Performance Audit: Construction Performance Metrics

Report of Finding and Recommendation

To

Sound Transit

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Report Findings and Recommendations

To

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Executive Summary

Sound Transit (ST) retained the services of Talson Solutions, LLC (Talson) as part of the performance audit program included in System Plan, ST3, to complete a Performance Audit focusing on Construction Performance Metrics, specifically Earned Value Management (EVM). The primary audit objectives were to identify opportunities for improved construction predictability in the areas such as cost, schedule, quality, user satisfaction, risk management, safety, and other notable assessable areas. Management responses to the audit recommendations were received inclusive of anticipated corrective actions and for select instances, justification for disagreement with auditor recommendations.

ST employs EVM as one of its priority metrics to measure and monitor performance during the construction of capital projects for Light Rail and Sounder transportation modes. Talson concluded that ST effectively employs industry-standard EVM practices; however, additional construction metrics, including physical elements, should be considered to enhance the timely measurement of cost, schedule, and construction productivity for project risks.

Construction performance metric requirements used by ST's project management and contractor teams are primarily defined by ST's Program Control Policies and Procedures - Earned Value Management System (PCPP-20). However, Talson noted that PCPP-20 does not clearly address the methodology for determining Estimate at Completion (EAC) costs for construction activities with Design-Build or General Contractor/Construction Management project delivery methodologies. PCPP-11 does reference forecasting and EAC, but do not make specific reference to contracting methodologies and how EAC should be incorporated.

Talson sampled four contracts (completed and ongoing) for compliance to PCPP-20; three design-build and one general contractor/construction manager project delivery method. Talson found that ST achieved an average of 96% compliance for applicable procedures contained in PCPP-20. In addition, ST personnel were extremely cooperative in participating in interviews and providing additional documentation to support the compliance review.

Talson reviewed industry literature and discussed ST construction metrics, particularly EVM, with benchmarking participants, Los Angeles County Metropolitan Transportation Authority (LA Metro), and Chicago Transit Authority (CTA). Additionally, Talson discussed construction metrics with Jacobs Engineering Group Inc. Talson concluded that ST has a robust EVM process and exceeds named agencies in alignment with Project Management Institute and AACE International EVM standards.

Talson noted that early schedule performance metrics for the design-build project delivery contracts were below the PCPP-20 threshold, and that it is not uncommon for design-build schedule challenges to adversely impact early schedule activities. However, Talson observed that as construction activities commenced, the overall schedule performance returned to the target threshold as critical and high-cost value activities more closely reflect work performed.

ST's overall management and use of EVM aligns with the intent of PCPP-20 and aligns with or exceeds similar EVM processes utilized within other agencies. In addition, ST's EVM processes and controls have been efficaciously implemented, allowing for efficient and effective oversight and management of capital projects.

II. Audit Objectives

The following objectives for the performance audit were:

1. To determine whether agency Construction Performance Metrics and Management practices are in alignment with industry best practices and that performance metrics are working as intended in specific to light rail and commuter rail projects;

2. Identifying opportunities for continuous improvement with recommendations for construction performance metrics and additional metrics for consideration; and

3. Benchmarking Sound Transit's performance against other similar agencies

III. Methodology

The audit was completed over a six (6) month period, from March through September 2021. Talson's methodology to meet the audit objectives primarily consisted of the following tasks:

1. Conducted interviews of ST personnel to gain a greater understanding of Portfolio Services Office, PCPP-20, and current EVM implementation or other metrics on completed and ongoing capital projects
2. Developed and performed checklist compliance review of the four sample contracts to PCPP-20
3. Conduct industry research and outreach to other transit agencies and major consulting firms for benchmarking and identification of best practices
4. Review available project documentation in ST's SharePoint, and other information provided by ST
5. Provide monthly or as needed progress update to Internal Audit;

The audit was conducted using ST's PCPP-20 policies and procedure for Earned Value Management System as the key document to review project compliance and alignment with industry best practices. Talson analyzed this policy to assess Sound Transit's

- EVMS process against industry best practices;
- Project team and Contractor roles and responsibilities in implementing the EVMS
- Project team demonstration of EVMS compliance

Talson used additional documentation for review, evidence, and analysis to determine its findings and conclusions. Described below with each listed document are the primary areas reviewed by Talson. In addition, Talson obtained reference documents directly from ST's project teams and within ST's SharePoint document management and storage platform.

Sound Transit Agency Progress Reports: Talson analyzed project monthly progress reports required by PCPP-20 (Earned Value Management System). Project team members are required to report EVMS information into this document. In addition, Talson assessed for corrective actions, contingency reporting, EV metrics, and impacts to schedule and budget.

Progress Payments: As a condition of payment, Contractors must provide EVMS related reports and updates. Talson analyzed these documents to assess compliance with these requirements as outlined in contract specifications and PCPP-20. Additionally, Talson analyzed ST's internal review of contractor payment submittals.

Baseline Cost-Loaded Schedules: Talson confirmed the use of a cost-loaded schedule or time-based budget as submitted by the Contractor as per PCPP-20 as the baseline for future schedule and cost events. Talson also assessed ST comments to Contractor submittals.

EVM Plans: Talson confirmed the use of an EVM Plan submitted by the Contractor as per PCPP-20. This document outlines the process, implementation, updating, and reporting activities to be carried out by the Contractor.

Earned Value Summaries: Talson analyzed Sound Transit's internal EVMS review documents to assess how project teams report and analyze the information provided from the Contractor's project progress payment documentation as per PCPP-20.

Miscellaneous Project Team Documentation: SharePoint provided project information in conformance to the PCPP. Relevant documents reviewed included Agreements, Preconstruction meeting minutes, Project Control Lead Reports, Resident Engineer Reports, and CPM schedule updates.

Talson conducted the performance audit according to Generally Accepted Government Auditing Standards and the International Standards for the Professional Practice of Internal Auditing issued by the Institute of Internal Auditors. Talson believes that the evidence obtained provides a reasonable basis for the findings and recommendations based on the audit objectives.

IV. Contract Selection Criteria and Interviews

The selection process for the audit sample was a risk-based approach that identified projects currently under construction or recently completed within Sound Transit's Link Light Rail Program and Sounder Program and the details of the projects for testing were selected from the January 2021 Agency Progress Report Capital Programs. Talson used the following primary considerations for the selection of capital construction contracts for the performance audit:

- Project type, status, contract value, contract change orders
- Contract delivery methodology (i.e., Design-Build, General Contractor, Construction Manager)
- Project complexities/execution issues

Talson selected the following four (4) contracts for the performance audit:

(1) **Contract N150, Roosevelt Station Finishes – Northgate Link Extension**

The Northgate Link Extension is comprised of nine construction contract packages ranging from demolition, site/civil, architectural finishes, and signal and track electrification. The

Construction Manager/General Contractor, Hoffman Construction, achieved Substantial Completion on September 24, 2019, and has continued work, including preventative maintenance, escalator lighting, and punch list activities as of January 2021. The contract experienced $18 million in change orders or approximately 12% of the initial contract value.

Interviewees: Senior Project Control Specialist, Senior Scheduling Engineer, Supervisor – Project Controls, Project Manager – Project Controls (North Corridor)

(2) **Contract M200, Link Operations, and Maintenance Facility East (OMF East):**

The Link Operations & Maintenance Facility: East is a Design-Build project located in the City of Bellevue and consists of two components. The Operations & Maintenance Facility is 145,000 square feet and is complemented with a 35,000 square foot Maintenance of Way building that will maintain, store and deploy Sound Transit's expanded light rail fleet. The M200 contractor, Hensel Phelps, achieved Substantial Completion in December 2020.

Interviewees: Senior Project Control Specialist, Senior Scheduling Engineer, Supervisor – Project Controls, Manager – Project Controls, Principal Construction Manager

(3) **Contract R200, Downtown Redmond Link Extension Design-Build:**

The Design-Build Downtown Redmond Link Extension under contractor Stacey Witbeck/Kuney (SWK) Joint Venture provides a new light rail line from the Redmond Technology Station to downtown Redmond. Funding for preliminary engineering was approved in 2008. However, the project was suspended in 2009 due to economic concerns. In February 2016, funding was restored, and preliminary engineering resumed. As of January 2021, the contract is 28 days behind schedule, and Sound Transit has requested a recovery schedule.

Interviewees: Senior Project Control Specialist, Senior Scheduling Engineer, Supervisor – Project Controls, Manager – Project Controls

(4) **Contract PSAI, Puyallup Station Access and Improvements:**

This Design-Build project aims to increase the number of parking spaces and improve access and user experience for Sounder commuters, drivers, bicyclists, and bus riders. The expansion includes approximately 600 parking spaces that consist of expanded surface parking and up to a five-level parking garage. Hensel Phelps is the design-build contractor under an initial contract value of $46.0 million. Puyallup Station is scheduled to open for service in the first quarter of 2022.

Interviewees: Senior Project Control Specialist, Manager – Scheduling Engineer, Construction Manager

V. Audit Results

Compliance to PCPP-20: Talson sampled four contracts (completed and ongoing) for adherence to PCPP-20; three design-build and one general contractor/construction manager project delivery method. As shown in Figure 1.0, Talson found that ST achieved an average of 96% compliance to applicable procedures contained in PCPP-20. In general, the PCPP is well-organized and addresses industry best practices for budget analysis, change management, document control, schedule analysis, and risk management. In addition, ST personnel were extremely cooperative in participating in interviews and providing extensive information upon request from Talson to support the compliance review documentation (i.e., project reports, cost-loaded schedules, invoice analysis, and other critical project documents).

Figure 1.0 PCPP-20 Compliance Scoring

Contract	Achieved / Applicable Items	Score
N150 Roosevelt Station Finishes	51 / 53	96%
M200 Operations & Maintenance Facility East	47 / 48	98%
R200 Redmond Link Extension	49 / 52	94%
PSAI Puyallup Station Parking	50 / 53	94%
Total / Average	**197 / 206**	**96%**

Agency Benchmarking / Industry Research: Talson discussed ST construction metrics, particularly EVM, with benchmarking participants, LA Metro, and CTA. Additionally, Talson discussed construction metrics with a Senior Project Controls representative from Jacobs Engineering Group Inc., an American international technical professional services firm. Additional outreach was solicited but unsuccessful from Washington Metropolitan Transportation Authority (Washington, DC), Capital Metropolitan Transportation Authority (Austin, TX), and STV Inc.

Talson concluded that ST has a robust EVM process and exceeds named agencies aligned with Project Management Institute and AACE International EVM standards. LA Metro and CTA primarily use EVM for design agreements and, similar to ST, use third-party consultants to augment in-house staff for project and program controls. LA Metro and ST employ project cost contingency drawdown or usage curve for approved cost changes to awarded contracts and a schedule contingency drawdown curve to help monitor available time or days that can be used for contract or other delays without impacting the planned revenue service date.

Schedule Performance: Based on interviews with ST personnel and the review of EVM reporting, Talson noted that early schedule performance metrics for the design-build project delivery contracts were below the PCPP-20 policy threshold (variances exceeding 10%). ST's Design Engineering and Construction Management teams could consider potential corrective actions to address the performance variances in the form of contract changes, design modifications, workforce adjustments, and securing jurisdictional approvals. It is not uncommon for early design-build activities (i.e., design reviews and permitting) to adversely impact schedule performance but not impact the overall completion date. Talson observed that as construction activities commenced,

the overall schedule performance returned to the target threshold as critical and high-cost value activities more closely reflect work performed.

Additionally, schedule performance within each contract is based on an agreed cost-loaded schedule with numerous activities when the measure is based on actual earned cost value against planned cost value. However, this would tend to ignore any duration-based measurement (i.e., days) or analysis such as schedule performance against the critical path. Therefore, Talson believes this analysis provides an additional metric for schedule performance.

Change Management: ST personnel identified that change management activities and related costs were not always fully considered in the EVM analysis due to the delayed ST formal change order approval process. However, the work is being performed via work directives, and the project teams are determining the SPI against the additional costs as 1.0. with little or no impact on the overall cumulative SPI. Talson believes this procedure has not adversely impacted the EVM analysis.

Contingency Analysis: ST effectively uses contingency analysis as a measure of cost performance during the construction duration. Changes during construction are analyzed and accounted for against the available contingency as part of the ST contingency plan and are represented in the ST internal analysis and project reports.

Schedule Analysis: Talson observed that the ST's project teams do not officially review detailed subcontractor schedules submitted to the prime contractor. ST reliance is based on the prime contractor's review and acceptance. Although ST thoroughly reviews the contractor's cost-loaded schedule for EVM analysis, Talson sees the value of an initial assessment or compliance audit of the subcontractor's detailed schedule after accepting the overall construction schedule.

VI. Recommendations

As ST's capital program continues to expand and develop with increasing usage of varied project delivery methodologies and the increasing need for agency, consultant, and contractor project controls personnel, the following recommendations to expand the use of applicable construction metrics are offered for ST's consideration:

1. Update PCPP-20 to address, in greater detail, the various project delivery methods (i.e. Design-Build or General Contractor/Construction Management), including updated EAC analysis, reporting and analysis templates and integration of contingency analysis.

   Management Response:
   Agree; PCPP-20 will be updated in early 2022.

2. Development of milestone measurement on early design or non-critical pre-construction activities (i.e., mobilization, key design events) for design-build agreements.

   Management Response:
   Disagree; Design work should be managed similar to the construction activities and should be progressed with measures developed as a percent complete reviewed by the

project team. It would not be effective, nor good practice, to base design payments purely on design submittal milestones as cash flow would be affected for the contractor/consultant.

3. EVM analysis on the initial critical path with established periodic updates during construction duration.

   Management Response:
   Partially agree; will explore use of additional metrics such as Critical Path Length Index (CPLI) and Baseline Execution Index (BEI). Implementation will require changes to contract specifications and additional schedule support resources.

4. Use of physical measurements for vital elements for the productivity measurements. Examples include cubic yards over time (per day, week), feet or miles of track installed, submittals per week, or tons of steel delivered/installed.

   Management Response:
   Disagree; production rates are heavily dependent upon site access, project constraints, crew and resource availability, geometric configuration, stacking of trades and many other project-specific factors. As such, it is impractical for an owner agency to measure and/or develop production standards as they would be of limited benefit and application.

5. Measure of person-hour/headcount profile to measure workforce participation and productivity for overall construction duration or to measure key project elements. For example, person-hour per feet/mile track installation. Also, similar to project S-curve, developing a person-hour curve over the project duration analyzes workforce productivity against the plan. This measure could be similar to cost loading activities and include resource/workforce loading as a measurement.

   Management Response:
   Disagree; similar rationale to response #4 above.

6. Partial EVM analysis using a combination of a cost-loaded schedule and physical quantities to measure key construction elements.

   Management Response:
   Agree; as we commented on the draft report, we already have the framework in place. Performance is measured in the field, and the contractor can only invoice for work confirmed complete. The cost-loaded schedule provides the basis for how much will be paid (dollars aligned with physical completion). The Schedule Performance Index (SPI) provides a measure of completed vs. work planned; if significant variance exists in completing work, modifications of schedule durations occur, or float is consumed, it should be visible in the Earned Value result. Sound Transit will evaluate isolating specific key construction elements to provide targeted (partial) EVM analysis for a handful of key, higher-risk activities with the aim of measuring and then adjusting while the opportunity still exists to mitigate

performance deficiencies. Implementation will require changes to contract specifications and additional schedule support resources.

7. Provide greater exposure to a measure of schedule contingency/schedule float analysis similar to cost contingency as part of the internal EVM template used by ST's project control personnel.

   Management Response:
   Agree; Schedule contingency plans are already prepared for major projects, and balances reported monthly in the Agency Progress Report. Schedule contingency is included in a new program reporting dashboard with a comparison against the schedule contingency drawdown plan (initial edition was published in Dec. 2021).

8. Investigate establishing metrics related to the number of Requests for Information (RFI) of construction drawings, non-conformance reports, or submittals. This information would assist in the early indication of additional construction activity due to incomplete drawings, design errors and omissions, or quality performance during construction.

   Management Response:
   Agree; we currently collect this information in a variety of ways, including in the weekly RE reports; we will investigate the benefits of establishing or enhancing related metrics, classifications and/or response rate standards in Q1 of 2022, and then establish a plan, resources and timeline for implementation.

9. Conduct an initial review or compliance audit of the subcontractor's detailed schedule after acceptance of the baseline construction schedule.

   Management Response:
   Disagree; as we discussed with the Talson team and commented on the draft report, the owner does not have a contractual obligation with the subcontractor, only the contractor. Receiving subcontractor's schedules for review would be highly unconventional; we requested Talson provide an example where this has occurred in the industry to understand how we could make it work.

Throughout the audit process, Sound Transit has been very cooperative and timely with providing documentation access and scheduling meetings with Talson. As a result, Talson has concluded upon review of Sound Transit's PCPP-20 procedure is in alignment with industry best practices for Earned Value Management and that the selected four projects reviewed in this performance audit closely follow PCPP-20.

~ End of Report ~