WHITE PAPER

# Where Systems Engineering and Project Management Merge:

Process Convergence Zones in Complex Defense Programs

Casey Shull, Ph.D., PMP, MBA · February 2026

## Abstract

Systems Engineering (SE) and Project Management (PM) are frequently treated as parallel but distinct disciplines, one concerned with what a system must do and how it must behave, the other with the schedule, cost, and resource constraints within which it must be delivered. In practice, on complex defense and platform integration programs, this separation is artificial and operationally dangerous. This paper identifies and examines seven discrete process convergence zones, locations in the program lifecycle where SE and PM activities are not merely adjacent but genuinely inseparable, and proposes an integrated execution model for each. Drawing on IEEE 15288, PMI PMBOK Seventh Edition, and applied frameworks including C - Modulus for program performance anomaly detection, this paper offers both a theoretical foundation and practical guidance for program leaders, Project Engineering Leads (PELs), and Integrated Product Team (IPT) managers operating in defense acquisition, platform systems integration, and other complex engineering environments.

**Keywords:** *Systems Engineering, Project Management, IEEE 15288, PMI PMBOK, Integrated Product Teams, Earned Value Management, Requirements Traceability, Technical Baseline, Defense Acquisition, Program Lifecycle, C-Modulus*

## 1. INTRODUCTION

The canonical view of program execution places Systems Engineering on one side of an organizational chart and Project Management on the other. The systems engineer defines requirements, architects solutions, manages interfaces, and verifies that the delivered system meets its intended purpose. The project manager plans the work, tracks schedule and cost, manages risks and resources, and reports status to stakeholders. Both disciplines have well-established bodies of knowledge, professional certifications, and governing standards. And yet, on complex defense programs, platform integration efforts involving avionics, mission systems, software, hardware, and supply chain disciplines simultaneously, this clean separation routinely breaks down.

The breakdown is not a failure of discipline. It is a structural feature of program complexity. When requirement change ripples through a system architecture, it immediately becomes a schedule and cost event. When earned value curves diverge from baseline, the cause is almost always a technical event, a design issue, an interface ambiguity, a verification failure, not a scheduling error in isolation. When a supplier delivers a non-conforming component, the response requires both a technical disposition and a program re-plan. In each of these scenarios, SE and PM are not operating in sequence, they are operating simultaneously, on the same problem, with shared authority over the outcome.

 

This paper names and examines these moments of convergence as Process Convergence Zones (PCZs): discrete locations in the program lifecycle where the activities, decisions, and tools of SE and PM cannot be meaningfully separated. Understanding PCZs is not an academic exercise. For the program leader, whether a Systems Engineer acting as technical authority, a Project Engineer coordinating cross-discipline execution, or a program manager driving delivery, knowing where convergence occurs is the foundation of effective integrated program execution.

**PREMISE**

*Systems Engineering and Project Management do not merge everywhere, but where they do merge, the consequences of treating them as separate are schedule slips, cost growth, and technical failures that trace back not to incompetence but to organizational seams that should not exist.*

## 2. FOUNDATIONAL FRAMEWORKS

Two bodies of knowledge govern this discussion. IEEE/ISO/IEC 15288:2023, Systems and Software Engineering: System Life Cycle Processes, defines the SE lifecycle in terms of 30 processes organized across four process groups: Agreement, Organizational Project-Enabling, Technical Management, and Technical Processes. The PMI PMBOK Seventh Edition (2021) reframes project management around eight performance domains and twelve principles, shifting from a process-centric to an outcomes-and-value-centric model. The DAU (Defense Acquisition University) Systems Engineering Guidebook and the DoD 5000.02 acquisition framework provide additional structure specific to defense program environments.

Critically, IEEE 15288 does not treat technical management as a purely SE function. Its Technical Management Process Group (Clause 6.3), which includes Planning, Assessment and Control, Decision Management, Risk Management, Configuration Management, Information Management, Measurement, and Quality Assurance maps almost exactly onto the knowledge areas of traditional project management. The overlap is not coincidental. ISO/IEC/IEEE recognized, in the 2015 revision and affirmed in 2023, that technical program execution cannot be cleanly separated from program management at the process level. The PMI PMBOK Seventh Edition similarly acknowledges that project performance cannot be governed through schedule and cost metrics alone; it requires technical performance measurement as an integrated element of program health.

The result is a de facto convergence zone at the standards level itself, both governing bodies have moved toward integration even as organizational practice continues to separate the disciplines. This paper “operationalizes” that convergence into seven specific program zones.

## 3. THE SEVEN PROCESS CONVERGENCE ZONES

The following seven PCZs represent the locations in a complex defense program lifecycle where SE and PM activities are operationally inseparable. Each zone is characterized by a shared decision space, a common artifact, or a joint accountability structure that cannot be assigned to either discipline alone.

 

### PCZ 1 — Requirements Definition and Work Breakdown Structure Alignment

The first convergence occurs at program inception, when systems engineers are defining and decomposing requirements through functional architecture and project managers are simultaneously constructing the Work Breakdown Structure (WBS). In a well-integrated program, these two activities are not sequential, they are co-generative. The WBS should be traceable to the functional decomposition of requirements; the functional architecture should be constrained by the organizational and contractual structure the WBS reflects.

In defense programs structured under MIL-STD-881 (Work Breakdown Structure (WBS) for Defense Materiel Items), the WBS is contractually mandated and dictates how cost accounts are established, how Earned Value Management System (EVMS) data is reported, and how performance is measured. When the SE functional decomposition diverges from the WBS, a common occurrence when SE and PM teams operate independently, the result is requirements that have no cost account, cost accounts that have no traceable requirement, and a program baseline that cannot accurately reflect technical progress.

> **INTEGRATION IMPERATIVE**
> *Requirements Traceability Matrices (RTMs) should be developed in parallel with WBS construction, with shared ownership between the lead systems engineer and the program control manager. Every Level 3 WBS element should trace to at least one allocated requirement. Every allocated requirement should trace to at least one WBS cost account.*

### PCZ 2 — Technical Baseline and Performance Measurement Baseline

The Technical Baseline (TB) approved set of requirements, architecture, interface definitions, and design constraints that govern program execution, is a Systems Engineering artifact. The Performance Measurement Baseline (PMB), the time-phased budget against which Earned Value is measured, is a Project Management artifact. In DoD Acquisition programs governed by EVMS (required on contracts over $20M), these two baselines must be synchronized: any change to the TB that affects scope, schedule, or cost must be reflected in the PMB through a formal Baseline Change Request (BCR) process.

In practice, TB changes frequently outrun PMB updates. An engineering change is approved at the system level, implemented in the design, and reflected in updated specifications, but the PMB is not updated until the next reporting cycle. The result is a phantom variance: the EVMS reports a cost or schedule deviation that is a legitimate scope change, not a performance problem. Conversely, PMB re-plans that are not tied to formal TB changes produce a Performance Measurement Baseline that no longer reflects the actual technical scope of work, a condition sometimes called "rubber baseline" that undermines EVMS integrity.

The convergence zone here requires a joint Configuration Control Board (CCB) process in which the technical authority (SE) and program control (PM) review and approve changes simultaneously, with explicit handshakes between the Engineering Change Proposal (ECP) process and the BCR process.

### PCZ 3 — Risk Management and Technical Risk Identification

Risk management is formally a shared function in both IEEE 15288 (Risk Management process) and PMI PMBOK (Uncertainty Performance Domain). In defense programs, DoD Instruction 5000.02 requires the development of an acquisition strategy or, as defined in this paper, an integrated risk management process that captures both programmatic risk (schedule, cost, resource) and technical risk (performance, reliability, interface, maturity). The convergence zone is the risk register itself: a single artifact that must

 

simultaneously reflect technical risk drivers, derived from system complexity, technology readiness levels (TRLs), interface uncertainties, and verification challenges, and programmatic risk drivers, derived from schedule margins, cost reserves, supplier performance, and contract constraints.

The breakdown most frequently observed in practice is the dual risk register: SE maintains a technical risk list organized by system element; PM maintains a program risk register organized by WBS element. The two lists are never reconciled. Technical risks that become schedule threats are not elevated to program risk status; programmatic risks that have technical root causes are treated as execution problems rather than engineering problems. The result is a risk management process that is formally compliant but operationally blind.

C-Modulus, a quantitative framework for detecting Cost Performance Index (CPI) and Schedule Performance Index (SPI) anomalies through pattern analysis of EVMS data, was developed specifically to address this blind spot. By identifying characteristic deviation signatures in earned value curves that correspond to underlying technical events (requirements instability, interface churn, verification failure rates), C-Modulus provides a systematic bridge between technical risk realization and programmatic early warning. The framework treats an EVMS anomaly not as a PM problem to be re-planned around, but as a signal to be diagnosed at the technical level, precisely because most program cost and schedule events originate in the SE domain.

> **C-MODULUS, CONVERGENCE TOOL**
> *When SPI and CPI diverge in characteristic patterns, CPI degrades while SPI holds, or SPI collapses suddenly after a stable period, the underlying cause is almost invariably a technical event: a design disclosure that exposed a previously unrecognized interface, a test failure that triggered a redesign, or a requirements change that was absorbed without a formal baseline change. C-Modulus quantifies these signatures and links EVMS anomalies to their probable SE origin, enabling joint SE/PM diagnosis rather than sequential blame assignment.*

### PCZ 4 — Integrated Master Schedule and Systems Engineering Management Plan

The Integrated Master Schedule (IMS) is the program's time-phased execution plan, owned by the project manager and governed by IPMDAR (Integrated Program Management Data and Analysis Report) requirements on DoD contracts. The Systems Engineering Management Plan (SEMP) defines the SE processes, reviews, artifacts, and decision gates that govern technical program execution. In a properly integrated program, the SEMP drives the IMS: every SE review milestone, every design disclosure event, every verification activity, and every interface control working group (ICWG) meeting should have a corresponding IMS activity with logic-linked predecessors and successors.

When SEMP and IMS are developed independently, as is common when SE and PM teams operate in organizational silos, the IMS becomes a schedule of administrative milestones that does not reflect the actual technical logic of the program. System Design Reviews (SDRs), Preliminary Design Reviews (PDRs), and Critical Design Reviews (CDRs) appear as point events rather than as gates with defined entry criteria, exit criteria, and traceable action item closure. The result is a schedule that passes milestone reviews on paper while technical readiness lags by weeks or months.

The convergence zone requires that the SEMP and IMS be co-developed, with the lead systems engineer and the program scheduler working from a shared understanding of technical dependencies. Every CDR

 

entrance criterion should have an IMS predecessor; every verification test completion should have a schedule activity that links both the test plan (SE artifact) and the EVMS cost account (PM artifact).

### PCZ 5 — Interface Management and Supplier/Subcontractor Control

Interface management, the SE discipline of defining, controlling, and verifying the physical, functional, and data interfaces between system elements, has a direct and underappreciated impact on program cost and schedule. Every unresolved interface is a latent schedule risk; every interface change that reaches hardware or software integration without proper control is a re-work event that consumes cost reserves. In a defense platform integration program involving multiple prime contractors, subcontractors, and government-furnished equipment (GFE), the volume and complexity of interface control activity is sufficient to drive the program schedule independently of any other single factor.

The PM dimension of interface management is supplier control: the use of contract data requirements (CDRLs), statement of work (SOW) provisions, and supplier surveillance activities to enforce interface compliance at the subcontract level. The SE dimension is Interface Control Documents (ICDs), Interface Control Working Groups (ICWGs), and the Interface Requirements Specification (IRS). The convergence zone is the supplier management review, the program event at which technical interface compliance and contractual performance are assessed simultaneously, by a team that includes both the systems engineer responsible for the interface definition and the contracts/supply chain representative responsible for contractual enforcement.

Programs that separate these reviews, holding a technical interface review in one forum and a supplier performance review in a separate program management review, consistently discover interface non-conformances later, at integration, when the cost of correction is orders of magnitude higher than it would have been at the design stage.

### PCZ 6 — Verification and Validation Planning and Schedule/Cost Integration

Verification and Validation (V&V) the SE processes by which a system is confirmed to meet its specified requirements (verification) and to fulfill its intended operational purpose (validation) are among the most resource-intensive activities in a defense program lifecycle. Test events consume facility time, hardware, software builds, personnel, and instrumentation. They also consume schedule: a test failure at CDR+12 months does not produce a re-plan; it produces a program crisis that PM and SE must jointly resolve.

The convergence zone in V&V occurs at three specific points. First, in test planning: the Verification Requirements Matrix (VRM) or System Verification Review (SVR) artifact must be directly linked to the IMS test schedule and to cost accounts that reflect actual test resource consumption. Second, at test execution: test failures trigger non-conformance reports (NCRs) that have both a technical disposition path (SE) and a schedule/cost impact path (PM). Third, at delta qualification or re-test events: the decision to re-test, accept with deviation, or seek a waiver is a joint technical-programmatic decision with significant cost and schedule implications.

Programs that treat V&V planning as purely a SE activity, disconnected from the IMS and from EVMS cost accounts, consistently underestimate test resource requirements, fail to reserve schedule margin for re-test, and discover cost overruns at the verification phase when the program has the least flexibility to absorb them.

 

### PCZ 7 — Design Reviews as Program Decision Gates

Formal design reviews, System Requirements Review (SRR), System Design Review (SDR), Preliminary Design Review (PDR), Critical Design Review (CDR), and Test Readiness Review (TRR) are defined in IEEE 15288 and MIL-HDBK-61B as SE artifacts: structured events at which the technical community assesses the maturity and adequacy of the evolving design. In defense acquisition programs, they are simultaneously program decision gates: events at which the government customer, the program management office, and the contractor leadership jointly assess program health and authorize continuation.

The convergence zone is the review itself. Design review entrance and exit criteria must be satisfied technically (SE) and administratively (PM). Action items generated at a PDR are both technical (unresolved design issues) and programmatic (schedule and cost implications of resolution). The decision to proceed from PDR to CDR, to authorize the investment in detailed design, is simultaneously a technical maturity judgment and a program risk decision. In DoD programs, this decision is typically made by an Acquisition Decision Authority who requires both the Technical Performance Measures (TPMs) from the SE community and the EVMS performance data from the PM community before granting approval.

Design reviews that are treated as purely SE events, with PM participation limited to scheduling logistics, consistently produce one of two failure modes: reviews that pass on technical grounds while the program is in cost or schedule distress, or reviews that are deferred for programmatic reasons while the technical community lacks clear authority to resolve design issues during the deferral period.

## 4. PROCESS CONVERGENCE ZONE SUMMARY

Table 1 summarizes the seven PCZs, their primary joint artifact, the shared decision authority required, and the most common failure mode when the disciplines operate independently.

| PCZ | Name | Joint Artifact | Failure Mode if Separated |
|---|---|---|---|
| 1 | Requirements & WBS Alignment | Requirements Traceability Matrix / WBS Dictionary | Requirements with no cost account; WBS elements with no traceable requirement |
| 2 | Technical & Performance Baselines | Baseline Change Request (BCR) / ECP linkage | "Rubber baseline" — PMB diverges from technical scope; phantom EVMS variances |
| 3 | Risk Management | Integrated Risk Register / C-Modulus | Dual risk lists; technical risks not elevated to program level; late cost surprises |
| 4 | IMS & SEMP Integration | IMS with SE review logic; SEMP milestone alignment | Schedule milestones not technically linked; CDR passes while design is immature |
| 5 | Interface & Supplier Control | ICD / CDRL / Supplier Surveillance Plan | Interface non-conformances discovered at integration; rework cost spikes |
| 6 | V&V Planning & Schedule | VRM / IMS test schedule / EVMS test cost accounts | Test resource underestimated; re-test events not scheduled; cost overruns at V&V |

 

| PCZ | Name | Joint Artifact | Failure Mode if Separated |
|---|---|---|---|
| 7 | Design Reviews as Decision Gates | Review entrance/exit criteria / TPM + EVMS package | Reviews pass technically while program is in distress; deferral creates authority gap |

*Table 1. Process Convergence Zones — Summary of joint artifacts, shared authority, and primary failure modes.*

## 5. AN INTEGRATED EXECUTION MODEL FOR DEFENSE PROGRAMS

Recognizing the seven PCZs is necessary but not sufficient. What is required is an organizational and procedural model that institutionalizes joint SE/PM authority at each convergence zone. The following principles define such a model for defense platform integration programs.

### 5.1 Joint Ownership at Every PCZ

Each PCZ should have a named SE owner and a named PM owner, jointly accountable for the artifacts and decisions produced in that zone. This is not a matrix responsibility, it is a co-accountability structure in which neither discipline can unilaterally close a PCZ artifact without the concurrence of the other. In Integrated Product Team (IPT) structures, this is naturally achieved through the IPT lead role, which carries both technical and programmatic authority. On programs without formal IPT structures, a Program Control Board or Joint Technical-Programmatic Review Board should be established to provide the same function.

### 5.2 Single Integrated Risk Register

Programs should maintain one risk register, not a technical risk list and a programmatic risk list. The register should be owned jointly by the chief systems engineer and the program manager, with entries that capture both the technical root cause and the programmatic consequence of each identified risk. Risk probability and impact assessments should be conducted jointly, with the technical assessment informing the programmatic consequence estimate. C-Modulus, applied to the program's EVMS data, should be used as a systematic input to the risk identification process, converting EVMS anomaly signatures into risk register entries with technical diagnostic context.

### 5.3 Synchronized Baseline Management

No change to the Technical Baseline should be approved without simultaneous assessment of PMB impact. No PMB re-plan should be approved without a corresponding review of whether the re-plan reflects a legitimate technical scope change or a performance recovery plan. The Configuration Control Board should include both the technical authority and the program control manager as voting members, with a documented decision record that links every approved change to both its ECP number and its BCR number.

### 5.4 SE-Driven IMS Logic

The IMS should be constructed from the SEMP down: SE review milestones, design disclosure events, verification activities, and interface control events should define the technical logic of the schedule, with PM translating that logic into time-phased resource assignments and cost accounts. Schedule margin should be explicitly allocated at each SE review gate, not as a general program reserve, but as a specific allowance for the uncertainty inherent in technical maturity progression.

 

### 5.5 Quantitative Technical Performance Measurement

Technical Performance Measures (TPMs), the SE discipline of tracking key performance parameters against planned growth curves, should be integrated into the EVMS reporting structure. TPM trends should be reviewed alongside Earned Value performance trends in every Program Management Review (PMR). When TPM trends indicate technical risk, a performance parameter tracking behind its planned maturity curve, that trend should trigger an immediate review of the corresponding EVMS cost and schedule accounts to assess whether the programmatic baseline reflects the technical reality.

## 6. CONCLUSION

Systems Engineering and Project Management are not converging disciplines in a general or theoretical sense, they are disciplines that have always shared operational territory at specific, identifiable locations in the program lifecycle. The contribution of this paper is to name those locations precisely, to characterize the joint artifacts and shared decision authority they require, and to describe the failure modes that result when the disciplines treat those locations as belonging to one side of the organizational chart rather than both.

The seven Process Convergence Zones, Requirements and WBS Alignment, Technical and Performance Baseline Management, Risk Management, IMS and SEMP Integration, Interface and Supplier Control, Verification and Validation Planning, and Design Reviews as Decision Gates, represent the operational core of integrated program execution on complex defense programs. Organizations that establish baselines and responsibility at each of these zones, maintain a single integrated risk register, synchronize their technical and performance baselines, and apply quantitative tools such as C-Modulus to bridge EVMS anomalies to their technical root causes will consistently outperform organizations that treat SE and PM as sequential or parallel rather than convergent.

The goal is not to eliminate the distinction between the disciplines, each has its own methods, its own standards, and its own professional expertise. The goal is to recognize that between those disciplines, at the seven locations described in this paper, there is territory that belongs to both, and that must be governed as such.

## 7. REFERENCES

IEEE/ISO/IEC 15288:2023. Systems and Software Engineering, System Life Cycle Processes. Geneva: International Organization for Standardization.

Project Management Institute. (2021). A Guide to the Project Management Body of Knowledge (PMBOK Guide), Seventh Edition. Newtown Square, PA: PMI.

U.S. Department of Defense. (2020). DoD Instruction 5000.02: Operation of the Adaptive Acquisition Framework. Washington, DC: Office of the Under Secretary of Defense for Acquisition and Sustainment.

Defense Acquisition University. (2022). Systems Engineering Guidebook. Fort Belvoir, VA: DAU Press.

MIL-STD-881F. (2020). Work Breakdown Structures for Defense Materiel Items. Washington, DC: Department of Defense.

 

MIL-HDBK-61B. (2020). Configuration Management Guidance. Washington, DC: Department of Defense.

Defense Contract Management Agency. (2019). Earned Value Management System (EVMS) Interpretation Guide. DCMA-INST 208.

Shull, C. (2016). Critical Infrastructure and Recovery: A Common Recovery Model for Grid Systems in Blackout Scenarios. INCOSE Insight Journal.

Shull, C. (2022). Resiliency Through the Interconnection of Energy Storage Distributed Energy Resources While Providing Uninterruptable Power. IEEE EESAT 2022, Austin, TX.

Shull, C. (ongoing). Casey's Modulus and C-Modulus: Cost Anomaly Detection in Project Management. Unpublished technical framework, FOCS LLC.

INCOSE. (2023). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities (5th ed.). Hoboken, NJ: Wiley.

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## 1. INTRODUCTION

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entrance criterion should have an IMS predecessor; every verification test completion should have a schedule activity that links both the test plan (SE artifact) and the EVMS cost account (PM artifact).

### PCZ 5 — Interface Management and Supplier/Subcontractor Control

Interface management, the SE discipline of defining, controlling, and verifying the physical, functional, and data interfaces between system elements, has a direct and underappreciated impact on program cost and schedule. Every unresolved interface is a latent schedule risk; every interface change that reaches hardware or software integration without proper control is a re-work event that consumes cost reserves. In a defense platform integration program involving multiple prime contractors, subcontractors, and government-furnished equipment (GFE), the volume and complexity of interface control activity is sufficient to drive the program schedule independently of any other single factor.

The PM dimension of interface management is supplier control: the use of contract data requirements (CDRLs), statement of work (SOW) provisions, and supplier surveillance activities to enforce interface compliance at the subcontract level. The SE dimension is Interface Control Documents (ICDs), Interface Control Working Groups (ICWGs), and the Interface Requirements Specification (IRS). The convergence zone is the supplier management review, the program event at which technical interface compliance and contractual performance are assessed simultaneously, by a team that includes both the systems engineer responsible for the interface definition and the contracts/supply chain representative responsible for contractual enforcement.

Programs that separate these reviews, holding a technical interface review in one forum and a supplier performance review in a separate program management review, consistently discover interface non-conformances later, at integration, when the cost of correction is orders of magnitude higher than it would have been at the design stage.

### PCZ 6 — Verification and Validation Planning and Schedule/Cost Integration

Verification and Validation (V&V) the SE processes by which a system is confirmed to meet its specified requirements (verification) and to fulfill its intended operational purpose (validation) are among the most resource-intensive activities in a defense program lifecycle. Test events consume facility time, hardware, software builds, personnel, and instrumentation. They also consume schedule: a test failure at CDR+12 months does not produce a re-plan; it produces a program crisis that PM and SE must jointly resolve.

The convergence zone in V&V occurs at three specific points. First, in test planning: the Verification Requirements Matrix (VRM) or System Verification Review (SVR) artifact must be directly linked to the IMS test schedule and to cost accounts that reflect actual test resource consumption. Second, at test execution: test failures trigger non-conformance reports (NCRs) that have both a technical disposition path (SE) and a schedule/cost impact path (PM). Third, at delta qualification or re-test events: the decision to re-test, accept with deviation, or seek a waiver is a joint technical-programmatic decision with significant cost and schedule implications.

Programs that treat V&V planning as purely a SE activity, disconnected from the IMS and from EVMS cost accounts, consistently underestimate test resource requirements, fail to reserve schedule margin for re-test, and discover cost overruns at the verification phase when the program has the least flexibility to absorb them.

 

### PCZ 7 — Design Reviews as Program Decision Gates

Formal design reviews, System Requirements Review (SRR), System Design Review (SDR), Preliminary Design Review (PDR), Critical Design Review (CDR), and Test Readiness Review (TRR) are defined in IEEE 15288 and MIL-HDBK-61B as SE artifacts: structured events at which the technical community assesses the maturity and adequacy of the evolving design. In defense acquisition programs, they are simultaneously program decision gates: events at which the government customer, the program management office, and the contractor leadership jointly assess program health and authorize continuation.

The convergence zone is the review itself. Design review entrance and exit criteria must be satisfied technically (SE) and administratively (PM). Action items generated at a PDR are both technical (unresolved design issues) and programmatic (schedule and cost implications of resolution). The decision to proceed from PDR to CDR, to authorize the investment in detailed design, is simultaneously a technical maturity judgment and a program risk decision. In DoD programs, this decision is typically made by an Acquisition Decision Authority who requires both the Technical Performance Measures (TPMs) from the SE community and the EVMS performance data from the PM community before granting approval.

Design reviews that are treated as purely SE events, with PM participation limited to scheduling logistics, consistently produce one of two failure modes: reviews that pass on technical grounds while the program is in cost or schedule distress, or reviews that are deferred for programmatic reasons while the technical community lacks clear authority to resolve design issues during the deferral period.

## 4. PROCESS CONVERGENCE ZONE SUMMARY

Table 1 summarizes the seven PCZs, their primary joint artifact, the shared decision authority required, and the most common failure mode when the disciplines operate independently.

| PCZ | Name | Joint Artifact | Failure Mode if Separated |
|---|---|---|---|
| 1 | Requirements & WBS Alignment | Requirements Traceability Matrix / WBS Dictionary | Requirements with no cost account; WBS elements with no traceable requirement |
| 2 | Technical & Performance Baselines | Baseline Change Request (BCR) / ECP linkage | "Rubber baseline" — PMB diverges from technical scope; phantom EVMS variances |
| 3 | Risk Management | Integrated Risk Register / C-Modulus | Dual risk lists; technical risks not elevated to program level; late cost surprises |
| 4 | IMS & SEMP Integration | IMS with SE review logic; SEMP milestone alignment | Schedule milestones not technically linked; CDR passes while design is immature |
| 5 | Interface & Supplier Control | ICD / CDRL / Supplier Surveillance Plan | Interface non-conformances discovered at integration; rework cost spikes |
| 6 | V&V Planning & Schedule | VRM / IMS test schedule / EVMS test cost accounts | Test resource underestimated; re-test events not scheduled; cost overruns at V&V |

 

| PCZ | Name | Joint Artifact | Failure Mode if Separated |
|---|---|---|---|
| 7 | Design Reviews as Decision Gates | Review entrance/exit criteria / TPM + EVMS package | Reviews pass technically while program is in distress; deferral creates authority gap |

*Table 1. Process Convergence Zones — Summary of joint artifacts, shared authority, and primary failure modes.*

## 5. AN INTEGRATED EXECUTION MODEL FOR DEFENSE PROGRAMS

Recognizing the seven PCZs is necessary but not sufficient. What is required is an organizational and procedural model that institutionalizes joint SE/PM authority at each convergence zone. The following principles define such a model for defense platform integration programs.

### 5.1 Joint Ownership at Every PCZ

Each PCZ should have a named SE owner and a named PM owner, jointly accountable for the artifacts and decisions produced in that zone. This is not a matrix responsibility, it is a co-accountability structure in which neither discipline can unilaterally close a PCZ artifact without the concurrence of the other. In Integrated Product Team (IPT) structures, this is naturally achieved through the IPT lead role, which carries both technical and programmatic authority. On programs without formal IPT structures, a Program Control Board or Joint Technical-Programmatic Review Board should be established to provide the same function.

### 5.2 Single Integrated Risk Register

Programs should maintain one risk register, not a technical risk list and a programmatic risk list. The register should be owned jointly by the chief systems engineer and the program manager, with entries that capture both the technical root cause and the programmatic consequence of each identified risk. Risk probability and impact assessments should be conducted jointly, with the technical assessment informing the programmatic consequence estimate. C-Modulus, applied to the program's EVMS data, should be used as a systematic input to the risk identification process, converting EVMS anomaly signatures into risk register entries with technical diagnostic context.

### 5.3 Synchronized Baseline Management

No change to the Technical Baseline should be approved without simultaneous assessment of PMB impact. No PMB re-plan should be approved without a corresponding review of whether the re-plan reflects a legitimate technical scope change or a performance recovery plan. The Configuration Control Board should include both the technical authority and the program control manager as voting members, with a documented decision record that links every approved change to both its ECP number and its BCR number.

### 5.4 SE-Driven IMS Logic

The IMS should be constructed from the SEMP down: SE review milestones, design disclosure events, verification activities, and interface control events should define the technical logic of the schedule, with PM translating that logic into time-phased resource assignments and cost accounts. Schedule margin should be explicitly allocated at each SE review gate, not as a general program reserve, but as a specific allowance for the uncertainty inherent in technical maturity progression.

### 5.5 Quantitative Technical Performance Measurement

Technical Performance Measures (TPMs), the SE discipline of tracking key performance parameters against planned growth curves, should be integrated into the EVMS reporting structure. TPM trends should be reviewed alongside Earned Value performance trends in every Program Management Review (PMR). When TPM trends indicate technical risk, a performance parameter tracking behind its planned maturity curve, that trend should trigger an immediate review of the corresponding EVMS cost and schedule accounts to assess whether the programmatic baseline reflects the technical reality.

## 6. CONCLUSION

Systems Engineering and Project Management are not converging disciplines in a general or theoretical sense, they are disciplines that have always shared operational territory at specific, identifiable locations in the program lifecycle. The contribution of this paper is to name those locations precisely, to characterize the joint artifacts and shared decision authority they require, and to describe the failure modes that result when the disciplines treat those locations as belonging to one side of the organizational chart rather than both.

The seven Process Convergence Zones, Requirements and WBS Alignment, Technical and Performance Baseline Management, Risk Management, IMS and SEMP Integration, Interface and Supplier Control, Verification and Validation Planning, and Design Reviews as Decision Gates, represent the operational core of integrated program execution on complex defense programs. Organizations that establish baselines and responsibility at each of these zones, maintain a single integrated risk register, synchronize their technical and performance baselines, and apply quantitative tools such as C-Modulus to bridge EVMS anomalies to their technical root causes will consistently outperform organizations that treat SE and PM as sequential or parallel rather than convergent.

The goal is not to eliminate the distinction between the disciplines, each has its own methods, its own standards, and its own professional expertise. The goal is to recognize that between those disciplines, at the seven locations described in this paper, there is territory that belongs to both, and that must be governed as such.

## 7. REFERENCES

IEEE/ISO/IEC 15288:2023. Systems and Software Engineering, System Life Cycle Processes. Geneva: International Organization for Standardization.

Project Management Institute. (2021). A Guide to the Project Management Body of Knowledge (PMBOK Guide), Seventh Edition. Newtown Square, PA: PMI.

U.S. Department of Defense. (2020). DoD Instruction 5000.02: Operation of the Adaptive Acquisition Framework. Washington, DC: Office of the Under Secretary of Defense for Acquisition and Sustainment.

Defense Acquisition University. (2022). Systems Engineering Guidebook. Fort Belvoir, VA: DAU Press.

MIL-STD-881F. (2020). Work Breakdown Structures for Defense Materiel Items. Washington, DC: Department of Defense.

 

MIL-HDBK-61B. (2020). Configuration Management Guidance. Washington, DC: Department of Defense.

Defense Contract Management Agency. (2019). Earned Value Management System (EVMS) Interpretation Guide. DCMA-INST 208.

Shull, C. (2016). Critical Infrastructure and Recovery: A Common Recovery Model for Grid Systems in Blackout Scenarios. INCOSE Insight Journal.

Shull, C. (2022). Resiliency Through the Interconnection of Energy Storage Distributed Energy Resources While Providing Uninterruptable Power. IEEE EESAT 2022, Austin, TX.

Shull, C. (ongoing). Casey's Modulus and C-Modulus: Cost Anomaly Detection in Project Management. Unpublished technical framework, FOCS LLC.

INCOSE. (2023). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities (5th ed.). Hoboken, NJ: Wiley.

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WHITE PAPER

# Where Systems Engineering and Project Management Merge:

## Process Convergence Zones in Complex Defense Programs

Casey Shull, Ph.D., PMP, MBA · February 2026

## Abstract

Systems Engineering (SE) and Project Management (PM) are frequently treated as parallel but distinct disciplines, one concerned with what a system must do and how it must behave, the other with the schedule, cost, and resource constraints within which it must be delivered. In practice, on complex defense and platform integration programs, this separation is artificial and operationally dangerous. This paper identifies and examines seven discrete process convergence zones, locations in the program lifecycle where SE and PM activities are not merely adjacent but genuinely inseparable, and proposes an integrated execution model for each. Drawing on IEEE 15288, PMI PMBOK Seventh Edition, and applied frameworks including C - Modulus for program performance anomaly detection, this paper offers both a theoretical foundation and practical guidance for program leaders, Project Engineering Leads (PELs), and Integrated Product Team (IPT) managers operating in defense acquisition, platform systems integration, and other complex engineering environments.

**Keywords:** *Systems Engineering, Project Management, IEEE 15288, PMI PMBOK, Integrated Product Teams, Earned Value Management, Requirements Traceability, Technical Baseline, Defense Acquisition, Program Lifecycle, C-Modulus*

## 1. INTRODUCTION

The canonical view of program execution places Systems Engineering on one side of an organizational chart and Project Management on the other. The systems engineer defines requirements, architects solutions, manages interfaces, and verifies that the delivered system meets its intended purpose. The project manager plans the work, tracks schedule and cost, manages risks and resources, and reports status to stakeholders. Both disciplines have well-established bodies of knowledge, professional certifications, and governing standards. And yet, on complex defense programs, platform integration efforts involving avionics, mission systems, software, hardware, and supply chain disciplines simultaneously, this clean separation routinely breaks down.

The breakdown is not a failure of discipline. It is a structural feature of program complexity. When requirement change ripples through a system architecture, it immediately becomes a schedule and cost event. When earned value curves diverge from baseline, the cause is almost always a technical event, a design issue, an interface ambiguity, a verification failure, not a scheduling error in isolation. When a supplier delivers a non-conforming component, the response requires both a technical disposition and a program re-plan. In each of these scenarios, SE and PM are not operating in sequence, they are operating simultaneously, on the same problem, with shared authority over the outcome.

 

This paper names and examines these moments of convergence as Process Convergence Zones (PCZs): discrete locations in the program lifecycle where the activities, decisions, and tools of SE and PM cannot be meaningfully separated. Understanding PCZs is not an academic exercise. For the program leader, whether a Systems Engineer acting as technical authority, a Project Engineer coordinating cross-discipline execution, or a program manager driving delivery, knowing where convergence occurs is the foundation of effective integrated program execution.

> **PREMISE**
> *Systems Engineering and Project Management do not merge everywhere, but where they do merge, the consequences of treating them as separate are schedule slips, cost growth, and technical failures that trace back not to incompetence but to organizational seams that should not exist.*

## 2. FOUNDATIONAL FRAMEWORKS

Two bodies of knowledge govern this discussion. IEEE/ISO/IEC 15288:2023, Systems and Software Engineering: System Life Cycle Processes, defines the SE lifecycle in terms of 30 processes organized across four process groups: Agreement, Organizational Project-Enabling, Technical Management, and Technical Processes. The PMI PMBOK Seventh Edition (2021) reframes project management around eight performance domains and twelve principles, shifting from a process-centric to an outcomes-and-value-centric model. The DAU (Defense Acquisition University) Systems Engineering Guidebook and the DoD 5000.02 acquisition framework provide additional structure specific to defense program environments.

Critically, IEEE 15288 does not treat technical management as a purely SE function. Its Technical Management Process Group (Clause 6.3), which includes Planning, Assessment and Control, Decision Management, Risk Management, Configuration Management, Information Management, Measurement, and Quality Assurance maps almost exactly onto the knowledge areas of traditional project management. The overlap is not coincidental. ISO/IEC/IEEE recognized, in the 2015 revision and affirmed in 2023, that technical program execution cannot be cleanly separated from program management at the process level. The PMI PMBOK Seventh Edition similarly acknowledges that project performance cannot be governed through schedule and cost metrics alone; it requires technical performance measurement as an integrated element of program health.

The result is a de facto convergence zone at the standards level itself, both governing bodies have moved toward integration even as organizational practice continues to separate the disciplines. This paper "operationalizes" that convergence into seven specific program zones.

## 3. THE SEVEN PROCESS CONVERGENCE ZONES

The following seven PCZs represent the locations in a complex defense program lifecycle where SE and PM activities are operationally inseparable. Each zone is characterized by a shared decision space, a common artifact, or a joint accountability structure that cannot be assigned to either discipline alone.

### PCZ 1 — Requirements Definition and Work Breakdown Structure Alignment

The first convergence occurs at program inception, when systems engineers are defining and decomposing requirements through functional architecture and project managers are simultaneously constructing the Work Breakdown Structure (WBS). In a well-integrated program, these two activities are not sequential, they are co-generative. The WBS should be traceable to the functional decomposition of requirements; the functional architecture should be constrained by the organizational and contractual structure the WBS reflects.

In defense programs structured under MIL-STD-881 (Work Breakdown Structure (WBS) for Defense Materiel Items), the WBS is contractually mandated and dictates how cost accounts are established, how Earned Value Management System (EVMS) data is reported, and how performance is measured. When the SE functional decomposition diverges from the WBS, a common occurrence when SE and PM teams operate independently, the result is requirements that have no cost account, cost accounts that have no traceable requirement, and a program baseline that cannot accurately reflect technical progress.

> **INTEGRATION IMPERATIVE**
> *Requirements Traceability Matrices (RTMs) should be developed in parallel with WBS construction, with shared ownership between the lead systems engineer and the program control manager. Every Level 3 WBS element should trace to at least one allocated requirement. Every allocated requirement should trace to at least one WBS cost account.*

### PCZ 2 — Technical Baseline and Performance Measurement Baseline

The Technical Baseline (TB) approved set of requirements, architecture, interface definitions, and design constraints that govern program execution, is a Systems Engineering artifact. The Performance Measurement Baseline (PMB), the time-phased budget against which Earned Value is measured, is a Project Management artifact. In DoD Acquisition programs governed by EVMS (required on contracts over $20M), these two baselines must be synchronized: any change to the TB that affects scope, schedule, or cost must be reflected in the PMB through a formal Baseline Change Request (BCR) process.

In practice, TB changes frequently outrun PMB updates. An engineering change is approved at the system level, implemented in the design, and reflected in updated specifications, but the PMB is not updated until the next reporting cycle. The result is a phantom variance: the EVMS reports a cost or schedule deviation that is a legitimate scope change, not a performance problem. Conversely, PMB re-plans that are not tied to formal TB changes produce a Performance Measurement Baseline that no longer reflects the actual technical scope of work, a condition sometimes called "rubber baseline" that undermines EVMS integrity.

The convergence zone here requires a joint Configuration Control Board (CCB) process in which the technical authority (SE) and program control (PM) review and approve changes simultaneously, with explicit handshakes between the Engineering Change Proposal (ECP) process and the BCR process.

### PCZ 3 — Risk Management and Technical Risk Identification

Risk management is formally a shared function in both IEEE 15288 (Risk Management process) and PMI PMBOK (Uncertainty Performance Domain). In defense programs, DoD Instruction 5000.02 requires the development of an acquisition strategy or, as defined in this paper, an integrated risk management process that captures both programmatic risk (schedule, cost, resource) and technical risk (performance, reliability, interface, maturity). The convergence zone is the risk register itself: a single artifact that must

 

simultaneously reflect technical risk drivers, derived from system complexity, technology readiness levels (TRLs), interface uncertainties, and verification challenges, and programmatic risk drivers, derived from schedule margins, cost reserves, supplier performance, and contract constraints.

The breakdown most frequently observed in practice is the dual risk register: SE maintains a technical risk list organized by system element; PM maintains a program risk register organized by WBS element. The two lists are never reconciled. Technical risks that become schedule threats are not elevated to program risk status; programmatic risks that have technical root causes are treated as execution problems rather than engineering problems. The result is a risk management process that is formally compliant but operationally blind.

C-Modulus, a quantitative framework for detecting Cost Performance Index (CPI) and Schedule Performance Index (SPI) anomalies through pattern analysis of EVMS data, was developed specifically to address this blind spot. By identifying characteristic deviation signatures in earned value curves that correspond to underlying technical events (requirements instability, interface churn, verification failure rates), C-Modulus provides a systematic bridge between technical risk realization and programmatic early warning. The framework treats an EVMS anomaly not as a PM problem to be re-planned around, but as a signal to be diagnosed at the technical level, precisely because most program cost and schedule events originate in the SE domain.

> **C-MODULUS, CONVERGENCE TOOL**
> *When SPI and CPI diverge in characteristic patterns, CPI degrades while SPI holds, or SPI collapses suddenly after a stable period, the underlying cause is almost invariably a technical event: a design disclosure that exposed a previously unrecognized interface, a test failure that triggered a redesign, or a requirements change that was absorbed without a formal baseline change. C-Modulus quantifies these signatures and links EVMS anomalies to their probable SE origin, enabling joint SE/PM diagnosis rather than sequential blame assignment.*

### PCZ 4 — Integrated Master Schedule and Systems Engineering Management Plan

The Integrated Master Schedule (IMS) is the program's time-phased execution plan, owned by the project manager and governed by IPMDAR (Integrated Program Management Data and Analysis Report) requirements on DoD contracts. The Systems Engineering Management Plan (SEMP) defines the SE processes, reviews, artifacts, and decision gates that govern technical program execution. In a properly integrated program, the SEMP drives the IMS: every SE review milestone, every design disclosure event, every verification activity, and every interface control working group (ICWG) meeting should have a corresponding IMS activity with logic-linked predecessors and successors.

When SEMP and IMS are developed independently, as is common when SE and PM teams operate in organizational silos, the IMS becomes a schedule of administrative milestones that does not reflect the actual technical logic of the program. System Design Reviews (SDRs), Preliminary Design Reviews (PDRs), and Critical Design Reviews (CDRs) appear as point events rather than as gates with defined entry criteria, exit criteria, and traceable action item closure. The result is a schedule that passes milestone reviews on paper while technical readiness lags by weeks or months.

The convergence zone requires that the SEMP and IMS be co-developed, with the lead systems engineer and the program scheduler working from a shared understanding of technical dependencies. Every CDR

 

entrance criterion should have an IMS predecessor; every verification test completion should have a schedule activity that links both the test plan (SE artifact) and the EVMS cost account (PM artifact).

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## 7. REFERENCES

IEEE/ISO/IEC 15288:2023. Systems and Software Engineering, System Life Cycle Processes. Geneva: International Organization for Standardization.

Project Management Institute. (2021). A Guide to the Project Management Body of Knowledge (PMBOK Guide), Seventh Edition. Newtown Square, PA: PMI.

U.S. Department of Defense. (2020). DoD Instruction 5000.02: Operation of the Adaptive Acquisition Framework. Washington, DC: Office of the Under Secretary of Defense for Acquisition and Sustainment.

Defense Acquisition University. (2022). Systems Engineering Guidebook. Fort Belvoir, VA: DAU Press.

MIL-STD-881F. (2020). Work Breakdown Structures for Defense Materiel Items. Washington, DC: Department of Defense.

 

MIL-HDBK-61B. (2020). Configuration Management Guidance. Washington, DC: Department of Defense.

Defense Contract Management Agency. (2019). Earned Value Management System (EVMS) Interpretation Guide. DCMA-INST 208.

Shull, C. (2016). Critical Infrastructure and Recovery: A Common Recovery Model for Grid Systems in Blackout Scenarios. INCOSE Insight Journal.

Shull, C. (2022). Resiliency Through the Interconnection of Energy Storage Distributed Energy Resources While Providing Uninterruptable Power. IEEE EESAT 2022, Austin, TX.

Shull, C. (ongoing). Casey's Modulus and C-Modulus: Cost Anomaly Detection in Project Management. Unpublished technical framework, FOCS LLC.

INCOSE. (2023). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities (5th ed.). Hoboken, NJ: Wiley.

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