

EXHIBIT X

LEAN DESIGN AND CONSTRUCTION

I. GENERAL

A. Application of Exhibit

This Exhibit is a Contract Document and is intended to supplement (1) the Consultant Agreement between the Massachusetts Port Authority (“Authority”) and the Authority’s Prime Design Consultant (“Consultant”) and (2) the Preconstruction Services Agreement and the Construction Services Agreement between the Authority and its Construction Manager (“CM”). References herein to the “Project Team” refers to representatives of the Authority, the Consultant, and the CM (as applicable depending on the phase of the Project).

B. Lean Project Delivery

The Authority expects that the Project will benefit by implementing Lean Project Delivery, which includes:

1. collaboration among all members of the Project Team;
2. planning and managing the Project as a network of commitments across organizational boundaries;
3. optimizing the Project as a whole, rather than any particular piece; and
4. promoting continuous improvement throughout the life of the Project.

The Authority intends that the Project Team, to the maximum extent possible, utilize Lean Project Delivery to facilitate design and construction of the Project. Specific Lean Tools available to the Project Team in support of Lean Project Delivery are set forth in this Exhibit.

C. Lean Deployment Plan

This Lean Design and Construction Exhibit provides the basis for development by the Project Team of a Lean Deployment Plan (“LDP”) for the Project. The LDP shall be developed by the Project Team within thirty (30) days after execution of the Agreement to which this Exhibit is appended. The LDP shall be updated, at a minimum, at the start of each Project phase (Project Definition, Preliminary Design, Final Design, and Construction), using a template that the Authority will supply to each Project Team. The Project LDP and all updates shall be subject to Authority approval.

The Designer and CM shall provide personnel with knowledge and experience of the Lean Tools selected for inclusion in the LDP. The Designer and CM each shall designate a person as its Lean representative for purposes of implementing, tracking, and updating the LDP.

II. REQUIRED LEAN TOOLS

A. Project Planning and Tracking Tools

1. Last Planner® System: For planning its activities and deliverables the Project Team shall use the framework of the Lean Construction Institute's Last Planner® System ("LPS") consisting of: collaborative development of a milestone schedule; phase or progression production plans; "make-ready" look ahead plans; weekly work plans; maintenance of variance and constraint logs; and methods for recording, measuring, and improving the reliability of Project planning and production.
2. Pull Planning Approach: Following the LPS framework, the Project Team shall use a pull planning approach to planning, scheduling, and tracking its work to ensure that preceding activities are not started sooner than is needed to assure the continuous performance of subsequent activities. Where the work of one Project Team member is dependent upon the prior performance of another Project Team member, the Project Team member whose work is dependent shall request of, and receive from, the prior performer a reliable commitment as to when the precedent work shall be finished. As part of the pull planning process, appropriate Project Team members shall agree on the criteria for hand-off and acceptance of items of work.
3. LPS Guide: The Project Team shall follow the *Massport Last Planner® System Guide*, including the following specific elements:
 - a. Master Schedule Alignment: The Project Team shall collaboratively review the Milestone Schedule to align the team on the major milestones, major phases of work, basic dependencies and durations, and major constraints or risk factors. The Milestone Schedule Alignment shall also include identification of pull planning phases and an action plan for initiating the Last Planner® System on the Project. Master Schedule Alignment update sessions shall be held periodically (usually prior to the beginning of new major phases of work).
 - b. Phase Production Planning: Phase planning shall be based on the collaborative efforts of all those performing work during a given period and shall indicate when work should be done to meet milestone dates.
 - c. Make-Ready/Look Ahead Planning: Make-ready look ahead plans shall be developed by the Project Team, identifying (i) each item of work that can be performed and completed during the given planning period; (ii) whether factors exist that would constrain performance and completion as planned; and (iii) the actions to be taken to negate or mitigate any such constraints. The Project Team shall maintain a Constraint Log to track constraints to planned activities and an action plan (what, when, who) for Constraint removal or resolution.
 - d. Weekly Work Planning: Weekly work plans shall be developed by the Project Team members to show the day on which specific activities will be completed. The weekly work plans shall indicate whether an assignment has been completed as scheduled and, if not, a reason shall be assigned for variance from the plan. The Project Team shall maintain a

Variance Log and take action to address Variances so that they do not impede the production plan in the future. The Project Team also shall record the overall and weekly Plan Percent Complete (PPC) for the Project and display this for management review.

4. Project Dashboard: The Project Team shall weekly submit to the Authority appropriate information from LPS in the Design and Construction Dashboards, as provided in the *Massport Last Planner® System Guide*.

B. Other Required Lean Tools

1. Conditions of Satisfaction (CoS): At the project level, CoS are measurable statements that tell the Project Team what tests the Project must pass to be a success. The Project Team shall develop project-level CoS, including using stakeholder engagement to identify stakeholder CoS. Project-level CoS also should be used by a project team to develop its LDP so that the Lean Tools it selects support delivery of the project-level CoS. The Project Team should update its project-level CoS, at a minimum, at the beginning of each Project phase (Project Definition, Preliminary Design, Final Design, and Construction).

At an individual activity level, a CoS is a detailed description by a customer of an activity specifying all requirements that must be satisfied by the performer in order for the customer to accept that he or she received exactly what was wanted, when it was needed. Individual activity-level CoS should be used as part of the LPS approach described in Section II (A) above.

2. A3 Process and Report: The A3 Process has six main elements that follow one another in a progressive and logical sequence:
 - a. problem statement;
 - b. background/current conditions;
 - c. future state desired (usually listed as CoS relating to the A3 subject matter);
 - d. root cause (gap) analysis;
 - e. proposed actions/implementation plan; and
 - f. performance metrics and follow up steps to review results and make adjustments as needed.

An A3 Report is a one-page report prepared on an 11 x 17 sheet of paper that can be used for (1) collaborative problem solving/decision-making, (2) strategy development, or (3) reporting. The Authority will furnish the Project Team with an A3 Report template to be used for the Project. All information in a A3 Report should be relatively simple, providing only what is needed for decision making (detailed backup information and data can be provided by hyperlinks). As part of its LPS approach, Project Teams shall consider whether the A3 Process can be used to support decision-making that is part of the Project's production planning.

3. Choosing by Advantages (CBA): Project teams shall consider the use of CBA as a decision-making system for determining and documenting the "best value" decision by comparing the

advantages of each option. For example, CBA can be used as a decision-making tool in the A3 Process. CBA's five phases of decision-making are:

- a. Stage-setting: establish the purpose and context for the decision
 - b. Innovation: formulate an adequate set of alternatives
 - c. Decision-making: choose the alternative with the greatest total importance of advantages
 - d. Reconsideration: change the decision if it should be revised or can be improved on
 - e. Implementation: make the decision happen, adjust as needed, and evaluate the process and results
4. Lean/BIM Coordination: To the extent possible, Lean and BIM shall be coordinated so that Lean Tools support the use of BIM, and BIM supports the use of Lean Tools. Both the LDP and the BIMxP shall expressly describe how Lean and BIM will be coordinated by the Project Team to maximize the value of each set of tools.
5. Lean SOPs: The Project Team shall implement the Authority's Lean SOPs:
- a. Expected Outcomes Agendas for meetings/work sessions and
 - b. Continuous Improvement (Plus/Deltas and Periodic Retrospectives).

The LDP should describe how these SOPs will be integrated into the Project Team's implementation of Lean Tools.

III. Other Lean Tools (Optional)

1. Big Room Approach: Project Teams may use a Big Room Approach to provide a platform for the Project Team to collaborate on, innovate, and implement Project planning and production. The Big Room Approach can range from physical co-location, to periodic Project Team in-person sessions, to virtual sharing/coordination. If a Big Room Approach is used, it should include a written Big Room Management Plan, and the Project Team should designate a Big Room Manager to plan and oversee the Big Room Approach.
2. Focus Groups: A Focus Group is a cross-functional and cross-organizational team of designated representatives of the Project Team collaborating on the design, development, assessment, or implementation of major Project components, systems, or deliverables. In particular, during the design phase the Project Team should consider using Focus Groups to develop recommendations that meet CoS and address cost/schedule constraints of the Project. If used, each Focus Group should have a designated Focus Group Leader who is responsible for planning and managing the activities of the Focus Group, including reporting periodically to the project management team (typically the PM level for the Authority, Consultant and CM) tracking all project metrics (scope, budget, and schedule). Immediately after a CM is on board, the CM should be integrated into Focus Groups to provide real time constructability, cost and schedule inputs.

3. Target Value Design (TVD): TVD is a design methodology that requires Project values, cost, quality, schedule, and constructability to be integrated components of basis of design criteria. TVD uses cost targets to drive innovation and reduce waste in designing a project that provides optimum value to the Authority. If TVD is used, the Project Team should develop a TVD plan that sets out the strategies for value analysis, including carrying multiple design options forward using Set-based Design and deferring decisions until the Last Responsible Moment to maximize the value of each Project element. Cost and schedule analysis should be the byproduct of the continuous TVD process, including the CM and trade/subcontractors providing ongoing cost and schedule information for portions of the work, systems, and details as they are developed or considered.

4. Miscellaneous Lean Tools: The Authority may, in its discretion, require the Designer and/or the CM to use other Lean Tools, such as Value Stream Mapping, Rapid Improvement Events, Visual Management, and Root Cause Analysis. Project Teams shall supply persons with knowledge of and experience in these Tools if the Authority selects them for use on any particular project.