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Timeboxed earned schedule approach (TESA): An innovative framework to program schedule management for programs within OTAs[1]

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Abstract

Use of Other Transaction Authority (OTA) vehicles helps accelerate research and development (R&D) of prototype technologies for government entities. However, OTA is not subject to Federal Acquisition Regulation (FAR) performance reporting requirements. This increases the potential for cost and schedule performance risk. To reduce this risk, the Office of Naval Research (ONR) Code 34 Force Health Protection portfolio is leveraging an innovative timeboxed earned schedule approach (TESA) to program schedule management that provides performance situational awareness without impeding the benefits of OTA for streamlining research and development.

TESA appropriates concepts from Agile project management and earned value analysis to provide a schedule performance monitoring protocol across multiple programs, projects, and performers. The approach retains EV's cumulative performance analysis benefits for evaluating schedule accomplishment across multiple efforts and accommodates different audience summarization needs at a variety of abstraction levels.

Introduction

The Navy's Future Naval Capability (FNC) program seeks to accelerate the transition of Office of Naval Research (ONR)-developed solutions to the fleet. To overcome collaboration and transition barriers, government research and development (R&D) programs may leverage OTA vehicles to support the development of prototype technologies. Not being subject to the FAR, OTA accelerates R&D by permitting use of commercial-like, negotiated agreements that can be awarded in 90 days or less; allowing highly flexible use of intellectual property; and promoting unique public/private partnerships to achieve program objectives.

However, the extent to which OTA is not subject to the FAR also includes performance reporting requirements (e.g., schedule, cost, and technical progress) wherein "there could be little, if any, performance reporting required" (Office of the Under Secretary of Defense for

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Acquisition and Sustainment [OUSD A&S], 2023, p. 27). This aspect of OTA offers potential risk in the form of "diminished oversight and exemption from laws and regulations designed to protect government and taxpayer interests" (Congressional Research Service, 2019, p. 8).

OTA's characteristic tension between the benefit of accelerated development and the potential for risk from diminished oversight requirements prompted interest in a simple Earned Value (EV)-like program schedule management approach that would provide schedule progress insight with minimal imposition on performers, beginning with initial implementation within two ONR Code 34 (Warfighter Performance) R&D programs. This paper describes the problem (e.g., desired outcomes, constraints), the approach undertaken to address the problem's facets, and the result of the TESA that was quickly devised and implemented within a few weeks to address program schedule control interests.

The Problem

Responses to professional practice problems must not only satisfy the desired outcomes; they must also contend with constraints that limit the range of response options. With respect to desired outcomes, a capability was sought to systematically answer these typical schedule management questions:

- What is the current schedule performance …
  - ... summarized across the overall perpetual portfolio of programs and projects?
  - ... summarized across the projects constituting a respective program?
  - ... summarized by each performer's project(s)?
  - ... evaluated for each task specified in a respective Statement of Work (SOW)?
  - ... summarized by alternative decomposition hierarchies (e.g., technology architecture roadmap, integrated master plan)
- What are the implications of the longitudinal performance trends at any of these respective levels of summarization (e.g., prognostication, schedule recovery realism)?
- Which activities are contributing to significant variances, the insight to which can facilitate remediation conversations (e.g., corrective actions, warranted replanning)?
- What is the characterization of actual cost expended relative to planned cost? What has been spent? What remains to be spent?

Although a conventional EIA-748 EV management approach (National Defense Industrial Association, 2018) seems suited to answer the preceding questions (especially those requiring alternative summarization hierarchies), the following constraints limited the schedule control approach options due to the nature of the R&D program contracts and budget:

- *Negligible obligatory reporting requirements* – The statements of work (SOWs) only require performers to provide quarterly progress reports in the form of narrative presentations or reports. Enlisting performer support for complex program/project management (PPM) controls and reporting not specified in the SOW might prove difficult.
- *Availability of limited schedule information* – The available schedule information might best be characterized as, "Here are the high-level tasks to be completed to receive payment for a respective milestone." The schedule information in the SOWs is typically limited to the identity and description of Level 1 tasks and, in some instances, Level 2 tasks. The SOWs also include tables specifying payment milestones with corresponding

dollar amounts and anticipated delivery dates. Although the payment milestone information includes designation of requisite tasks, thereby signaling at least a deadline finish date for each task, no task start date information is available.

- *Costs are allocated to SOW-specified payment milestones but not SOW-identified tasks* – This condition affects the resolution of cost distribution with respect to time on which a conventional EV management approach relies. For example, suppose a payment milestone with a designated value of $1.5 million is scheduled for delivery at “project start plus three months.” Since there is no reasonable means for arbitrarily distributing that cost to that milestone’s requisite tasks specified in the SOW, the resultant cumulative *Planned Value* plot is too coarse to provide sufficient resolution for schedule control. In this example, the cumulative *Planned Value* would be zero for the first 3 months of that project, negating evaluation of whether the project is “on schedule” during that time interval.
- *Diversity in performers’ schedule management practices and maturity* – One example of schedule management practice diversity is the variation observed in performer-level schedule progress reporting cadences. Performers’ status reporting cycles for their operational control varies by organization (e.g., weekly, bi-weekly, mid-month, month-end, 27th day of the month).

  Regarding practice maturity, although some performers appear to exhibit schedule management rigor suitable to the context of their respective projects (based on conversations with some of the principals responsible for PPM controls), other performers rely on subjective characterization of progress (e.g., “Progress towards realization of milestone X is approximately 45% complete”).
- *No established schedule information protocols* – The SOWs contain no prescription of obligatory schedule information protocols (e.g., data elements, format and electronic sharing of schedule management artifacts). The combination of the aforenoted diversity in performers’ schedule management practice maturity in conjunction with the prospect of reasonable performer concerns about disclosure of proprietary R&D methods as may be reflected in their schedule management artifacts constrains employment of a portfolio/program schedule management approach that would need to rely on sharing of Performer schedule management artifacts.
- *Need immediacy* – Although operational protocols for cost management were already in place, the need to implement a capability to systematically answer the previously discussed schedule management questions was immediate; the programs and projects were already in progress.

In summary, a schedule management approach capable of providing answers to schedule management questions needed to honor the aforenoted constraints. Furthermore, simplicity would be necessary to move quickly and elicit support for an approach for which performers had no SOW-specified obligation.

The Approach

One of the dilemmas in formulating a suitable schedule management approach is that neither the schedule management literature nor the practice standards in project management professional societies’ bodies of knowledge (e.g., PMI, IPMA, AACE International) provide prescriptive guidance wholly sufficient to address the programmatic needs and constraints. For example, although one might presume that uniform prescriptive guidance exists for practices like an Integrated Master Schedule (IMS), “one box does not fit all” situations. As the

Department of Defense (DoD; 2023) noted, “The IMP [Integrated Master Plan] and IMS should be tailored and scaled according to the size, content, maturity, and risk of the project” (p. 9). Ultimately, practitioner discretion shapes the tailoring decisions to fit the practice context.

In lieu of limited literature guidance, the needs and constraints of the R&D programs necessitated a reflective practice response (Schön, 1983) characteristic of the “rethinking project management” (RPM) school of thought (Winter et al., 2006). The RPM movement advocates that the approach for addressing a particular PPM practice situation emerges from rigorous adaptation of the current body of knowledge to the unique context of that situation (Remington & Pollack, 2011).

This section describes the approach that resulted in the formulation of TESA. The first subsection presents a conceptual framework borne of reflective practice that informed TESA along with the supporting rationale. The remaining subsection discusses the employment of TESA (i.e., practical application).

Conceptual Framework

Earned Schedule

The need to summarize schedule performance at a variety of abstraction levels, including support for alterative summarization hierarchies (e.g., technology architecture roadmap), warranted consideration of a cumulative EV-like approach. To realize that outcome, TESA uses cumulative EV mechanics wherein the evaluation is focused on the abscissa temporal relationship between cumulative *Planned Value* (PV) and *Earned Value* (EV).

In an example illustrated by Figure 1, the cumulative EV noted for the Status Date should have been achieved at the earlier date identified by the equivalent cumulative PV. Since the X-axis is delineated in temporal units of measure (i.e., days, weeks, months), the offset between the current cumulative EV and the equivalent cumulative PV indicates the number of days the project is ahead or, in the case of the example depicted in Figure 1, behind schedule.

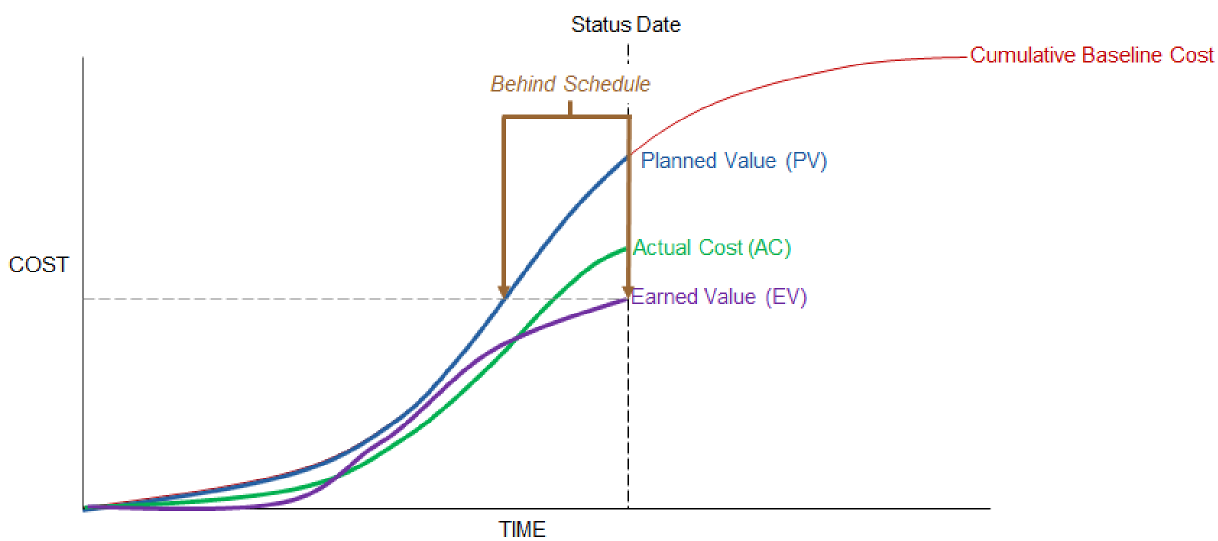


Figure 1. Illustration of the Abscissa Temporal Relationship Between Cumulative PV and EV

The relationship between cumulative PV and EV is well known. This relationship provided the basis for actualizing measurements for an *EV Forecast Finish Date* (Oliver, 1999) and a *Schedule Recovery Date* (Oliver, 2002). Lipke (2003, 2012) proposed formalization of this aspect EV analysis advocating the concept of Earned Schedule (ES), the fundamental tenet of which is illustrated by Figure 2.

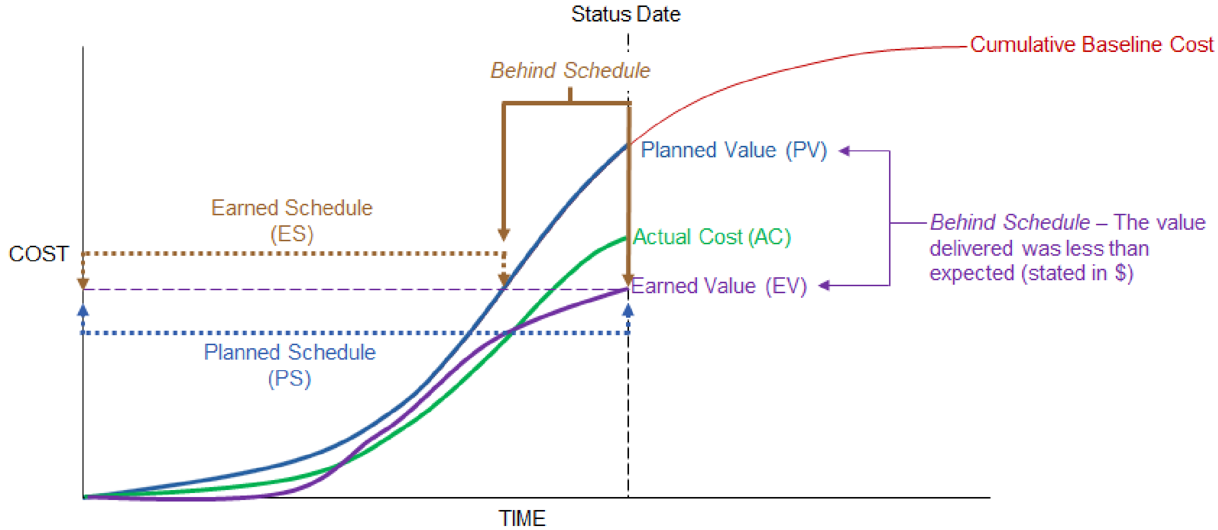


Figure 2. Illustration of Earned Schedule (ES) and Planned Schedule (PS) in Contrast With Conventional EV Schedule Variance

Lipke's work intended to address EV's historic dilemma of expressing schedule performance stated in currency units of measure (i.e., cost) that focused on the ordinate relationship between cumulative PV and EV. For example, suppose that for a respective Status Date, the cumulative PV indicates the project should have delivered $8,000 of EV. If by that date, only $6,000 of cumulative EV has been delivered, conventional EV analysis would characterize the project as being "$2,000" behind schedule. Although the Y-axis offset between cumulative PV and EV does indicate the extent to which a project is ahead, behind, or on schedule, the valuation of schedule variance in terms of "dollars and cents" communicates little about the magnitude of that variance in temporal units of measure (e.g., days, weeks, months). In contrast, ES provides a meaningful evaluation of EV-based schedule performance expressed in temporal units of measure.

Where TESA parts company with Lipke's (2003, 2012) ES approach is the basis for establishing cost. Lipke's cost-basis for ES is situated in cost defined in currency units of measure, but ultimately expressed in temporal units of measure (e.g., days). TESA's contention with two of the previously discussed constraints—availability of limited schedule information and allocation of costs to only zero duration SOW payment milestones—precluded use of currency units of measure as a cost basis.

To address these constraints, TESA proceeded with a reasonable assumption that although the SOWs provide no information about the duration or start and finish dates for each specified high-level task, the performers likely have that information, which would have been necessary to finalize the SOWs. The extent to which this assumption is reliable reduces the likelihood of an implicit constraint about performer concerns of incurring additional overhead work to support new schedule controls not specified in the current SOWs.

Since task duration can be established for SOW-specified tasks, as described in Table 1, TESA used *duration* as an EV cost basis instead of cost stated in monetary units of measure.

Table 1. ***Characterization of Detail Task PV, EV, and Actual Cost (AC) Based on Task Duration as a Cost Basis***

Metric	Characterization
PV (i.e., PS)	PV, when based on Duration as a cost basis, indicates the number of days of task outcome (i.e., planned accomplishment) the task was obligated to deliver by a designated Status Date. For example, suppose that *Task A* has a baseline duration of 10 days and was scheduled to have started on Monday morning of the current week. As of the Friday “end of day” Status Date in this current week, *Task A* should have delivered 5 of 10 days of intended task outcome(s). If—for the illustration purpose—*Task A* was situated in the construction industry and represented the work to complete rough-in electric power distribution to floors 1 and 2 of a building, assuming the goal at the end of week 1 was completion of rough-in for floor 1, the PV (i.e., expected outcome) by the Friday status date is a 5 days of *Planned Schedule* (i.e., completion of floor 1).
EV (i.e., ES)	EV, when based on Duration as a cost basis, The number of days of delivered task outcome (i.e., actual accomplishment). Continuing with the preceding example, suppose the Actual Start of Task A did not occur until Tuesday morning due to late delivery of materials. If by the Friday status date, an additional remaining duration of 1 day is needed to complete floor 1, the EV (i.e., delivered outcome or E*arned Schedule*) is 4 days. As the *Earned Schedule* value of 4 days is less than the *Planned Schedule* value of 5 days, *Task A* is 1 day behind schedule
AC	Although TESA’s focus is evaluation of schedule performance, characterization of AC from an ES perspective is warranted. When *duration* is used as an EV cost basis, AC reflects the passage (i.e., expenditure) of time defined by the interval between a task’s Actual Start and “time now”. Whether used effectively or not, the expenditure of time is ongoing and cannot be halted. Continuing with the previous example, although the task is behind schedule, the 4 days of ES has an AC of 4 days; the task is on budget from a duration-based cost perspective. Upon eventual task completion, AC equals Actual Duration.

TESA’s utilization of duration as an EV cost basis is not without support. In recounting use of alternative EV cost bases (e.g., effort hours, binary) for several thousand projects within a global IT system integrator’s portfolio, Peterson and Oliver (2001, Application section, para. 2) observed:

> Granted, the earned value methods exercised on this project would not satisfy either the Full/DOD or ANSI EV implementation levels. They neither adhere to DOD prescriptions for reporting and auditing, nor would they satisfy all 32 ANSI earned value criteria. However, with at least the Level 3/EV-Lite approach, the BCWS, BCWP, and ACWP developed at each reporting were no different at the project level than they would have been with the full rigor of either Full/DOD or ANSI-compliant approaches. Furthermore, this was accomplished with minimal overhead. In fact, the actual evaluation of EV performance with EVAnalyzer [Oliver, 1999] is done with one click of a button. If the overall intent for developing EV information is project control, does the rigor of Full/DOD or ANSI matter, particularly when the resulting control information, available for management decision-making, is the same?

Khamooshi and Golafshani (2014), who further explored the implications of ES (Lipke, 2003, 2012), advocated use of duration as an EV cost basis for evaluation of schedule performance:

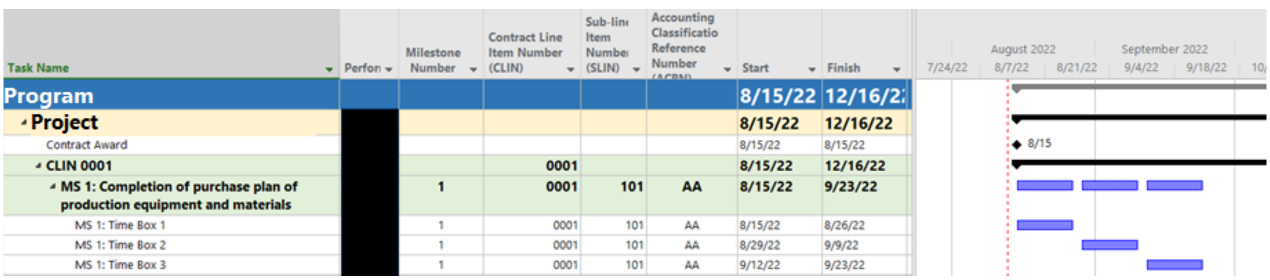
> overemphasis on EVM and using cost as a proxy for schedule performance could provide misleading information to the project team in assessing the schedule. Therefore, to provide more accurate performance measures there’s a need to decouple the schedule and cost dimensions. With that in mind, we developed the following *duration-based* [emphasis added] performance measures along with their analogues EVM (cost-based) counterpart measures to more accurately present schedule and cost status. (p. 1023)

Agile Timeboxing

In the conception of TESA, observations of Agile practice warranted consideration to address initial concerns about task duration granularity for SOW tasks with durations potentially spanning more than two reporting periods. Barring use of alternative progress evaluation metrics (e.g., a task entailing repetitive activity of similar durations like “install a new entry doorknob for each of 220 hotel rooms” wherein each installation instance likely requires the same duration, and therefore the number of completed rooms can serve as a measure of schedule progress), schedule management professionals ideally prefer that the final disposition of a detail task be known by no later than the subsequent reporting period. This reduces the likelihood of repeated subjective assurances from task owners across multiple reporting periods that task progress is on schedule.

Thus far, the typical TESA reporting interval has been monthly. Therefore, the ideal maximum duration for any detail task (i.e., a task at the lowest level of detail that is not further subdivided into additional subtasks) should not exceed 2 months.

Since some of the tasks specified in the SOWs were observed to likely have durations spanning more than two reporting periods, the initial conception of TESA proposed the use of timeboxing, appropriated from Agile’s sprint concept, wherein project work is apportioned into a consecutive series of fixed duration timeboxes. For example, Figure 3 illustrates decomposition of a fictional SOW payment milestone (i.e., MS 1) into three 10-day duration consecutive timeboxes wherein the start date of the first timebox reflects when work in support of MS 1 will commence and the finish date for the final timebox concluding on the planned MS 1 completion date.



Task Name	Perfor	Milestone Number	Contract Line Item Number (CLIN)	Sub-line Item Number (SLIN)	Accounting Classification Reference Number (ACRN)	Start	Finish
Program						8/15/22	12/16/2
Project	[redacted]					8/15/22	12/16/22
Contract Award	[redacted]					8/15/22	8/15/22
CLIN 0001	[redacted]		0001			8/15/22	12/16/22
MS 1: Completion of purchase plan of production equipment and materials	[redacted]	1	0001	101	AA	8/15/22	9/23/22
MS 1: Time Box 1	[redacted]	1	0001	101	AA	8/15/22	8/26/22
MS 1: Time Box 2	[redacted]	1	0001	101	AA	8/29/22	9/9/22
MS 1: Time Box 3	[redacted]	1	0001	101	AA	9/12/22	9/23/22

Figure 3. Illustration of Payment Milestone Timeboxes

The proposed approach for TESA arbitrarily proposed that one to five objectives be defined for each timebox. These objectives serve as criteria for establishing what Agile practitioners call “done-done” (i.e., exit criteria signaling whole completion of the timebox).

Although use of uniform consecutive timeboxes with designated objectives remains a useful option for TESA (hence retention of that term in the approach name), in practical application, conversations with performers revealed their preference for using SOW-specified requisite tasks for the respective payment milestones as timeboxes, despite some of those tasks spanning more than two reporting periods. The rationale for this modification is situated in performers’ routine familiarity with summarizing their progress to the high-level SOW tasks for narrative status briefings. Thus far, despite tasks with durations spanning more than two reporting periods, TESA seems sufficient for answering the previously discussed schedule management questions.

Schedule Artifact Characterization

As illustrated by Figure 4, although the TESA schedule artifact serves the purpose of an IMS, clarification of its nature is warranted due to the various mental models regarding the IMS construct that are often informed by visions of an overarching master schedule that includes *all* tasks from every constituent project schedule. Although this vision shaping expectations of IMS constitution has been observed in some large monolithic programs within the defense and aerospace industries wherein the IMS owner can enforce uniform schedule management protocols, the literature is relatively silent about the extent to which such approaches constitute best practice for all situations. Furthermore, advocacy that the IMS be representative of *all* activity does not require that every detailed task be in a singular schedule artifact. Barker (2014) noted:

> The PMO IMS does not need to be huge, but it should "pull" information that enhances the government PM's SA [situational awareness] at any given time. A contractor might produce a 15,000-line schedule in order to cover its contract scope and associated tasks, but the associated government PMO IMS might only be 200 to 300 lines. A PMO IMS might expand in some sections to provide detailed insight into high risks but remain more general for low-risk areas. It will also expand and contract in size over time as the program evolves. External events or inputs that might influence the program are always included, along with key risk-handling efforts and decision points. (p. 22)

Task Name	Performer Status Date	Planned Schedule (PS)	Earned Schedule (ES)	PPC%	PC%	SPI(es)	TSPI(es)	SV(es)	ES Forecast Finish	Baseline Cost	Cumulative Invoiced	Remaining Available (to invoice)
Portfolio	NA	6238 days	7085.11 days	57.16	64.92	1.14	0.82	-847.11 days	5/13/25	$47,489,876	$32,499,776	$14,990,100
Program	NA	6238 days	7085.11 days	57.16	64.92	1.14	0.82	-847.11 days	5/13/25	$47,489,876	$32,499,776	$14,990,100
Project A	4/23/23	1906 days	1906 days	100	100	1	0	0 days	NA	$18,984,876	$18,984,876	$0
Project B	1/24/24	4332 days	5179.11 days	48.09	57.49	1.2	0.82	-847.11 days	6/4/25	$28,505,000	$13,514,900	$14,990,100
Contract Award	1/24/24	0 days	0 days	100	100	1	0	0 days	NA	$0	$0	$0
Phase 1: [redacted]	1/24/24	4321 days	5167.01 days	56.81	67.93	1.2	0.74	-846.01 days	6/14/24	$22,485,000	$13,514,900	$8,970,100
1.1 [redacted]	1/24/24	3457 days	4106.59 days	54.76	65.05	1.19	0.77	-649.59 days	7/8/24	$17,970,000	$11,483,150	$6,486,850
1.1.[redacted]	1/24/24	289 days	374.5 days	54.84	71.06	1.3	0.64	-85.5 days	4/2/24	$1,806,000	$1,210,020	$595,980
1.1.1.1 - Design Initiatio	1/24/24	22 days	22 days	100	100	1	0	0 days	NA	$90,300	$90,300	$0
1.1.1.2 - Design Parts Re	1/24/24	70 days	70 days	100	100	1	0	0 days	NA	$577,920	$577,920	$0
1.1.1.3 - Design Fabricat	1/24/24	130 days	130 days	100	100	1	0	0 days	NA	$541,800	$541,800	$0
1.1.1.4 - Test Report	1/24/24	67 days	152.5 days	21.97	50	2.28	0.64	-85.5 days	7/22/24	$595,980	$0	$595,980
1.1.2 [redacted]	1/24/24	288 days	307.7 days	54.75	58.5	1.07	0.92	-19.7 days	10/22/24	$602,000	$403,340	$198,660
1.1.2.1 - Design Initiatio	1/24/24	22 days	22 days	100	100	1	0	0 days	NA	$30,100	$30,100	$0
1.1.2.2 - Design Parts Re	1/24/24	69 days	69 days	100	100	1	0	0 days	NA	$192,640	$192,640	$0
1.1.2.3 - Design Fabricat	1/24/24	65 days	65 days	100	100	1	0	0 days	NA	$180,600	$180,600	$0
1.1.2.4 - Test Report	1/24/24	132 days	151.7 days	35.68	41	1.15	0.92	-19.7 days	11/8/24	$198,660	$0	$198,660
1.1.3 [redacted]	1/24/24	288 days	288.49 days	54.75	54.85	1	1	-0.49 days	12/19/24	$3,010,000	$2,016,700	$993,300
1.1.3.1 - Design Initiatio	1/24/24	22 days	22 days	100	100	1	0	0 days	NA	$150,500	$150,500	$0
1.1.3.2 - Design Parts Re	1/24/24	89 days	89 days	100	100	1	0	0 days	NA	$963,200	$963,200	$0
1.1.3.3 - Design Fabricat	1/24/24	154 days	154 days	100	100	1	0	0 days	NA	$903,000	$903,000	$0
1.1.3.4 - Test Report	1/24/24	23 days	23.49 days	8.81	9	1.02	1	-0.49 days	12/20/24	$993,300	$0	$993,300
1.1.4 [redacted]	1/24/24	288 days	373.5 days	54.75	71.01	1.3	0.64	-85.5 days	4/2/24	$602,000	$403,340	$198,660
1.1.4.1 - Design Initiatio	1/24/24	22 days	22 days	100	100	1	0	0 days	NA	$30,100	$30,100	$0
1.1.4.2 - Design Parts Re	1/24/24	69 days	69 days	100	100	1	0	0 days	NA	$192,640	$192,640	$0
1.1.4.3 - Design Fabricat	1/24/24	130 days	130 days	100	100	1	0	0 days	NA	$180,600	$180,600	$0
1.1.4.4 - Test Report	1/24/24	67 days	152.5 days	21.97	50	2.28	0.64	-85.5 days	7/22/24	$198,660	$0	$198,660
1.1.5 [redacted]	1/24/24	288 days	379.6 days	54.75	72.17	1.32	0.62	-91.6 days	3/13/24	$301,000	$201,670	$99,330
1.1.5.1 - Design Initiatio	1/24/24	22 days	22 days	100	100	1	0	0 days	NA	$15,050	$15,050	$0

Figure 4. Redacted Representation of the TESA Management Summary Schedule Artifact

The TESA schedule artifact is perhaps best characterized as a *management summary schedule* providing a level of detail (e.g., contractually-specified major tasks and milestones) sufficient to enable intended users to understand all aspects of the embodied effort (Fard et al., 2017). It serves as a temporal boundary object enabling different stakeholders to visualize, make sense, monitor, evaluate, and share a common understanding of a complex endeavor (Chang et al., 2013).

Practical Application

As discussed in the previous subtopic, TESA's conceptual framework is situated in an ES time-phased evaluation of cost wherein "cost" is based on the activity durations for consecutive time-boxes or SOW-specified tasks, either of which are designated as requisite activities for respective SOW payment milestones. This subtopic describes how TESA is applied in actual practice with attention given to the enabling technology employed, the processes for schedule development and progress data capture, the performance metrics employed, and some examples of progress reporting.

Enabling Technology

Microsoft *Excel* was initially used during TESA's conceptualization. However, as evident from Figures 3 and 4, Microsoft Project was ultimately chosen for implementation based on the following considerations:

- provision of hierarchical summarization mechanisms, including Project's *grouping* feature for creating a variety of alternative virtual decomposition hierarchies (e.g., technology architecture roadmap),
- availability of temporal data types (e.g., duration, dates) and functions for manipulating those types,
- features for defining TESA's custom calculated fields,
- means for creating custom views leveraging traditional schedule management formats (e.g., Gantt, Task Usage) and facilities for developing custom reports, and
- programmatic access via Visual Basic for Applications to Microsoft Project's time-scaled data object. Although TESA does not presently use this feature of Microsoft Project, eventual use is likely to address tentatively envisioned future reporting needs.

Granted, Microsoft Excel could have been used for implementation. However, substantial work would have been necessary to do so. The choice to use Microsoft Project accelerated TESA's implementation.

Schedule Development Process

The process for incorporating a new SOW-defined body of work in the TESA management summary schedule artifact entails the following steps:

1. A brief overview of TESA is provided to any Performer lacking prior familiarity with the employment of TESA. The overview is intended to answer questions, clarify intentions, ensure comfort with the approach, and ultimately enlist their support.
2. The TESA administrator uses a Microsoft Project template based on the TESA management summary schedule to prepare an initial model of the payment milestones and high-level tasks (i.e., timeboxes) specified in the SOW. Although dependencies between tasks and milestones may be used, dependency logic is not required for TESA. Since the overall goal is establishing a baseline for "what's happening when," SOW activities (e.g., tasks, payment milestones) are typically entered as fixed duration events and positioned in time with a *Start-No-Earlier-Than* constraint date.

   Note that the rationale for developing the initial schedule model for a new SOW separated from the TESA management summary schedule is to avoid disclosure of information about other programs and performers' projects that are already in the TESA management summary schedule.

3. The initial schedule model is sent to the Performer for their review and validation.
4. Upon the Performer's acceptance of the initial schedule model, the TESA administrator adds the information from that model to the TESA management summary schedule and establishes the performance measurement baseline for the newly incorporated information, after which the recurring progress data capture process begins.

Although not discussed as a discrete process, the TESA master summary schedule is always subject to configuration control. All changes to baseline information involve collaboration between the funding organization and the respective Performer(s).

Progress Data Capture

The process for progress data capture requires minimal effort by the performers. The rationale in so doing is to elicit their support for a new schedule management control not specified in their current SOW.

Although the present implementation of TESA utilizes a monthly status reporting cadence, the actual capture date within the month may vary by Performer (e.g., end of the month, mid-month, 27th day of each month). To reduce the Performer burden, TESA's practice is to gather information from each Performer *after* they complete their internal monthly schedule progress evaluation.

For each TESA monthly reporting period, Performers provide answers to three simple questions:

1. Are all objectives for an active task (i.e., timebox) complete? If so, that activity is marked as 100% complete (e.g., task ID 2 named *SOW Task A* appearing in Figure 5). If available, what was the Actual Finish date?
2. Did work on a new task (i.e., timebox) begin? If so, what was the Actual Start date (e.g., task ID 7 named *SOW Task Q* appearing in Figure 5)?
3. For any task (i.e., timebox) which previously started and is still in progress:
   A. Progress completion through the Performer's *Status Date* is assumed (e.g., "whatever the Performer planned to accomplish by the *Status Da*te is regarded as having occurred") by the TESA administrator and applied, resulting in an auto-calculated update of Actual Duration and by extension, Microsoft Project's *%Complete* value (i.e., duration completion percentage).
   B. The Performer communicates either an updated forecast Finish date OR the Remaining Duration necessary to complete that activity (e.g., task ID 7 named *SOW Task Q* appearing in Figure 5 wherein the Performer is signaling that not only did the task start late by 1 day, but also that 2 additional days of Remaining Duration will likely be necessary to complete that activity).

	ES Status	Task Name	Performer Status Date	Baseline Duration	Duration	Actual Duration	Remaining Duration	Planned Schedule (PS)	Earned Schedule (ES)	SV(es)	SPI(es)	PPC%	PC%	Jan
0		TESA Example	1/27/24	68 days	68 days	14.76 days	53.24 days	35 days	31.43 days	3.57 days	0.9	23.97	21.53	
1		Summary Task 1	1/27/24	68 days	68 days	14.02 days	53.98 days	20 days	19.55 days	0.45 days	0.98	21.51	21.02	
2		SOW Task A	1/27/24	10 days	10 days	10 days	0 days	10 days	10 days	0 days	1	100	100	
3		SOW Task B	1/27/24	25 days	27 days	5 days	22 days	5 days	4.75 days	0.25 days	0.95	20	19	
4		SOW Task C	1/27/24	40 days	42 days	5 days	37 days	5 days	4.8 days	0.2 days	0.96	12.5	12	
5		SOW Task D	1/27/24	18 days	18 days	0 days	18 days	0 days	0 days	0 days	0	0	0	
6		Summary Task 2	1/27/24	53 days	51 days	12.05 days	38.95 days	15 days	11.88 days	3.12 days	0.79	28.3	22.41	
7		SOW Task Q	1/27/24	22 days	24 days	13 days	11 days	15 days	11.88 days	3.12 days	0.79	68.18	54	
8		SOW Task R	1/27/24	17 days	17 days	0 days	17 days	0 days	0 days	0 days	0	0	0	
9		SOW Task S	1/27/24	14 days	14 days	0 days	14 days	0 days	0 days	0 days	0	0	0	

Figure 5. An Example of TESA Progress Data Capture

Regarding the rationale for the assumption associated with item 3.A, this is done because at the TESA level of abstraction, no finely granular information is available to reflect the quantitative mechanics that may be characteristic of a Performer's detailed project schedule like the resource allocation (e.g., full-time, part-time), availability (e.g., vacations, holidays, partial work weeks), incorporation of schedule risk contingency (e.g., deliberate introduction of free float to buffer task nodes exhibiting merge bias), intentional utilization of fixed duration tasks (e.g., an interval of time to model a response window for an external party), etc. However, this level of detail does not matter in the TESA context because the SOW-specified tasks—which for some SOWs encountered to date reflect individual projects performed under the purview of the Performer—already account for that finely granular detail; otherwise, finalization of the SOW would not have been possible.

TESA presumes that whatever the Performer intended to accomplish through the current monthly progress reporting occurred as planned. TESA's greater interest is whether that high-level SOW activity will still be completed by its Baseline Finish date OR will it be early or late, and if so, by how many days? As observed in Figure 5, this drives TESA's evaluation of ES performance.

Performance Metrics

Except for use of duration as a cost basis, most of TESA's performance metrics mirror their conventional EV counterpart. Table 2 describes TESA's core metrics.

Table 2. Description and Formulation of Primary TESA Performance Metrics

TESA Performance Metric	Description	Value Type	Detail Task Basis	Summary Task Basis
Performer Status Date	This date value is updated during each monthly TESA progress reporting cycle and propagated to all tasks (e.g., detail, summary) related to a respective SOW's body of work. The date entered coincides with a respective Performer's status update cycle. This feature of TESA accommodates Performers' status reporting date diversity.	Date	Manual Entry	Manual Entry

TESA Performance Metric	Description	Value Type	Detail Task Basis	Summary Task Basis

Planned Schedule (PS)	PS is the TESA equivalent to conventional EV's *Planned Value*. Derived from the *Baseline Duration* relative to the *Performer Status Date*, *PS* indicates the number of calendar days of accomplishment a task should have delivered.	Duration	If *Performer Status Date* is a valid date Then
			If *Baseline Duration* > 0 Then
			If *Baseline Finish* <= *Performer Status Date* Then
			PS = *Baseline Duration*
			Else
			If *Baseline Start* < *Performer Status Date* Then
			PS = *Performer Status Date* - *Baseline Start*
			Else
			PS = *0*
			End If
			End If
			Else
			PS = *0*
			End If
			Else
			PS = *0*
			End If
				Sum the PS values of related Detail Task children

Earned Schedule (ES)	*ES* is the TESA equivalent to conventional EV's Earned Value. ES is derived from the ratio of Actual Duration to the total Duration (i.e., Microsoft Project task *%Complete*) relative to the *Performer Status Date. ES* indicates the number of calendar days of accomplishment a task has delivered.	Duration	If *Performer Status Date* is a valid date Then
			If *Baseline Start* < *Performer Status Date* Then
			If *%Complete* = 100% Then
			ES = *Baseline Duration*
			Else
			ES = *Baseline Duration* * *%Complete*
			End If
			Else
			ES = *0*
			End If
			Else
			ES = *0*
			End If
				Sum the ES values of related Detail Task children

SV(es)	Like conventional EV's calculation of schedule variance, *SV(es)* conveys *ES* variance, indicating the difference between *PS* and *ES*.	Duration	SV(es) = PS - ES	Use the Detail Task formula

SPI(es)	*SPI(es)* is comparable to conventional EV's calculation of a *Schedule Performance Index* (SPI) value, reflecting the rate at which project work is being delivered. Whereas an *SPI(es)* value > 1 indicates a faster delivery rate, a value < 1 indicates a slower delivery rate. Tasks running on schedule as planned	Numeric	If %Complete = 100 Then
			SPI = 1
			Else
			If PS >0 Then
			SPI = ES / PS
			Else
			SPI = 0
			End If
			End If
				Use the Detail Task formula

TESA Performance Metric	Description	Value Type	Detail Task Basis	Summary Task Basis
	exhibit an *SPI(es)* value of 1.			
Cumulative Baseline Duration	The *Cumulative Baseline Duration* is an ES counterpart to conventional EV's *Cumulative Baseline Cost*. It serves as variable for other TESA performance metrics.	Duration	Baseline Duration	Sum the baseline duration values of related Detail Task children

PPC%	PPC% indicates a baseline expected completion percentage. Like its conventional EV counterpart, PPC% conveys the level of accomplishment expressed as a percentage that *should* be complete by the *Performer Status Date* according to the baseline.	Numeric	If %Complete = 100 Then
			PPC% = 100
			Else
			If Cumulative Baseline Duration > 0 Then
			PPC% = (PS / Cumulative Baseline Duration) * 100
			Else
			PPC% = 0
			End If
			End If
				Use the Detail Task formula

PC%	Like its conventional EV counterpart, PC% indicates the percentage of what *has* been completed by the *Performer Status Date.*	Numeric	If %Complete = 100 Then
			PC% = 100
			Else
			If Cumulative Baseline Duration > 0 Then
			PC% = (ES / Cumulative Baseline Duration) * 100
			Else
			PC% = 0
			End If
			End If
				Use the Detail Task formula

Reporting

In addition to the core metrics presented in Table 2, TESA employs other calculated indicators to

- provide alternative forecasts based on current performance trends (e.g., $TSPI_{(es)}$, ES Forecast Finish Variance, ES Forecast Finish date, correlation of milestone payment amounts with respect to time along with identifying what has been paid and what remains to be paid) and . . .
- . . . generate condition-driven analysis narratives and graphic indicators that speed analysis and automate generation of executive summary reports.

Furthermore, since EV measurements like those employed by TESA can readily be summarized by any number of attribute-driven hierarchies, TESA takes advantage of Microsoft Project's grouping features to provide alterative analyses of schedule information. This enables rendering cross-project views to answer questions like, "To what extent has progress been made on a capability R&D effort from a technology architecture roadmap perspective? Where are the gaps? What is the magnitude of the work that remains to be done to address those gaps?"

Figures 6 and 7 illustrate some of these "art of the possible" aspects of reporting. Other examples may also be seen in Figures 4 and 5.

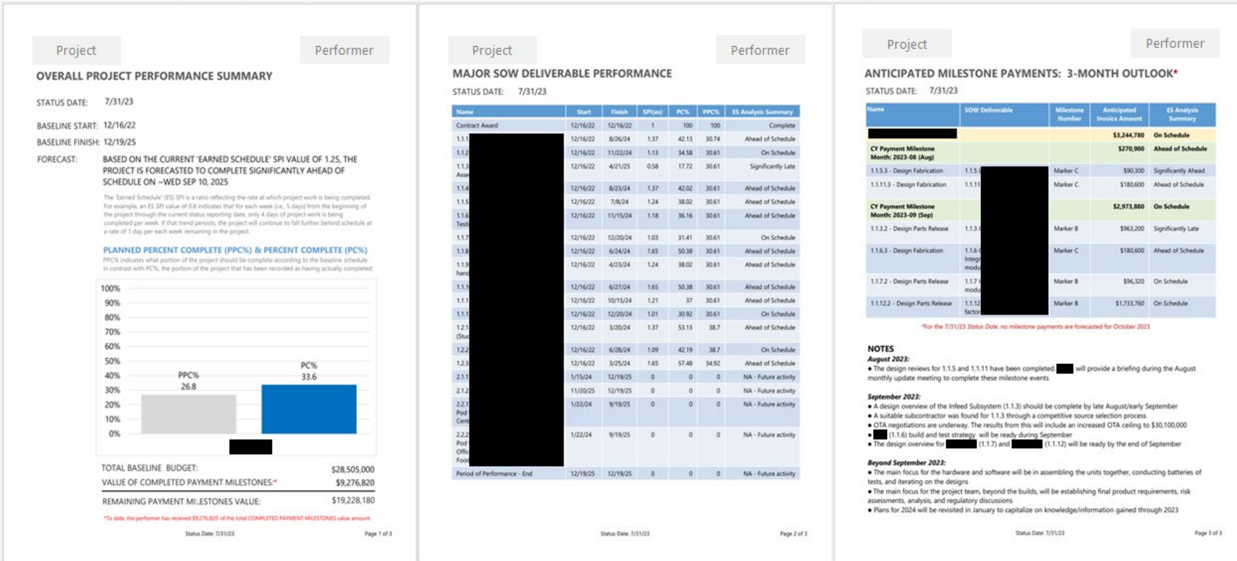
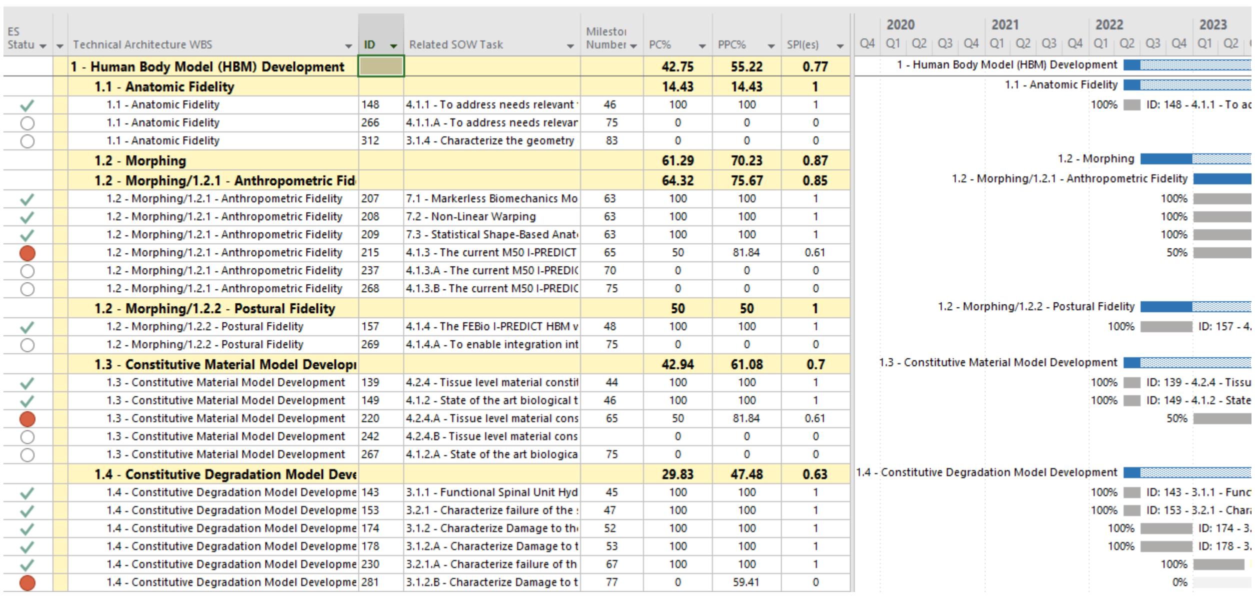


Figure 6. Redacted Example of an Autogenerated Management Summary Report for a Respective Perfomer



Technical Architecture WBS	ID	Related SOW Task	Milestone Number	PC%	PPC%	SPI(es)
1 - Human Body Model (HBM) Development				**42.75**	**55.22**	**0.77**
1.1 - Anatomic Fidelity				**14.43**	**14.43**	**1**
1.1 - Anatomic Fidelity	148	4.1.1 - To address needs relevant	46	100	100	1
1.1 - Anatomic Fidelity	266	4.1.1.A - To address needs relevar	75	0	0	0
1.1 - Anatomic Fidelity	312	3.1.4 - Characterize the geometry	83	0	0	0
1.2 - Morphing				**61.29**	**70.23**	**0.87**
1.2 - Morphing/1.2.1 - Anthropometric Fid				**64.32**	**75.67**	**0.85**
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	207	7.1 - Markerless Biomechanics Mo	63	100	100	1
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	208	7.2 - Non-Linear Warping	63	100	100	1
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	209	7.3 - Statistical Shape-Based Anat	63	100	100	1
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	215	4.1.3 - The current M50 I-PREDICT	65	50	81.84	0.61
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	237	4.1.3.A - The current M50 I-PREDI(	70	0	0	0
1.2 - Morphing/1.2.1 - Anthropometric Fidelity	268	4.1.3.B - The current M50 I-PREDIC	75	0	0	0
1.2 - Morphing/1.2.2 - Postural Fidelity				**50**	**50**	**1**
1.2 - Morphing/1.2.2 - Postural Fidelity	157	4.1.4 - The FEBio I-PREDICT HBM v	48	100	100	1
1.2 - Morphing/1.2.2 - Postural Fidelity	269	4.1.4.A - To enable integration int	75	0	0	0
1.3 - Constitutive Material Model Develop				**42.94**	**61.08**	**0.7**
1.3 - Constitutive Material Model Development	139	4.2.4 - Tissue level material constit	44	100	100	1
1.3 - Constitutive Material Model Development	149	4.1.2 - State of the art biological t	46	100	100	1
1.3 - Constitutive Material Model Development	220	4.2.4.A - Tissue level material cons	65	50	81.84	0.61
1.3 - Constitutive Material Model Development	242	4.2.4.B - Tissue level material cons		0	0	0
1.3 - Constitutive Material Model Development	267	4.1.2.A - State of the art biologica	75	0	0	0
1.4 - Constitutive Degradation Model Deve				**29.83**	**47.48**	**0.63**
1.4 - Constitutive Degradation Model Developme	143	3.1.1 - Functional Spinal Unit Hyd	45	100	100	1
1.4 - Constitutive Degradation Model Developme	153	3.2.1 - Characterize failure of the	47	100	100	1
1.4 - Constitutive Degradation Model Developme	174	3.1.2 - Characterize Damage to th	52	100	100	1
1.4 - Constitutive Degradation Model Developme	178	3.1.2.A - Characterize Damage to t	53	100	100	1
1.4 - Constitutive Degradation Model Developme	230	3.2.1.A - Characterize failure of th	67	100	100	1
1.4 - Constitutive Degradation Model Developme	281	3.1.2.B - Characterize Damage to t	77	0	59.41	0

Figure 7. Example of an Alternative Hierarchical View From a Technology Architecture Roadmap Perspective

The Result

Having previously described the dimensions of the problem (e.g., desired outcomes, constraints), the approach (e.g., conceptual framework, practical application dimensions) that culminated in proposition of TESA, this section describes the results beginning with the observed practical application benefits of TESA, as well as its limitations and their related mitigations. This section concludes with recommendations for further future research.

Benefits

Thus far in practical application, TESA seems sufficiently suitable for:

- constrained practice settings where schedule posture is an important situation awareness need and implementation time is limited,

- contexts exhibiting diversity in performers' project schedule management capability maturity and development methods (e.g., rigor sufficiency, artifact quality), which further complicates deployment of schedule control approaches of increasing complexity, and
- situations wherein SOW-specified project management obligations are negligible and enlistment of Performer support might prove challenging in direct proportion to the perceived additional overhead effort required to implement a schedule control process not specified in the SOWs.

Although the desired outcomes did not request accommodation of Agile contexts, as observed by Van De Velde (2017), ES approaches seem suited to address the agility practice dilemma of schedule performance accountability. When a sprint concludes, the technical debt incurred by the incomplete work from that sprint has both cost and schedule consequences that merit acknowledgment and address. As an ES-based approach, TESA could address that dilemma.

TESA's benefits include:

- a "light-touch" approach for providing schedule situational awareness with minimal effort,
- accommodation of variety in Performer status report dates; Performers are not required to operate together in lockstep for progress reporting,
- protection of Performers' proprietary work management methods by not requiring incorporation of all performer-managed schedule details into the TESA management summary schedule. The high-level activities and payment milestones specified in the SOWs are sufficient for implementation of TESA,
- not requiring dependency network logic to evaluate the consequential ripple effects of schedule accomplishment,
- independence from needing direct access to Performers' schedule artifacts,
- avoiding the complexity of a traditional IMS artifact, and
- retention of EV management's cumulative analysis benefits that simplify evaluation of schedule accomplishment across multiple programs and projects to support various audiences' summarization needs (e.g., portfolio, program, performer, project, capability roadmap).

Limitations

TESA is not devoid of limitations, three of which include:

- *Duration granularity resolution risk* – As previously discussed in *The Approach* subtopic of *Agile Timeboxing*, schedule control risk increases for tasks whose duration spans more than two reporting periods. Agile timeboxing was initially envisioned as a risk mitigation for this aspect of TESA. However, in actual practice, Performers preferred use of the SOW tasks instead of timeboxes with finer duration granularity.

  Amelioration of this risk rests on the assumption that Performers possess detailed project schedules for their own operational control and are therefore capable of informing the higher-level SOW task summarizations.

- *No direct account for potential exhibition of merge bias risk inherent in dependency network design behavior* – TESA does not rely on dependency network behavior for evaluation of schedule performance (i.e., the ripple effect), nor does it have access to the underlying details about the dependency network and nature of resource application within the Performer's local operational control schedule that might clarify potential opportunities for realizing merge bias risk.

However, even without incorporation of dependency information within the TESA management summary schedule or access to additional detailed information within Performers' operational control schedules, instances of steepening slope exhibited in the cumulative PS curve likely signal increased concurrent activity with a higher likelihood for incurring merge bias risk and therefore merit closer attention when "time now" traverses that interval.

- *Reliance on timely and accurate communication of performance information* – The bane of any PPM control system is the quality and reliability of the information provided by respective project and task owners. TESA mitigation of this risk entails promotion of narratives that encourage Performers to provide reliable information. For example, one narrative routinely socialized through the TESA overview shared new Performers emphasizes that TESA is not a means for micromanagement; it helps the Sponsor visualize the totality of the portfolio and facilitates collaborative discussions to resolve emergent issues.

Recommendations for Further Research

The limited time with which to conceive and implement TESA in response to an immediate need necessitated a reflective practice approach (Schön, 1983). Consistent with reflective practice theory as employed by several professions (e.g., medical, legal, educational, architectural, project management), the authors framed the problem, engaged adaptive rigor in appropriating components from their profession's body knowledge, and devised a practice response situated in their professional experience and knowledge (e.g., Oliver, 1999, 2002; Peterson & Oliver, 2001).

The occasion of preparing this paper post-implementation of TESA provided an opportunity to discover additional literature further exploring duration-based EV-situated approaches. A systematic literature review with the intent of proposing a standard nomenclature for duration-based EV approaches seems warranted. Results from this research would better differentiate conventional EV performance measurement nomenclature from what Khamooshi and Golafshani (2014) have designated as *earned duration management* (EDM). As an example, TESA uses the term SPI(es) to differentiate its schedule performance index based on duration from conventional EV's SPI using a currency cost-basis. In contrast, Khamooshi and Golafshani's (2014) *Earned Duration Index* (EDI) provides terminological specificity for differentiating a duration-based schedule performance index from conventional EV's currency-based SPI indicator.

Conclusion

Regarding the question of whether complexity is a prerequisite for effectiveness, Hopej-Kamińska et al. (2015) observed, " structure should not always be simple but should be the simplest of all the possibilities" (p. 272). Despite its utilization of time-phased cost mechanics appropriated conventional EV, TESA seems to fit the characterization of being the simplest of all possibilities for realizing the desired outcomes while accommodating specific practice constraints. Consistent with the practical application tenets of reflective practice theory (Schön, 1983), monitoring of TESA's effectiveness as a practice response continues with modifications being made as needed.

References

Chang, A., Hatcher, C., & Kim, J. (2013). Temporal boundary objects in megaprojects: Mapping the system with the integrated master schedule. *International Journal of Project Management*, *31*(3), 323–332.

Congressional Research Service. (2019). *Department of Defense use of Other Transaction Authority: Background, analysis, and issues for Congress* (CRS R45521). https://crsreports.congress.gov/product/pdf/R/R45521

DoD. (2023). *Integrated master plan (IMP) and integrated master schedule (IMS) preparation and use guide*. Office of the Under Secretary of Defense for Research and Engineering. https://www.dau.edu/cop/se/documents/IMS%20and%20IMP%20Preparation%20and%20User%20Guide

Fard, M. M., Dysert, L. R., Terouhid, S. A., & Lovejoy, V. (2017). *Management summary schedule - Recommended practice no. 89-R16 (pp. 1-8)*. Association for the Advancement of Cost Engineering, International. https://web.aacei.org/docs/default-source/rps/89r-16.pdf?sfvrsn=d70ad0b5_18

Hopej-Kamińska, M., Zgrzywa-Ziemak, A., Hopej, M., Kamiński, R., & Martan, J. (2015). Simplicity as a feature of an organizational structure. *Argumenta Oeconomica*, *1*(34), 259–276.

Khamooshi, H., & Golafshani, H. (2014). EDM: Earned duration management, a new approach to schedule performance management and measurement. *International Journal of Project Management*, *32*(6), 1019–1041.

Lipke, W. (2003). Schedule is different. *The Measurable News – The Quarterly Magazine of the College of Performance Management*, *4*, 31–34.

Lipke, W. H. (2012). *Earned schedule: An extension to earned value management*. Lulu.

National Defense Industrial Association. (2018). *Earned value management systems EIA-748-D intent guide*. https://www.humphreys-assoc.com/evms/evms-documents/ndia/ndia_ipmd_intent_guide_ver_d_aug282018.pdf

Office of the Under Secretary of Defense for Acquisition and Sustainment. (2023). *Other transactions guide*. https://www.acq.osd.mil/asda/dpc/cp/policy/docs/guidebook/TAB%20A1%20%20DoD%20OT%20Guide%20JUL%202023_final.pdf

Oliver, M. E. (1999). *System and method for project management and assessment* (U.S. Patent No. 5,907,490). U.S. Patent and Trademark Office. https://ppubs.uspto.gov/dirsearch-public/print/downloadPdf/5907490

Oliver, M. E. (2002). *System and method for project management and assessment* (U.S. Patent No. 20,020,082,889). U.S. Patent and Trademark Office. https://ppubs.uspto.gov/dirsearch-public/print/downloadPdf/20020082889

Peterson, C. D., & Oliver, M. E. (2001). EV-Lite – Earned value control for fast paced projects. In *32nd Annual Project Management Institute Seminars and Symposium*. https://www.pmi.org/learning/library/earned-value-control-fast-paced-pm-7962

Remington, K., & Pollack, J. (2011). Tools for complex projects. In T. Cooke-Davies, L. Crawford, J. R. Patton, C. Stevens, & T. M. Williams (Eds.), *Aspects of complexity: Managing projects in a complex world* (pp. 29–40). Project Management Institute.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.

Van De Velde, R. (2017). Agile's earned schedule baseline. *The Measurable News – The Quarterly Magazine of the College of Performance Management*, *4*, 37–42.

Winter, M., Smith, C., Morris, P., & Cicmil, S. (2006). Directions for future research in project management: The main findings of a UK government-funded research network. *International Journal of Project Management*, *24*, 638–649. doi:10.1016/j.ijproman.2006.08.009

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