

Assessment and Control

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The purpose of systems engineering assessment and control (SEAC) is to provide adequate visibility into the project's actual technical progress and risks with respect to the technical plans (i.e., systems engineering management plan (SEMP) or systems engineering plan (SEP) and subordinate plans). The visibility allows the project team to take timely preventive action when disruptive trends are recognized or corrective action when performance deviates beyond established thresholds or expected values. SEAC includes preparing for and conducting reviews and audits to monitor performance. The results of the reviews and measurement analyses are used to identify and record findings/discrepancies and may lead to causal analysis and corrective/preventive action plans. Action plans are implemented, tracked, and monitored to closure. (NASA 2007, Section 6.7; SEG-ITS, 2009, Section 3.9.3, 3.9.10; INCOSE, 2010, Clause 6.2; SEI, 2007)



Contents

Systems Engineering Assessment and Control Process Overview

Linkages to Other Systems Engineering Management Topics

Practical Considerations

 Pitfalls

 Good Practices

References

Works Cited

Primary References

Additional References

Systems Engineering Assessment and Control Process Overview

The SEAC process involves determining and initiating the appropriate handling strategies and actions for findings and/or discrepancies that are uncovered in the enterprise, infrastructure, or life cycle activities associated with the project. Analysis of the causes of the findings/discrepancies aids in the determination of appropriate handling strategies. Implementation of approved preventive, corrective, or improvement actions ensures satisfactory completion of the project within planned technical, schedule, and cost objectives. Potential action plans for findings and/or discrepancies are reviewed in the context of the overall set of actions and priorities in order to optimize the benefits to the project and/or organization. Interrelated items are analyzed together to obtain a consistent and cost-effective resolution.

The SEAC process includes the following steps:

- monitor and review technical performance and resource use against plans
- monitor technical risk, escalate significant risks to the project risk register and seek project funding to execute risk mitigation plans
- hold technical reviews and report outcomes at the project reviews
- analyze issues and determine appropriate actions
- manage actions to closure
- hold a post-delivery assessment (also known as a post-project review) to capture knowledge associated with the project (this may be a separate technical assessment or it may be conducted as part of the project assessment and control process).

The following activities are normally conducted as part of a project assessment and control process:

- authorization, release and closure of work
- monitor project performance and resource usage

against plan

- monitor project risk and authorize expenditure of project funds to execute risk mitigation plans
- hold project reviews
- analyze issues and determine appropriate actions
- manage actions to closure
- hold a post-delivery assessment (also known as a post-project review) to capture knowledge associated with the project

Examples of major technical reviews used in SEAC are shown in Table 1 from DAU (2010).

Table 1. Major Technical Review Examples (DAU 2012).

Released by Defense Acquisition University (DAU)/U.S. Department of Defense (DoD).

Name	Description
Alternative Systems Review	A multi-disciplined review to ensure the resulting set of requirements agrees with the customers' needs and expectations.
Critical Design Review (CDR)	A multi-disciplined review establishing the initial product baseline to ensure that the system under review has a reasonable expectation of satisfying the requirements of the capability development document within the currently allocated budget and schedule.
Functional Configuration Audit	Formal examination of the as-tested characteristics of a configuration item (hardware and software) with the objective of verifying that actual performance complies with design and interface requirements in the functional baseline.
In-Service Review	A multi-disciplined product and process assessment that is performed to ensure that the system under review is operationally employed with well-understood and managed risk.
Initial Technical Review	A multi-disciplined review that supports a program's initial program objective memorandum submission.
Integrated Baseline Review	A joint assessment conducted by the government program manager and the contractor to establish the performance measurement baseline.

Operational Test Readiness Review	<p>A multi-disciplined product and process assessment to ensure that the system can proceed into initial operational test and evaluation with a high probability of success, and also that the system is effective and suitable for service introduction.</p>
Production Readiness Review (PRR)	<p>The examination of a program to determine if the design is ready for production and if the prime contractor and major subcontractors have accomplished adequate production planning without incurring unacceptable risks that will breach thresholds of schedule, performance, cost, or other established criteria.</p>
Physical Configuration Audit	<p>An examination of the actual configuration of an item being produced around the time of the full-rate production decision.</p>
Preliminary Design Review (PDR)	<p>A technical assessment establishing the physically allocated baseline to ensure that the system under review has a reasonable expectation of being judged operationally effective and suitable.</p>
System Functional Review (SFR)	<p>A multi-disciplined review to ensure that the system's functional baseline is established and has a reasonable expectation of satisfying the requirements of the initial capabilities document or draft capability development document within the currently allocated budget and schedule.</p>
System Requirements Review (SRR)	<p>A multi-disciplined review to ensure that the system under review can proceed into initial systems development and that all system requirements and performance requirements derived from the initial capabilities document or draft capability development document are defined and testable, as well as being consistent with cost, schedule, risk, technology readiness, and other system constraints.</p>

System Verification Review (SVR)	A multi-disciplined product and process assessment to ensure the system under review can proceed into low-rate initial production and full-rate production within cost (program budget), schedule (program schedule), risk, and other system constraints.
Technology Readiness Assessment	A systematic, metrics-based process that assesses the maturity of critical technology elements, such as sustainment drivers.
Test Readiness Review (TRR)	A multi-disciplined review designed to ensure that the subsystem or system under review is ready to proceed into formal testing.

Linkages to Other Systems

Engineering Management Topics

The SE assessment and control process is closely coupled with the measurement, planning, decision management, and risk management processes. The measurement process provides indicators for comparing actuals to plans. Planning provides estimates and milestones that constitute plans for monitoring as well as the project plan, which uses measurements to monitor progress. Decision management uses the results of project monitoring as decision criteria for making control decisions.

Practical Considerations

Key pitfalls and good practices related to SEAC are described in the next two sections.

Pitfalls

Some of the key pitfalls encountered in planning and performing SE assessment and control are shown in Table 2.

Table 2. Major Pitfalls with Assessment and Control.
(SEBoK Original)

Name	Description
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No Measurement	<p>Since the assessment and control activities are highly dependent on insightful measurement information, it is usually ineffective to proceed independently from the measurement efforts - what you get is what you measure.</p>
"Something in Time" Culture	<p>Some things are easier to measure than others - for instance, delivery to cost and schedule. Don't focus on these and neglect harder things to measure like quality of the system. Avoid a "something in time" culture where meeting the schedule takes priority over everything else, but what is delivered is not fit for purpose, resulting in the need to rework the project.</p>
No Teeth	<p>Make sure that the technical review gates have "teeth". Sometimes the project manager is given authority (or can appeal to someone with authority) to over-ride a gate decision and allow work to proceed, even when the gate has exposed significant issues with the technical quality of the system or associated work products. This is a major risk if the organization is strongly schedule-driven; it can't afford the time to do it right, but somehow it finds the time to do it again (rework).</p>
Too Early Baselining	<p>Don't baseline requirements or designs too early. Often there is strong pressure to baseline system requirements and designs before they are fully understood or agreed, in order to start subsystem or component development. This just guarantees high levels of rework.</p>

Good Practices

Some good practices gathered from the references are shown in Table 3.

Table 3. Proven Practices with Assessment and Control.
(SEBoK Original)

Name	Description
Independence	Provide independent (from customer) assessment and recommendations on resources, schedule, technical status, and risk based on experience and trend analysis.
Peer Reviews	Use peer reviews to ensure the quality of a product's work before they are submitted for gate review.

Accept Uncertainty	Communicate uncertainties in requirements or designs and accept that uncertainty is a normal part of developing a system.
Risk Mitigation Plans	Do not penalize a project at gate review if they admit uncertainty in requirements - ask for their risk mitigation plan to manage the uncertainty.
Just In-Time Baselineing	Baseline requirements and designs only when you need to - when other work is committed based on the stability of the requirement or design. If work must start and the requirement or design is still uncertain, consider how you can build robustness into the system to handle the uncertainty with minimum rework.
Communication	Document and communicate status findings and recommendations to stakeholders.
Full Visibility	Ensure that action items and action-item status, as well as other key status items, are visible to all project participants.
Leverage Previous Root Cause Analysis	When performing root cause analysis, take into account the root cause and resolution data documented in previous related findings/discrepancies.
Concurrent Management	Plan and perform assessment and control concurrently with the activities for Measurement and Risk Management.
Lessons Learned and Post-Mortems	Hold post-delivery assessments or post-project reviews to capture knowledge associated with the project - e.g., to augment and improve estimation models, lessons learned databases, gate review checklists, etc.

Additional good practices can be found in INCOSE (2010, Clause 6.2), SEG-ITS (2009, Sections 3.9.3 and 3.9.10), INCOSE (2010, Section 5.2.1.5), and NASA (2007, Section 6.7).

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