Capital Project User Guide

Updated 2022
Dear Colleagues,

The purpose of the Capital Project User Guide is to communicate the work processes and other important and relevant information needed to effectively complete capital projects at Princeton University. Our goal is to provide a guidebook with key information and processes for our colleagues working on capital projects and an understanding of the tools used by Facilities staff to guide the delivery of projects.

The first two sections of this handbook summarize the project team and overall process, with phases, deliverables, and milestone approvals required to complete each phase. The remainder of the handbook provides detail on each of the four phases: project initiation, study, authorization, and approval.

We expect to update this guide periodically as we work on projects envisioned in the 2026 Campus Plan. We welcome your feedback as you complete project phases and projects.

Respectfully,

Kyujung Whang

Vice President for Facilities
Office of the Vice President for Facilities
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## GLOSSARY
Intended for campus user groups and stakeholders, this guide provides information on the processes, approvals, and project team roles involved in a large capital project, typically with project costs exceeding $7.5M. The goals of its authors are: to set expectations, share our experience, and facilitate communication among campus leadership, Facilities, user groups, and stakeholders. Following the processes outlined in this guide helps ensure that capital projects will:

- meet University objectives and guidelines;
- attain sustainability goals;
- satisfy user needs; and
- finish on budget and on schedule.

Projects will be assessed individually to confirm whether the processes outlined in this guide will apply. As determined, these processes may apply to some projects less than $7.5M or to projects developed by an entity external to the University, such as a developer.

A companion document, the Small Project User Guide, outlines the processes for those capital projects that are defined as small and which require fewer approval steps.

Princeton University’s Strategic Framework, approved by the trustees in 2016, identifies institutional priorities and emerging academic needs as they relate to the University’s core mission. The 2026 Campus Plan provides a framework to guide the evolution of our campus over the next 10 to 30 years. Both the Strategic Framework and the Campus Plan help identify capital projects, shape their objectives, and provide checkpoints throughout a capital project.

The trustees have also approved a Capital Plan which is a listing of potential projects with financial allocations. Projects on this list, however, are still subject to the process of approvals outlined in this guide.

Users (students, faculty, staff, and our larger University community) are critical participants in the success of a capital project. As representatives of Facilities, we look forward to working with you, the users, to design and build facilities that meet the needs of our University today and well into the future.
Accomplishing a major capital project typically requires a large project team that will be involved in a complex process from project inception to completion.

The many participants in such an undertaking include entities that govern decisions on projects; architects and engineers who contract with the University; user groups whose needs are addressed by the project; stakeholders, and other constituents specific to the particular project. These participants inform important aspects of a project, such as function, materials, building systems, safety elements, and operational aspects of the project. In this section of the guide, the roles and responsibilities of each participant and stakeholder are outlined broadly; they will be described in more detail for each project phase later in this guide.

Throughout the life of a project, participants will be engaged in an intensive, creative, collaborative process that will enable the project to develop into the best possible solution. During the project, clear communication is central to achieving success.
PRINCETON TEAM

Provost (Client)
The client for all capital projects is the provost.
The provost confirms the academic or operational need for a particular project, provides leadership and guidance during the project process, and appoints and coordinates with an executive sponsor. The provost manages approvals required by Facilities Planning Group (FPG) and the trustees, and approves documents that describe the project scope, budget, and project objectives, which are prepared by Facilities in collaboration with an executive sponsor.

Executive Sponsor (ES)
The executive sponsor is a senior University administrator who...
- provides leadership to the project team, ensuring that project objectives, target costs/budgets, and the project timeline align with University goals;
- participates in the preparation of project documents for approval by the provost;
- leads funding discussions, coordinates with users, develops strategies, and provides direction on key issues, particularly those relating to program, cost, and schedule; and
- is accessible and approachable to the project team seeking guidance.

User Representatives
A user is a representative of a school, college, department, center or administrative unit responsible for the functional and operational requirements of a major capital project, who...
- provides general and detailed project requirements and programming information to the project team;
- coordinates with the executive sponsor to establish a governance and communications plan with user groups; and
- facilitates clear and decisive communications with user groups.

For large projects, users groups may include dozens or even hundreds of individuals. To foster a clear understanding of project objectives and the capital project process, Facilities and the executive sponsor will advise users in the development of effective use of communication plans. Communications within user groups, including the means by which users provide input, is also discussed in more detail later on page 8.

University Stakeholders
Subject matter experts within the University are the stakeholders responsible for reviewing project design at major milestones to ensure compliance with University standards, such as those of...
- Department of Public Safety;
- Environmental Health and Safety;
- Office of Community and Regional Affairs;
- System management (such as technology networks and building controls);
- and others.

Stakeholders may also include campus entities that may be affected by the construction of the project in some way. Facilities will coordinate and communicate closely with these groups during all phases of the project.

FACILITIES TEAM

Facilities represents the provost in leading the project through the design and construction process, ensuring that each project achieves project objectives, complies with University standards, and is designed and constructed within the approved budget and schedule.

Project Management Team
The Office of Capital Projects (OCP) manages the project in close collaboration with the Office of the University Architect (OUA) and other departments within Facilities. OCP and OUA collaborate closely, with each group providing leadership in areas of responsibility throughout the duration of the project.

“A user is a representative of a school, college, department, center or administrative unit responsible for the functional and operational requirements of a major capital project.”
OCP is primarily responsible for efficient communication with internal University stakeholders, users, and the project team, monitoring cost targets, anticipated costs, schedule, quality control, and compliance with municipal regulations. OCP reports on project cost and status, and prepares documentation on funding and other approvals for the executive sponsor, provost and trustees.

OUA is primarily responsible for alignment with the Campus Plan, architectural design, landscape design and stormwater management.

OCP and OUA share responsibilities for project initiation, regulatory, zoning, and land use approvals.

**Program Manager**
The OCP program manager provides:
- leadership to the project manager and project team, particularly at project milestones and project completion;
- input to the project team on governance, resources, priorities, risks, and communication;
- liaison with the executive sponsor, users, and University administration; and
- monitoring of the plan for project governance, authorization, and approval.

**Project Manager (PM)**
The OCP project manager is:
- responsible for the day-to-day management of the project, including tracking project progress, team performance, and projected cost and quality; and
- the central point of contact for users, stakeholders and outside team members.

**Project Planner**
The OUA project planner is the OUA point of contact to collaborate with the project team, providing guidance throughout all phases of the project.

**Field Manager (FM)**
The OCP field manager:
- partners with the PM early in the design phases and assumes increasing responsibilities as the project move through construction,
- provides support during the design and construction phases through constructibility analyses, site logistics planning, and schedule monitoring and reporting, and,
- as a full time presence on site during construction and move-in, provides construction phase oversight of contractor procurement, project controls, change management, and commissioning and turnover to facility maintenance.

**Facilities**
Subject matter experts within Facilities are responsible for reviewing project design at major milestones to ensure compliance with University standards. Integral to the project team are:
- **Engineering and Campus Energy**, responsible for energy management on the campus, using best engineering practices to reduce energy use and environmental impacts;
- **Financial and Administrative Services**, which supports project financial management, procurement, and contracting needs;
- **Operations**, which provides input to confirm compliance with University standards, and to ensure durability, maintainability, and operability; and
- **Office of Sustainability**, which oversees the University’s Sustainability Plan and coordinates with the project team to establish sustainability goals and review alignment of the project design with goals.

**OUTSIDE TEAM**

**Architect**
For major projects, the design professional, usually the architect leading a team of sub-consultants, will provide comprehensive services, including architectural, structural, mechanical, and electrical engineering and cost estimating services. This consultant is usually brought on board through a selection process during the project initiation phase, after the project scope, location, and target cost have been defined.

**Builder**
A builder, or construction manager (CM), is engaged early in project design, usually during schematic design in the Study Phase, to provide input during the design phases on cost, construction methods, and schedule. Once construction documentation is completed, the CM will engage trade contractors (such as masonry contractors, roofing contractors, plumbing contractors, and so on) through a competitive selection process and lead them in constructing the project.

**Specialists**
Depending on the specific programmatic and/or technical requirements for a particular project, other specialized consultants may join the project team, as needed. Some of these may be:
- acoustical engineers
- audio-visual consultants
- code compliance consultants
- cost estimators
- laboratory specialists
- landscape architects
- storm water engineers
PROJECT APPROVAL LEVELS

Large capital projects inherently involve significant investments in time and money, and accordingly they require several levels of approval. The provost, with input from Facilities and the executive sponsor, plays a central role in the approval process for major projects, which is outlined in “Approval Milestones” on pages 12-13 and discussed in detail throughout this document. Below is a list of the approving groups with their specific financial authority levels.

APPROVAL TIERS

<table>
<thead>
<tr>
<th>Approving Group</th>
<th>Authority Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to $350,000</td>
<td>Approves study budgets or small projects up to $350,000. This level can include both studies for the design phase of major projects, and total funding for the design and construction of smaller projects.</td>
</tr>
<tr>
<td>facilities Planning Group (FPG)</td>
<td>Approves funding requests from $350,000 to $7.5M, and recommends trustees take appropriate action to authorize and approve projects greater than $7.5M. The FPG includes the provost, executive vice president, VP for Facilities, University architect, treasurer, other representatives from Facilities, University advancement, and government and community affairs.</td>
</tr>
<tr>
<td>over $7,500,000</td>
<td>The Board of Trustees authorizes and approves projects greater than $7.5M.</td>
</tr>
</tbody>
</table>

Andlinger Center for Energy and the Environment project manager Sam Rozycki guiding a student engineering class during construction in 2014.
COMMUNICATIONS

The success of capital projects centers on clear, timely communication among users, leadership, stakeholders, Facilities, and external project team members. During project initiation, Facilities works with the executive sponsor to establish clear protocols:
- Who will be responsible for communications, input and decision-making;
- How information will be conveyed from front-line user groups to the project team; and
- How questions and clarifications of user needs will occur and be documented.

Ideally, one individual will be identified to represent all distinct user groups. This single user representative will be responsible for gathering data and consensus from all user groups, and for forwarding the necessary information to the project team, ensuring that user interests are represented. This individual must be available to attend all regularly scheduled meetings.

While the individual users may need to interact directly with the design team from time to time, typically most user project requirements will be communicated through this central user representative.

To promote clear communications and avoid potential delays to the project, the University will work with the design team in a highly collaborative process, an integrative design process. In this inclusive process, which includes broad representation of design disciplines as well as user groups, decisions can be influenced by a greater number of project participants, enabling optimally integrated solutions.

Informational sessions called primers, described in detail on page 10, will occur at strategic times during the project to further clarify the process and roles and responsibilities.

"Ideally, one individual will be identified to represent all distinct user groups. This single user representative will be responsible for gathering data and consensus from all user groups."
GOVERNANCE

Timely decision-making on a project ensures that objectives, budgets, and schedules are met. During the Project Initiation Phase, the executive sponsor and Facilities establish governance committees to help capital project users and other participants understand their roles and responsibilities and enable project decision-making. Users are involved at all levels of discussions regarding project objectives and design solutions, as outlined below.

Executive Sponsor meetings occur as needed for the executive sponsor to ensure that the project is in compliance with the value proposition and project objectives, and to recommend approval or input by the provost at certain project milestones, including trustee approvals.

*Members:* executive sponsor, executive committee

*Frequency:* at milestones

The Executive Committee is responsible for reviewing project progress as it relates to the value proposition, project objectives, and target cost/budget and schedule milestones. This group provides decisions on points elevated by the Building Committee, and develops options or decision points for consideration by the executive sponsor.

*Members:* executive sponsor representative, user leadership, facilities leadership (VP and AVP), Facilities project team members

*Frequency:* Monthly, but may vary

The Building Committee, which includes user and stakeholder representatives and the Princeton project team, provides detailed program requirements and recommendations to the project team in compliance with the value proposition, project objectives and target cost/budget. This group will define decision points for elevation to the executive committee.

*Members:* executive sponsor and user representative(s), Facilities project team members, Facilities stakeholders (e.g., Sustainability, Engineering and Campus Energy, Operations)

*Frequency:* Every two weeks, but may vary

The Project Team is responsible for the day-to-day management of the project to ensure that it achieves the preliminary project objectives, satisfies the functional program requirements, and meets the established target cost/budget and schedule. This group organizes agendas and prepares materials for all meetings and workshops, and works closely with the Building Committee to secure detailed project requirements and determine decision points.

*Members:* project manager, program manager, University architect, project planner, external consultants (e.g., the architect, engineers, builder)

*User and project team workshops:* Project development requires collaboration and creativity at all levels to ensure that accurate information is shared and that the best ideas are considered. Users should expect to be invited to a variety of programming and design workshop discussions with the project team, particularly in the early phases of the project. The project team will organize and schedule the workshops, confirming that appropriate attendees are included according to the subject. The Building Committee, which includes user group representatives and the Princeton members of the project team, will provide detailed input and consideration for decision points to ensure that the project is developed successfully.

“The Building Committee provides detailed project requirements and recommendations to the project team in compliance with the value proposition, project objectives, and target cost/budget.”
What Are Project Primers?

Project primers are meetings held periodically to help guide users through the project delivery process. These sessions enable all participants to understand the process, expectations, their roles, and the short-term and long-term objectives for the project. During the life of a large project, seven primers are offered:

1. once the provost approves the project to proceed and appoints an executive sponsor
2. prior to architect selection
3. at start of Programming and Concept Design
4. at start of Schematic Design
5. at start of Design Development
6. at start of Construction Documentation
7. at start of Construction

These meetings are arranged by Facilities, and include the executive sponsor, users, and project teams. Sessions cover the following topics:

- roles and responsibilities, including expected levels of effort
- overall project delivery process
- upcoming phase of project in greater detail
- governance, approvals, and decisions that will occur
- project objectives, including the Project Definition Document
- feedback on project progress and communications

Blair Walk, originally designed by Beatrix Farrand during her time as a landscape architect with Princeton University from 1912 to 1943, restored in 2011.
PROCESS OVERVIEW

FOUR-PHASE PROJECT DELIVERY

- Project Initiation Phase
- Study Phase
- Authorization Phase
- Approval Phase

These four phases are segments of a project’s path through the University governance process. Each phase requires a great deal of communication and collaboration among members of the project team and the University.

The chart below provides an overview of what to expect in each phase. Further detailed processes and approvals are described later in this document.
### APPROVAL MILESTONES

#### Project Initiation

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the need, project type and size</td>
<td>3 to 9 months</td>
</tr>
<tr>
<td>Assign Facilities staff</td>
<td></td>
</tr>
<tr>
<td>Identify executive sponsor</td>
<td></td>
</tr>
<tr>
<td>Set target cost and funding strategy</td>
<td></td>
</tr>
</tbody>
</table>

#### Study Phase

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Programming/Concept</th>
<th>Schematic Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Project Definition Document including value proposition and preliminary project objectives (PPOs) Establish governance and communications plan Select architect</td>
<td>Document program Create conceptual design layout options and cost estimates Confirm options are within target cost Hold design reviews and sustainability charrette Refine Project Definition Document</td>
<td>Continue design development of preferred plan adding general materials, building systems and form Refine Project Definition Document Engage builder Confirm cost is within target cost Set project budget</td>
</tr>
</tbody>
</table>

#### Approval Milestones

- **Provost approves** need
- **Provost approves** preliminary project parameters, target cost, and appoints executive sponsor
- **Funding Strategy** identified
- **FPG notified** of project initiation
- **Executive Sponsor** endorses project definition document; recommends approval to provost
- **Provost approves** project definition document including PPOs, target cost, and architect selection criteria
- **Architect selected**
- **FPG Study Funding approval**
- **Executive Sponsor** updates
- **Executive Sponsor** reviews design options and recommends preferred option to provost
- **Provost approves** preferred design option, Project Definition Document, and confirms target cost (end of concept)
- **Trustee Grounds and Buildings Committee review** of concept design
- **Executive Sponsor** updates
- **Executive Sponsor** endorses schematic design, project budget, and recommends authorization
- **Funding plan** confirmed
- **Fundraising goal** progressing
- **Provost approves** schematic design, Project Definition Document, and recommends authorization (end of schematic)
- **FPG recommends** authorization
- **Trustee Grounds and Buildings Committee Authorization**

### Milestones

- **Executive Sponsor**
- **Provost**
- **Facilities Planning Group**
- **Trustees**
- **Facilities**
- **Project Primer**
## Authorization Phase

**12 to 18 months**

<table>
<thead>
<tr>
<th>Design Development</th>
<th>Construction Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue to develop design, adding details, materials, and building system diagrams</td>
<td>Complete detailed construction documentation and specifications of materials and building systems</td>
</tr>
<tr>
<td>Confirm cost is within the project budget</td>
<td>Secure contractor pricing</td>
</tr>
<tr>
<td>Begin regulatory submission process and furniture design</td>
<td>Confirm budget</td>
</tr>
</tbody>
</table>

**Executive Sponsor** updates

- Executive Sponsor updates
- Executive Sponsor recommendation for Trustee approval
- Funding plan confirmed, Fundraising goal met
- Provost recommends approval to construct
- FPG recommends approval
- Trustee Committee on Finance approval

## Approval Phase

**12 to 36 months**

<table>
<thead>
<tr>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare construction site</td>
</tr>
<tr>
<td>Construct the project</td>
</tr>
<tr>
<td>Create move-in plan</td>
</tr>
<tr>
<td>Order furniture</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Move-in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupants move in</td>
</tr>
<tr>
<td>Measure project objectives</td>
</tr>
<tr>
<td>Lessons learned</td>
</tr>
</tbody>
</table>

**Executive Sponsor** updates

- Executive Sponsor recommends scope/program changes to the provost for approval

**Executive Sponsor** updates

- Executive Sponsor updates
- Close project
- FPG project closure

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**Process Overview**
Architect Selection

The selection of the architectural designer is among the most important steps in the project initiation phase. Given the diverse building types and functions on Princeton’s campus, the University selects architectural firms with deep experience in, and understanding of, the higher education environment, the specific programmatic requirements of the project, and the campus context.

The University Architect (UA) initiates the selection process by identifying a long list of architectural firms with appropriate experience and demonstrated ability to collaborate successfully with the constituents of complex institutions. The President’s Advisory Committee on Architecture (PACA) informs the project planning and design objectives to be incorporated into the selection criteria. A long list of firms (approximately 8 to 15) receive a Request for Qualifications (RFQ) from Princeton University, which provides a general description of the project and the value proposition. Firms are asked to confirm their interest in the project and to respond with a written presentation of their qualifications.

Facilities reviews the RFQ submissions, and the UA and VP for Facilities recommend a short list to the Executive Sponsor for consideration to receive a Request for Proposal (RFP).

The approved short-listed firms receive a Request for Proposal, which describes the project in more detail, including the preliminary project objectives, program summary, size and location, schedule, target cost range, scope of services, and criteria to be used for selection. After reviewing the submitted proposals and conducting a thorough review of each firm’s experience and quality of their team, a meeting is convened with Facilities and key users where a short list of firms to be interviewed is recommended to the executive sponsor. A selection committee put in place by the president will conduct the interviews.

Interviews enable representatives from each architectural firm to present their qualifications and approach to the project in person, while also giving Princeton University the opportunity to meet and interact with the designers and engineers with whom we will collaborate for the duration of the project. The selection committee makes a recommendation to the president, who determines the final selection.

This process may vary depending upon the project. For example, some projects may skip the RFQ process, and use only an RFP.
Project Initiation
PROJECT INITIATION PHASE

OVERVIEW

Confirm the project need and campus plan alignment; establish a target cost and project objectives.

During the Project Initiation Phase, the provost examines the need and level of investment, with support from the executive sponsor, user representative, and Facilities, to confirm that the project should proceed to the study phase. The focus is on creating a critical scope document, called a Project Definition Document, while verifying that the conceptual project aligns with University priorities, available resources, and the Campus Plan.

Included in the Project Definition Document, the Value Proposition is the stated goal of the project, and explains the value that will be delivered within the framework of the University’s strategic priorities.

Preliminary Project Objectives (PPOs) break down the project into key goals and targets that, when reached, deliver an end result that fulfills the project’s overall goal and value proposition. PPOs may include objectives for: functionality, teaching, research, collaboration, flexibility, character of space, sustainability, durability and operations.

DESCRIPTION

The Project Initiation Phase begins with the provost’s review and confirmation of the academic or administrative need, along with project parameters such as the project functional goals, project size, location and target cost. Many of these assumptions are based on the campus planning process outlined in the 2026 Campus Plan and the related Capital Plan, which includes target project budgets.

Having approved of the basis for the project, the provost identifies an executive sponsor, and Facilities assigns representatives to support the project throughout its duration. The Facilities Planning Group (FPG) is also advised that the project has been initiated.

With guidance from the executive sponsor and input from the user, Facilities drafts a Project Definition Document that includes the following elements:

1. Purpose
2. Problem/Opportunity
3. Project Goal/Value Proposition
4. Preliminary Project Objectives
5. Project Scope
6. Governance
7. Users
8. Key Stakeholders
9. Outcomes/Success Criteria
10. Assumptions/Constraints
11. Risks
12. Estimated Cost
13. Source of Funding/Fundraising
14. Estimated Duration
15. Project Delivery

Facilities will also work with the executive sponsor and user to establish a governance structure and a communications plan, which are outlined in detail in the “Project Team” and “Process” sections of this Capital Project User Guide. A funding strategy, including potential gifts and related timeline, will also be examined in parallel and incorporated into the document.

The Project Definition Document continues to be refined throughout the Project Initiation Phase. This is an iterative process that is informed by re-examining original assumptions. For example, Facilities will recommend options to establish an appropriate target cost by researching similar projects, and may engage cost estimators specializing in a particular building type.
The target cost represents the construction cost. A target project budget, which includes the target cost and non-related costs such as fees, permits and furniture, is also established using a project multiplier.

At the end of this phase, prior to the selection of an architect, the Project Definition Document is finalized and approved by the executive sponsor and the provost. The contents of the Project Definition Document are integral in the criteria for selecting an architect, a process that is outlined on page 14 of this guide.

Once the architect is selected, Facilities drafts funding request documents for study funding so the architect can begin working. Once endorsed and recommended by the executive sponsor, the provost and the Facilities Planning Group will approve the funding and the Study Phase can begin.

**GOALS**

- Confirm academic or administrative need
- Identify executive sponsor and Facilities team
- Establish project type, function and approximate size
- Confirm target cost and funding strategy
- Establish project governance and communications plan
- Draft, refine and finalize the Project Definition Document
- Select architect
- Approve Study Phase funding

**GOVERNANCE APPROVALS**

The Project Initiation Phase is the one requiring the greatest number of approvals by the provost, to ensure the project is appropriately defined and cost-targeted correctly from the beginning. For the project, the provost will need to approve the following:

- the Project Definition Document, which includes
  - the Value Proposition
  - Preliminary Project Objectives
  - Target Cost and Target Project Budget
  - other project elements
- Architect selection criteria and the selection

**USER INVOLVEMENT**

During the Project Initiation Phase, user involvement provides input outlining the academic or operational need; general project requirements, including function, size location, operational objectives; and the building occupants.

These requirements will be reviewed in greater detail in the Study Phase once the project is approved by the provost.

Fields Center addition and renovation located at 58 Prospect Ave., designed by Ann Beha Architects, completed in 2009.
Estimating Construction Cost

During the Project Initiation Phase, Facilities will present options to establish an appropriate target cost for a new project by researching similar projects. These include projects completed both on our own campus and elsewhere.

The target cost is the construction cost target established for the project and does not include “soft costs” or non-construction related costs, such as design fees, permits, and furniture. For budgeting purposes, a project multiplier is added to cover these costs which become the target project budget.

Projects may require the removal or relocation of an existing campus function or a collateral project. Related enabling projects, such as roads or utilities may also be required. These related costs are also identified in the Project Initiation Phase. Once the provost approves the project to proceed, cost estimates will be prepared during each project phase to confirm that the project continues to adhere to the target cost.

The iterative process of concept design, occurring in the Study Phase, generates design options with estimates attached, to identify functional and cost tradeoffs. At the end of Programming/Concept, during the Study Phase, a final option is selected. During Schematic Design the preferred design is refined and a detailed cost estimate sets the project budget, including detailed soft costs, which is used throughout the project delivery process.

During the project design, Facilities prepares estimates to confirm that the project cost still falls within or below the project budget, usually at these milestones:
- during the Study Phase, at the end of Programming/Concept
- during the Study Phase, at the end of Schematic Design
- during the Authorization Phase, at the end of Design Development
- during the Authorization Phase, at 50% completion of Construction Documentation
- during the Authorization Phase, at 85% completion of Construction Documentation

Project teams may also prepare cost estimates at other times, often to test the price impacts of building system choices, such as those for building envelope or ventilation. The estimates are prepared by professional cost estimators engaged by the architect. A builder/construction manager, engaged during early design, will prepare an independent estimate to confirm the cost consultant’s estimate. Often, trade contractors (e.g., masonry, mechanical, plumbing) are also invited to provide trade cost estimates as a means to further test the cost and the marketplace.

When the estimated cost exceeds the budget, the project team and Facilities will lead an inclusive process, with the executive sponsor, user and stakeholder input, to recommend changes to the design (a step sometimes called value engineering), incorporating less costly alternative materials or design solutions in order to preserve the functional project objectives within budget. If these measures do not result in bringing the estimated cost within or below the budget, the architect and consultants redesign the project to meet the budget. These proposed changes may require modifying the project objectives, which will be reviewed and approved by the executive sponsor and provost.

Once Facilities confirms that the cost reductions have reduced the cost estimate to meet the project budget, the design team is directed to continue to the next phase.

The new Frick Chemistry Laboratory, designed by Hopkins Architects and completed in 2010, includes floating sculptures created specifically for this building by artist Kendall Buster.
Study Phase

Programming/Concept
Schematic Design
STUDY PHASE

OVERVIEW

Conceptualize and define the project with enough detail to select a final design and budget.

With the architect on board, the Study Phase begins with extensive user input guiding the architect’s understanding of the project.

Facilities and the architect will lead a process involving users to develop a detailed program, a document that defines the functional needs, relationships among the spaces, and other specific details about the project.

The architect will begin to create design options depicting the functional needs and relationships while considering the advantages of each scheme. With user involvement, the iterative process continues along with assessments of each option’s building systems and cost estimates. Eventually, final options are presented to the executive sponsor and provost, and one final design is selected to proceed into Schematic Design.

Schematic Design adds significant detail to the project, again with user input. At the end of this phase, the project budget is established and the project can proceed to the Authorization Phase.

SUB-PHASES

Programming/Concept

The Programming/Concept sub-phase happens in two parts; first the Programming and then Concept Design, one right after the other.

Programming is the process of systematically collecting, documenting and communicating the detailed criteria for the expected performance of the facility and site. The programming effort will reflect the value proposition and the preliminary project objectives.

Programming is a critically important phase of the project, essential for a successful design. The elements of the program can include:

- the functional needs and relationships
- building system requirements
- sustainability goals (energy, water, storm water)
- environmental requirements
- campus planning requirements
- zoning requirements

During Concept Design, Facilities and the architect will lead the user and executive sponsor in a review of options, outlining advantages and disadvantages of different design concepts. User input provides direction for the architect to refine the options and work toward a final range of preferred design options, which will continue to be developed in more detail.

Sustainability goals, which are discussed in detail on page 22, are considered and set during a Sustainability Charrette where the project team, users, stakeholders and sustainability experts meet and review possible sustainability strategies in detail. These goals continue to be reviewed and measured through the project development process.

This iterative design process continues, along with assessments of each option’s building systems and related cost estimates. Concept design options meeting the target cost will be presented to the executive sponsor and the provost. A funding strategy, including fundraising goals being met, will be confirmed prior to proceeding to the next phase.
Schematic Design (SD)

Once the provost approves the preferred option to move forward, Schematic Design adds significant details to the project, documenting:

- site strategies
- functional relationships and building organization
- sustainability strategies
- building form
- general materials
- the building systems such as exterior envelope and HVAC defined.

The user, the executive sponsor, and Facilities all provide guidance that is critical at this phase of the design, to refine the project requirements and to verify that the project objectives and University guidelines are satisfied.

A builder, or construction manager, is engaged as part of the project team to provide input on the design and related cost.

An assessment of increased operations and maintenance (O&M) costs for a project begins in this phase. The project manager opens discussions with the user and university services providers such as Facilities, Department of Public Safety and University Services to compile O&M types and approximate costs for items like energy use, building custodial costs, or special security needs. At the end of this phase these preliminary costs are reviewed and endorsed by the Provost Budget Group.

At the end of Schematic Design, the projected cost is confirmed to fall within the target cost, the project budget is established and the Project Definition Document is refined to reflect any adjustments to PPOs and project scope. Once these documents are approved by the provost and FPG, the project is recommended for authorization by the Board of Trustees Grounds and Buildings Committee to continue into the next phase, with the understanding that no significant changes are to be made in the subsequent design and documentation phases.

GOALS

- develop detailed program
- examine and document space layouts and options
- define project systems, such as HVAC, electrical and envelope
- assess operations and maintenance needs
- engage construction manager
- develop related costs for layout options
- select preferred option
- document preferred option in schematic design, including project systems and sustainability strategies
- confirm cost is within target cost
- confirm cost range for operations and maintenance
- refine PPOs and related project parameters
- set project budget
- no significant changes made after this phase

GOVERNANCE APPROVALS

- program and preferred concept layout option approved
- Schematic Design approved
- refined Project Definition Document approved
- fundraising goals met
- projected operations and maintenance costs endorsed
- project budget approved by the provost and FPG
- project authorized by Board of Trustees Grounds and Buildings Committee to continue

USER INVOLVEMENT

The Study Phase, Programming through Schematic Design, is the one in which user leadership and user groups are the most engaged with the project, providing important direction on program, layout, priorities, and details of the project requirements as they are being incorporated into the design.
Sustainability Considerations

Sustainability and campus planning are now integrated into our current Campus Plan, where sustainability objectives and strategies have been outlined.

These sustainable strategies, among others, will be incorporated into early sustainability workshops:

- Reduced greenhouse gas emissions: Continue to decrease carbon emissions, notwithstanding campus expansion, by utilizing efficient building systems and increased use of renewable energy sources.
- Compact campus footprint: Continue making more efficient use of campus lands to preserve natural areas.
- Transportation: Decrease use of single-occupancy vehicles arriving to campus; promote shared or active transportation. Promote walking and bicycling on campus.
- Storm water management: Increase quantity of storm water managed on campus and improve quality of storm water discharge.
- Water consumption: Continue to reduce potable water use.
- Habitat integrity: Increase and preserve qualified forested areas on campus for wildlife, recreation, storm-resiliency and campus-as-lab.
- Waste reduction: Continue reduction of waste into landfills.
- Reliability: Continue to maintain a high level of reliability of campus systems to avoid outages.

Prior to commencing with concept design, Facilities will conduct a Sustainability Charrette, during which a highly experienced team of experts will join users and the project team to examine a myriad of approaches, taking into account building type, hours of use, siting, and other relevant aspects of the project. Active strategies, such as energy efficient systems, and passive strategies, such as building siting, will be examined.

As the integrative design process (IDP) progresses, sustainable goals, drawn from the workshop described above, will be established in a project charter, which outlines overall project intent but also integrates sustainability and project performance goals. These goals will be prioritized and strategies will be incorporated into the project to achieve these goals as the design process continues.

To measure success in integrating these strategies, Facilities will consider and recommend using an independent, industry recognized measurement process such as LEED. Measurement will involve submission of project information and data to this independent organization to confirm that sustainable strategies have been incorporated into the project design.

Green roof of Sherrerd Hall, both designed by architect Frederick Fisher & Partners, completed in 2008.
Authorization Phase

Design Development

Construction Documentation
OVERVIEW

Design the project in progressive levels of detail and contract with a builder.

During the Authorization Phase, the architect focuses on documenting the approved Schematic Design, and continues to develop drawings and documents that describe the project in increasing detail.

Project materials and elements are refined and confirmed in this phase, including the envelope (roofing, walls and windows) and the interior (partitions, building systems, lighting, and finishes). Building systems such as HVAC and lighting are described in detail and depicted in drawings, in both 2-D and 3-D. Written descriptions of selected materials and systems now describe these elements in detail, as specifications.

Eventually, a builder/construction manager, who has been part of the team since the Study Phase, will develop a final cost for the project, which will form the project budget to be recommended for trustee approval.

SUB PHASES

Design Development (DD)
The architect works intensively with users and Facilities to continue refining and developing the project design documentation. These documents, both drawings and text documents, describe the following in general terms:

- exterior envelope design, including roof, wall sections, windows, foundations
- structural systems; foundations and building superstructure
- interior circulation, corridors, stairs, doors
- functional partition layouts with materials generally identified
- building systems including lighting, HVAC, electrical in diagrammatic and outline form
- site and utility work
- interior finishes
- furniture layout and design (furniture selection begins)

At the end of the Design Development sub-phase, Facilities leads the architect through a review of the design documents with users and stakeholders, referencing project user requirements and University standards. Based on this feedback, the documents are amended and cost estimates prepared.

During design development, Facilities will also begin a regulatory submission process relating to zoning and land use. At this point, overall user input is often reduced since the project requirements are outlined in the documentation. However, furniture layout, design and selection will still require significant user input. Once the cost is confirmed to be within the project budget, Construction Documentation can proceed.
**Construction Documentation (CD)**

In this sub-phase, the architect documents the building in sufficient detail for trade contractors to construct the project, adding dimensions and details such as structural reinforcement and HVAC system elements such as ductwork. The drawings are scrutinized to ensure that adequate physical space is provided in the project for utilities, pipes, and access points for maintenance. Many project teams use a 3-D technology, known as Building Information Modeling (BIM), to design the building in “real space,” enabling a thorough review of spatial relationships to ensure that the building can be built with a minimum amount of changes and efficiently maintained by Facilities and others.

Drawing reviews and cost checks occur in this phase, at the 50% completion and 85% completion stages, to confirm that the estimated costs fall within the project budget.

The Project Manager will engage with the user and university service providers at the end of this phase to confirm operations and maintenance costs, which will be reviewed and approved by the Provost Budget Group.

Once the drawings reach 85% completion, the builder prepares a Guaranteed Maximum Price (GMP) based primarily on a competitive selection of trade contractors.

The GMP is used by Facilities to prepare the final funding and approval request in the Approval Phase: to construct and move into the facility. This request is reviewed by the executive sponsor, and approved by the provost and FPG who will recommend approval by the Trustee Finance Committee. Once this approval is obtained, the project team continues working to complete the documentation, secure municipal approval and permits, and commence the construction of the project.

**GOALS**

- complete design and construction documentation and technical specifications to construct project
- include strategies to achieve sustainability goals
- confirm projected operations and maintenance costs
- confirm estimated cost is within project budget
- confirm project objectives are met

**GOVERNANCE APPROVALS**

- confirmation of project objectives
- Design Documentation approval
- confirmation at regular intervals that the projected cost is within budget
- approval of projected operations and maintenance costs
- approval of final funding by trustees for project to proceed to the Approval Phase; construction and move-in

**USER INVOLVEMENT**

Overall user input usually diminishes in the Design Development sub-phase, focused on providing input on furniture selection and input on the drawings to ensure that the design meets the project requirements. Some highly technical projects, including laboratories, do require a continuing high level of user input in Design Development.

In the Construction Documentation sub-phase, user input is also typically reduced, since the architect’s team is focused on describing the project in detail, documenting decisions made in previous phases. While reviews occur, they are limited to confirming that the design is tracking to earlier parameters. If changes are contemplated that may affect the project objectives, either to keep the project within the authorized budget, or for another reason, Facilities will review these proposed modifications in detail with users.
Furniture Selection

Furniture plays a critical role in a building project, in terms both of how it functions, how durable it is and how its design complements the project objectives. Occupants of a finished space interact closely with its furnishings, in both spatial and tactile ways, so the successful outcome of a project depends on thoughtful and deliberate selection of furniture pieces.

As a general rule, the University strives to create appropriately designed spaces that satisfy project objectives while also promoting a consistent application of furniture design solutions. Furniture solutions are designed to establish thoughtful, functional and flexible standards for the building and are not customized to individual requests.

During the Programming/Concept sub-phase of the Study Phase, the architect generally considers the functional furniture objectives for each space. Subsequently, the actual layout of furniture begins in the Schematic Design sub-phase. The sizes and arrangements of desks, chairs, tables, and other elements and equipment are confirmed to ensure that each space functions well and complies with codes relating to egress and accessibility. Cost assumptions are made using knowledge of the industry and based on previous university projects. These general arrangements are then reviewed with users at the end of the Study Phase.

In the next phase, the Design Development sub-phase of the Authorization Phase, project designers, including architects and often interior designers, select all of the building materials including walls, ceilings, and flooring. Furniture options are also proposed by the designers and reviewed by users and project stakeholders for function, fit, and aesthetics. Facilities will confirm that the proposed selections meet applicable codes and University standards for durability, and are within the allocated budget.

University procurement rules dictate a competitive furniture selection process to ensure the best quality for the lowest cost. Multiple furniture manufacturers will be considered, and products are often tested by the project team and users to ensure that the most appropriate pieces or systems are selected. Facilities will coordinate the selection and the final user reviews of the proposed furniture. The overall furniture selection process often continues through the Construction Documentation phase, and it is important to ensure adequate time to obtain furniture mock-ups, competitive bids, and final delivery. Furniture can often take between 10 to 16 weeks to deliver after an order is placed, a duration that Facilities will take into account in developing the project plan.

The goal is always to have the furniture delivered and installed prior to move-in.
Approval Phase

Construction
Move-In
OVERVIEW

Build the project, move in, and evaluate its success.

Within the Approval Phase, the project is constructed and the users move in.

Construction phase activities are closely monitored by Facilities, which continues to track progress against the detailed construction schedule. Quality control is applied through a detailed submittal process, where each element of the design is confirmed by the design team, Facilities, and stakeholders to ensure compliance with project requirements and University standards.

A move-in plan is established to ensure a smooth transition into the building. After move-in, Facilities will seek feedback from the users, executive sponsor, and stakeholders on how well the project has met the project objectives.

SUB-PHASES

Construction

Prior to construction, Facilities approves the builder’s site logistics plan, which outlines barriers that will isolate the site from the campus for safety reasons. The plan shows how material will be delivered, disruptions to nearby traffic (pedestrian and vehicular), and locations of other items such as cranes and pathways for vehicles to enter and leave the site. Permits and other approvals are secured by the project team.

Facilities, continuing in its central role to track construction progress and monitor quality, will:

• schedule periodic meetings to review progress, issues, and quality control
• monitor the submittal process, where each element of the project goes through a technical review process with Facilities Tech Team to ensure that project requirements are met and University standards are followed
• monitor progress on the project site
• monitor projected costs to ensure that costs are within project budget
• communicate periodically with executive sponsor, users, stakeholders and provost on progress and adherence to project delivery plan
• track quality control by ensuring that inspections occur as construction progresses
• ensure that systems are inspected and tested through commissioning process
• oversee final selection, procurement, and delivery of furniture

Well before construction nears completion, Facilities will work with stakeholders to develop a plan to test and accept the building. In this process, called commissioning, steps are taken to test the function of equipment and systems prior to accepting the project as complete.

A detailed move-in plan will be created with user input to ensure a smooth transition for users and stakeholders who will now occupy and operate the new facility. The move-in plan provides for occupant belongings, materials, and any special equipment to be relocated in an organized, safe manner. Facilities hires movers (including specialized equipment movers) and assists users to develop a plan for packing and unpacking.
Move-In
The move-in plan developed during construction is implemented, including moving items and equipment into the building and ensuring that the building is tested, accepted by the University, and operational. Facilities also assists in training the users and stakeholders in operating the building systems, including HVAC, lighting, and other special systems such as security.

When post-move-in questions or issues emerge, Facilities will continue to be the contact for correcting conditions or responding to issues.

After move-in, Facilities solicits feedback from the users and stakeholders on the project delivery process and how successfully the project satisfied objectives. We will be asking questions such as:

- Does the project satisfy the project objectives as outlined and tracked through the overall process?
- Does the project meet the needs of users?
- Does the project function as anticipated?
- Was the process to design and build the project well-organized?
- Was communication during the project effective?
- Were users and stakeholders supported in understanding the project process?

Responses may be solicited through online surveys and/or interviews. This critical feedback is used by Facilities and leadership to continue improving how Princeton projects are delivered.

GOALS
- monitor and report on construction progress
- ensure that construction quality meets University standards
- monitor testing, commissioning and acceptance of building systems
- develop and implement a move-in plan
- monitor delivery and installation of furniture and equipment
- gather user and stakeholder feedback

GOVERNANCE APPROVALS
- project objectives confirmed

USER INVOLVEMENT
User input is important to finalize furniture selection, establish and implement the move-in plan, and to provide feedback after move-in.

Firestone Library’s renovated third floor reading room, designed by Frederick Fisher & Partners, and Shepley Bulfinch, as part of the multi-year renovation project from 2011 to 2018.
1. Washington Road Streetscape Enhancements
2. Lake Carnegie Landscape
3. East-West Campus Connector
4. North-South Campus Connector
5. Residential College Sites
6. Diagonal Walk
7. Frist/Guyot/McCosh Node; Wilson College, Eno Hall, 1915 Hall Sites
8. Dillon Gym Expansion
9. Potential Residential Mixed-Use Corridor
10. New Space for Engineering and Environmental Studies
11. East Campus Entry
12. Enhancements behind 185 Nassau Street and along William Street
13. Lake Campus Walk
14. Tiger Lane Crossing and Transit Hub
15. Academic Partnerships, Innovation Space, Administration and Housing
16. Athletics
17. Parking
18. Campus Meadow
# Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>A/E</td>
<td>Architect/Engineer consultant</td>
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<tr>
<td>AIA</td>
<td>American Institute of Architects</td>
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<tr>
<td>CA</td>
<td>The abbreviation for Construction Administration, which occurs in the construction phase</td>
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<tr>
<td>CD</td>
<td>Construction Documents</td>
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<tr>
<td>CM</td>
<td>Construction Manager</td>
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<tr>
<td>CM/GC</td>
<td>Construction Manager/General Contractor</td>
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<td>CMAR</td>
<td>Construction Manager at Risk</td>
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<tr>
<td>CMU</td>
<td>Concrete Masonry Unit, concrete blocks used in construction</td>
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<tr>
<td>CO</td>
<td>Change Order</td>
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<tr>
<td>CPM</td>
<td>Critical Path Method</td>
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<td>DD</td>
<td>Design Development</td>
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<tr>
<td>DSM</td>
<td>Design Standards Manual</td>
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<tr>
<td>ES</td>
<td>Executive Sponsor</td>
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<tr>
<td>FF&amp;E</td>
<td>Furnishings, Fixtures, and Equipment</td>
</tr>
<tr>
<td>FPG</td>
<td>Facilities Planning Group</td>
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<tr>
<td>G&amp;B</td>
<td>Grounds and Buildings Committee</td>
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<tr>
<td>GC/CM</td>
<td>General Contractor/Construction Manager</td>
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<td>GMP</td>
<td>Guaranteed Maximum Price</td>
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<tr>
<td>GSF</td>
<td>Gross Square Feet</td>
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<tr>
<td>HVAC</td>
<td>Heating, Ventilation, Air-Conditioning, the mechanical systems of a building</td>
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<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
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<tr>
<td>NASF</td>
<td>Net Assignable Square Feet</td>
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<tr>
<td>NSF</td>
<td>Net Square Feet</td>
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<tr>
<td>NTP</td>
<td>Notice to Proceed</td>
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<tr>
<td>PACA</td>
<td>President’s Advisory Committee on Architecture</td>
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<tr>
<td>PCO</td>
<td>Potential Change Order</td>
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<tr>
<td>PPO</td>
<td>Preliminary Project Objectives</td>
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<tr>
<td>RFI</td>
<td>Request for Information</td>
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<tr>
<td>RFP</td>
<td>Request for Proposals</td>
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<td>RFQ</td>
<td>Request for Qualifications</td>
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<tr>
<td>SD</td>
<td>Schematic Design</td>
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<tr>
<td>SOQ</td>
<td>Statement of Qualifications</td>
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<tr>
<td>UBC</td>
<td>Uniform Building Code</td>
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<tr>
<td>USGBC</td>
<td>United States Green Building Council</td>
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<tr>
<td>VE</td>
<td>Value Engineering</td>
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<tr>
<td>VPSPP</td>
<td>Vice Provost for Space Planning and Programming</td>
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</tbody>
</table>

**Add Alternate**  Project components desired by the owner but not included in the base bid. If the bids are lower than the budget, these alternative items may be added to the bid proposal.

**Additional Services**  Services provided by an A/E consultant that are not included in “Basic Services,” which may be performed by the A/E as part of the Contract only if and to the extent specifically authorized by Princeton University in writing.

**Allowance**  A dollar amount allocated to cover the cost of items of work that are of indefinite scope or quantity, or where the quality, configuration or other characteristics have not yet been determined. Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts, together with all costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses.

**Approval (Princeton Governance)**  The approval of a project by the Princeton trustee Finance Committee, at the end of the Authorization Phase, to proceed with construction based on a final design and an approved project budget.

**Approval Phase**  The fourth and final phase of a Princeton capital project, after the Authorization Phase, which includes sub-phases Construction and Move-In.

**Architect-Engineer (A/E)**  The term “Architect-Engineer” aggregately refers to all of the architects and engineers in the employ of the Architect-Engineer, as well as Basic Subconsultants and Specialized Subconsultants separately engaged by the Architect-Engineer in the performance of this Contract.

**As-Built Drawings**  Drawings, prepared by the contractors, which accurately reflect what was constructed, including field verification.

**Authorization (Princeton Governance)**  The authorization of the project by the Princeton trustee Finance Committee, at the end of the Study Phase (Schematic Design), to continue with design documentation based on the schematic design and the project budget.
Authorization Phase  The third phase of a Princeton capital project, after the Study Phase, which includes the sub-phases Design Development and Construction Documentation.

Base Bid  The competitive bid submitted by a contractor for base scope of a project. The apparent low base bid is not necessarily accepted until an analysis of add alternates and deduct alternates are included in the comparison.

Basic Services  Consulting architectural and engineering services from programming through construction and acceptance, provided by the architect, or principal consultant, including architectural, structural, mechanical, and electrical engineering and cost estimating services for a project.

Basic Subconsultants  The Subconsultants retained by the Architect-Engineer for the performance of structural, mechanical, and electrical engineering services, cost estimating and specification writing services for the Project.

Benchmarking  A measurement and analysis process that compares practices, processes, and relevant measures to those of a selected basis of comparison (i.e., the benchmark) with the goal of improving performance. Princeton will often employ a benchmarking process to examine quantitative and qualitative aspects of projects on or off campus to inform the target cost or schedule for planned capital projects.

Beneficial Occupancy  Use of a building, structure, or facility by the owner for its intended purpose (functionally complete), although other contract work, nonessential to the function, remains to be completed.

Bid Package  Drawings, specifications, instructions to bidders and other related documents necessary to solicit competitive bids for a scope of work.

Bidding  The process of soliciting and collecting competitive bids from contractors.

Budget  A planned allocation of financial resources to apply towards a proposed project or scope of work often including separate line items for discreet areas of work or effort.

Budget Contingency  A line item and amount in a budget to allow for items, conditions, or events for which the occurrence is uncertain, but that experience shows will likely result in additional costs. Typically estimated using statistical analysis or judgment based on past project experience. Contingency excludes major scope changes and extraordinary events such as major strikes or natural disasters.

Budget Estimate  An estimate generally prepared to form the basis for authorization and/or appropriation of funds.

Budgeting  The process by which financial resources are applied to one or numerous projects or areas of work.

Building Efficiency Ratio  The ratio of net square feet to gross square feet. Often expressed as a percentage. The formula is: NSF/GSF x 100 = Building Efficiency.

Capital Plan  A listing of potential university projects approved by the trustees along with the related financial allocation. Projects in the capital plan are still subject to processes and approvals outlined in this guide.

Capital Project  A project that benefits a program for more than a year (definition varies state to state) and which the cost of the end result or product is capitalized (i.e., cost will be depreciated). The product is usually a physical asset such as property, real estate or infrastructure, but may include other assets that are depreciable.

Casework  The built-in cabinets, shelving, and counters that are part of a project.

Code  General term which includes all municipal, state, and national building and life safety codes that pertain to a project.

Change Order (CO)  Written authorization from a building owner or the owner’s agent to a contractor to change the scope of work, design, materials used, or equipment installed.

Chiller  The piece of HVAC equipment that chills the water used to cool a building. Chillers are fueled by electricity, gas, or steam.

Commissioning  The process for achieving, verifying, and documenting that the performance of a building and its systems meets design intent as well as the owner and occupant’s operational needs. The process extends through all phases of a project, from initial concept to occupancy and operations, and includes the training of maintenance personnel. May include performance tests on mechanical equipment, water washing, flushing and drying of equipment and piping, control systems operability checks, checking of safety and fire protection devices, and operation of systems. Commissioning normally follows mechanical completion and ends with initial operation or startup.

Conceptual Estimate  An estimate generally prepared based on very limited information.
**Construction Administration** The administration by the owner, or the owner’s representative (typically the architect), of the construction phase of a capital project.

**Construction Budget** A financial allocation established by Princeton University for the construction of the project, including trade subcontractors, contractor’s general conditions (staff, site requirements, etc.), design and construction contingencies, insurance, bonds (if any) and the contractor’s fee. The construction budget is set at the end of the Schematic Design sub-phase. The A/E shall design the project so that the construction cost does not exceed the construction budget.

**Construction Contingency** That portion of the construction cost that may be reserved to cover increased or added costs resulting from circumstances that may not be completely predictable or foreseeable at the time that the Guaranteed Maximum Price (GMP) is established but that can reasonably be assumed to be included within the scope of work for the project and presumed to have been included in but was omitted from the GMP.

**Construction Cost** The total actual or estimated cost of all elements of the project designed or specified by the A/E, including trade subcontractors, contractor’s general conditions (staff, site requirements, etc.), design and construction contingencies, insurance, bonds (if any) and the construction contractor’s fee. Construction cost does not include the compensation of the A/E, the costs of the land, rights-of-way, financing and other non-construction expenses.

**Construction Documents** The construction drawings, specifications, general conditions, supplementary general conditions, special conditions, addenda, and electronic submittals developed to set forth in detail all aspects of design, function and construction and that will be used for estimating the cost of the project, securing bids for constructing the project, and directing a contractor in construction of the project. The Construction Documents will enable the contractor to carry out the project.

**Construction Manager (CM)** A broad term covering a variety of project delivery scenarios in which a construction manager is engaged to oversee scheduling, cost control, constructibility, project management bidding or negotiating construction contracts, and construction. Princeton utilizes several contract methods to engage a CM, depending on the project requirements, such as GMP (Guaranteed Maximum Price) and CPFF (Cost plus a fixed fee).

**Construction Schedule** The schedule for the construction of the project, prepared by the Contractor during the Design Development Phase.

**Contract** An agreement between Princeton University and an architect, contractor or some other suppliers creating mutual obligations enforceable by law. The basic elements required for the agreement to be a legally enforceable contract are: mutual assent, expressed by a valid offer and acceptance; adequate consideration; capacity; and legality.

**Contract Documents** The documents that compromise the Contract, including the construction documents, as more fully set forth in the Contract.

**Contract Time** The period of time established in the contract within which the work must be substantially completed. The contact time can be adjusted only by change order.

**Contractor** The prime general contractor performing the construction work on the project, or the contractor retained by the university to provide pre-construction services. Sometimes used interchangeably with CM.

**Cost Estimate** A compilation of all the probable costs of the elements of a project or effort included within agreed-upon scope.

**Cost Estimate Classification System** There are numerous characteristics that can be used to categorize project cost estimate types. Some of these characteristics are: level of project definition, end usage of the estimate, estimating methodology, and the effort and time needed to prepare the estimate. The American Association of Cost Engineers (AACE) recommends that the primary characteristic used to define the classification category is the level of the project. The other characteristics are considered secondary. The level of project definition defines maturity, or the extent and types of input information available to the estimating process. Such inputs include project scope definition, requirements documents, specifications, project plans, drawings, calculations, lessons learned from past projects, reconnaissance data, and other deliverables and information that must be developed to define the project. Each industry will have a typical set of designing deliverables that are used to support the type of estimates used in that industry. The set of deliverables becomes more definitive and complete as the level of project definition (e.g., project engineering) progresses. For projects, the estimate class designations that follow below are labeled Class 1, 2, 3, 4, and 5. A Class 5 estimate is based upon the lowest level of project definition, and a Class 1 estimate is closest to the full project definition and maturity. This “countdown” approach considers that estimating is a process whereby successive estimates are prepared until a final estimate closes the process.
Cost Estimate Classification System, Class 5
Estimate (Typical Level of project definition required: > 0% to 2% of full project definition.)
Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. As such, some organizations have elected to determine that due to inherent inaccuracies, such estimates cannot be classified in a conventional and systematic manner. Class 5 estimates, due to the requirements of end use, may be prepared within a very limited amount of time and with little effort expended. Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.

Cost Estimate Classification System, Class 4
Estimate (Typical Level of project definition required: 1% to 15% of full project definition.)
Class 4 estimates are generally prepared based on limited information, and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary (but generally not final) budget approval. Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to the next stage.

Cost Estimate Classification System, Class 3
Estimate (Typical Level of project definition required: 10% to 40% of full project definition.) Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation and/or funding. Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase “control estimate” against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.

Cost Estimate Classification System, Class 2
Estimate (Typical Level of project definition required: 30% to 75% of full project definition.) Class 2 estimates are generally prepared to form detailed control baseline against which all project work is monitored in terms of cost and progress control. For contractors, this class of estimate is often used as the “bid” estimate to establish contract value.

Cost Estimate Classification System, Class 1
Estimate (Typical Level of project definition required: 65% to 100% of full project definition.)
Class 1 estimates are generally prepared for discrete parts or sections of the total project rather than for the entire project. The parts of the project estimated at this level of detail will typically be used by subcontractors for bids or by owners for check estimates. The updated estimate is often referred to as the current control estimate and becomes the new baseline for cost/schedule control of the project. Class 1 estimates may be prepared for parts of the project to compromise a fair price estimate to compare against a contractor’s or vendor’s bid estimate, or to evaluate dispute claims or change orders.

Cost Estimating  The predictive process used to quantify, cost, and price the resource required by the scope of an investment option, activity, or project. Cost estimating is a process used to predict uncertain future costs. In that regard, a goal of cost estimating is to minimize the uncertainty of the estimate given the level and quality of scope definition. The outcome of cost estimating ideally includes both an expected cost and a probabilistic cost distribution. As a predictive process, historical reference cost data (where applicable) improve the reliability of cost estimating. Cost estimating, by providing the basis for budgets, also shares a goal with cost control of maximizing the probability of the actual cost outcome being the same as predicted.

Critical Path Method (CPM) A step-by-step methodology, technique or algorithm for planning projects that involve complex, interdependent interactions. It identifies critical and not-critical paths to prevent conflicts and bottlenecks.

Deduct Alternates  Project components that are desired by the owner but could be removed from the base bid if the bids exceed the budget.

Design-Bid-Build  The traditional method of project delivery, in which the owner commissions an architect or engineer to prepare drawings and specifications under a design services contract, which are put out to bid, after which the owner separately contracts with a contractor for construction.

Design-Build  A project delivery method in which the client contracts with a single entity to provide both design and construction services. The design-build entity may be a single firm, a consortium, or a joint venture assembled for the project.

Design Concepts A design option or idea, usually early in the concept phase, that provides adequate information to determine if a concept is worth pursuing. An idea for a solution to a client/owner’s architectural problem.
Design Development Phase  The first sub-phase of Princeton’s Authorization Phase, the Design Development phase is focused on identifying and verifying technical solutions to meet requirements of the schematic design, approved at the end of the Study Phase.

Design Development Documents  Plans, outline specifications and related documents developed from the Schematic Design Documents in greater detail to confirm or adjust, as required, all aspects of the schematic plans such as exterior design, mechanical and electrical systems, structural systems, area arrangement, foundation plans, etc., and to facilitate revised cost information to be prepared to reflect the more detailed development.

Design Documents  Collectively the Schematic Design Documents, the Design Development Documents and the Construction Documents, prepared by the A/E.

Design Review  A formal, documented, comprehensive and systematic examination of a design to evaluate design requirements and capability of the design to meet these requirement and to identify problems and propose solutions.

Design Schedule  The detailed schedule for the design phases of the project that includes milestones for design and approvals.

Design Standards Manual (DSM)  An online resource for the architect that specifies requirements and processes relating to anticipated quality of building materials, systems and operational objectives. These requirements, once incorporated into the documents by the A/E, will be reflected in the construction documentation for installation during the construction phase.

Escalation  A budget allowance that may be created for uncertain changes in economic market conditions over time. Inflation (or deflation) is a component of escalation.

Estimate  A prediction or forecast of the resources (i.e., time, cost, materials, etc.) required to achieve or obtain and agreed upon scope (i.e., for an investment, activity, project, etc.) See also Cost Estimate.

Estimate to Complete (ETC)  The expected cost to finish all the remaining project work.

Executive Sponsor  A Princeton senior university official assigned by the provost to a project during the project initiation phase. The executive sponsor provides leadership to the project team, ensuring that project objectives, cost ranges and project timeline are met. The executive sponsor leads funding discussions, develops strategies on key decision points, and participates in the creation and approval of project documents by the provost.

Facilities Planning Group (FPG)  The university committee responsible for review and approval of capital projects with authority up to $7.5M. FPG also recommends trustee approval for projects over $7.5M. Chaired by the provost with other University leadership and facilities representatives.

Fast Track  A process in which certain design activities overlap with construction activities in order to expedite the owner’s completion or occupancy of the project.

Feasibility Study  A study performed to determine if a project is financially, physically, and legally possible.

Fixed Fee  The architect-engineer’s fixed price compensation for the performance of its basic services and those of its basic sub-consultants. The fixed fee does not include compensation for reimbursable expenses or specialized sub-consultants.

Furnishings, Fixtures, and Equipment (FFE)  The furnishings, blinds, carpets, shelves, (sometimes) casework, movable lighting, and other equipment that is not hard-wired or hard-plumbed into a building.

General Conditions  The general costs for a general contractor or construction manager including costs for material and labor for supervision, administration, clean up, protection, and related costs.

General Contractor (GC)  A firm that performs the work under contract all by itself, or through the use of subcontractors whose activities it supervises and coordinates, or a combination of the two.

General Terms and Conditions  General definition of the legal relationships and responsibilities of the parties to the contract and how the contract is to be administered.

Gross Square Feet (GSF)  All of the floor space inside a building, measured from the outside surfaces of exterior walls.

Guaranteed Maximum Price (GMP)  The maximum amount payable to the contractor for the performance of the work under a GMP contract.
Historical Database  Records accumulating past project experience stored as data for use in planning, estimating, forecasting and predicting future events. Often includes data that has been processed so as to facilitate planning and other purpose such as validation and benchmarking (e.g., metrics, etc.).


LEED  Process to achieve certification for sustainability achievements in building design and construction governed through the USGBC (United States Green Building Council). The Leadership in Energy and Environment Design (LEED) is based on a points system, which includes levels such as silver, gold and platinum, and requires technical submittals and reviews to assure compliance with goals.

Legal Requirements  Any and all requirements of law, code, permit, regulation, rule, order, judgment, decree, ordinance, or provision of any federal, state, or local government agency, authority, or court pertaining to (i) the contract, or (ii) the work undertaken by the contractor pursuant to the contract.

Life Cycle  The stages or phases that occur during the lifetime of an object or endeavor. In a life cycle cost or investment analysis, the life cycle is the length of time over which an investment is analyzed (i.e., study period).

Life Cycle Cost  The sum of initial costs and operating, maintenance and replacement costs, less salvage value, over the life of the facility.

Life Cycle Cost (LCC) Method  A technique of economic evaluation that sums over a given study period the costs of initial investing (less resale value), replacements, operations (including energy use), and maintenance and repair of an investment decision (expressed in present or annual value terms).

Material Testing  The verification of the quality and quantity of materials used in construction, usually performed by a third-party testing firm under the supervision of the owner.

Materials  Collectively the supplies, apparatus, appliances, equipment, fixtures, tools, and other materials required in connection with the work.

Milestone  A zero-duration activity or event, which is part of a project schedule, which is used to denote an approval, or start or completion of a scheduled activity.

Milestone Schedule  A summary-level schedule comprised of key durations, events or milestones selected as a result of coordination between the owner and the contractor's project management. These events are generally critical accomplishments planned at timed intervals throughout the project and used as a basis to monitor overall project performance.

Net Assignable Square Feet (NASF)  The Net Square Feet that can be specifically assigned to users.

Net Square Feet (NSF)  The net floor space in a building measured from the inside surfaces of exterior walls and excluding interior walls, partitions, mechanical equipment rooms, lavatories, janitorial closets, elevators, stairways, major circulation corridors, aisles, and elevator lobbies.

Notice to Proceed (NTP)  The official notification by the owner to a consultant or contractor that work on the project can begin.

Not-to-Exceed Price (NTE)  The maximum amount payable to the contractor for the performance of the work under a time-and-materials contract. The maximum compensation to the Architect-Engineer for basic services, which is comprised of the fixed fee, the specialized sub-consultants NTE amount, and the reimbursable expense NTE amount.

Open Shop  An employment or project condition where either union or non-union contractors or individuals may be working.

Owner  Often confused with “user” or “client,” the “owner” is the entity that officially owns and/or operates a completed capital project. For Princeton, the owner is the Board of Trustees.

Planning  A general term to examine the preliminary arrangement of spaces or functions, which can occur at the campus level, or the building or space level.

Post-Occupancy Evaluation  Evaluations that focus on the satisfaction and behavior of a project users or project participants.

Pre-Design  The phase of the project where the services provided by an A/E could include Feasibility studies, master planning, programming, the concept design, and research for a design project.

Preliminary Project Objectives (PPOs)  Key project objectives which are set in the Project Initiation Phase that will lead to success in achieving the value proposition. PPOs may include objectives for: functionality, teaching, research, collaboration, flexibility, character of space, sustainability, durability and operations.
**Prime Consultant** The consultant, most often an architect, who takes the lead on a project team. Depending on the type of project, the prime consultant could also be a landscape architect or an engineer.

**Prime Contractor** Also known as the general contractor, or construction manager.

**Princeton University** The term “Princeton University” means The Trustees of Princeton University, the owner of the project, acting through its Princeton University representatives.

**Principal Architect** Usually the highest-ranking member of the A/E firm on the design team. Often the individual responsible for major design direction.

**Programming/Concept Phase** During the Programming/Concept sub-phase, which is the first sub-phase in Princeton’s Study Phase, facilities and the design team will lead a process involving users to develop a detailed program, a document that defines the functional needs, relationships and details about the project. Conceptual design options will be created depicting the functional needs and outlining pros and cons of each option examining function and cost. Eventually one final option is approved to proceed in further design during the schematic design phase.

**Programming** A process of systematically collecting, documenting and communicating the detailed criteria for the proposed performance of the facility and site. It may include the functional needs and relationships, building system requirements, and other parameters such as sustainability, planning and zoning criteria.

**Project Architect** The architectural consultant responsible for managing the design effort on a project.

**Project Budget** The total budget required to build and occupy a facility, composed of the construction budget and allowances to provide for design fees, furniture, equipment, permits, contingency and other costs not directly associated with construction.

**Project Definition Document** A document created in the Project Initiation Phase which includes the value proposition, preliminary project objectives, and other project parameters such as location and target cost.

**Project Initiation Phase** The first major phase of a Princeton capital project where Project Definition Documents and related project documents are created and approved.

**Project Manager (PM)** A representative of Princeton’s Office of Design and Construction (ODC), who is assigned during the Project Initiation Phase. The project manager is responsible for the day-to-day management of the project, for instance tracking project progress, team performance and projected cost and quality. The PM is the central point of contact for users, stakeholders and consultants.

**Project Planner** A representative of Princeton’s University Architect, who is assigned to a project in the Project Implementation Phase to provide guidance throughout the project to ensure alignment with the Campus Plan and University aesthetic goals.

**Project Schedule** The work product of a planning process that identifies the duration and interdependent relationships of all activities that influence the progress of a project. This schedule is to be developed and maintained in a format and level of detail necessary to support critical path method (CPM) analysis. Princeton University typically develops a conceptual-level planning version of a project schedule which is used to determine the milestone design schedule dates. This same work product becomes the project schedule and will incorporate the design schedule and the construction schedule. The contractor will assume responsibility for maintaining project schedule during the preconstruction phase.

**Proposal** The submittal prepared in response to an owner’s request for proposals (RFP).

**Proprietary Specification** When an owner or architect specifies a particular brand of equipment or technique in the construction documents. A proprietary specification prohibits the contractor from using any other brand or manufacturer’s product.

**Punch List** The punch list itemizes work that must be completed or issues that must be resolved by the contractor. This list is prepared by the responsible A/E for the project, and can include tasks as minimal as touching up the paint on a wall or as major as troubleshooting an HVAC system that isn’t functioning as designed.

**Record Drawings** Final construction drawings and documentation, prepared by the architect its sub-consultants, which include significant changes made during the course of the project.

**Reimbursable Expenses** Permitted expenses incurred by the architect and its sub-consultants in the performance of basic services. These often include travel and lodging expenses, printing and copying costs, postage, etc.
Request for Information (RFI) A request from a contractor to the architect or owner for a clarification of intent or understanding in the construction documents.

Request for Proposals (RFP) A document issued by an owner, often as part of a competitive bidding process, that solicits proposals from architects, contractors or other suppliers for a product or service.

Request for Qualifications (RFQ) A step sometimes used in the formal process of procuring a product or service. It is typically used as a screening step to establish a pool of architects, contractors or other suppliers that are then qualified, and thus eligible to submit responses to a request for proposals (RFP). In this two-step process, the response to the RFQ will describe the supplier’s general qualifications to perform a service or supply a product, but generally will not include specific details or price proposals.

Retainage A portion of the money earned by the contractor that is withheld from periodic payments and retained by the owner as assurance that the contractor will complete the project.

Schematic Design A sub-phase of Princeton’s Study Phase, occurring after the Programming/Concept Design Phase, where an approved design concept is further studied and refined. Schematic design adds additional detail such as building form, site, energy use and sustainability strategies, general materials and building systems.

Scope Creep A general term used to describe unanticipated or unapproved needs or requirements requested by a user, stakeholder or other party. Princeton’s governance process, which utilizes an executive sponsor, provides a forum for consideration of these unplanned needs.

Site The geographical location of the project.

Site Development The planning, design, and construction of the area immediately outside of a building, which can include landscaping, parking, plazas, courtyards, sidewalks, etc. Usually defined as the area more than five feet from the exterior wall of a building.

Soft Costs A general term used to describe expenses or allowances in a budget that are non-construction related, including items such as permits, inspections, testing, fees, and furniture.

Specialized Subconsultants The sub-consultants, other than basic sub-consultants, retained by the A/E, as approved by Princeton University, including without limitation, civil engineering, acoustics, audio-visual, food service, lighting, security, interior design, and graphics design.

Specifications A document that describes in words what cannot be visualized or explained on a drawing or in a model. This document can be incredibly wide-ranging and include a detailed description of dimensions, construction, workmanship, materials, etc. of the work to be done. It can also address the performance criteria of the asset, the quality of the systems and products, which standards are applicable and how they should be executed, and even the products to be used.

Stakeholder An individual group, or organization that may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome or a project. Princeton stakeholders can be subject matter experts representing university departments in connection with compliance for elements such as public safety, environmental health and safety, as well as compliance with engineering and design standards. A Princeton stakeholder can also be a person or department which is impacted by the project, particularly the construction phase.

Startup In the final Approval phase of a Princeton project, at the end of construction, a general term to describe the activities that take place between commissioning and the achievement of steady-state operation. In some usage, the term startup, may include both commissioning (i.e., testing after mechanical completion) and startup of systems.

Statement of Construction Cost The periodic estimates of the construction cost of the project prepared at the end of each design phase by the contractor and by the A/E’s cost sub-consultant.

Statement of Qualifications The submittal prepared in response to an owner’s request for qualifications.

Study Phase The second phase of a Princeton capital project, after the Project Initiation Phase, which includes sub-phases Programming/Concept Design and Schematic Design.

Sub-consultant A consultant who contracts with the prime consultant. Typical sub-consultants are structural, electrical, civil, and mechanical engineers; interior designers; landscape architects; acousticians; and telecommunications specialists.

Subcontractor A contractor who contracts directly with the prime contractor. Typical subcontractors are demolition, concrete, structural steel, mechanical, electrical, plumbing, fire alarm and carpentry.
**Substantial Completion**  A milestone identifying that the work is sufficiently complete in accordance with the contract documents so that Princeton University may occupy, operate, or use the work or designated portion for the purpose for which it is intended.

**Substantial Completion Date**  The date that Princeton and the CM/GC agree that a project is substantially complete.

**Sustainability Charrette**  A collaborative session or sessions during the early phases of a capital project where sustainable strategies and approaches are considered. This session, led by facilities and the architect, includes users and stakeholders, considers a wide range of possible elements, and through research and consideration throughout the early phases, recommends goals to incorporate selected sustainable elements.

**Target Cost**  The early cost for a project, or for construction of a project, approved by the Provost, toward which the project team works to develop a design solution.

**Tech Review**  Periodic review by the university tech team for compliance with university standards and objectives.

**Tech Team**  A group of stakeholders assembled by Facilities to review the project documentation, usually at the end of a design phase, to ensure compliance with University standards and functional objectives. Comments from this process are then conveyed back to the design team to incorporate into the project design.

**Testing and Inspection**  Services directed by Princeton, either by a third-party inspection or testing entity, or a municipality having jurisdiction, to verify compliance with material specifications, drawings and codes.

**Users**  A Princeton representative, or representatives, of a school, college, department, center or administrative unit responsible for the functional and operational requirements of a major capital project. A user provides general and detailed project requirements, facilitates decisions with user groups, and coordinates with the executive sponsor to establish clear communications and governance processes.

**USGBC**  United States Green Building Council, an organization which governs a process by which owners can seek LEED certification for a project to recognize sustainable strategies incorporated into the design and construction of a project.

**Utility Infrastructure**  The network of utility systems that support any building project, including power, water, sewer, chilled water, telecommunications, steam, etc.

**Value Engineering (VE)**  A process that identifies and assigns values to the various functions of a building element, product or system and then seeks a final design that maximizes functional value and reliability while minimizing cost. While value engineering should occur throughout the course of design, it most often is used toward the end of the process in order to reconcile a construction budget that exceeds the target cost or authorized budget.

**Value Proposition**  A statement of value that should be delivered by the project that ensures success in achieving University strategic priorities. The statement, which also outlines academic and functional objectives, is approved by the Provost in the Project Initiation Phase.
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