E firm during the design process and the General Contractor during the construction process to submit formal quality control plans to ensure that the contractor performs the required design or construction activities in compliance with the specifications of the contract. The BDCD also requires that the General Contractor's superintendent has an established background in quality control or subcontracts for a quality control specialist to be on-site during construction.

Design Review. Fairfax County typically completes multiple types of design review for a County facility project, including:

- Design team reviews at 15%, 35%, and 50% design completion – the design team includes the Project Manager, the Project Engineer, representatives from the County's building maintenance division and Department of Information Technology, and the facility's end-user department.
- Value engineering review (at 35% completion) for projects costing at least $5 million.
- Design team review at 100% design completion that also includes review by staff with expertise in special construction areas (mechanical, electrical, structural etc.). The A/E must respond to and address every comment made by the review team.
- For major projects, the Division requires a constructability review at 50% design completion by an independent design consultant.

BDCD staff note that the A/E must formally sign-off that they have conducted a quality control review before submitting documents at each required review stage.

Construction Management and Monitoring. As noted above, the Project Manager, Project Engineer, and Building Inspectors are responsible for managing and monitoring construction. During the construction process, the General Contractor must provide weekly written progress reports and conduct bi-weekly project meetings at the construction site. All key participants in the construction process are required to attend the project meetings. The Project Engineer is typically on-site three to four times per week, while the Building Inspector is on-site each day. The contracted A/E firm is also present at various points during construction to monitor progress. For some larger and more complex projects, the Division will have all construction team personnel on site full-time, including the Project Manager, Project Engineer, BDCD inspectors, and the A/E firm representative. The General Contractor and/or various sub-contractors are required to generate daily activity/progress reports during construction.

Inspections, Tests, and Approvals. Fairfax County facility projects undergo multiple layers of inspections that purposefully build-in redundancy to the process. All County facility projects, like any commercial construction, are subject to building permit-related inspections through the DPWES' Permitting and Plan Review Division. If a project falls under the County's Special Inspections Program (Fairfax staff note that most County facilities do), an independent, third-party inspector hired by BDCD conducts the required tests and inspections instead of Permitting and Plan Review staff.

Outside of building permit-related inspections, all projects receive additional reviews and inspections from BDCD staff and third-party inspectors. In general, internal Building Inspectors conduct daily construction and quality control reviews while independent, third-party inspectors conduct formal tests and inspections. The types of materials and structures inspected by the third-party inspectors for non-permit related inspections vary depending on the project. For certain projects, Fairfax will require the contractors to hire their own third-party inspection consultant as an additional quality control measure.

Prince George's County, Maryland

Organizational Structure

The Prince George's County Office of Central Services (OCS), Facilities Operations and Management Division manages the design and construction of all County vertical building projects.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Prince George's County contracts separately with an Architect/Engineering (A/E) firm to design the facility and a General Contractor to construct the facility via the County's procurement process. Key policies, procedures, and structures typically used by Prince George's County to manage these processes are summarized below.

Process and/or Procedure Documents. Prince George's incorporates all the design and/or construction standards and other project requirements into the individual contracts between the County and any consultants/contractors and does not have a separate design and/or construction procedures manual for County facility projects.

Prince George's has a written Third-Party Inspection Program (TPIP) Manual that establishes a building inspections procedure to use independent, qualified third-party professionals instead of County staff as the primary inspecting agent on construction projects. The Manual defines the structures that are subject to the TPIP, the reporting and communication process for the inspectors, and the specific type and schedules of required inspections.[20]

Project Management. The Office of Central Services assigns an internal Project Manager to each County facility project. The Project Manager is responsible for leading, managing, and coordinating the entire project through both the design and construction phases. On larger or more complex projects, OCS will hire an outside Construction Manager, which is a consultant that takes over and/or assists with overall project management responsibilities. When using a Construction Manager, OCS will bring the firm on board during the design process. OCS staff note that this sequencing helps coordinate the design concepts with the eventual construction phase.

Quality Control Plans. OCS requires both the A/E firm (during the design process) and the General Contractor (during the construction process) to submit formal quality control plans, and specifies the quality control measures a plan must address in the contracts with each firm. These plans are intended to ensure that the contractor performs the required design or construction activities in compliance with the specifications of the contract.

Design Review. Prince George's County typically completes multiple types of design review for a County facility project, including:

- Staff Design Review. At four stages in the design process (25%, 50%, 75%, and 100% completion), OCS conducts formal, internal staff reviews of the design drawings.

- Independent Design Review. Prior to submitting the finalized design documents for permit review, OCS has an independent architectural/engineering firm review and offer comments and recommended revisions to each aspect of the project design.

[20] http://www.princegeorgescountymd.gov/Government/AgencyIndex/DER/PDFs/TPIP-manual.pdf.

- Constructability Review. Prior to bidding the actual construction of the facility, Prince George's has an independent firm examine the set of construction documents developed through the design process and identify any potential obstacles that might lead to errors, delays, conflicts, or cost overruns during the construction process.

- Building Information Modeling (BIM). OCS used BIM for the first time on two recent projects. BIM is a process that utilizes software programs to virtually construct a three-dimensional model of a project as designed and identifies potential conflicts, errors, and omissions. OCS staff report that BIM has been helpful both from a design review perspective and in showing the user department how a facility will look.

Construction Management and Monitoring. During the construction process, the General Contractor must provide weekly written progress reports and conduct bi-weekly project meetings at the construction site. All key participants in the construction process are required to attend the project meetings. The OCS Project Manager will typically visit the project site every day to review and monitor progress for each active project in their portfolio. The Construction Manager is required to be on-site every day and the A/E firm typically visits the site semi-frequently. In addition, a formal pre-construction meeting is required for every project that is subject to the TPIP to review the inspection requirements of the project, establish roles and responsibilities, and establish a schedule of inspections.

Inspections, Tests, and Approvals. The County's Department of Permits, Inspections, and Enforcement issues building permits for all construction projects (including County facilities) and ensures compliance with the various construction codes and standards required under the permit. (Prior to July 1, 2013, theses functions were conducted by two different divisions within the Department of Environmental Resources).

OCS reports that most inspections, tests, and approvals required as part of the construction process for County projects are conducted by third-party inspection firms. Inspection firms are selected by OCS from a pre-approved list maintained by the permitting authority. For projects that fall under the TPIP, the inspection and testing consultant conducts all inspections required under a building permit (except for the final inspection which is always conducted by the County's permitting authority) and any additional tests and inspections required by OCS or the project A/E as part of the construction process.

The County assigns an internal staff member, a Quality Assurance Inspector, to oversee the work of the third-party inspector on each project. The third-party inspector must submit routine inspection reports to the assigned County inspector within five business days for every inspection conducted. Additionally, the County inspector will randomly visit the project site to observe and monitor the work of the third-party consultant. Overall, OCS staff note that the third-party firms tend to have staff that are well-trained and tested within their various specialty fields.

For projects that do not fall under the TPIP, County inspectors conduct any test and inspections required under the building permit and the OCS hires an independent inspection firm to conduct any additional testing it requires for the project.

Montgomery County Public Schools (MCPS)[21]

Organizational Structure

The Montgomery County Public Schools' Department of Facilities Management, Division of Construction manages the design and construction of school facilities.

Summary of Management and Oversight Policies and Procedures

Upon approval of a specific school construction, addition, or renovation project, MCPS hires consultants for design and construction services via MCPS' procurement process. For facility projects up to approximately $15 million, MCPS hires an Architect/Engineering (A/E) firm for the design work and a General Contractor for the construction work (a Design-Bid-Build project delivery system). For projects over $15 million, MCPS hires an A/E firm for the design work and a Construction Manager that acts as a consultant for MCPS during the design phase and then acts as the General Contractor during the construction phase (a Construction Manager at-Risk, or CMR, project delivery system).

Process and/or Procedure Documents. MCPS has multiple written procedures and guidelines related to the design and construction of school facilities. MCPS staff report that the written procedures documents are intended to help create clear understanding of various processes, and consistent scopes, designs, and specifications for capital projects. In particular, MCPS has developed a set of Facility Guidelines that summarize the requirements for all MCPS projects in two parts:

- *Book 1-Administrative Procedures* provides standard procedures for pre-design, schematics, design development, construction documents, construction, and post-construction; and
- *Book 2-Technical Design Guidelines* provides the A/E and contractors with specific guidance by work category: project administration, civil/architectural/structural, electrical, and mechanical.

All specific project requirements and specifications are included in the contracts with the design and construction consultants. Additionally, every MCPS project that makes it to the design phase has already undergone a detailed feasibility study that identified a clear scope of work and implementation strategies for each project.

Project Management. During the design phase, the Division of Construction assigns an internal Project Manager to facilitate and oversee the design work of the A/E and make sure it aligns with MCPS' requirements (the same project manager also managed the feasibility study for the project). MCPS' Project Managers are all licensed professional architects or engineers. The project managers are involved in the construction phase by addressing the school/community concerns and coordinating design issues with the A/E. If the project uses a CMR delivery method, a Construction Manager is hired to provide preconstruction services during the design phase, serving as a consultant for MCPS, to help review and oversee the project design from a constructability perspective.

Once the projects are bid and contractors are identified, MCPS has a construction inspection team that manages and oversees the construction phase of a project. The team currently consists of ten employees, each of which has a specialty (building, electrical, mechanical, etc.). The inspection team works with the A/E and oversees the work of the Construction Manager and/or General Contractor.

[21] MCPS facility projects differ from those of Montgomery County Government since MPCS primarily builds one type of structure – a school building. However, since MPCS projects account for a sizeable portion of the public facility construction in the County, OLO found it useful to include a summary of MCPS' practices.

Quality Control Plans. MCPS implements quality control measures by: identifying a clear scope of work; thorough design reviews; hiring qualified contractors; layers of inspections to ensure conformance with codes, standards, and contract documents; and continuous improvement process reviews upon completion of projects. These processes help ensure that the contractor performs the required design or construction activities in compliance with the specifications of the contract.

Design Review. MCPS completes multiple layers of design reviews for projects, including: staff design reviews conducted by the Project Manager at various milestones in the design process (minimum of five reviews); Construction Manager design reviews focusing on constructability; value engineering reviews to examine any opportunities for providing the same functionality at a lower cost by utilizing different methodologies, material, etc.; and cost estimate reviews at milestone stages to examine how well the current design aligns with the project's budget. Additionally, MPCS projects also have design review from the appropriate permitting agencies, and the Maryland State Department of Education and/or Department of General Services review at key milestones. For complex projects, a separate constructability consultant conducts design reviews.

Construction Management and Monitoring. Before any construction work begins, MCPS holds a pre-construction meeting with the general contractor and subcontractors. Once construction starts, the MCPS construction inspection team holds bi-weekly construction progress meetings with all relevant parties to discuss: schedule, requests for information, change orders, and any outstanding issues. The MCPS construction inspection team members visit and inspect the site regularly to review and monitor progress, and the Construction Manager and/or General Contractor is on-site every day to coordinate construction activities and inspection of work completed by subcontractors.

Inspections, Tests, and Approvals. In addition to the daily on-site review and inspection responsibilities of the Construction Manager or General Contractor, MCPS' formal inspection process for each project involves its internal construction inspection team, A/E, permitting authorities, and third-party inspectors.

- MCPS Construction Inspection Team. As part of its construction monitoring responsibilities, the MCPS inspection team members will conduct ongoing inspections of each part of the construction work within their specialty area. MCPS notes that many of its internal inspection staff have the qualifications needed to conduct Special Inspections under the building code.
- Architects/Engineers. By contract, the A/E has responsibility to inspect the construction work on a frequent basis to ensure compliance with codes and contract requirements.
- Permitting Authority. County or municipal inspectors conduct all tests and inspections required under the building permit at various stages in the process, unless the project qualifies as a complex structure and is subject to a Special Inspections Program.
- Third-Party Inspectors. MCPS hires an independent, third-party inspection consultant to conduct all permit-related inspections for projects that qualify for a Special Inspections Program and to conduct additional tests and inspections on every project as required by MCPS. Specifically, MCPS utilizes third-party inspections on all projects to inspect and test critical trades and materials (such as soil, concrete, steel, electrical, mechanical, etc.).

Performance Measurement. During the course of construction, MCPS tracks a variety of project performance measures. MCPS staff report that the performance data is then incorporated into its different process improvement structures. Data MCPS collects for each project to assess performance includes the rate of change orders, the number of days a project finishes ahead of or behind schedule, and the number of items on the final punch-list at substantial completion of a project.

District of Columbia

Organizational Structure

The Department of General Services (DGS) manages the design and construction of public facilities (both municipal and school facilities) in the District of Columbia. The Department was created in 2011 through a consolidation of the former Department of Real Estate Services (previously responsible for municipal capital projects), former Office of Public Education Facilities Modernization (previously responsible for school capital projects), and the capital construction and property management functions of other agencies. A majority of DGS' funding allotments are for education facilities.

Summary of Management and Oversight Policies and Procedures

The District utilizes both Design-Bid-Build (DBB) and modified Design Build (DB) methods of delivery for the construction of public facilities projects. Under the Design-Bid-Build method, DGS contracts separately with an Architect/ Engineering (A/E) firm to design the facility and a General Contractor to construct the facility. Under the modified Design Build method, the District contracts with an A/E to complete preliminary design and with a design-builder for pre-construction services. DGS assigns the A/E's contract to the design-builder to complete the design and construction upon execution of a guaranteed maximum price (GMP). Historically, the modified DB method was used in school facility projects and the DBB method was used in municipal projects. Since the consolidation in 2011, DGS prefers to use the modified DB method for a majority of the agency projects, but still uses DBB for larger, more complex projects. Key practices and procedures for both delivery methods are highlighted below.

Process and/or Procedure Documents. The District has several procedure and policy manuals that outline the processes and procedures for construction management – including the *Project Delivery Manual* and the *Workplace Design Guidelines*. DGS is currently updating the guidelines and manuals to align with the Department's new organizational structure.

Project Management. DGS assigns an internal Project Manager to monitor each project through both the design and construction, no matter which delivery method is used. The DGS Project Managers use a comprehensive project management information system software program (Prolog) to help manage the design and construction of public facilities.

- Modified Design Build. Under this process, DGS hires an A/E firm to complete a preliminary design. At 35% completion, DGS procures a General Contractor (with an early guaranteed maximum price contract) to assist in finalizing the design and then to complete the construction of the project. The DGS Project Manager works closely with both the A/E and the General Contractor to manage the project, and the A/E reports directly to the General Contractor once that firm is procured. In addition, DGS contracts with a private program management firm (DC Partners for the Revitalization of Education Projects) to provide management services for all school facility construction, renovation, and modernization projects.

- Design-Bid-Build. Under this process, the DGS Project Manager oversees the A/E during the design phase and the General Contractor during the construction phase. DGS will also hire a Construction Manager consultant firm for these projects early in the process to assist with the overall project management responsibilities.

DGS has a roster of firms on several indefinite delivery/indefinite quantity (IDIQ) contracts, including A/E firms, construction management firms, small general contractors, and on-call contractors.

Quality Control Plans. The District requires the General Contractor to develop a Quality Control Plan and use quality control procedures. Quality Control Plans help ensure that the contractor performs the required design or construction activities in compliance with the specifications of the contract.

Design Review. For both delivery methods, the District conducts numerous design reviews, including:

- Independent peer reviews at 35%, 65%, 90% and 95% of design completion. These professional-level reviews examine the project design and offer comments or recommendations for improvement, along with pointing out any discrepancies.
- Independent government cost estimate reviews to compare the estimated construction cost based on the current design with the project budget.
- Constructability reviews to examine the set of construction documents developed through the design process and identify any potential obstacles that might lead to error, delays, conflicts, or cost overruns during the construction process.
- Value engineering reviews to determine whether any aspects of the design (or alternate) can be provided at a lower cost, without impacting the mission of the project.
- On large projects, DGS hires the construction management firm early in the design phase to provide services.
- DGS also has utilized Building Information Modeling for complex projects, but it is not a standardized practice.

Construction Management and Monitoring. Prior to construction, DGS holds a preconstruction meeting to outline the roles and responsibilities of the relevant parties including the Project Manager, Construction Manager, the A/E, and inspectors. During construction, the construction management team completes daily field reports and holds bi-weekly progress meetings. The DGS Project Manager is on-site several times a week and on an as-needed basis.

Inspections, Tests, and Approvals. Construction projects using both types of delivery methods have similar inspection requirements. Since the District's public facility projects qualify as commercial construction, DGS is required to undergo inspections from the DC Department of Consumer and Regulatory Affairs (DCRA). All formal tests and inspections are conducted by third-party inspectors. The DCRA also conducts a Preliminary Design Review Meeting prior to construction to review code compliance. In addition to DCRA inspections, DGS conducts its own quality assurance/quality control inspections during construction, including inspections by DGS staff, the construction management firm, A/E firm, or third-party inspectors.

State of Maryland

Organizational Structure

The Maryland Department of General Services manages the design and construction of state facilities (excluding transportation facilities).

Summary of Management and Oversight Policies and Procedures

For a standard public facility construction project, the State of Maryland will contract with an Architect/Engineer (A/E) for the design phase and a General Contractor for the construction phase. DGS staff note that the State is moving to a construction manager at-risk project delivery method in the near future. Key policies and procedures used by Maryland Department of General Services to manage these processes are summarized below.

Process and/or Procedure Documents. Maryland has created the "Procedures Manual for Professional Services" which serves as a guide for the management of professional services during the design and construction phases of public facilities. The Manual includes the Standard Form of Agreement with Architects and Engineers, Architectural and Building Standards, and templates for design and construction documents.

Project Management. The Maryland Department of General Services assigns an internal Project Manager to oversee a project through both the design and construction phases. The Project Manager works closely with a representative from the user agency on project scope and functionality during all phases of the project. During the design phase, a DGS design team is responsible for the daily work on a project with the Office of Construction taking responsibility when construction begins. For larger and more complex projects, the State sometimes contracts for a project management consultant or scheduler to assist the internal Project Manager.

Quality Control Plans. Maryland requires that the contracts for design and construction include provisions that the contractor establish formal Quality Assurance/Quality Control (QA/QC) plans for the project. The QA/QC plans help to ensure that the project adheres to the contract requirements.

Design Review. Maryland requires that the A/E complete a monthly progress report during all phases of design. In addition, the State completes a variety of internal design reviews: 1) design reviews at 25%, 50%, 95%, 100% completion; 2) cost estimates at 50% and 95% completion; and 3) value engineering.

Construction Management and Monitoring. The DGS Project Manager is responsible for the management of the project during the construction phase. Prior to construction, the Project Manager holds a pre-construction meeting with the A/E, user agency, and inspection team to review administrative procedures, schedule, and payment. During construction, there are bi-weekly (weekly on larger projects) progress meetings. The project manager visits the site for the progress meetings and as-needed.

Inspections, Tests, and Approvals. State facilities are not required to obtain local jurisdiction building permits. For simple projects, DGS has a team of general inspectors who monitor construction and complete daily inspection reports. For larger projects, DGS will assign an inspector to be on-site full-time. For more complex projects and all electrical inspections, DGS hires third-party inspectors. Additionally, DGS uses independent inspectors for any structure or material that requires a third-party inspection under the building code.

Maryland Stadium Authority

Organizational Structure

The Maryland Stadium Authority was established via State legislation to build, manage, and maintain facilities for professional baseball and football in the State of Maryland. The mission has since expanded to plan, finance, build and manage sports and entertainment facilities, including partnering with local governments, universities, and private enterprises to build such facilities. The Authority is now also responsible for the Baltimore City School Program.

Summary of Management and Oversight Policies and Procedures

The Maryland Stadium Authority contracts with an Architect/Engineering (A/E) firm to design a facility and a Construction Manager to participate in the design process and manage the construction process (referred to as a construction manager at-risk project delivery method). Key policies, procedures, and structures typically used to oversee these processes are summarized below.

Process and/or Procedure Documents. The Stadium Authority is currently in the process of developing an electronic procedures manual. Currently, the specific requirements and standards for each project are incorporated into the contract documents between the Authority and the consultants.

Project Management. The Stadium Authority has a project management process that includes both internal Project Managers and a contracted Construction Manager. The Authority assigns an internal Project Manager to oversee every project through both the design and construction phases. Additionally, the Authority engages a Construction Manager at the same time the A/E is selected. During the design phase, the Construction Manager works as an "agent" of the Authority to help the Project Manager review and shape the design, determine cost-effectiveness, etc.

Once the design phase is complete, the relationship between the Authority and the Construction Manager changes from "agent" to "at-risk"; the Construction Manager becomes responsible for management of the construction process and delivery of the facility within a guaranteed maximum price. The Authority's Project Manager oversees the work of the Construction Manager.

Design Review. The Stadium Authority's Project Manager works closely with the contracted Construction Manager to monitor and review the design work of the A/E. Typically, the design review process will include: 1) standard reviews at each stage in the design process; 2) value engineering reviews; and 3) constructability reviews. A unique feature of having the Construction Manager participate during the design phase is that it allows the Stadium Authority to incorporate review principals like value engineering and constructability into the review at each stage instead of a single point-in-time. Additionally, the Authority will sometimes hire a separate consultant to do an independent design review if the project is particularly complex or high-risk. The Authority has used Building Information Modeling in the past, but not as part of its standard review procedures.

Construction Management and Monitoring. As noted above, the Construction Manager manages the day-to-day construction activities with oversight from the Authority's Project Manager. On some projects, the Authority will increase the contract services of the structural engineer on the project during the construction phase for increased oversight.

Inspections, Tests, and Approvals. The Authority hires third-party inspectors, who report directly to the Authority's Project Manager, for all required project tests and inspections. The Authority requires that an inspector is at the job site every day during "high risk" components of construction.

Arlington County, Virginia

Organizational Structure

The Arlington County Department of Environmental Services, Division of Facilities and Engineering (DFE) is responsible for the design, construction, and maintenance of public facilities.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Arlington County uses the Design-Bid-Build method for delivery of a public facility. Arlington County contracts separately with an Architect/Engineering (A/E) firm to design the facility and a General Contractor to construct the facility via the County's procurement process. Key policies and procedures typically used by Arlington County to manage these processes are summarized below.

Process and/or Procedure Documents. Arlington County staff report that the primary document for project requirements is the General Terms and Conditions within the contracts between the County and consultants/contractors. In addition, Arlington County has the following documents to provide guidance during public facility design and construction:

- Facilities Standard Manual;
- Project specification book (written by design firm); and
- Special Inspection and Pre-Construction Manual.

Project Management. DFE assigns an internal Project Manager responsible for leading the project and overseeing the contractors through both the design and construction phases. DFE also involves other County departments and stakeholders (including the eventual user department of the facility and the Department of Management and Finance) at various points in the process as part of the overall project management team.

Quality Control Plans. Arlington requires that contractors develop a Quality Control Plan and use quality control procedures for both the design and construction phases. Quality Control Plans help ensure that the contractor performs the required design or construction activities in compliance with the specifications of the contract.

Design Review. Arlington County typically completes multiple design reviews for a County facility project, including:

- Staff Design Review. At four stages in the design process (20-30%, 50-60%, 75%, and 90% completion), DFE conducts internal staff reviews with both the user group and the Facilities Management Bureau, who will maintain the design drawings. Each stage also includes a review of construction cost estimates.

- Building Information Modeling (BIM). Arlington does not currently require design consultants to use BIM, but will be adding this requirement in the Facility Design Standards 2013. BIM is a process that utilizes software programs to virtually construct a three-dimensional model of a project as designed and identifies potential conflicts, errors, and omissions. On projects where the County will require BIM, the design firm will be required to provide the model to the selected construction contractor.

Construction Management and Monitoring. The DFE Project Manager oversees the construction process and will typically visit a project site several times a week. For all projects, the DFE Facilities and Design team holds a pre-construction planning meeting with third-party inspectors and County inspectors. During construction, there are progress meetings every two weeks. In addition, formal process and coordination meetings are also held at various milestone points in the construction project. Arlington also utilizes a Commissioning Agent on its projects that reviews work during construction.

Inspections, Tests, and Approvals. Arlington County facility projects, like any commercial construction, are subject to building permit-related inspections through the Department of Community, Planning, Housing, and Development's Inspections Services Division. In addition, DFE hires a third-party inspection consultant to do further tests and inspections as required by the project specifications.

County building inspectors review and approve incremental work, and conduct building code related inspections for mechanical, structural, life-safety, etc. systems. The third-party inspectors test and inspect all critical systems, e.g. soils, structures, concrete, etc. The third-party inspectors provide all test results to the Project Manager and are required to submit formal monthly reports. The third-party inspector's reports and certification of acceptance of special inspections, along with the structural engineer's certification of final review, are required before the County will issue a Certificate of Occupancy.

Loudoun County, Virginia

Organizational Structure

The Loudoun County Department of Transportation and Capital Infrastructure (DTCI) is responsible for planning, financing, designing and constructing public facilities.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Loudoun County contracts separately with an Architect/ Engineering (A/E) firm to design the facility and a General Contractor to construct the facility via the County's procurement process. Key policies, procedures, and structures typically used to manage these processes are summarized below.

Process and/or Procedure Documents. Loudoun County staff report that all project requirements are incorporated into the General Terms and Conditions for contracts between the County and consultants/contractors. In addition, Loudoun County has a "Facilities Standards Manual" that outlines the land development and design and construction standards for all construction in the County, including public facilities. The Manual is reviewed (and changes recommended) on an annual basis by a committee appointed by the Board of Supervisors.

Project Management. DTCI's Capital Planning, Budget and Design Division provides project and contract management for these projects during the design phase of capital facility development. The Design Division includes design managers and engineering teams.

Loudoun County uses a software program called eBuilder to manage all aspects of the design and construction phases for public facility projects. All Division staff are trained to use the program, which includes multiple modules such as cost/schedule management, progress reporting, document management, and forecasting. If an activity is programmed in to the system and is not marked as complete within three days of the scheduled date, the system automatically notifies the project supervisor of the issue. eBuilder also allows for integration into the jurisdictions' ERP, accounting, GIS, and project management systems. All employees are given iPads so that they have constant access to information in the eBuilder system.

Design Review. Loudoun County typically completes standardized design reviews at 35%, 65%, and 95% design completion. Additionally, constructability reviews and quality assurance/quality control reviews are completed during the design submittal process.

Construction Management and Monitoring. The Construction and Transportation Division provides contract and project management services during the construction phase of the County's capital projects. Loudoun County does not contract out for construction management and currently employs six internal construction managers. Each construction manager has numerous field technicians, who are responsible for daily visits to all project sites and submitting daily reports.

Inspections, Tests, and Approvals. Loudoun County facility projects receive inspections from both County and third-party inspectors. The County's Department of Building and Development conducts all building-permit related inspections to ensure the buildings are safe and adhere to code. Additionally, DTCI hires an independent, third-party inspections contractor to conduct all other tests, inspections, and approvals required as part of the construction contract. The County has a task order contract with three to four firms at any given time that it uses for inspection services.

City of Austin, Texas

Organizational Structure

The City of Austin's Public Works Department (PWD) is responsible for 70-75% of public facility design and construction in the Capital Improvement Plan.[22]

Summary of Management and Oversight Policies and Procedures

The City of Austin utilizes both the Design-Bid-Build (DBB) and Design Build (DB) methods for delivery of public facility construction. Under the DBB method, PWD contracts separately with an Architect/ Engineering (A/E) firm to design the facility and a General Contractor to construct the facility. Under the DB method, the City contracts with an A/E to complete preliminary design and with a design-builder to advance the design and complete construction. Staff report that the use of DB is increasing. Key practices and procedures for both delivery methods are highlighted below.

Process and/or Procedure Documents. The City of Austin has a Project Management Manual that summarizes the processes and procedures used for the design and construction of public facilities. The PWD also has extensive documentation on quality control/quality assurance standards.

Project Management. The PWD has a Project Management Division that assigns a Project Manager to every project. All Project Managers are licensed architects/engineers who must complete an internal Project Management Academy training. The Academy includes over 30 modules on a variety of topics including cost, communication, and quality management. On Design Build projects, the construction manager at-risk will come into the project management role at 25% design completion.

Quality Control Plans. The City has a Quality and Standards Division in the PWD to manage and monitor the quality assurance and quality control (QA/QC) of design and construction. The contractor is required to submit a QA/QC plan at the beginning of the project and provide updates at consistent intervals. An internal Quality Standard Management Group also reviews design plans.

Design Review. The City of Austin typically completes several design reviews, including:

- Reviews with the user agency to ensure the project meets its needs;
- Constructability reviews at several intervals;
- Independent design reviews as part of QA/QC;
- Value engineering reviews; and
- Internal design reviews at 60% and 90% completion.

Construction Management and Monitoring. The PWD Project Manager oversees the construction process and will typically visit a project site several times a week. For all projects, the PWD team holds a pre-construction planning meeting and bi-weekly progress meetings to monitor the project.

Inspections, Tests, and Approvals. Austin facility projects are subject to building permit-related inspections through the Building Inspection Division of the Planning Development and Review Department. In addition, the PWD has an internal Construction Inspection Division to conduct inspections related to project specifications. Internal inspectors are on a job site every day. If necessary, PWD hires an independent, third-party inspection consultant to do further tests.

[22] Austin Energy is responsible for the remaining construction in the City (mostly electricity facilities). This summary only addresses the Public Works Department's policies and procedures.

Miami-Dade County, Florida

Organizational Structure

The Miami-Dade County Internal Services Department, Architectural & Engineering Unit, Design & Construction Services Division (DCSD) manages the procurement of design, engineering, and construction services in County.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Miami-Dade County contracts with an Architect/Engineering (A/E) firm to design the facility and a General Contractor to construct the facility via the County's procurement process. Key policies, procedures, and structures typically used by Miami-Dade County to manage these processes are summarized below.

Process and/or Procedure Documents. Miami-Dade Administrative Order 3-39, "Standard Process for Construction of Capital Improvements, Acquisition of Professional Services, Construction Contracting, Change Orders and Reporting," provides general guidelines and standards for County facility projects. For each individual project, the County incorporates all the project standards and requirements into the General Terms and Conditions for contracts between the County and consultants/contractors. In addition, the Architectural & Engineering Unit has several process and procedure templates for various components of the design and construction phases.

Project Management. During the design phase, the DCSD assigns a staff member to lead a team that manages the design process. The design team includes representatives of the user department, the budget office, technical staff, and the contracted design professionals. During the construction phase, DCSD assigns an internal Construction Administrator to oversee and manage the project. Miami-Dade's project management structure emphasizes "pre-planning" to establish macro objectives, project parameters, goal requirements, and master schedules before each phase of the project begins.

Design Review. Miami-Dade typically conducts multiple types of design review for a County facility project, including:

- Staff design reviews are conducted at 25%, 50%, 75%, and 100% completion. Additionally, the design documents are sent to the Department of Regulatory and Economic Resources for review and comment at the 90% completion stage.
- Quality Assurance reviews are conducted to specifically examine logistics and constructability of the various design components.
- A value engineering review is conducted on all projects costing $1 million or more. This review is conducted by an independent, third-party firm and the results of the value engineering analysis are presented to a Committee of project stakeholders that decide which recommended changes must be incorporated into the project by the A/E.
- Building Information Modeling (BIM) reviews for selected projects. If the County requires BIM, it is typically performed by the A/E firm as a condition of their contract.

Construction Management and Monitoring. During the construction process, the Construction Administrator or General Contractor holds regular progress meetings as well as meeting to address any issues as they arise. The County's Construction Administrator will make regular visits to the project site and conduct random checks and reviews at multiple stages in the process. The County also assigns an internal Field Representative, reporting to the Construction Administrator, who visits the project site every day, prepares daily reports, tracks progress against the original schedules, and reviews all quality assurance issues.

Inspections, Tests, and Approvals. Miami-Dade facility projects receive inspections from internal staff, the County's permitting authority, and/or third-party inspectors. The County's Field Representative reviews field verification tests and inspections conducted during the construction process by the General Contractor's Superintendent (required as part of the quality assurance protocols).

The County's Regulatory and Economic Resources Department conducts all inspections required under the building permit for conformance with building codes and regulations, unless the facility qualifies as a "Threshold Building" and requires special inspections. The County must hire an independent, third-party consultant to conduct any special inspections. Miami-Dade also hires inspection firms to conduct inspection and verifications of work separate from the required special inspections.

New York City, New York

Organizational Structure

The New York City Department of Design and Construction (DDC), Division of Public Buildings manages the design and construction of the City's public facilities.

Summary of Management and Oversight Policies and Procedures

New York City uses a "Quality-Based Selection" process to select project architects (A/E) and construction managers. Key structures, policies, and procedures used by New York City to manage these processes are described below.

Process and/or Procedure Documents. As part of the City's Design + Construction Excellence (D+CE) program, initiated in 2004, New York has developed written documents that describe design and construction policies and guidelines, including:

- A *Design Consultant Guide* that describes the design criteria of the agency; services and deliverables expected; and the approvals and procedures necessary to complete design projects for DDC. The Guide is a part of the contract with the design consultant.
- *BIM Guidelines* which provides instruction for the consistent development and use of Building Information Modeling (BIM) across multiple building types.

Project Management. DDC assigns an internal staff Project Manager to oversee and coordinate both the design and construction phases of a project. Additionally, each project is assigned a Design Liaison. The responsibility of the Liaison is to "ensure the maintenance of design throughout the life of a project. Traditionally, scheduling and budget have been given priority in project management, with design quality often neglected as a result. To avoid this, Design Liaisons are charged with monitoring the design process of all D+CE projects and are important players every step of the way – from RFP development and consultant procurement through construction completion."[23]

Design Review. An internal staff team conducts formal design reviews and manages the review process. New York City requires several types of design reviews for each facility project, including:

- Peer Review. Projects are required to undergo professional peer review at various milestone points during the design process. The purpose of the peer review structure is described as follows: "By re-examining the project's needs and posing other possible solutions, the strategy helps avoid the problem of getting locked in to a design idea too early."[24]
- Constructability Review. This process requires a comprehensive review of construction documents before they are put out to bid in order to decrease the likelihood of flawed bids and significant change orders due to incomplete or uncoordinated construction documents. DDC has a constructability review team that performs these reviews at 50% and 100% completion of the construction documents.
- Value Engineering. If requested by the City's Office of Management and Budget, a value engineering review is conducted during the design.

[23] City of New York, *Design + Construction Excellence: How New York City is Improving its Capital Program*, July 2008, pg. 23.
[24] Ibid, pg. 27.

- Building Information Modeling (BIM). The City utilizes BIM during design review on many projects to find and address potential design conflicts early in the process.

Construction Project Meetings and Monitoring. During the construction phase, a DDC Resident Engineer oversees the work of the contractors. If a Construction Manager is retained for a project, the Resident Engineer monitors the Construction Manager's performance. In addition to a formal construction kick-off meeting, progress meeting are held on the job site bi-weekly.

Performance Evaluation. DDC evaluates the performance of project consultants and sub-consultants on a periodic basis during design and construction. These evaluations become part of a City-wide database used by DDC and other agencies in selecting consultants. Evaluation is done by the DDC Contract Manager and the design review staff and focuses on:

- Design Quality;
- Technical Proficiency;
- Construction Document Quality;
- Effective Communication with DDC and other Agencies; and
- Project Administration.

Design Quality Assessment. DDC also has a Design Quality Indicator Program (DQI), which is a tool for assessing and measuring the design quality on a capital project. The DQI process starts with a pre-design project briefing in which the stakeholders collectively identify what should be important in the design of the building. Assessment meetings occur at three points: mid-design, construction completion, and post-occupancy. During the assessment meetings, the stakeholders evaluate the project according to the values identified in the initial briefing and indicate how well those values are being achieved.

Santa Clara County, California

Organizational Structure

The Santa Clara County Capital Programs Division (CPD) within the Facilities and Fleet Department is responsible for the planning, design and construction of facilities and buildings for the County.

Summary of Management and Oversight Policies and Procedures

Upon approval of a particular project, Santa Clara County uses the Design-Bid-Build method of constructing a public facility. The County contracts separately with an Architect/Engineering (A/E) firm to design the facility and a General Contractor to construct the facility. Key policies and procedures typically used by Santa Clara County to manage these processes are summarized below.

Process and/or Procedure Documents. Santa Clara County has extensive documentation of processes and procedures for the construction of public facilities, including:

- The *eManual* is a project management manual that outlines the processes from project initiation to closeout and includes a summary of the responsibilities of the project manager.
- The *AE Design Guide* helps consultants understand the design services agreement and identifies the County's "technical standards" that must be incorporated into the design.

Project Management. CPD assigns an internal Project Manager to manage and oversee the consultants through both the design and construction phases. All Project Managers in the CPD are certified architects/engineers. For larger projects, the CPD will engage a construction management firm early in the design phase to support the Project Manager.

Quality Control Plans. Santa Clara County uses the Contractor Quality Control (CQC) system of implementing quality workmanship on construction projects (which is incorporated into the contract). The CQC Program defines specific processes and controls the consultant must implement to plan for quality, test for quality, and document efforts to achieve quality. As part of the system, the consultant must employ an independent subcontractor to oversee quality control.

Design Review. The number of design reviews for a project varies on the complexity and schedule of a particular project. For typical projects, Santa Clara County conducts independent peer reviews at 35%, 65%, and 100% of design completion. The Project Manager may also require the design consultant to conduct bidability studies, constructability reviews, and value engineering. On larger projects, the County has used Building Information Modeling as part of design review.

Construction Management and Monitoring. The CPD Project Manager oversees the construction process and will typically visit a site several times a week or everyday on larger projects. For all projects, the Project Manager will hold a pre-construction planning meeting with the general contractor, A/E design team, and inspectors. During construction, there are bi-weekly progress meetings and daily progress reports filed.

Inspections, Tests, and Approvals. Like all commercial construction, public facilities in Santa Clara County are subject to building permit related inspections through the County's Development Services Office. In addition, Santa Clara hires an independent, third-party inspection consultant to do further tests and inspections as required by the project specifications. The A/E design team and the construction management's quality control subcontractor also monitor and inspect the project.

Ventura County, California

Organizational Structure

The Ventura County Engineering Services Department of the Public Works Agency is responsible for design and construction of capital projects in the County.

Summary of Management and Oversight Policies and Procedures

Ventura County primarily uses the Design-Bid-Build method of constructing a public facility. The County will contract with an Architect/Engineer (A/E) firm to design the facility and a General Contractor to construct the facility. Key policies and procedures used to manage these processes and ensure the facility meets the needs and requirements of the State are summarized below.

Process and/or Procedure Documents. Ventura County has extensive documentation on the processes and procedures for design and construction within the County including contract templates, schedule documents, and process flow charts. Two of the more comprehensive documents are:

- The *Project Processing Procedures Manual* that establishes uniform policies and procedures for the Project Managers during the design, bidding and construction phases of projects; and
- The *Consultant's Guide* that outlines the selection, negotiation, contract terms and performance of consulting services contractors.

Project Management. Engineering Services assigns an internal Project Manager (with staff) to oversee and monitor a project from design through construction. The Project Managers, who are all registered architects or engineers, complete monthly progress reports on the status of each project they are managing. Additionally, Ventura will involve other project stakeholders (such as representatives from the user department) as part of a broader management and oversight team throughout the project. For certain large and/or complex projects, Ventura will also hire a consultant to assist internal staff with project management responsibilities.

Quality Control Plans. The State of California has very rigorous requirements for quality control plans in facility construction. Ventura County requires that the contractors provide detailed quality control plans for both the design and construction phases of a project. The quality control plans establish processes the contractors must follow to meet all project requirements, as well as establish testing protocols, etc. to ensure all technical specifications are met.

Design Review. The specific type of design reviews completed for Ventura's facility projects depend upon the complexity of the project. All necessary design reviews are outlined in a particular project's contract terms. At minimum, there are internal design reviews at 30%, 70%, and 90% completion and value engineering. Complex projects may receive additional reviews either by the review team or by an independent third-party. For example, a project may receive a specialized review covering a single discipline (e.g., electrical, structural, mechanical) or a specialized review for multiple disciplines.

Construction Management and Monitoring. The internal Project Manager is responsible for the oversight of the construction phase of a project and will visit a project site several times a week. The Department also typically has a staff inspector on the project daily. The Department may also retain the services of the A/E to review drawings and make project site visits.

Inspections, Tests, and Approvals. Engineering Services has a team of inspectors who monitor construction on a daily basis. The Department will also contract out for third-party inspection services for components of a project that are too specialized for internal staff or are required under a building permit.

Like all commercial construction in the County, public facilities are required to be inspected by the County's Resource Management Agency, Division of Building and Safety. The Division is legally required to approve the building in the design stage before issuance of any permit for construction. When the Division does not have the staff expertise to inspect projects, the County code specifies that the special inspector be employed by the owner. In addition, the State of California mandates third-party inspection for specified types of structures.

Chapter V. Agency Comments

The Office of Legislative Oversight circulated a final draft of this report to the Chief Administrative Officer for Montgomery County. OLO appreciates the time taken by County Government staff to review the draft report and provide feedback, and this final report incorporates technical comments and corrections submitted during the review process.

Written comments on the final draft report from the Chief Administrative Officer are attached in their entirety, beginning on the next page.

OFFICE OF THE COUNTY EXECUTIVE

Isiah Leggett
County Executive

Timothy L. Firestine
Chief Administrative Officer

MEMORANDUM

July 24, 2013

TO: Chris Cihlar, Director, Office of Legislative Oversight

FROM: Timothy L. Firestine, Chief Administrative Officer Timothy L. Firestine

SUBJECT: OLO Draft Report No. 2013-8 - Managing the Design and Construction of Public Facilities: A Comparative Review

I am in receipt of the Draft Report No. 2013-8, dated July 10, 2013, regarding Managing the Design and Construction of Public Facilities. Your report accurately captures the design and construction management processes employed in DGS for all capital projects. I agree with your overall finding that, "the structures and practices used by Montgomery County Government to oversee the design and construction of public facilities largely align with the models and practices used by other jurisdictions and with the 'best practices' literature."

I thank the Office of Legislative Oversight for its thorough and detailed review. If you have any questions or need additional information please contact Fariba Kassiri, Assistant Chief Administrative Officer.

TLF:dd

cc: Fariba Kassiri, Assistant Chief Administrative Officer
David Dise, Director, Department of General Services
Diane Jones, Director, Department of Permitting Services