



National Defense Industrial Association
Integrated Program Management Division

An Industry Practice Guide for Agile on Earned Value Management Programs

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Abbreviations and Acronyms

The abbreviations and acronyms listed here are used in the main body of the guide. Additional abbreviations and acronyms are included in the appendices.

ACWP	Actual Cost of Work Performed
AIS	Automated Information System
BAC	Budget at Completion
BCR	Baseline Change Request
BCWP	Budgeted Cost for Work Performed
CA	Control Account
CAM	Control Account Manager
CAP	Control Account Plan
CBB	Contract Budget Base
CDRL	Contract Data Requirements List
CO	Contracting Officer
CSCI	Computer Software Configuration Item
CPI	Cost Performance Index
DCMA	Defense Contract Management Agency
DoD	Department of Defense
EAC	Estimate at Completion
ETC	Estimate to Complete
EVM	Earned Value Management
EVMS	Earned Value Management System
EVMSIG	Earned Value Management System Interpretation Guide
GUI	Graphical User Interface
HW	Hardware
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
IPT	Integrated Product Team
MR	Management Reserve
PARCA	Performance Assessments and Root Cause Analyses
PC	Percent Complete
PMB	Performance Measurement Baseline
PO	Product Owner
POP	Period of Performance

PP	Planning Package
QBD	Quantifiable Backup Data
SAFe®	Scaled Agile Framework®
SLPP	Summary Level Planning Package
SP	Story Points
SPI	Schedule Performance Index
STD	Standard
SW	Software
TAB	Total Allocated Budget
UB	Undistributed Budget
WBS	Work Breakdown Structure
WP	Work Package

1 Introduction: EVM for Agile Programs

The growing importance of quickly and affordably delivering software intensive systems requires programs to swiftly react to changing demands of the operational environment and has led to an increased focus on capability-based planning and iterative product development. Capability-based planning and execution focuses on delivering the highest priority system Features to the stakeholders as quickly and affordably as possible. To meet this demand, Program Managers need a planning and execution method that can quickly and efficiently react to changes across all levels of the program.

Agile has emerged as the leading industry software development methodology, and has seen growing adoption across the DoD and other federal agencies. Agile implements the needed method by focusing on small, frequent capability releases, working software through demonstration of capabilities, responding rapidly to changes in operations, technology, and budgets, and actively involving users throughout development to ensure high operational value.¹

These emerging needs across program levels require continual prioritization, development and delivery of major system capabilities to address the requirements needed to meet emerging operational demands. Changes at the detailed program level involve continual adjustment of implementation processes and technical approaches to meet cost, schedule and quality requirements. Agile development techniques prove to be effective in meeting these demands.

The demand for responsiveness and efficiency extends to all aspects of system development and delivery, starting with negotiation of the contract, applicable Contract Data Requirements Lists (CDRLs), and effective implementation of Earned Value Management (EVM). The EVM system must support these changing demands while enabling cost and schedule performance measurement against the Performance Measurement Baseline (PMB). This need creates challenges to applying EVM to Agile development programs. The intent of this Guide is to address these challenges.

Agile development methods provide a disciplined process for defining work and tracking progress of this work against planned cost and schedule. Integrating Agile performance data with the EVM system provides a vertical integrated view of cost, schedule, and scope, from development activities to program performance measures.

1.1 Purpose of the Guide

This Guide provides practices drawn from lessons learned by multiple aerospace and defense firms and their software development activities. This Guide provides a recommended structure for the Work Breakdown Structure (WBS), Integrated Master Plan (IMP) and Integrated Master Schedule (IMS) content, Control Accounts (CA), Work Packages (WP), and Planning Packages (PP) to be used on an Agile development program. Program performance measurement in an Agile iterative development framework is defined along with Baseline change control.

Appendix A is an EVM Agile Data Dictionary, with both Agile and EVM terms and definitions. Appendix B provides examples of EVM Agile progress report charts. This Guide assumes a basic understanding of Earned Value and Agile development techniques. For introductory materials, see Appendix C, References. Appendix D describes in more detail the method of building a product roadmap. Appendix E credits the contributors to this Guide.

¹ Defense Agile Acquisition Guide, Pete Modigliani and Su Chang, Mitre Corporation, March 2014

1.2 Definitions

Customer The government, commercial organization, or other entity for which one or more program or projects are being executed. Typically, the external customer is the Government or a prime Contractor.

Project Involves planned effort to achieve an outcome, the progress toward which is directly measurable. A project will have an established scope, schedule and budget.

Program Group of related projects managed in a coordinated way to obtain benefits and control unavailable from managing them individually.

This Guide uses the term “program” rather than “project”, as “program” is often referenced within an Earned Value Management context. However, the Guide is generally applicable to both programs and projects.

2 Agile Program Planning

Work planning in Agile development is driven by prioritization of business value defined by the customer. This planning process focuses on the value of the functionality or capabilities needed by the customer, in the order defined in the Product Roadmap. This value is delivered through the iterative and incremental decomposition of the work of the product's functionality. Epics or Capabilities, hereafter known as Epics/Capabilities, contain product Features decomposed into User Stories.

Agile Planning is performed by the entire development Team using the needed Epics/Capabilities, Features and Stories. Therefore planning is product based, and done through iterative and incremental decomposition of Capabilities/Epics and subsequently Features into smaller components of product functionality.

2.1 Product Planning

Product Planning produces a Product Roadmap for the time-phased product delivery plan. This plan is the technical basis of the Earned Value Management Performance Measurement Baseline (PMB). Every [Scrum](#) team (development team) has a [Product Owner](#) (PO), representing the customer's value. In programs with multiple Teams, there may also be a chief PO that coordinates across program POs and their teams.

The Product Roadmap is a top level planning activity that can precede or inform development activities for the IMP, IMS, and PMB. During Product Planning, the PO and customer representative reference contractual and product performance requirements to specify and prioritize the set of system capabilities, or Epics/Capabilities, needed to deliver the contractually required system. Epics/Capabilities are then assigned to one or more Cadence Releases, thus forming the Product Roadmap. See Appendix D for more detail on Product Roadmap development.

Product Planning starting with Contract Award establishes the Cadence Release cycle, Product Roadmap, and Product Backlog. Product planning is performed throughout the life of the program to refine and update the Product Backlog. Typically the PO, with Customer representatives, is responsible for managing the product planning activities. Program leadership assigns the PO who may also fill the role of a Control Account Manager (CAM). The Product Backlog is the master list of all functionality at the Epic and Feature level that is desired in the product and any other elements needed to produce the product, even if not in the final product. Product Backlog is prioritized from most to least important by the PO and Stakeholders. All items which are added to the Product Backlog should also include a cost estimate and a mapping to the SOW. Cost estimates may be developed by the PO/CAM using Epic/Feature size and productivity estimates. The Product Roadmap may precede, inform, or supplant the development of an IMP, and informs the top level plan of the IMS.

The CAM(s) use size and productivity estimates from Product Planning along with the staffing plan to establish the time-phased budgets that comprise the initial performance measurement baseline. Product Planning defines the CAs and Planning Packages and their networking at a high level; during release planning, the Planning Packages for that release are decomposed into Work Packages. Ongoing customer involvement, regular demonstrations of Capability, and granular Agile Quantifiable Backup Data (QBD) or other supplemental information reference this baseline and define progress; to learn more about the assumptions and approach to managing change of a Baseline on an Agile program, see Section 5, Managing Baseline Change on Agile Programs. Section 5 also addresses where planned work is not completed within a planned release.

2.2 Release Planning

Release planning is a process in which the team periodically maps the Product Backlog with its Epics/Capabilities to Features and candidate [Stories](#) that are to be delivered in a Sprint. Assigning the Stories to a Sprint, based on Customer priority, defines what the product must do and when the functionality will be delivered within a Release. The Product Backlog and Product Roadmap satisfying required product functionality are inputs to the Release Plan. This is a process similar to creating an Integrated Master Schedule (IMS) from an Integrated Master Plan (IMP). It is within release planning and as part of the Integrated Master Schedule planning that Features are assigned to Work Packages and Planning Packages.

Each Cadence Release planning cycle should be chosen to coincide with Rolling Wave planning used in an EVM program as they are similar activities². Prior to each Cadence Release or Rolling Wave planning cycle, the PO (or chief PO on large-scale Agile programs) conducts release planning to develop the Cadenced Release plan. The Cadence Release plan is the set of Features that have been refined from Epics/Capabilities on the Product Roadmap and have been selected to be implemented within the Cadence Release. The Cadence Release duration is expressed as a number of Sprints, aligning with the start of the first Sprint in the Release and the end of the last Sprint in the Release. Cadence Release planning is completed prior to the start of each Cadence Release cycle; the Rolling Wave planning cycle is adjusted to be completed synchronously with each Cadence Release.

Prior to the release planning meeting, the person with content authority, e.g. chief PO or PO, communicates the next highest priority build capabilities for the upcoming Cadence Release. The POs decompose build Epics/Capabilities into a set of Features that will implement the requested build capabilities.

Depending on program scale, the chief PO or PO facilitates the release planning meeting. During this meeting, each Feature is reviewed in order of priority and a set of Features for the Release is chosen based on Feature priority, Feature size, productivity, and available staff. On large-scale programs with multiple Scrum teams, the release planning meeting includes coordination of Feature planning among the various POs to achieve a release plan that supports the required product deliveries and overall goals of the program.

The CAM(s) use the output of release planning to implement the plan. During Release planning, Work Packages specify scope via the Features selected at release planning. The CAM, working in collaboration with PO(s), creates the Work Packages. Work Packages may align with individual Features or with logical groups of related Features. There may be one or more Features associated with a Work Package within a Control Account (CA). The budget for the Work Package is determined by the estimated effort to complete the work scope in terms of hours and resources.

Release Planning is the activity most closely related to developing the Integrated Master Schedule, and subsequent Rolling Wave planning represented in the IMS.

2.3 Sprint Planning

Sprint planning is collaboration between the Scrum Team and the Product Owner to determine what Features and Stories will be developed in the coming Sprint. The Scrum Master ensures that the Sprint Planning event takes place and that attendees understand the purpose of the planning session. Sprint planning is the process whereby Scrum teams commit to the

² The Agile and Earned Value Management: A Program Manager's Desk Guide, OUSD AT&L (PARCA), 03 March 2016, notes the equivalency of Cadence Release and rolling wave planning.

completion of specific Stories within the current timeboxed (fixed time period) Sprint and confirms the criteria for work completion.

Features selected from the planning process are decomposed into Stories in preparation for Sprint Execution. These Stories are prioritized by the Product Owner and the Agile Team. The Sprint Planning process is completed before any work starts on the Sprint. During this process, Stories are sized and prioritized for implementation during the Sprint. The Scrum team's list of Stories from that Sprint are placed on the Sprint Backlog. The Scrum Master is responsible for facilitating Sprint Planning.

During the Sprint, as Stories are completed, progress is determined by the completion status of the planned number and size of Stories for the Feature assigned to that Work Package. The results of Sprint planning in terms of the number and size of Stories planned for the Sprint, and therefore completed versus total planned Story Points in the Sprint, is reflected in the IMS through the QBD for the Stories and Feature. Sprint planning connects to the earned value process by finalizing the specific Stories to be implemented in the Sprint that will contribute to completion of the corresponding Feature.

2.4 Daily Planning – Scrum Standup


During the Scrum standup meeting, the Team reviews development activities in the Sprint for alignment with the Sprint Plan to confirm progress of the Team’s commitment to the Sprint goals.

1. During the daily Scrum each team member reports: What they did the previous day.
2. What they plan to do today.
3. Roadblocks that are impeding their progress.

Product completion status is reviewed on a daily basis and updated to provide program performance measurement based on the number of Story Points associated with completed Stories compared to the planned Story Points for the Sprint.

The tiered Agile planning levels are shown in Table 1. The hierarchy of the Planning Artifacts is described in more detail in Section 3.2. The Work Breakdown Structure, used for Agile programs, is described in more detail in section 3.1.

Agile Planning Levels Related to EVM Processes



Planning Level	Planning Frequency	Planning Horizon	Planning Precision	Planning Artifact	EVM Processes
Product Planning	Project startup; updates throughout the project	Project Duration	Capabilities Releases	Product Backlog; Prod Roadmap, Minimal Viable Product (MVP)	IMP planning of Epics/ Capabilities to Releases (Cadency and Capability).
Release Planning	Each Cadence Release	Cadence Release	Feature /Stories	Product Backlog Updates Release Plan	IMS planning of Features to Work & Planning Packages. Networking them to Capabilities and Releases.
Sprint Planning	Each sprint	Weeks	Stories/Tasks	Sprint Backlog	Defining measure of effort and duration for Work and Planning Packages based on Release Sprint Story alignment to Features.
Daily Planning	Daily	Day	Tasks	Updated Sprint Backlog	Update story status in order to determine EV for each Work Package

Table 1: Agile planning levels and their relationship to EVM processes. Sprint and daily planning contribute to QBD that supports EVM reporting at higher levels.

3 Agile EVM Performance Measurement Baseline (PMB)

3.1 The Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) defines the program in terms of hierarchically-related, product-oriented elements. The WBS is a product-oriented family tree composed of hardware, software, services, data, and facilities that displays and defines the product to be developed during the acquisition.^[3] The WBS represents all scope and work being performed on a program, both level of effort (such as program management) and discrete deliverables.

For programs using Agile methodologies, the WBS should be the basis for the Product Backlog. This structure focuses on completed products that provide measurable customer value implemented in Epics and Capabilities. The Agile development Sprints and Cadence Releases, with resulting Features and Stories that deliver products, are the basis for the Performance Measurement Baseline. However this level of detail should not appear in the contract WBS, since these items emerge in the normal work processes of Agile.

Therefore, it is key for successful Agile EVM application to establish a product based WBS. MIL-STD-881 provides product-based WBS templates for a variety of systems, which can be applied to an Agile Epics/Capabilities-based structure. While these terms of product hierarchy are fully defined in Appendix A, the EVM/Agile Data Dictionary, Figure 1 illustrates the two separate hierarchies used in Agile, for Product, applicable to WBS, and for Time. Separate Product and Time hierarchies allow work to be planned by periodically assigning appropriately-sized products into selected Releases or Sprints.

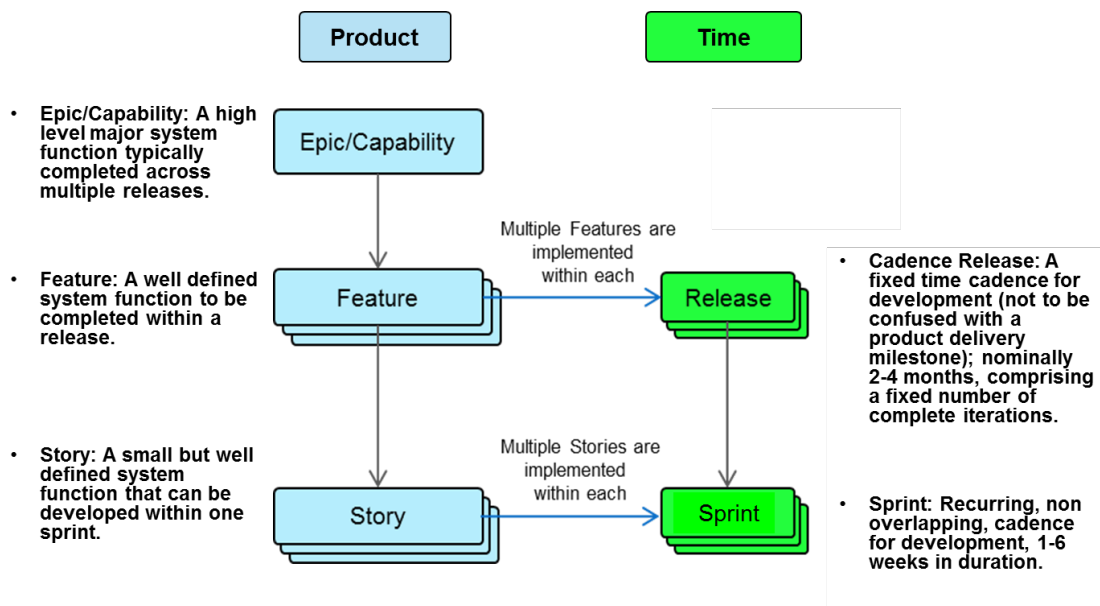


Figure 1: Hierarchy of Agile Products and Agile Timeboxed Elements and Relationships illustrates the two hierarchies in Agile: for Product, based on WBS, and for Time, the basis for PMB.

The WBS defines Epics/Capabilities or Products at the highest summary levels; these are later decomposed into Features and ultimately to Stories. The program contract period of performance is broken down into “Cadence Releases”, which in Agile are strictly timeboxed or calendar-driven, and further broken down into predetermined timeboxed, fixed cadence Sprints

³ MIL-STD-881-C

of typically 2 weeks (1-6 week Sprint durations have been seen also), selected to best work for the program and company. Note that “Sprint” is often used synonymously with “Iteration”; since “Sprint” is a commonly used term beyond a single Agile method such as Scrum, “Sprint” will be used here for the 1-6 week timeboxed cadence.

See Figure 2, which illustrates a typical, not mandatory, EVMS to Agile Hierarchy alignment. The figure illustrates that traceability between the EVMS and Agile hierarchies is defined and maintained throughout the program, aligning Scope and Budget via assigning sized Agile Products to CA, WP and PP within the EVMS. Sizing of Agile Products is based on complexity of effort, and is calibrated to equate to resources planned for each product. See Section 5 for more detail and an illustration of how scope/budget alignment is maintained within both hierarchies.

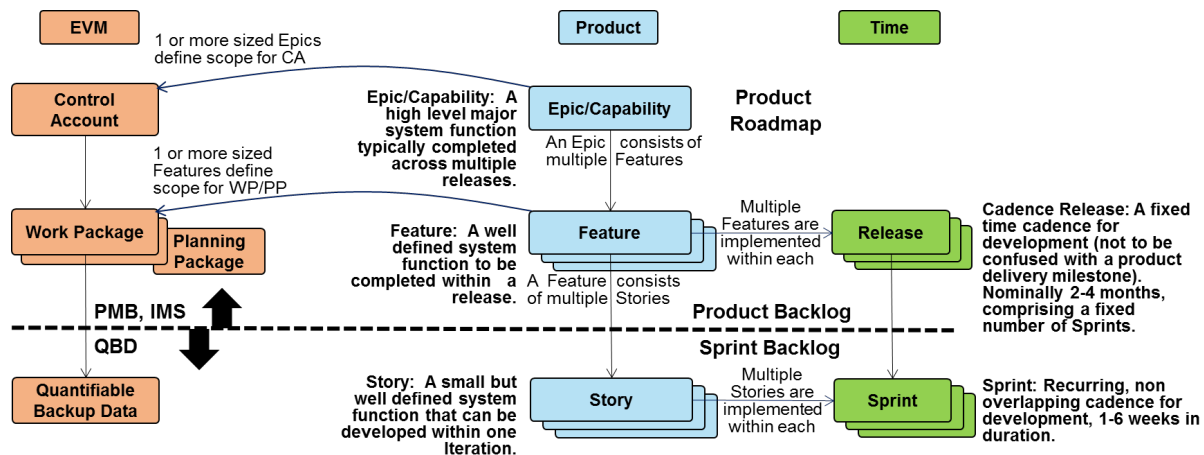


Figure 2: Typical alignment of EVMS to the Agile Hierarchy, however, depending on program size and system description, other alignments have been observed in industry also. Note that traceability both within and between each hierarchy has been defined at program start at the CA/Epic/Capability and WP/PP levels, and for more detailed levels, at successive Cadence Release Planning/Rolling Wave Planning and Sprint Planning activities. What is most important, as illustrated by the black dashed line, is that there is a clear line established above which earned value is maintained, and below which Agile methods are preserved that provide Quantifiable Backup Data to support appropriate baseline change management.

While there is no single standard template for a WBS, MIL-STD-881 is a common reference used in DoD systems and automated information systems. The WBS outlined in MIL-STD-881 Appendix K is selected to create a template that illustrates the application of Agile development techniques. MIL-STD-881 allows considerable tailoring for specific programs.

There are options for what defines the Agile product beyond the necessary Epics/Capabilities, as described in Table 2 for a software product (e.g. Automated Information System). Table 2 does not attempt to provide a comprehensive picture of the WBS, but instead focuses on the core Agile developed software products.

WBS	Task Name	Notes
1	Automated Information System (AIS)	

WBS	Task Name	Notes
1.1	Automated Information System Prime Mission Product Release/Increment X	Multiple elements at this level would be appropriate if the customer views major deliveries as independent products and desires a WBS organized around them (e.g., the deliveries are viewed as separate projects). From an Agile perspective the important point is that elements at this level have no relationship with the Agile cadence “release”.
1.1.1	Custom Applications SW 1..n	
1.1.1.2	Subsystem SW CSCI 1..n	Appropriate if Computer Software Configuration Items (CSCIs) are viewed as key products (with Epics/Capabilities contained within them); may be at L4 or not present at all (as explained below)
1.1.1.2 or 1.1.1.2.1	Agile Epic/Capability 1..n	Would occur at Level 4 or 5. When Epics/Capabilities are the primary organizing method for products then these could be at L4 (preferred). Alternatively, Epics/Capabilities could be viewed as products within CSCIs. Epics/Capabilities are often preferred over CSCIs in the WBS, as Epics/Capabilities are organized around system functionality (value add, end user products) while CSCIs are organized around the internal architectural structure of the system, which doesn't necessarily align directly with usable functionality and customer value.

Table 2: Example WBS, indicating WBS Number, Task Name, and comments on how best to apply in an Agile EVM program.

Products described by Features and Stories below the Epics/Capabilities will be described in later sections in the context of the IMS and performance management.

Another example WBS shown in Table 3, derived from MIL-STD-881 Appendix B on Electronic Systems, indicates how Agile is incorporated into a program involving both software and hardware development. Again, Table 3 does not attempt to provide a comprehensive picture of the WBS; instead it focuses on the core Agile developed products.

WBS	Task Name	Notes
1.0	Avionics System	
1.1	Prime Mission Product	
1.1.1 (L3) and/or	Product 1 . . n	For products that are hardware only or hardware and software combined as the key deliverables
1.1.1 (L3)	Software Product 1 . . n	For software applications that are viewed as key products/deliverables

WBS	Task Name	Notes
1.1.1.X (L4) and	Agile Epic/Capability 1 . . n	When Epics/Capabilities are the primary organizing method for products then these could be at L4. Epics/Capabilities are often preferred over CSCIs/Subsystems in the WBS, as Epics/Capabilities are organized around system functionality (value add, end user products) while CSCIs/Subsystems are organized around the internal architectural structure of the system, which doesn't necessarily align directly with usable functionality and customer value. Each Capability L4 WBS Includes all systems, and development and integration of each Capability on its own.
1.1.1.Y (L4)	Agile Epic/Capability Systems, Integration and Test	Includes all systems, integration and test activities (in a host environment) associated with PMP Software product (L4). Also includes DO-178/CSCI requirements based testing activities not completed within each Capability defined in 1.1.1.x. (Note: WBS not needed if all effort covered within each 1.1.1.x, or in 1.1.Z (PMP Integration Assembly, Test and Checkout)).
1.1.Z (L3)		PMP integration assembly, test and checkout (e.g. includes system/ARP-4754 verification) of all Products

Table 3: Example WBS, indicating WBS Number, Task Name, and comments on how best to apply in an Agile EVM program.

3.2 Integrated Master Plan (IMP)

The Integrated Master Plan (IMP) precedes the IMS and draws from the product-oriented WBS Statement of Work, Statement of Objectives, and Concept of Operations. In Agile the IMP Program Events can describe Epics/Capabilities of the product defined in these documents. Program Events can include major customer milestones, Capability Releases, and other customer deliveries.

This is a similar paradigm to the Integrated Master Plan described “Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide.”^[4] The IMP is an event-based plan consisting of a hierarchy of program events, with each event being supported by specific accomplishments, and each accomplishment associated with specific criteria to be satisfied for its completion.

The IMP may be initially developed in conjunction with an Agile Roadmap or the Product Backlog planning activity. The IMP reflects all the major customer milestones and deliveries, showing the order of the capabilities produced by the program. The Product Roadmap and Release Planning is the basis of the “Definition of Done” (DOD). The DOD equates to IMP’s Significant Accomplishments and Accomplishment Criteria, for each Epic/Capability and their Features. Figure 3, Agile Product and Time Hierarchies, is an example graphic illustrating how the IMP, EVMS, and Agile elements are vertically and horizontally traceable in a single framework integrating Agile and Earned Value Management.

IMP events that are compatible with Agile programs include planned customer deliveries aligned to customer milestones. Initial delivery of completed work products, and later deliveries, are aligned with key mission milestones. For example, if building a space vehicle system, the control system events include deliveries to support launch, Initial Operational Capability (IOC),

⁴ Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide, October 2005, OUSD(AT&L)

and Full Operational Capability (FOC). The IMP events may also include customer demonstration events, e.g., formal demos of an initial flight demonstration.

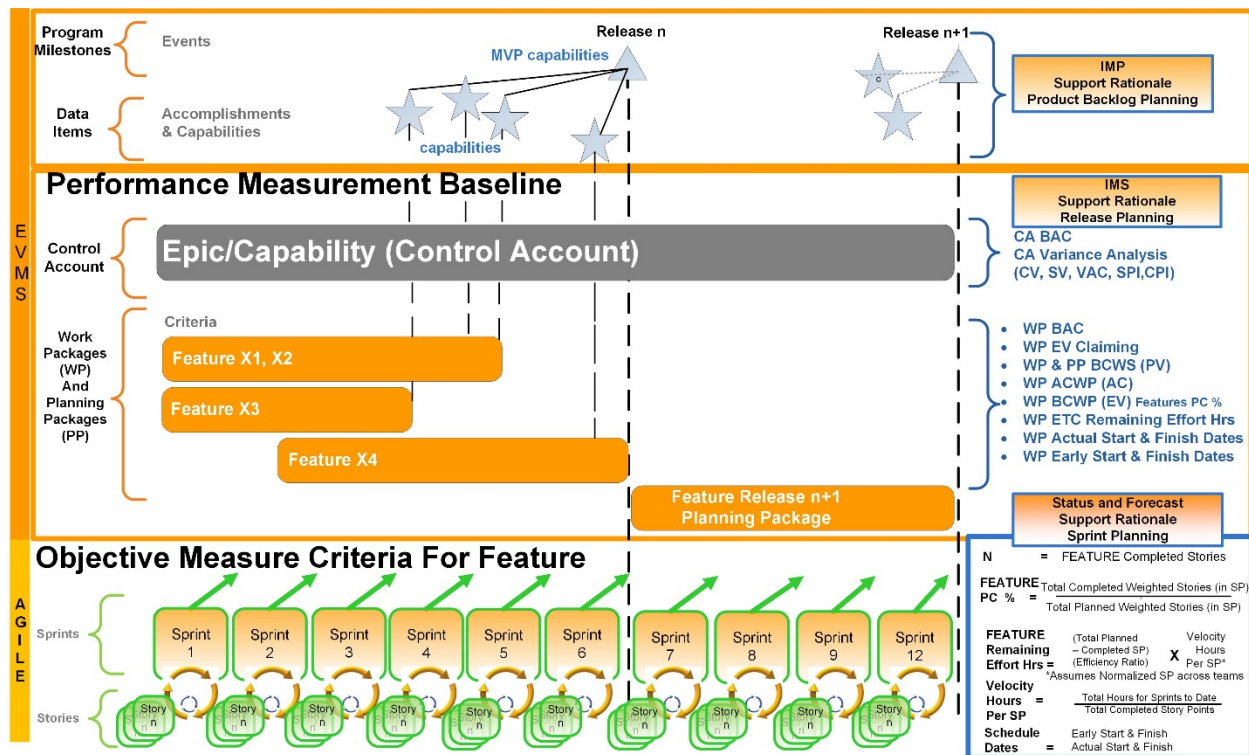


Figure 3: Agile Product and Time Hierarchies. IMP events are equivalent to Releases, with Significant Accomplishments and Accomplishment Criteria representing delivered capabilities delivered in Work Packages where Features are implemented.

3.3 Integrated Master Schedule (IMS)

Epics/Capabilities are decomposed into Feature and Story entities. An Epic/Capability delivers one or more Features and a Feature delivers one or more Stories. On larger programs, one or more “sub-Epics” may exist between Epics and Features to manage the product decomposition to usable sizes, hence the chosen term in this Guide of Epic/Capability. Features are sized to fit within Agile Cadence Releases and represent significant pieces of the delivered product. Features should be the lowest level of an IMS, provided that there are no logic dependencies necessary for management control at a lower level. If there is a need to track a subordinate level of detail, then the Feature scope must be defined at a lower level of detail so that the desired level of tracking and IMS logic is supported. Stories serve as the implementation details of the Feature and are more efficiently maintained by Scrum teams outside the IMS in an Agile development tool.

At program start, an initial Product Roadmap with work product functionality will be created showing a plan for Epic/Capability and Feature development across the Cadence Releases, considering architectural and product dependencies as well as customer milestones. The IMS content, Features and their associated start/end dates and dependencies, will be finalized through Rolling Wave planning, prior to the start of the execution of the associated Cadence Release. Figure 4 shows a Rolling Wave Planning process in the IMS with Cadence Release 1 planned, while the content for the next Cadence Releases still contained in Planning Packages remains to be refined in subsequent Rolling Waves.

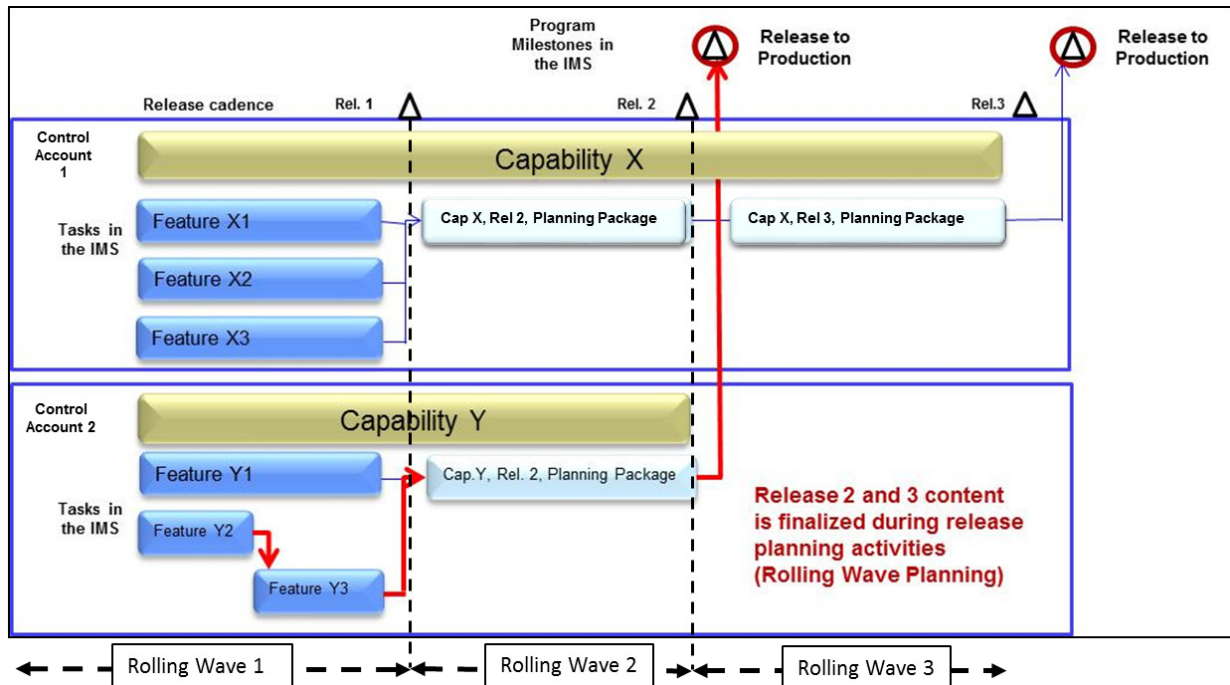


Figure 4: Illustration of Rolling Wave Planning in an IMS

Stories implement the Features in the IMS. Stories are assigned to Sprints in the Agile management tool and are vertically traceable to Features in the IMS through coding fields like WBS, Control Account Number, and Work Package Number. This traceability provides the needed visibility to Program Management from the BCWS to *objectively assess accomplishments at the work performance level* in accordance with EIA-748-C, Page 1.

Features may be longer in duration compared to programs not using the Agile methodology; this is suitable if the task reflects the work, possesses accurate network logic, and is backed up by Agile-based QBD. Completion of each Story's scope of effort is the recommended method for assessing credit, taken against its related Feature completion by dividing total completed Stories by total planned Stories' weighted values for that Feature. Specifically, full credit is taken upon Story completion (100%) to mark progress towards Feature completion. Other methods for claiming progress of completed scope of effort are outlined in Sections 4.3 and 5.5.

Example IMS tasks and subtasks are shown in Figure 5 below. These correspond to CAs and Work Packages. Work Packages align with a single Feature or group of related Features. Figure 5, an example of an IMS subset, is based on the example WBS in Table 2. It shows part of a program with Cadence Releases of 85 working days. Two Epic/Capabilities are developed, each requiring three Features that would each trace to a Work Package, plus Planning Packages assigned to future Cadence Releases. The Cadence Release milestone is a fixed date as it is timeboxed, and has no defined dependencies with the product IMS tasks.

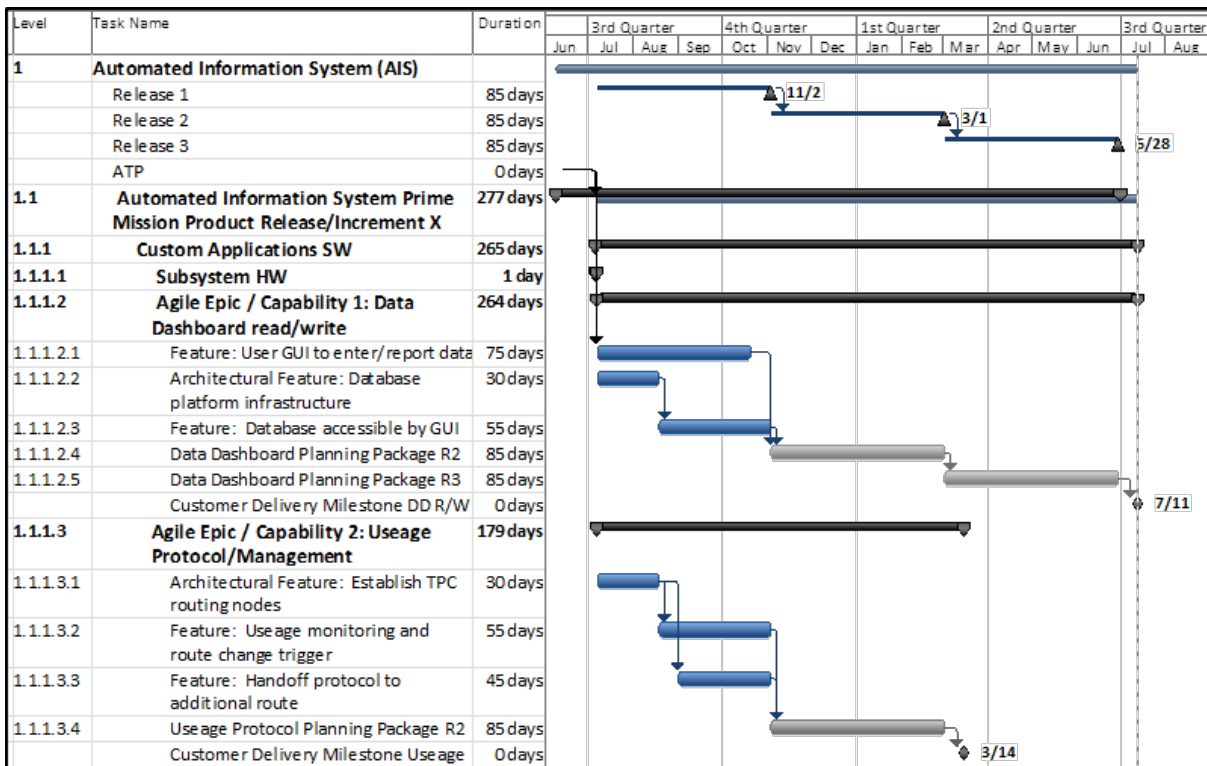


Figure 5: Example of an IMS subset, based on the WBS example in Table 2.

IMS considerations drawing from the IMS example in Figure 5:

- Networking between Work Packages shows dependencies across product Features. In Figure 5, the Architectural Feature of level 1.1.1.2.2 for a *Database platform infrastructure* must complete before the Feature of *Database accessible by GUI*, level 1.1.1.2.3, can be started. Other dependencies include test equipment, power supplies, hardware, or simulation software, as well as dependencies between the to-be-developed products. The cross-functional Agile teams should minimize dependencies/handoffs between teams based on disciplines (e.g., systems engineering, development, and test). To the extent that product level dependencies still exist, they must be modeled in the IMS to establish a critical path.
- The IMS is baselined prior to any work for the Cadence Release content being started. Release Planning in the IMS defines where the IMS is synced with the Agile plan, prior to execution of the work.
- IMS progress is informed by Agile progress tracking reports through burn-up or burn-down reports. See Section 4, Metrics for more details.
- In the IMS, work or planning package tasks can span the duration of a Release given no significant inter-CAM handoffs or major Feature-to-Feature dependencies will be modelled.

3.4 Freeze Period Considerations

To avoid any misinterpretation of the DoD EVMSIG with respect to the freeze period, the freeze period should be adjusted, through formal changes to a company's System Description or other supplementary guidance, to be short enough that it accommodates the Agile planning cycle. However, while a contractor's System Description is in the process of being updated to incorporate Agile adaptation for freeze period, the contractor program should document the Agile process used in the interim along with the plan for updating the System Description.

A key point is that planning, including detail planning of planning packages, completes prior to the start of work for any of the products in the upcoming Cadence Release. The customer should be highly integrated into the release planning process, with ample opportunity to provide input on the plan if there are concerns.

For Performance Assessments and Root Cause Analyses (PARCA) guidance on this topic, please see Section 2.e of the Agile and Earned Value Management: A Program Manager's Desk Guide, OUSD AT&L (PARCA), 03 March 2016.

4 Structures for Performance Metrics

This section describes current best practices in industry in how to plan and then measure program earned value performance in Work Packages and CAs, using Agile progress measures.

4.1 Control Account Plan

Control Account (CA) scope corresponds to Epics/Capabilities and their Features of the system. The specific technical scope and schedule of each CA is based on the system Epic/Capability decomposition into Work Packages and Planning Packages containing the Features needed to deliver those Epics/Capabilities. The schedule for delivery of system functions results from the planned Release of working software, the span of control desired by program leadership, and other similar considerations. Thus CA durations may vary from one to many Cadence Releases. However, it is recommended that CA scope correspond to a single Epic/Capability.

WPs are an element of control within CAs. The number, content, size, and duration of Work Packages needed in a CA will vary subject to internal management needs and organizational policies along with the size and complexity of the program. A work package is the point where work is planned, progress is measured, and earned value is assessed. It is recommended to align one Feature or at most a small set of logically related Features with a Work Package.

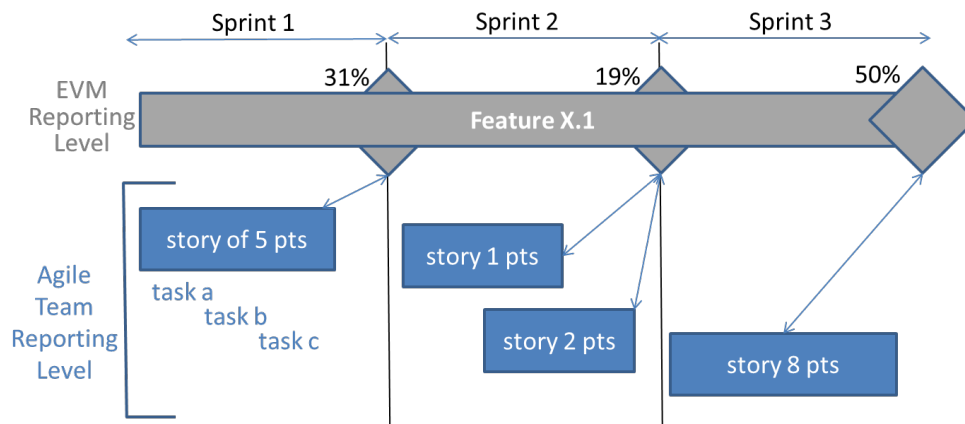
On Agile programs, the Work Package scope and budget corresponds to Features of the system. The budget for the Work Package is determined by the estimated effort to complete the work scope in terms of hours and resources. A single Work Package corresponds to one or more Features and the Period of Performance may span the Cadence Release duration or only a part of it. While a WP may contain multiple Features, each Feature should be entirely contained within a single WP. Whether a WP contains a single or multiple Features, there should be a logical relationship between Features and Epics/Capabilities and to Releases (either Capability or Cadence) with the program's WBS, Control Account and Work Package structure. As an example, Figure 5's IMS shows two Agile CAs – 1.1.1.2 and 1.1.1.3. The 1.1.1.2 CA, *Data Dashboard read/write*, contains Work Packages that each align to a Feature, such as 1.1.1.2.1, *User Graphical User Interface (GUI) to Enter/Report Data*. Epic/Capability milestones align to CAs as well, such as for CA 1.1.1.3, *Usage Protocol/Management*, a Customer Delivery Milestone is scheduled on March 14th.

After initial planning, Work Packages are defined during program execution through a series of Rolling Wave or Cadence Release planning cycles. The Cadence Release planning period is a fixed duration determined in Product Planning at the start of the program, and each WP should be scheduled to fit within one Agile Cadence Release. For Features beyond the current Agile Cadence Release, the scope may be in Planning Packages, which will be refined during future release planning cycles.

4.2 Aligning Agile Progress Metrics with Earned Value Reporting Levels

Figure 6 and Figure 7 are examples of Agile progress reporting used to status the PMB in the Earned Value Management System. In Figure 6, the completion of Agile Stories, with attributed Story Points proportional to the effort, determines the completion status (Percent Complete (PC)) for a Feature, which is the lowest reporting level. The Story Points assigned therefore create a weighted Story Value for product completion status calculations.

Earned Value Measured at the Feature Level



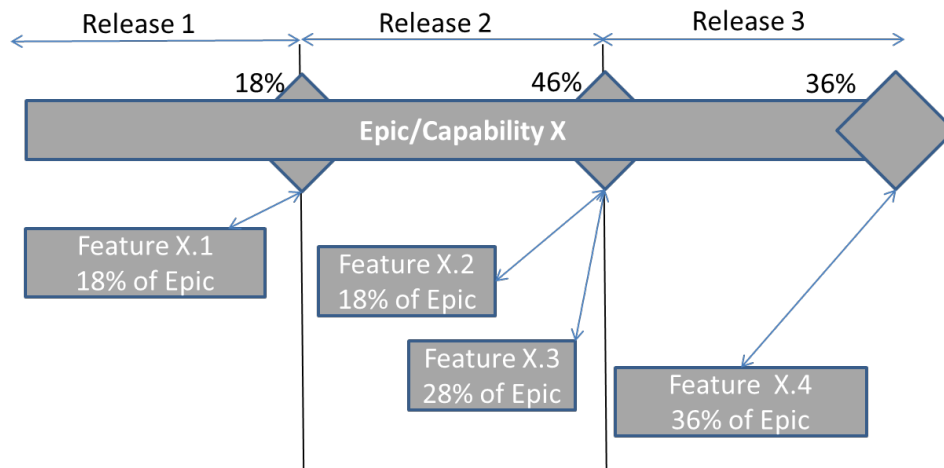
Percent Complete (PC) for the feature at the end of each sprint, assuming stories are completed:

- At the end of sprint 1, feature PC = 31%
- At the end of sprint 2, feature PC = 50%
- At the end of sprint 3, feature PC = 100%

Figure 6: Example of Agile product completion status rolling up into EVM reporting at the Feature level. The Feature is planned to be developed over 3 Sprints, with percent complete at each Sprint calculated using the Feature’s weighted Story values. The Agile Team is working on other Features not shown in this example; points indicate only part of their total workload.

Figure 7 shows measures of Percent Complete (PC) at the Capability level which are derived from Percent Complete at the Feature level using PC from the Feature level in Figure 6. Individual Feature Completion (PC) will still be determined based on completed Stories (similar to Figure 6); now the Feature PC is used in roll-up reporting to the higher level item. One or more features are contained in a Work Package; therefore, the Epics/Capabilities, comprising Features, would logically align to CAs.

Earned Value Reflected at the Epic/Capability Level



Percent Complete (PC) for the epic/capability at the end of each release:

- At the end of release 1, epic PC = 18%
- At the end of release 2, epic PC = 64%
- At the end of release 3, epic PC = 100%

Figure 7: Example of a higher level of rollup of Agile product completion status to EVM reporting. Features with Work Package level earned value calculated using weighted Story Values roll up at each Cadence Release to weighted milestones based on Features completed within each Cadence Release.

4.3 Computing & Reporting Earned Value Performance

Using the earned value technique of Percent Complete (PC), Agile progress reports are based on weighted Stories completed divided by weighted Stories planned for the Sprint. This percent represents Percent Complete for the related Stories' Features, and is used in the calculation of Earned Value (BCWP) (EV). More information on normalizing Story Points, which happens during initial Release and Sprint planning, is provided in Appendix C, Reference 6, where a four-step method is described to normalize different teams' estimated Story Points based on their commonly identified small Story which has been defined as equal to one Story Point. If a teams' Story Point estimates have not been normalized to a common reference during Release planning activities, one cannot combine such QBD into a rolled-up progress report without a relative sizing calculation first to account for different team's estimation data.

One way progress can be calculated is to track Stories, their planned points, and their completion based on the Earned Value Technique chosen. Then report, at the multiple-Story Feature level, a PC that can then be translated into earned value in an EVM System based on PC inputs by Work Package/resource. See an example of this calculation of Feature level status by giving 100% weighted Story value credit when the Story is completed (shown below in Figure 8).

Agile Tool ID	Task Description	Story Points	Story Weighting	Story Complete %	NWA %Claim
PMG-245	Story #1 Title	2	8.7%	100%	8.7%
PMG-246	Story #2 Title	5	21.7%	0%	0%
PGM-247	Story #3 Title	8	34.8%	100%	34.8%
PGM-248	Story #4 Title	5	21.7%	0%	0%
PGM-249	Story #5 Title	3	13.0%	0%	0%
	Total Story Points	23	100%		43.5%

Figure 8: Another example of how planned Story Points, or weighted Story Values, may be applied to create QBD to calculate earned value as a PC.

4.4 When Do You Take Credit for A Story?

When to take credit for a Story is dependent, of course, on its Definition of Done, however, it is also dependent on the chosen Earned Value Technique for a WP, such as PC or Percent Complete Weighted Milestones. Given those decisions and that Story value normalization has been established across Scrum teams during backlog planning, weighted Story values or estimated “ideal hours” effort for Stories can be translated into planned and then earned value and rolled up as QBD into an EV system entity such as a WP or CA (for definition of earned value techniques, see Appendix A, EVM Data Dictionary section).

In initial adoption of Agile, industry adopted several options on when one could take credit for completing a Story, such as 0/100, 50/50, and partial claiming. Since inception of this Guide however, industry has moved to the standardized use of 0/100 as the most objective measurement of credit for Story completion. Due to the binary nature of the corresponding Agile principle (“Working software is the primary measure of progress.”), it is recommended that programs employ a 0/100 method, taking credit only when the Story is done, or meets the predetermined “Definition of Done”. See below for a summary of the 0/100 approach:

0/100: No credit is taken for a Story until completed (e.g., accepted by the PO), at which time full credit is taken.

- Pros – This is easy and straight-forward and ensures that the claim is not taken until the Definition of Done and Acceptance Criteria are met. Encourages finer resolution of Stories so that multiple Stories are completed per Sprint, providing more accurate QBD to justify earned value numbers.
- Cons – If work does not get done, the claims may be low causing an artificially low Schedule Performance Index (SPI) or Cost Performance Indicator (CPI). The impact of this depends on the size of the Stories and the number of Stories that are in this state. There are likely to be open Stories that are not able to be claimed but have actuals recorded, hence causing a lower Budgeted Cost for Work Performed (BCWP) since there is no credit for incomplete work. Shorter-duration Stories are necessary to achieve a granularity for accurate SPI/CPI reporting within financial business rhythms. Story granularity ideally allows at least several Stories to begin and complete within each Sprint so that progress is visible throughout the Sprint rather than just at its conclusion, allowing course corrections as a team works the Sprint assigned Stories.

4.5 Feature Cost/Risk to be Considered When Establishing Baseline

In Agile development, as well as in any product development, there are always uncertainties. It is recommended that these be considered when sizing the Features and establishing a Work Package cost/schedule baseline for that Feature. For identified risks, Stories should be planned as risk mitigation activities. For unknown risks, as usual in any earned value managed program, Management Reserve can be held at a higher level for use when in-scope unanticipated work is discovered and new Stories must be added to complete a product.

4.6 Variance from the Baseline: Examples with Agile EVM

Variance is a natural consequence of developing complex products and there are cases where the scope achieved took more or less effort than planned. The examples below show how cost and schedule variances could be observed on an Agile program.

Assume that there is a plan to complete a Feature estimated at a total of 20 Story Points, with planned labor of 400 hours in the associated work. The Feature consists of ten Stories of 2 points weighted Story Value, which translates to an estimate of 40 hours per Story or 20 hours per Story Point. During the first Sprint the team plans to complete 4 Stories of 2 points equal weighted Story Value each for a total 8 points. This equates to an estimate of 160 hours of labor ($8/20 * 400$ hours). The following are examples of possible variances after a Sprint:

- Consider the case where a team completes the planned amount of work in a Sprint for the Feature, but took 200 hours rather than the expected 160 hours to complete it. This could result in a cost variance at the Work Package level if the remaining six Stories complete as planned.
- A schedule variance could appear at the Work Package level if the team completed 3 of 4 planned Stories (6 of their planned 8 Story Points) using the hours associated with those Stories, 120 hours, with the remaining Story allocated to a later Sprint.
- During a Sprint, a team discovers a new 2-point Story is necessary to complete a planned Feature, and they decide to add that to the current Sprint. In this case, the extra Story is completed as part of the originally planned 160 labor hours; there is no variance to report into the Work Package: all planned work was completed as planned and on budget, 5 Stories of 10 points in 160 hours.
- During a Sprint, a team discovers a new 2-point Story is necessary to complete a planned Feature, and they decide to add that to the current Sprint. In this case, the extra Story is completed along with the original 4 using 200 total labor hours rather than the planned 160 labor hours. This could result in a cost variance at the Work Package level.
- During a Sprint, a team discovers a new 2-point Story is necessary to complete a planned Feature, and that new Story goes into the Backlog for a future Sprint assignment. The planned 4 Stories of 8 points are completed on schedule within planned hours; however, because of the additional Story in the Backlog, there could be a resultant cost and schedule variance at the Work Package level. It might be necessary to report a lower BCWP based on the added Story in the Story Point total.

In each of these cases an EVM variance could appear at the Work Package level based on QBD calculations for that Feature; in any case Feature performance can be both projected and managed using the Agile work flow.

4.7 How to Use Agile Metrics to Forecast ETC/EAC

The Agile methodology endorses use of Planning Packages. Agile does not advocate detailed planning all the way through to program end, which traditionally enables ETC/EAC forecasting. This avoidance of detailed longer-term planning is based on the principle that it is not possible to do accurately early on given limited data and the likelihood of customer-desired outcomes changing. Yet EAC forecasting is essential in EVM-managed, or any managed program.

For an Agile EVM managed program, a program's entire budget can be plotted out at a summary level via roadmap planning and top-level IMP/IMS. At the roadmap level, Epics/Capabilities and Features are estimated and allocated to Cadence Releases, and a baseline is established. At each release planning event, the Planning Package for the next Cadence Release will be detail planned by finalizing the assignment of Features to the Cadence Release and Work Packages that have been initially allocated to the roadmap Epic/Capability plan in the form of Work Packages in the first Cadence Release and Planning Packages in subsequent Cadence Releases.

In a large program where both Agile and EVM is in practice, Rolling Wave planning that typically occurred on a purely EVM program every 6 or 12 months can be replaced by this Rolling Wave planning at Cadence Release events. In this way the strong planning rhythm offered by Agile enables Rolling Wave planning in traditional EVM to be taken to a new level of currency and accuracy, supported by Agile planning practices. ^[5]

Each Sprint, within a Cadence Release, includes work activities for product development. Work performance for deliverables completed in past Sprints and Cadence Releases can be used to generate an ETC and EAC. Using the relative size of completed work, compared to future work is known and actual cost and schedule performance against past work is known, predictions can readily be performed for that future work. Note that, as in traditional EVM, changes in estimated work made as the program progresses are not changes in work scope; scope remains the same as described in the program baseline.

The formulas in Appendix A include methods to calculate an estimate to complete and are illustrated below. The formulae express how to calculate progress via PC on a single Feature as weighted Story Values expressed in Story Points (SP) completed versus the total weighted Stories planned, then how to calculate remaining hours of effort for a Feature using planned and completed weighted Stories in SP and hours used per completed Story Point.

$$\text{Feature Percent Complete} = \frac{\text{Total Completed Weighted Stories (in SP)}}{\text{Total Planned Weighted Stories (in SP)}}$$

Feature Remaining Effort Hours

$$= (\text{Total Planned SP} - \text{Total Completed SP}) \times \frac{\text{Total Hours for Sprints to Date}}{\text{Total Completed SP}}$$

⁵ See Agile and Earned Value Management: A Program Manager's Desk Guide, OUSD AT&L (PARCA), 03 March 2016 Section 2.d for guidance on developing Rolling Waves.

The latter equation, put more simply:

$$\begin{aligned} & \textit{Feature Remaining Effort Hours} \\ &= (\textit{Total Planned SP} - \textit{Completed SP}) \times \frac{\textit{Total Hours to Date}}{\textit{Total Completed SP}} \end{aligned}$$

Appendix B provides examples of Agile EVM progress tracking.

5 Managing Baseline Change on Agile Programs

This speaks to industry best practices for managing baseline changes on Agile development programs also using Earned Value Management. These best practices represent a knowledge network of Earned Value and Agile practitioners promoting a consolidated view. The working group recognizes there are various policies, procedures, processes, and tools within industry and this guide recognizes variability can exist. The working group laid out a set of scenarios and associated guidance that are currently occurring within industry. We encourage continuous feedback, comments, ideas and suggestions to the working group to continue to promote best practices on this topic.

5.1 Baseline Change Parameters

Here are some baseline change scenarios using Agile development methodology which are also using Earned Value.

- Recognizing there are multiple Agile approaches, this section is based on Scaled Agile Framework® (SAFe®) concepts (See Appendix C, Reference 7), which is widely used in industry today.
- Recognizing that Agile development methodology is in use across a wide variety of programs and companies, this discussion is limited to contracts that would benefit from an EVMS; i.e., contracts that have some level of pre-defined goals or outcomes (requirements) tied to program events or milestones.
- Commercial programs developing product to take to market are not addressed.
- Level of Effort or staff augmentation contracts awarded in support of a government led initiative are not addressed.

5.2 Baseline Assumptions

There is Agile terminology and assumptions made in the establishment of a program Performance Measurement Baseline (PMB) for EVMS, used as the basis for the change scenarios in Section 5.3.

The program described here assumes an Agile implementation methodology that includes planning work within recurring timeboxed boundaries such as Sprints and Releases as described in Section 3.1.

- Agile Product Hierarchy (best practice example):
 - The Agile product hierarchy is made up of Epics that are decomposed into Features, which are sized to be scheduled to complete within a single release. Each Feature is further decomposed into Stories, which are sized to complete within one Sprint, as depicted in Section 3.1. Stories are developed and maintained below the level of the EVMS PMB.
- EV Hierarchy and definitions (best practice example):
 - CAs for this program are established at the Epic/Capability (product) level and may span many releases.
 - Work Packages for EVMS are created at the Feature Level. Feature Work Packages represent working product and have documented exit criteria (definition of done).

- Planning Packages represent working product associated with a future release.
- The Product Backlog documents the technical scope of each CA.
- All items listed on the Product Backlog include rough size complexity estimates (weighted Story Value in Story Points, ideal hours, T-Shirt size (relative sizing method for typically smaller Agile efforts, in S, M, L, XL etc.), other) that are refined over time as knowledge is gained.
- All Items listed on the Product Backlog are traceable to a Work Package or Planning Package in the PMB.
- A Release Roadmap is maintained that documents the prioritized product Backlog. Epics and Features on the Product Backlog are mapped to specific releases as part of the Product Planning process.
 - Backlog grooming (refining) is a continuous and normal part of Agile management and it is possible that Future Epics and Features may be reprioritized and mapped to different releases based on discovery or user feedback.
- The program does Rolling Wave planning at Cadence Release points. Rolling wave planning occurs after the Release Planning Event. The current release is detail planned and decomposed into “Feature Work Packages” (for Section 5 scenarios assume that there is only one Feature for each Work Package). Budget for future releases remains in Planning Packages.

5.3 Baseline Change Scenarios

Baseline Change Scenarios		
Scenario	PMB Action	Product Backlog Action
1. The Work Package/Feature is not open and work has not started. It is determined the Feature is not needed for the current release. (Scenario 1 graphic included at end of Section 5.3.)	Baseline Change: Re-plan Work Package to future release. If the baseline start of the Feature is inside the program’s “freeze period”, appropriate control and notification mechanisms apply.	Feature and related Stories are returned to Product Backlog and mapped to future release.
2. The Work Package/Feature is 30% complete, but did not complete by a formal delivery date. The delivery date is held as planned. The customer accepts the delivery without the Feature functionality.	In most cases, this is not a baseline change. Although the customer accepted the delivery, the original plan was not met. In this case the Feature remains open, showing a schedule variance until the work is completed.	The unfinished Feature’s Stories are moved to the next release and planned in a Sprint. The WP identifier remains unchanged.

Baseline Change Scenarios		
Scenario	PMB Action	Product Backlog Action
3. Features for the current Release are re-prioritized. A planned Feature is swapped with a different Feature from the Product Backlog of a similar size that was mapped to a future release. <i>(This is unusual.)</i>	Baseline Change: The swap is documented, even if the overall budget and baseline schedule dates do not change. IMS task descriptions and Feature Work Package descriptions/exit criteria are updated as necessary.	Features and related Stories are re-mapped to applicable WP and release PP. WP and PP identifiers are updated.
4. The Contracting Officer (CO) issues a contract letter which removes the scope of an Epic/Capability (requirement). The change affects a Feature which is currently baselined in an open Work Package.	Baseline Change: The in-progress WP is closed by setting BCWS equal to BCWP. The entire unclaimed budget associated with the Capability is returned to Undistributed Budget (UB) until dispositioned by contract mod (de-scope).	The unfinished Stories, Features and Epic/Capability are removed from the Product Backlog.
5. The exit criteria for Feature 1 Work Package are updated to add additional functionality (requirements) to that Feature. Stories are created to satisfy the additional requirements. <i>The important consideration here is that the exit criteria of the Feature Work Package have changed.</i>	Baseline Change: The scope of Feature 1 has increased. Budget must be added for that new scope. If this is the result of a customer desired enhancement (new scope) the budget will come from UB. If this is an unplanned in scope increase, the budget will come from Management Reserve (MR)	The exit criteria for Feature 1 are updated. Stories are created and added to the Product Backlog and mapped to Feature 1.

Scenario 1 Graphics: Example of a Change Modeled in the PMB and Product Backlog

In scenario 1, an unstarted baselined Feature Work Package is not needed for the current release and is rebaselined to a future release. The two graphics below depict this scenario. The first graphic shows the current CA baseline, and how it is modeled in the Product Backlog and in the Control Account Plan (CAP). To maintain traceability from the Backlog to the CAP, a common field (the Work Package/PP ID number) is found in both.

- ▶ The backlog includes a coding structure that traces to the CAP. (WP's and PP's)
- ▶ Budgets for Features are allocated based on complexity of the effort
- ▶ The Control Account BAC represents the planned cost for completing the product (EPIC)

Product Backlog				Control Account Plan	
Release	User Stories	Features	Work Pkg / Planning Pkg	Work Pkg / Planning Pkg	BUDGET
A	X1	X	A00X	A00X	\$ 8,000
	X2				
	X3				
	X4				
	X5				
	Y1	Y	A00Y	A00Y	\$ 7,000
	Y2				
	Y3				
	Y4				
	Y5				
Z1	Z	A00Z	A00Z	\$ 10,000	
Z2					
Z3					
Z4					
Z5					
B	N1	P	B00PP	B00PP	\$ 25,000
	N2				
	N3				
	N4				
	N5				
	TBD				
	Q				
	R				
	S				
	T				
C	TBD	U-W	C00PP	C00PP	\$ 25,000
				BAC	\$ 75,000



The Product Backlog traces to the Control Account Plan

In the second graphic below, Feature Y is rebaselined to a future release and the graphic shows how the change is modeled in the Product Backlog and the CAP. The Feature and associated Stories are moved to the next release in the Product Backlog, and the Feature Work Package in the CAP is rebaselined, moving the budget for Feature Y into the Release B time frame. This demonstrates the movement of scope and budget together

Feature "Y" (Wk Pkg A00Y) rebaselined* from Release A to Release B

Product Backlog				Control Account Plan	
Release	User Stories	Features	Work Pkg / Planning Pkg	Work Pkg / Planning Pkg	BUDGET
Release A - Jan - Mar	X1	X	A00X	A00X	\$ 8,000
	X2				
	X3				
	X4				
	X5				
	Y1	Y	A00Y	A00Y	\$ 7,000
	Y2				
	Y3				
	Y4				
	Y5				
Z1	Z	A00Z	A00Z	\$ 10,000	
Z2					
Z3					
Z4					
Z5					
Release B - Apr - Jun	N1	P	B00PP	B00PP	\$ 25,000
	N2				
	N3				
	N4				
	N5				
	TBD				
	Q				
	R				
	S				
	T				
C	TBD	U-W	C00PP	C00PP	\$ 25,000
				BAC	\$ 75,000

Backlog and PMB reflect Feature A00Y movement from Release A to Release B

* This graphic shows the effect of a schedule rebaseline. In most cases, Wk Pkg A00Y would not be rebaselined and would incur a schedule variance.

5.4 Forecast Change Scenarios

Forecast Change Scenarios		
Scenario	PMB Action	Product Backlog Action
1. A Feature Work Package that spans 3 Sprints has started. The team determines that some of the Stories mapped to the Feature planned in the first Sprint will not be completed and moves those Stories to the second Sprint which still falls inside the baseline finish date of the Feature.	No change to Feature Work Package baseline budget or baseline schedule. Stories can be moved from Sprint to Sprint within the planned duration of the Feature Work Package without impacting the baseline.	The product Backlog is updated to move the Stories not completed in the first Sprint into the second Sprint.
2. A Feature Work Package that spans 3 Sprints has started. The team determines that some of the Stories mapped to the Feature planned in the first Sprint will not be completed and move those Stories to Sprint 4, which is beyond the baseline finish date of the Feature.	No change to Feature Work Package baseline budget or baseline schedule. The in-progress Feature IMS task shows a slip to the baseline finish date. BCWP is only claimed for the Stories actually completed. BCWP compared to BCWS identifies a schedule variance. Reflect changes in IMS Forecast, EAC.	The Product Backlog is updated to move the Stories not completed in the first Sprint into the fourth Sprint
3. A Feature Work Package has started but will not be completed by a formal delivery date. Customer states that the functionality is needed for the formal delivery.	No change to Feature Work Package baseline budget or baseline schedule. The Feature is forecasted to slip beyond the delivery date. The IMS shows a late delivery. Critical Path (float) is impacted. Reflect changes in IMS Forecast, EAC.	The unfinished Stories are moved into the Sprint in the next release cycle where they are forecasted to be completed.
4. The PO and team determine a Story is deemed unnecessary for the accomplishment of the Feature due to an increased understanding of Feature exit criteria (requirements). The Exit Criteria for the Feature has not changed. The Feature WP is in progress. Feature QBD is the Stories mapped to the Feature.	No change to Feature Work Package baseline budget or baseline schedule. Feature QBD is updated to remove the Story. Removal of the Story from QBD may result in an increase in Feature WP percent complete since the percentage of unfinished effort has decreased. Reflect changes in IMS Forecast, EAC.	The Story is removed from the Product Backlog.
5. The PO and team determine a Story needs to be added for the accomplishment of the Feature due to an increased understanding of Feature exit criteria (requirements). The Exit Criteria for the Feature has not changed. The Feature WP is in progress. Feature QBD is the Stories mapped to the Feature.	No change to Feature Work Package baseline budget or baseline schedule. Feature QBD is updated to add the Story. Adding the Story to the QBD may result in a decrease in Feature WP percent complete since the percentage of unfinished effort has increased. Reflect changes in IMS Forecast, EAC.	The Story is added to the Product Backlog and mapped to the Feature. A Feature Work Package identifier is added.

Forecast Change Scenarios		
Scenario	PMB Action	Product Backlog Action
6. After a Feature Work Package and the associated Stories are accepted and claimed 100% complete, a problem is found. The defect must be corrected before the functionality can be released. A Defect Report (DR) is written.	<p>a. If a stand-alone Work Package has already been established for DRs in the current release, the new DR is added to the QBD for that Work Package.</p> <p>b. It may be appropriate in some cases to unclaim BCWP on the Feature Work Package if the work is not truly completed. The Feature QBD percent complete and forecast finish date are adjusted accordingly. Reflect changes in IMS Forecast, EAC.</p>	<p>a. The new DR Story is added to the product Backlog and mapped to the established DR Work Package.</p> <p>b. The DR Story is added to product Backlog and mapped to the Feature Work Package.</p>
7. Features mapped to future releases are reprioritized based on discovery and user feedback and mapped to other future releases. Budget for future releases is in a Planning Package.	<p>No change to budget or baseline schedule. This is not a baseline change because this work has not been detail planned.</p> <p>This kind of re-prioritization is expected; however, the roadmap should be analyzed for potential bow-wave (work consistently moving 'to the right' without corresponding work moving forward) and related critical path impacts. If a bow-wave is apparent, a baseline change may be required to adjust the PP monthly budget spread. Reflect changes in IMS Forecast, EAC.</p>	The product Backlog is updated and the Features are mapped to the resulting releases on the release roadmap.

5.5 Agile/EV Recommendations

- The Contractor should establish a freeze period (Appendix C, Reference 8, Guideline 29) that supports the flexible nature of Agile development. Discovery and change are a normal part of Agile development, and change assessments occur frequently, often at the end of each Sprint. Assuming a Sprint cadence of every 2 weeks, and Rolling Wave planning at 3 month Cadence Release points, the Contractor may want to establish a short freeze period, perhaps a 2 week forward window, or the current Sprint Period of Performance (POP). A traditional freeze period such as “current month plus 1” will greatly limit the program’s ability to respond to change quickly. A Contractor’s freeze period should be defined in a way to support Agile and EV.
- Rolling Wave Planning Package Breakout. Allowing programs to wait until after the planning meeting is held for the next increment of work before finalizing the detailed plan should minimize changes once the work has started. A typical Agile business rhythm holds the release planning meeting for the next increment of work at the end of the current increment, just prior to the start of the next increment or Cadence Release cycle. The decomposition of scope from planning packages to work packages is not a change to the baseline and is not subject to the change control rules required by the freeze period. Once work packages are defined and budgeted, controls must be established to minimize further changes to budgets, schedule, or scope of work. It is acceptable to

decompose planning packages and create work packages inside the current period for work that has not yet started. The detail plan must be approved prior to the start of the work, and such an approach must be compatible with the contractor EVM System Description.

- The Contractor should establish the definition of product and the Definition of Done at the Feature and Epic level to allow for the creation, removal, and modification of Stories that are developed to satisfy the Feature and Epic functionality without an impact to budget or scope. Requirements are understood at a high level, but we also expect some level of change to emerge as Stories/Features are built and new knowledge is gained. It comes down to having the appropriate level of granularity of the Feature exit criteria. Detailed enough to have a good foundation of “what”, but not so prescriptive as to inhibit beneficial change. *“Stories are not stand-alone requirements, in that they represent a statement of intent rather than a contractually required behavior” (Leffingwell)*
- The Contractor should establish budgets, or MR reserves, that are inclusive of estimated DRs related to the development effort. When establishing the PMB, some portion of the development effort’s budget is retained for eventual DR work off. This allows for risk reduction and addresses the reality of defect identification during later program phases. Proactive identification of DR budgets or reserved capacity can also be accommodated by including this in assumptions for an Epic's Features.

Appendix A - EVM/Agile Data Dictionary

This appendix is organized into three sections.

1. **EVM Agile Data Dictionary.** This section provides an EVM Agile Data Dictionary and thesaurus of Agile terms and rationale. The intent is to create a common vernacular and a method to harmoniously blend EVM and Agile program management practices.
2. **Agile Data Dictionary.** The section is a combination of Agile terms from Scrum Alliance and Agile Alliance.
3. **EVM Data Dictionary.** This section includes common EV Systems Management (EVMS) terminology consistent with the EIA-748 Standard for EV Systems.

EVM Agile Data Dictionary

EVM Abv.	EVM Link Term Definition	Rationale to Agile/Scrum Term	AGILE Link Related Term
AC	Actual Cost	Synonymous with ACWP	
ACWP	Actual Cost of Work Performed	Cumulative hours and/or cost to time now for Sprint, Feature, Story, Epic/Capability, and Work Package, as collected by Contractor's corporate accounting system.	Sprint, Feature, Story, Epic/Capability
ASD	Actual Start Date	The start date for the Work Package is when work starts on the earliest Story in Work Package	Story
AFD	Actual Finish Date	The finish date for the Work Package is when work ends on the latest Story in Work Package	Story
BAC	Budget At Completion	Summary of the Work Package, Planning Package, and Summary Level Planning Package budgets	Story, Feature, Epic/Capability
BAC WP	Budget At Completion for Work Package	Total planned Story Points for the Work Package translated to hours, dollars, or other measureable terms based on a validated conversion formula	Story Points
BCWP	Budgeted Cost for Work Performed	<p>The value of work completed at a given point in time, synonymous with "Earned Value". Expressed in dollars representing the portion of the budgeted value of the baseline Work Package that is complete.</p> <p>Example Formula: $BCWP = \% \text{ Complete} * BAC$, where $\% \text{ Complete} = \frac{\text{completed Work Package Story Points}}{\text{current total Work Package Story Points}}$.</p> <p>Note: the Work Package baseline budget (BAC) of the calculation does not fluctuate if the team adds or removes Stories / Story Points provided that the baseline Work Package scope does not change. Changing the total Story Points in a Work Package would impact the $\% \text{ Complete}$ recognition but does not require a baseline change.</p> <p>Example: BAC WP for WP xyz has a baselined estimated cost of \$100,000. The team targeted to deliver 33 of 100 Story Points by the end of Sprint n for WP xyz. At time now the team delivered 28 Story Points.</p> <p>WP xyz: The BCWP \$ and % $100,000 * (28/100) = \\$28,000$ $(28/100) * 100 = 28\%$</p>	Story Points, Definition of Done, Burnup metric, Story
BCWS	Budgeted Cost for Work Scheduled	The time phased Planned Value for the Feature(s), and their Stories associated to the Work Package. This can be summed to the program level and is developed during release and Sprint planning.	Definition of Done, Features, Story, Release Planning, Sprint Planning

EVM Abv.	EVM Link Term Definition	Rationale to Agile/Scrum Term	AGILE Link Related Term
CV	Cost Variance	<p>A metric for cost performance on a program. It is the difference between budgeted cost of work performed and actual cost (CV = BCWP – ACWP.) A positive value indicates a favorable position and a negative value indicates an unfavorable condition, and is expressed in dollars or as a percentage. The calculation for CV dollars is the difference of BCWP – ACWP. The calculation for CV percentage is the ((CV divided by BCWP) * 100).</p> <p>Example: The team targeted to deliver 33 of 100 Story Points weighted Story Value by the end of Sprint n for WP xyz. At time now the team delivered 28 Story Points of weighted Story Value. ACWP cum to date for WP xyz is \$25,000 at end of Sprint n.</p> <p>The Cost Variance \$ and % BCWP to date – ACWP cum to date = CV (100,000 * (28/100) – \$25,000 = \$3000 CV / BCWP to date = CV % (\$3,000 /\$28,000) * 100 = 11%</p>	Story Points, Burnup metric, Story
DUR	Duration	The Work Package performance period is the earliest start and latest finish of all features (and their weighted Stories) associated to the Work Package	Story
EAC	Estimate at Completion	An EVM performance metric that equals Actual Cost of Work Performed plus the estimated costs to complete (Estimate To Complete (ETC)) of the authorized work remaining.	
ESD	Early Start Date	The earliest forecasted start date of the Feature, Epic/Capability, Work Package or Planning Package.	Feature, Epic/Capability
EFD	Early Finish Date	The earliest forecasted finish date of the Feature, Epic/Capability, Work Package or Planning Package.	Feature, Epic/Capability
ETC	Estimate to Complete	<p>The total expected costs for all work remaining on the contract. There are several ways an agile program can calculate the ETC. An example is using the remaining Story Points of the related Feature and/or Work Package. This number is translated into hours by dividing the remaining Story Points by the Team's Velocity and then multiplying by the number of hours in one Sprint. A dollar value may then be determined by applying the appropriate resource rate.</p> <p>Remaining Story Points: 500 Team Velocity: 125 Story Points / Sprint Hours / Sprint: 400 ETC = 500/125 * 400 = 1,600 hours</p>	Story Point, Team, Feature, Velocity, Sprint Backlog, Tasks
EV	Earned Value	The value of completed work expressed in terms of the budget assigned to that work. Synonymous with rationale of BCWP.	

EVM Abv.	EVM Link Term Definition	Rationale to Agile/Scrum Term	AGILE Link Related Term
EVMS	EV System	A program management system that establishes the relationship between the cost, schedule, and technical aspects of the work; measures progress objectively with earned value metrics. The Agile/Scrum data can be leveraged for input of the program scope, schedule and cost performance and estimate to complete into the EVMS. Typically, the Agile/Scrum data resides in the Agile tool.	
EVT	Earned Value Technique	Defines the method used to earn the budgeted value for performance on a Work Package. Examples are LOE, percent complete, 0/100, 25/75, 40/60, 50/50, and weighted milestones. In many examples in this document, the EVT used is Percent Complete, with Stories/Story Points representing the subordinate detail.	Story, Definition of Done
HR	Hours	Fundamental unit of measure for budget or performance; for example, weighted Story Values expressed as Story Points converted to effort hours.	Story Points
IMP	Integrated Master Plan	An event driven plan to manage program activities, which defines measurable and traceable program Events, Accomplishments, and Criteria to satisfy programmatic, and technical product and service requirements. This planning aligns to Product Backlog refinement which aligns with the event driven concepts (Events, Accomplishments, and Criteria) of the IMP. Includes defining the work products (Epic/Capabilities and Features) for the complete system and aligning to program milestones.	Product Backlog Refinement, Epic/Capability, Features
IMS	Integrated Master Schedule	A time dependent, task oriented schedule containing the networked, detailed tasks necessary to ensure successful program execution and that is integrated with the Integrated Master Plan. This aligns with the Product Roadmap and the Product Backlog refinement resulting in scheduling the Epic/Capabilities and Features into releases, i.e. release planning throughout the development life cycle allows us to plan to a Work Package level of the IMS. The Release and Sprint planning must contain the necessary logic and time-phasing to support program requirements and provide accurate progress information toward Product Backlog completion.	Product Backlog Refinement, Release Planning, Sprint Planning, Sprint Backlog
IPT	Integrated Product Team	Cross functional team members working together consistently in a predefined pattern. In contrast to traditional methods that bring people in as needed.	Team
LOE	Level of Effort	Any effort which is defined as a support type task having no practicable measurable output or product that can be discretely planned and objectively measured at the Work Package level.	

EVM Abv.	EVM Link Term Definition	Rationale to Agile/Scrum Term	AGILE Link Related Term
Interim Milestone	Interim Milestone	In an IMS, a milestone may indicate the start, an interim step, or the end of one or more activities. The term weighted milestone as used in the Earned Value Management System represents an Earned Value Technique (EVT) and the milestone is weighted with a value of hours, dollars, or other unit of measurement for performance recognition.	Product Backlog Planning, Epic/Capability, Features, Release, Definition of Done
Milestone	Milestone	Any zero duration event that marks the completion of a significant activity e.g. releases, reviews, Sprints	Releases, Reviews, Sprints
PMB	Performance Measurement Baseline	The time phased budget plan against which contract performance is measured. Through product and release planning, establish budget values for Epics/Capabilities throughout the program and their Features within next Release(s) for time phased work. Nearest release Features are assigned to Work Packages, Planning Packages may be used for ensuing Releases. These Planning Packages and Work Packages have been networked, resource loaded and leveled to establish the PMB.	Features, Release
POP	Period of Performance	The number of working days or calendar days, from a specified commencement date to a specified completion date. The Work Package period of performance can be aligned to the beginning of the first Sprint and end of last Sprint.	Sprint
PP	Planning Package	A logical aggregation of work within a Control Account, normally far-term effort, which does not have sufficient definition to define individual Work Packages. It is collection of Epics/Capabilities or Features budgeted and time phased to corresponding future Releases.	Epic/Capability, Features, Release
Product Roadmap	Product Roadmap	The Product Roadmap is the time-phased delivery plan for the functionality in the Product Backlog. The Product Roadmap is also referred to as the "Program Roadmap" or "Release Roadmap".	Product Roadmap, Release Roadmap
RAM	Responsibility Assignment Matrix	A depiction of the relationship between the Work Breakdown Structure (WBS) elements and the Organizational Breakdown Structure (OBS) assigned, and defines who is responsible for the CA budget. In Agile, the PO manages the product Backlog and coordinates with the CAM for the scope, schedule, and costs of the product being produced.	PO, Product Backlog
SOW	Statement of Work	Product Backlog and Release plan should be traceable to the SOW	Product Backlog, Release Plan

EVM Abv.	EVM Link Term Definition	Rationale to Agile/Scrum Term	AGILE Link Related Term
Status Meeting	Status Meeting	A status meeting includes Agile reporting artifacts and EVM performance metrics and reports.	Agile reporting artifacts
SRA	Schedule Risk Assessment	Schedule Risk Assessment (SRA) is a technique to connect the risk information of program activities to the baseline schedule, in order to provide sensitivity information of individual program activities to assess the potential impact of uncertainty on the final program duration and cost.	
SV	Schedule Variance	<p>A variance from baseline plan indicating an ahead-of, or behind, schedule position expressed in dollars representing the value of work that is ahead or behind the baseline plan. The calculation for SV in dollars is the difference of BCWP – BCWS. The calculation for SV percentage is the ((SV divided by BCWS) * 100).</p> <p>Example: BAC WP for WP xyz has a baselined estimated cost of \$100,000. The team targeted to deliver 33 of 100 Story Points by the end of Sprint n for WP xyz. At time now the team delivered 28 Story Points.</p> <p>The Schedule Variance \$ and %</p> $\text{BCWP to date} - \text{BCWS cum to date} = \text{SV}$ $(\$100,000 * (28/100) - (\$100,000) * (33/100)) = \$-5000$ $\text{SV} / \text{BCWS} = \text{SV \%}$ $(-\$5,000 / \$33,000) * 100 = -15\%$	Story , Story Point , Sprint
TASK	Task	An IMS Task is typically a Work Package, however, in Agile, Teams typically define task at a level below the Story (outside of the IMS). Not all Agile teams explicitly track tasks.	Story , Tasks
VARs	Variance Analysis Reports	An EVM systems output that provides variance information of actual performance compared to the baseline plan. Supporting documentation from the Agile system can/should support the VAR.	Agile System Impediment List
VAC	Variance at Completion	The difference between the total budget and the estimated cost at completion. The calculation is BAC minus EAC (EAC = actuals incurred to date plus estimate to complete (ETC)).	
WBS	Work Breakdown Structure	A hierarchical product-oriented division of product scope is typically depicted as Epic/Capability, Features, Story, Tasks, for authorization, tracking, and reporting purposes	Epic/Capability , Features , Story , Tasks
WP	Work Package	A Work Package is simply a task/activity or grouping of work. A Work Package is the point at which work is planned, progress is measured, and earned value is computed. An Agile Work Package will typically contain one or more Features.	Feature

Agile Data Dictionary

AGILE TERM	AGILE DEFINITION
BURNDOWN CHART	The trend of work remaining across time in a Sprint, a release or in a product. The burn down chart is a publicly displayed chart showing remaining work in the Sprint Backlog. Updated every day, it gives a simple view of the Sprint progress.
BURNUP CHART	The trend of work completed across time in a Sprint, a release or in a product. The burnup chart is a publicly displayed chart showing completed work in the Sprint Backlog. Updated every day, it gives a simple view of the Sprint progress.
BACKLOG GROOMING	<p>The team (or part of the team including the PO) meet regularly to "groom the product Backlog", in a formal or informal meeting which can lead to any of the following:</p> <ul style="list-style-type: none"> • removing Stories that no longer appear relevant • creating new Stories in response to newly discovered needs • re-assessing the relative priority of Stories • assigning estimates to Stories which have yet to receive one • correcting estimates in light of newly discovered information • splitting Stories which are high priority but too coarse grained to fit in an upcoming Sprint
BACKLOG	<p>A Backlog is a list of Features or technical tasks which the team maintains and which, at a given moment, are known to be necessary and sufficient to complete a program or a release:</p> <ul style="list-style-type: none"> • if an item on the Backlog does not contribute to the program's goal, it should be removed; • on the other hand, if at any time a task or Feature becomes known that is considered necessary to the program, it should be added to the Backlog.
CADENCE	Refer to definition for Release: Cadence Release.
CAPABILITY	Capability and Epics may be used interchangeably. Both are recognized as customer required abilities of the system that provide value and is associated with specific Feature(s) and their Stories that must be satisfied for its completion.
DAILY SCRUM MEETING	A short status meeting held daily by each team. Team members synchronize their work and progress and report any impediments to the Scrum Master for removal.
DEFINITION OF DONE	Complete as mutually agreed to by all parties and conforming to an organization's standards, conventions and guidelines. Note that an outcome of product and release planning is to create a "Definition of Done", which equates to IMP accomplishment criteria, for Epic/Capabilities and Features respectively.
EPIC	Epics may represent core business capabilities which are defined by the customer or stakeholders. A large grained definition of a need that will likely take more than one release to complete. Can be split into Features and eventually Stories. Epics are part of the product Backlog and should have some form of relative sizing estimate.
ESTIMATED WORK REMAINING	The number of estimated hours that remain to be worked for any Story/task. This estimate is updated on a regular basis until the Story/task is complete for the definition of done.

AGILE TERM	AGILE DEFINITION
FEATURE	A discrete or coherent functionality within an Epic/Capability, scheduled to be completed within a release (cadence or Capability), and comprised of a collection of logically cohesive Stories. All Features should have clearly defined objective technical completion criteria. This is the lowest level of earned value baseline scope definition.
IMPEDIMENT LIST	List of items or bugs impeding progress
INCREMENT	Synonymous with Cadence Release (also known as Release or Capability Release)
ITERATION	Synonymous with Sprint
PRODUCT BACKLOG	The master list of all functionality at the Epic and Feature level that is desired in the product and any other elements needed to produce the product, even if not in the final product. Product Backlog is prioritized from most to least important.
PRODUCT BACKLOG DELTA	Reports the difference in total Features, and/or equivalent weighted Story Value in Story Points summarized to Features, planned based on changes to the Sprint Backlog.
PRODUCT BACKLOG PLANNING	A process in which the team maps the product Epic/Capabilities to Features that are to be accomplished based on customer agreement that specifies what the product must do and when the functionality will be delivered within a timeboxed schedule.
PRODUCT OWNER (PO)	The person responsible for maintaining the Product Backlog by representing the interests of the stakeholders.
RELEASE	There are two broad types of releases. Capability Release - A Capability Release is typically based on customer agreement that specifies what the product must do in context to the release plan. Cadence Release - working software released on a regular or timeboxed schedule. Timebox length varies widely, but is static throughout the development. In either case, the content of the release is determined thru product Backlog refinement/release planning. Agile development efforts commonly use Cadence Releases.
RELEASE PLANNING	A process in which the team maps the product Backlog Epic/Capabilities to Features and Stories that are to be accomplished based on customer agreement that specifies what the product must do and when the functionality will be delivered within a timeboxed schedule.
SCRUM	An incremental product development methodology commonly used to manage the program when applying Agile practices. A Scrum team works in a highly collaborative and team centric manner to achieve the team objectives.
SCRUM MASTER	The person responsible for the Scrum process, making sure it is used correctly and maximizes its benefits. Scrum is facilitated by a Scrum Master, whose primary job is to remove impediments to the ability of the team to deliver the Sprint goal. The Scrum Master is not the leader of the team (as they are self-organizing) but acts as a buffer between the team and any distracting influences. The Scrum Master ensures that the Scrum process is used as intended.
SCRUM TEAM	The Scrum Team is made up of the PO, Scrum Master and Team.

AGILE TERM	AGILE DEFINITION
SPRINT	A timebox of work for which the duration is defined by the team and related to their optimal work cadence. Sprint durations are typically fixed and are usually between 1 and 6 weeks in duration. During the Sprint, the team works to turn a portion of the Product Backlog it has selected into an increment of potentially shippable product functionality.
SPRINT BACKLOG	A list of tasks to be completed during the Sprint.
SPRINT BACKLOG TASK	One of the tasks that the team or a team member defines as required turning committed Product Backlog items into system functionality.
SPRINT PLANNING MEETING	A meeting at the beginning of each Sprint in which the team plans the work to be accomplished during the Sprint and confirms the criteria for work completion.
SPRINT RETROSPECTIVE MEETING	A meeting of short duration which is facilitated by the Scrum Master at which the Team discusses the just concluded Sprint that determines what could be changed that might make the next Sprint more enjoyable or productive.
SPRINT REVIEW MEETING	A short meeting at the end of every Sprint at which the team demonstrates to the PO and interested stakeholders what it was able to accomplish during the Sprint. A key objective of the review is to get product feedback from the stakeholders.
STAKEHOLDER	Someone with an interest in the outcome of a program, either because he or she has funded it, will use it or will be affected by it.
STORY (USER STORY)	Part of a Feature that can be estimated in Relative size and complexity and prioritized in Sprint Backlog. Stories are sized to fit within a Sprint. The completion of Stories can be used to calculate earned value.
STORY MAPPING	<p>A recent practice intended to provide a more structured approach to release planning; Story mapping consists of ordering Stories along two independent dimensions. The "map" arranges user activities along the horizontal axis in rough order of priority (or "the order in which you would describe activities to explain the behavior of the system"). Down the vertical axis, it represents increasing sophistication of the implementation.</p> <p>Given a Story map so arranged, the first horizontal row represents a "walking skeleton", a barebones but usable version of the product. Working through successive rows fleshes out the product with additional functionality.</p>
STORY POINTS (ESTIMATES IN)	<p>Agile teams express estimates in units of "Story Points", providing for the use of Story Point Velocity for planning purposes. "Velocity", in the sense Agile teams use the term, has no preferred unit of measurement. Velocity allows teams to compute the expected remaining duration of the program, as a number of Sprints, each Sprint delivering some amount of Features.</p> <p>Another important reason has to do with the social and psychological aspects of estimation: using units such as Story Points to estimate a weighted Story Value, emphasizing relative difficulty over absolute duration, relieves some of the tensions that often arise between developers and managers around estimation: for instance, asking developers for an estimate then holding them accountable as if it had been a firm commitment.</p>

AGILE TERM	AGILE DEFINITION
<p>STORY SPLITTING</p>	<p>Before a Story is ready to be scheduled for implementation in an upcoming Sprint, it should be "small enough", the usual rule of thumb being "a Story that can be completed within the Sprint".</p> <p>However, many Stories start out larger than that. "Splitting" consists of breaking up one Story into smaller ones, while preserving the property that each Story separately has measurable business value.</p>
<p>TEAM</p>	<p>A cross-functional group of people that is responsible for managing itself to develop product for every Sprint. Team members' work together consistently in a predefined pattern. In contrast to traditional methods that bring people in as needed.</p>
<p>TIMEBOX or TIMEBOXED</p>	<p>A period of time that cannot be exceeded and within which an event or meeting occurs. An example is the Daily Scrum meeting which is typically timeboxed to 15 minutes and ends at that time regardless.</p>
<p>VELOCITY</p>	<p>At the end of each Sprint, the team adds up effort associated with Stories that were completed during that Sprint. This total is called velocity. (Completed weighted Story Value in Story Points / Sprint Length)</p> <p>Knowing velocity, the team can compute (or revise) an estimate of how long the program will take to complete, based on the estimates associated with remaining Stories and assuming that velocity over the remaining Sprints will remain approximately the same.</p>

EVM Data Dictionary

EVM TERM	EVM DEFINITION
ACCOUNTING PERIOD	The period of time during which actuals will be collected for transfer into the EV System for reporting purposes.
ACTUAL COST (AC)	The costs actually incurred and recorded in the general ledger.
ACTUAL COST OF WORK PERFORMED (ACWP)	The costs actually incurred and recorded in the EV System for accomplishing the work performed within a given accounting period. ACWP reflects the applied costs that may be expressed as a value for a specific period or cumulative to date. (See also <i>Estimated Actuals</i> .)
ALLOCATED BUDGET	See <i>Total Allocated Budget</i> .
APPORTIONED EFFORT (AE)	Effort that by itself is not readily measured or divisible into discrete Work Packages but is related in direct proportion to the planning and performance of other discrete effort.
AUTHORIZATION TO PROCEED (ATP)	Official authority for the Contractor to begin work. It is usually issued by the procuring contracting officer.
AUTHORIZED UNPRICED WORK (AUW)	A contract scope change which has been directed by the government contracting officer but has not yet been fully negotiated/definitized. It includes a value, excluding fee or profit, typically associated with the authorized, unpriced change order.
AUTHORIZED WORK	That effort that has been definitized and is on contract plus that effort for which definitized contract costs have not been agreed to but for which written authorization has been received.
BASELINE	See <i>Performance Measurement Baseline</i> .
BASELINE SCHEDULE	The original time-phased plan incorporated into the Integrated Master Schedule against which schedule status is compared or measured.
BILL OF MATERIAL (BOM)	A listing of material items required to complete the production of a single unit. When actual or expected prices are applied, it becomes the Priced Bill of Material (PBOM).
BLOCK PLANNING	The periodic process of converting Summary Level Planning Packages into control accounts and Control Account Planning Packages into Work Packages. The time period chosen reflects blocks of time from a specific contractual milestone to a subsequent specific contractual milestone.
BUDGET AT COMPLETION (BAC)	The sum of all budgets established for the contract through any given WBS/OBS level. When associated with a level it becomes Control Account BAC, Performance Measurement Baseline BAC, etc. (See <i>Total Allocated Budget</i> .)
BUDGETED COST FOR WORK PERFORMED (BCWP)	The sum of the budgets for completed Work Packages and completed portions of open Work Packages, plus the applicable portion of the budgets for level of effort and apportioned effort. May be expressed as a value for a specific period or cumulative to date.

EVM TERM	EVM DEFINITION
BUDGETED COST FOR WORK SCHEDULED (BCWS)	The sum of the budgets for all Work Packages, Planning Packages, etc., scheduled to be accomplished (including in-process Work Packages), plus the amount of level of effort and apportioned effort scheduled to be accomplished within a given time period. May be expressed as a value for a specific period, or cumulative to date.
CONTRACT BUDGET BASE (CBB)	The sum of the negotiated contract cost plus the estimated cost of authorized unpriced work. This represents the total amount of performance measurement budget that may be allocated to contract work. (<i>See Total Allocated Budget</i>).
CONTRACT DATA REQUIREMENTS LIST (CDRL)	The standard format for identifying potential data requirements in a solicitation, and deliverable data requirements in a contract. The purpose of the CDRL is to provide a standardized method of clearly and unambiguously delineating the Government's minimum essential data needs.
CONTRACT PERFORMANCE REPORT (CPR)	A contractually required report, prepared by the Contractor, containing performance information derived from the internal EV System that provides status of progress on the contract (DI-MGMT-81466A). (<i>See also Integrated Program Management Report</i>).
CONTRACT WORK BREAKDOWN STRUCTURE (CWBS)	The complete WBS for a contract. It includes the DoD approved WBS for reporting purposes and its discretionary extension to lower levels by the Contractor, in accordance with government direction and the contract work statement. It provides for the product-oriented decomposition of contract work into major elements that include all the hardware, software, data and/or services that are the responsibility of the Contractor.
CONTRACTOR	An entity in private industry which enters into contracts with the government. In this guide, the word also applies to government-owned, government-operated activities which perform work on major defense programs.
CONTROL ACCOUNT (CA)	The Control Account is the intersection of one WBS element and one OBS element representing a discrete portion of program scope assigned to an individual manager. The Control Account is the minimum level where technical, schedule, and cost responsibility exists.
CONTROL ACCOUNT MANAGER (CAM)	A single manager within the Contractor's organizational structure that has been given the authority and responsibility to manage one or more control accounts.
CONTROL ACCOUNT PLAN (CAP)	The documented representation of the time-phased integration of scope, schedule and resources for all control account authorized work.
COST ACCOUNTING STANDARDS (CAS)	Requirements established by the CAS Board to ensure consistent and proper accounting for direct and indirect costs applied to government contracts.

EVM TERM	EVM DEFINITION
COST ACCOUNTING STANDARDS BOARD (CASB)	An independently established statutory Board. The Board has the exclusive authority to make, promulgate, and amend cost accounting standards and interpretations designed to achieve uniformity and consistency in the cost accounting practices governing the measurement, assignment, and allocation of costs to contracts with the United States (41 U.S.C. 1501 et seq., formerly, 41 U.S.C. 422).
COST ACCOUNTING STANDARDS BOARD (CASB) DISCLOSURE STATEMENT	A written description of a Contractor's cost accounting practices and procedures.
COST PERFORMANCE INDEX (CPI)	The ratio of earned value to actual cost expenditure.
COST VARIANCE (CV)	A metric for showing cost performance derived from earned value data. It is the mathematical difference between Budgeted Cost for Work Performed and Actual Cost of Work Performed. A positive value indicates a favorable condition and a negative value indicates an unfavorable condition. It may be expressed as a value for a specific period of time or cumulative to date.
CRITICAL ACTIVITY	A discrete Work Package or Planning Package (or lower level tasks/activities) that resides on the critical path.
CRITICAL PATH	A sequence of discrete Work Packages and Planning Packages (or lower level tasks/activities) in the network that has the longest total duration with the least amount of total float/slack through an end point that is calculated by the schedule software application.
CRITICAL PATH ANALYSIS	A network analysis technique used to predict program duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float). See <i>Network Schedule</i> .
CURRENT PERIOD	Accounting period in which the program is currently executing, i.e., time now.
DETAIL PLANNING	The act of defining the scope, schedule and budget of a Planning Package into more detailed Work Packages with earned value techniques. Or the act of further defining the scope, schedule and budget of a SLPP into more detailed control accounts.
DIRECT COSTS	Any costs that may be specifically identified with a singular cost objective.
DISCRETE EFFORT	Tasks related to the completion of specific end products or services and can be directly planned and measured.
DRIVING PATH	The longest sequence of discrete tasks/activities from time-now to a selected interim contract milestone. Discrete tasks/activities on the driving path have the least amount of total float/slack to the interim contract milestone. Driving path may not be part of the contract critical path.
EARNED VALUE (EV)	See Budgeted Cost for Work Performed (BCWP).
EV (EVM)	A program management technique for measuring program performance and progress in an objective manner.

EVM TERM	EVM DEFINITION
EV SYSTEM (EVMS)	An integrated management system that integrates the work scope, schedule, and cost parameters of a program in a manner that provides objective performance measurement data. It measures progress objectively with earned value metrics; accumulates direct costs; allows for analysis of deviations from plans; facilitates forecasting the achievement of milestones and contract events; provides supporting data for forecasting of estimated costs; and fosters discipline in incorporating changes to the baseline in a timely manner.
EV SYSTEM COMPLIANCE	The continuing implementation, operation, and maintenance of the Contractor's EV System in accordance with the 32 Guidelines in EIA-748.
EV SYSTEM (EVMS) GUIDELINES	The 32 Guidelines contained in the EIA-748 (current version) Standard that establish the framework for a Contractor's EVMS.
EV SYSTEM SURVEILLANCE	A recurring process for assessing the continuous compliance of the Contractor's EV System against the 32 Guidelines in EIA-748.
EARNED VALUE TECHNIQUE (EVT)	A specific technique (e.g., Milestone Method, Percent Complete, 50/50, 0/100, Units Complete, Apportioned Effort, LOE, etc.) selected to represent the measurement of work scope progress and accomplishment in a Work Package.
ELEMENTS OF COSTS (EOC)	Product costs are decomposed into the elements of cost. These elements are comprised of labor, materials, other direct costs and overhead. EOCs represent the cost of products that are typical across industry.
ENTERPRISE RESOURCE PLANNING (ERP)	See Manufacturing/Enterprise Resource Planning (M/ERP) System.
ESTIMATE AT COMPLETION (EAC)	The current estimated total cost for program authorized work. It equals Actual Cost of Work Performed plus the estimated costs to complete (Estimate To Complete (ETC)) the authorized work remaining. EAC does not include profit or fee.
ESTIMATE TO COMPLETE (ETC)	Estimate of costs to complete all work from a point in time to the end of the program.
ESTIMATED ACTUALS (EA)	A value entered into the EV System to represent direct costs for material and/or subcontracted items for which earned value has been taken but invoices or billings have not entered the accounting system.
ESTIMATED COST (ESTIMATED ACTUAL)	An anticipated cost for specified work scope. Also known as estimated actual.
FORMAL REPROGRAMMING	The process of establishing an Over Target Baseline (OTB) and/or Over Target Schedule (OTS).
FORWARD PRICING RATE AGREEMENT (FPRA)	An agreement between a Contractor and a government agency in which certain indirect rates are established for a specified period of time. These rates are estimates of costs and are used to price contracts and contract modifications.

EVM TERM	EVM DEFINITION
FREEZE PERIOD	A period of time when baseline changes are limited. See Guideline 29 (For reference see Appendix C Item 8) for information on exceptions to making baseline changes within the freeze period.
GENERALLY ACCEPTED ACCOUNTING PRINCIPLES (GAAP)	The standard framework of guidelines for financial accounting used in any given jurisdiction; generally known as accounting standards or standard accounting practice.
GENERAL LEDGER	A complete record of financial transactions over the life of a company. The ledger holds account information that is needed to prepare financial statements, and includes accounts for assets, liabilities, owners' equity, revenues and expenses.
GENERAL & ADMINISTRATIVE (G&A)	Per FAR Subpart 2.1: G&A expense means any management, financial, and other expense which is incurred by or allocated to a business unit and which is for the general management and administration of the business unit as a whole. G&A expense does not include those management expenses whose beneficial or causal relationship to cost objectives can be more directly measured by a base other than a cost input base representing the total activity of a business unit during a cost accounting period.
GROUPING, PEGGING, AND DISTRIBUTION	Developed as a way to combine material requirements across programs for procurement, fabrication, and assembly purposes but still allow for exact cost assignment back to the originating requirement.
HIGH VALUE MATERIAL	Major components, assemblies, or critical piece-part items, etc. that are identified based on an analysis of material categories a company needs to procure and consume in the integration and build of an end item on a program.
HORIZONTAL INTEGRATION	The logical relationships and time-phasing between tasks and milestones from –program start to finish.
HOURS	Unit of measure.
INDIRECT COSTS	Costs that cannot be identified specifically against a particular program or activity and must be controlled and budgeted at a functional or organizational level.
INTEGRATED MASTER PLAN (IMP)	An event-driven plan that documents the significant accomplishments necessary to complete the work and ties each accomplishment to a key program event.
INTEGRATED MASTER SCHEDULE (IMS)	An integrated, networked schedule containing all of the detailed activities necessary to accomplish the objectives of a program. When coupled with the Integrated Master Plan, it provides the time spans needed to complete the accomplishments and criteria of the Integrated Master Plan events. The IMS normally contains all levels of schedules for the program (master, intermediate, and detailed).
INTEGRATED PRODUCT TEAM (IPT)	A multidisciplinary team assigned management responsibility for one or more elements of an acquisition program.

EVM TERM	EVM DEFINITION
INTEGRATED PROGRAM MANAGEMENT REPORT (IPMR)	A contractually required report, prepared by the Contractor, containing performance information derived from the internal EV System. Provides status of contract cost and schedule performance (DI-MGMT- 81861A). The IPMR is being phased in to replace the Contract Performance Reports (DI-MGMT-81466) and the Integrated Master Schedule (DI-MGMT-81650).
INTERIM MILESTONE	A zero duration interim step within the schedule that links to an event milestone marking the due date for specified work scope criteria completed. An interim milestone may mark the start, an interim step, or the end of one or more activities.
LABOR EFFICIENCY VARIANCE	A variance relative to labor that is equal to the earned labor hours less actual labor hours multiplied by the earned hourly rate (i.e., (Earned Hours – Actual Hours) x Earned Rate). It reflects the number of hours actually expended versus the number of hours earned to complete the planned work.
LEVEL OF EFFORT (LOE)	Any effort with no measurable output or product that cannot be discretely planned or objectively measured; support type tasks are an example of LOE.
MANAGEMENT RESERVE (MR)	An amount of the total budget withheld for management control purposes for future considerations to handle execution risks. It is not part of the Performance Measurement Baseline.
MANUFACTURING RESOURCE PLANNING (MRP)	See Manufacturing/Enterprise Resource Planning (M/ERP) System.
MANUFACTURING/ENTERPRISE RESOURCE PLANNING (M/ERP) SYSTEM	A method for the effective planning of all resources of a manufacturing Contractor. It integrates planning of all aspects (not just production) of a manufacturing firm. It includes functions such as business planning, production planning and scheduling, capacity requirement planning, job costing, financial management and forecasting, order processing, shop floor control, time and attendance, performance measurement, and sales and operations planning.
MATERIAL CATEGORIES	Classes of material defined in the Contractor’s EV System Description and Manufacturing/Enterprise Resource Planning System Description.
MATERIAL CONTROL SYSTEM	See Manufacturing/Enterprise Resource Planning System and Material Management and Accounting System.
MATERIAL MANAGEMENT AND ACCOUNTING SYSTEM (MMAS)	A system used by a Contractor for the planning, controlling, and accounting for the acquisition, disbursements, and disposition of material. They may be stand-alone systems or may integrate with planning, engineering, estimating, purchasing, inventory, accounting, or other systems.
MILESTONE	A zero duration schedule event marking the due date for accomplishment of a specified work scope or objective. A milestone may mark the start, an interim step, or the end of one or more activities.

EVM TERM	EVM DEFINITION
NEAR-CRITICAL PATH	The lowest float or slack paths of discrete Work Packages and Planning Packages (or lower level activities) in the network that has the next longest total duration nearest to the critical path.
NEGOTIATED CONTRACT COST (NCC)	The cost negotiated in a cost-plus-fixed-fee contract or the negotiated contract target cost in either a fixed-price-incentive contract or a cost-plus-incentive-fee contract; does not contain profit or fee. NCC does not include the estimated value of undefinitized change orders, known as Authorized Unpriced Work.
NETWORK SCHEDULE	A schedule format in which the activities and milestones are represented along with the interdependencies between activities. It expresses the logic of how the program will be accomplished.
NOT TO EXCEED (NTE)	The portion of an estimated price for work scope the Contractor is allowed to bill the government before reaching a final agreement on contract terms. Expenditures against this work scope are limited to this value.
ORGANIZATIONAL BREAKDOWN STRUCTURE (OBS)	The hierarchical arrangement of the organization established to manage the resources tasked with performing the work on a specific contract or program.
OTHER DIRECT COSTS (ODC)	A cost that can be identified specifically with a final cost objective that is not treated as a direct material cost or a direct labor cost.
OVER TARGET BASELINE (OTB)	A new baseline for management when the original objectives cannot be met and new goals are needed for management purposes. An overrun to the Contract Budget Base (CBB) which is formally incorporated into the Performance Measurement Baseline for management purposes. The difference between the Total Allocated Budget and CBB is the amount of the overrun incorporated into the budget.
OVER TARGET SCHEDULE (OTS)	A replanned schedule baseline that extends beyond the contract milestones and/or delivery dates. An OTS is usually accompanied by an increase in budgets resulting in a corresponding Over Target Baseline (OTB).
OVERHEAD	See <i>Indirect Cost</i> .
PERFORMANCE MEASUREMENT BASELINE (PMB)	A time-phased resourced plan against which the accomplishment of authorized work can be measured.
PERFORMING ORGANIZATION	The organizational unit that applies resources to accomplish assigned work scope.
PERIOD OF PERFORMANCE (POP)	The number of working days or calendar days, from a specified commencement date to a specified completion date, as provided for in a contract.
PLANNING PACKAGE (PP)	A logical aggregation of future work within a control account that cannot yet be planned in detail at the Work Package or task level.

EVM TERM	EVM DEFINITION
PRICE VARIANCE	A variance relative to material that is equal to the budgeted unit price less the actual unit price multiplied by the actual quantity of material used, (i.e. (Budgeted Unit Price – Actual Unit Price) x Actual Quantity.) It reflects a change between the originally budgeted price of material and the actual price.
PROGRAM BUDGET	The total budget for the program including all allocated budget, management reserve, and undistributed budget.
RATE VARIANCE	A variance relative to labor that is equal to the planned labor rate less actual labor rate multiplied by the actual labor hours used to execute the effort, (i.e., (Budgeted Rate – Actual rate) x Actual Hours.) It reflects a change between the originally budgeted labor rate and the actual labor rate.
REPLANNING	A realignment of schedule or reallocation of budget for remaining effort within the existing cost and schedule constraints of the contract. In this case, the Total Allocated Budget does not exceed the Contract Budget Base, nor is the schedule adjusted to extend beyond the contractually defined milestones.
RESIDUAL MATERIAL	Material procured for a contract that becomes excess to the needs of the contract.
RESOURCE PLAN	The schedule for the planned expenditure of program resources for accomplishment of program work scope.
RESPONSIBILITY ASSIGNMENT MATRIX (RAM)	A chart showing the relationship between the Contract Work Breakdown Structure elements and the organizations assigned responsibility for ensuring their accomplishment. The RAM depicts the assignment of each control account to a single manager. When resource values are applied to these relationships, it may be referred to as a dollarized RAM.
RESPONSIBLE ORGANIZATION	The organizational unit responsible for accomplishment of assigned work scope.
RISK ASSESSMENT	The definition of risk management that identifies and analyzes potential program risk events in terms of probability and their consequences/impacts.
RISK/OPPORTUNITY REGISTER	A risk/opportunity management tool used by the program manager and program personnel that provides a means of recording and quantifying the identified risks/opportunities.
ROLLING WAVE	The continuous process of converting Summary Level Planning Packages into control accounts and control account Planning Packages into Work Packages.
SCHEDULE	A plan that defines when specified work must be done to accomplish program objectives on time.
SCHEDULE MARGIN	A management method for accommodating schedule contingencies. It is a designated buffer within the schedule and does not have assigned resources.
SCHEDULE PERFORMANCE INDEX (SPI)	The ratio of work accomplished to work planned to be accomplished, as measured by the associated budget value.

EVM TERM	EVM DEFINITION
SCHEDULE RISK ASSESSMENT (SRA)	A process which uses statistical techniques to identify technical, programmatic, and schedule risks in a program and quantifies the impact of those risks on the program's schedule.
SCHEDULE VARIANCE (SV)	A metric for schedule performance on a program. It is the mathematical difference between Budgeted Cost for Work Performed and the Budgeted Cost for Work Scheduled. A positive value is a favorable condition, while a negative value is unfavorable.
SCHEDULE VISIBILITY TASKS (SVTs)	Tasks, activities or milestones in the Integrated Master Schedule (IMS) that increase management visibility and functionality of the schedule for non-Performance Measurement Baseline related items. SVTs are included in the IMS to characterize potential impacts to the logic-driven network.
SINGLE POINT ADJUSTMENT (SPA)	Process that sets existing contract cost and/or schedule variances to zero and typically accompanies a re-plan of all remaining effort with the goal of completing the program on schedule and on budget.
STATEMENT OF WORK (SOW)	Contractual document that defines the work scope requirements for a program.
STATUS MEETING	A meeting to report program progress and performance towards achieving deliverable targets and any foreseeable concerns or issues that may cause delays or problems.
SUBCONTRACTOR	An entity in private industry which enters into a contract with a prime Contractor that has entered into a contract with the government.
SUMMARY LEVEL PLANNING PACKAGE (SLPP)	An aggregation of work for far-term efforts that are not able to be identified at the control account level, but can be distributed to reporting level Work Breakdown Structure elements (and, therefore, are not "Undistributed Budget").
SYSTEM DESCRIPTION (SD)	The set or series of integrated process descriptions/procedures that describe a Contractor's EV System.
TASK	An element of work performed during the course of a program. A task/activity has an expected duration, expected cost and expected resource requirements. Some systems may define task/activity at a level below the Work Package while other systems do not differentiate between the two.
TOTAL ALLOCATED BUDGET (TAB)	The sum of all budgets allocated to the contract. TAB consists of the Performance Measurement Baseline and all Management Reserve. In the event an Over Target Baseline is in place, the TAB must reconcile to the Contract Budget Base and any recognized over target budget.
UNDEFINITIZED WORK	Authorized work for which a firm contract value has not been negotiated or otherwise determined.
UNDISTRIBUTED BUDGET (UB)	Budget associated with specific work scope or contract changes that have not been distributed to a control account or summary level Planning Package.

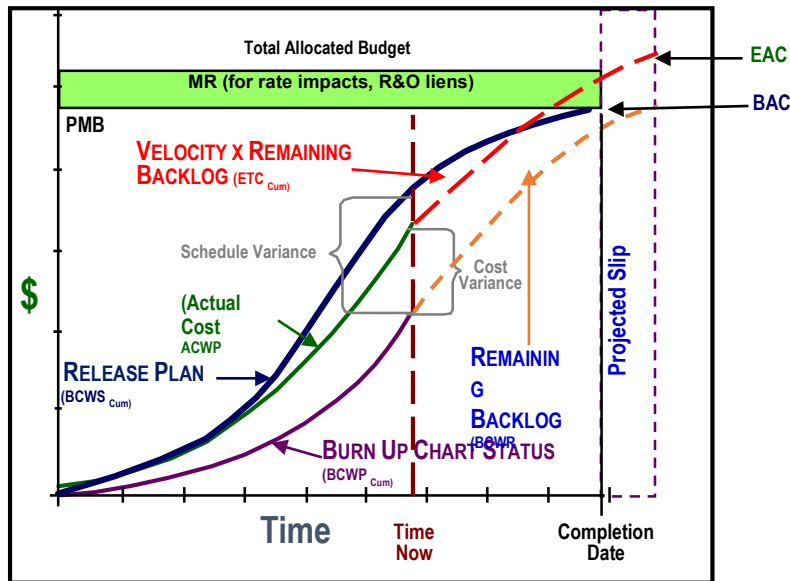
EVM TERM	EVM DEFINITION
USAGE VARIANCE	A variance relative to material that is equal to the budgeted quantity less the actual quantity multiplied by the budgeted unit price, (i.e., (Budgeted Quantity - Actual Quantity) x Budgeted Unit Price.)
VARIANCE AT COMPLETION (VAC)	The difference between the Budget at Completion (BAC) and the Estimate at Completion (EAC) (VAC = BAC – EAC). It may be calculated at any level from the control account up to the total contract. It represents the amount of expected overrun (negative VAC) or underrun (positive VAC).
VERTICAL INTEGRATION	Demonstrates the consistency of data between the various levels of schedules and consistency of data between various Work Breakdown Structure elements and/or Integrated Master Plan/Integrated Master Schedule elements (if applicable) within the schedules.
WORK AUTHORIZATION DOCUMENTATION (WAD)	A Contractor’s internal process for authorizing the commencement of program work. All work within a program is described in terms of work scope, budget and schedule and authorized through the work authorization system.
WORK BREAKDOWN STRUCTURE (WBS)	A hierarchical product-oriented division of program tasks depicting the breakdown of work scope for work authorization, tracking, and reporting purposes.
WORK BREAKDOWN STRUCTURE (WBS) DICTIONARY	A listing of WBS elements with a description of the work scope content in each element. The work descriptions are normally summary level and provide for clear segregation of work for work authorization and accounting purposes.
WORK PACKAGE (WP)	Natural subdivision of Control Accounts. A WP is simply a task/activity or grouping of work. A WP is the point at which work is planned, progress is measured, and earned value is computed.

Appendix B - Examples of Agile EVM Progress Tracking Charts

Graphs can be created that overlay Agile program data metrics on the EVM calculations and metrics to show how Agile may be used to perform EVM analysis for a program with the Agile-EVM model of application. For example, a graph connecting Story Points (associated with completed weighted Stories) burn-up status with Performance Management Baseline (PMB) type data as a plot. This is illustrated below in Figures 9, 10 (Lockheed Martin Platinum Card) that illustrates both PMB and completed Story burn-up in Story Points.

Figures 9 and 10 are the copyright of Lockheed Martin Corporation and are included in this guide. Figure 11 is a slightly different example from Rockwell Collins that shows explicitly the progress as measured via Story Points associated with completed Stories in the Agile Tool as “bars” on the graph as indexed by the left axis, along with the costs as indexed by the right axis to be able to visually see any disconnects or trends. Figure 12 shows an example program-level remaining weighted Stories burndown chart in Story Points courtesy of Raytheon with both overall status and forecasted Sprint iteration number the program will complete. All figures were used with permission.

PLATINUM CARD EVM FOR AGILE DEVELOPMENT



Variations Positive is Favorable, Negative is Unfavorable

Cost Variance	CV	= Burn Up Status - Actual Cost (BCWP - ACWP)	CV %
		= (CV / BCWP) * 100	
Schedule Variance	SV	= Burn Up Status - Release Plan (BCWP - BCWS)	
SV %		= (SV / BCWS) * 100	
Variance at Completion	VAC	= BAC - EAC	
	VAC %	= (VAC / BAC) * 100	

DoD Metrics

Favorable is > 1.0, Unfavorable is < 1.0

Cost Efficiency **CPI** = Burn Up Status / Actual Cost (BCWP / ACWP)

Schedule Efficiency **SPI** = Burn Up Status / Release Plan (BCWP / BCWS)

Program Agile Team Estimate @ Completion

ETC = Velocity x Remaining Backlog

EAC = Actual Cost + (Velocity x Remaining Backlog)

Independent Estimate @ Completion #

= ACTUALS TO DATE + [(REMAINING WORK) / (PERFORMANCE FACTOR)]

EAC_{CPI} = ACWP_{CUM} + [Remaining Backlog / CPI_{CUM}]

= ACWP_{CUM} + [(BAC - BCWP_{CUM}) / CPI_{CUM}]

EAC_{Composite} = ACWP_{CUM} + [Remaining Backlog / (CPI_{CUM} * SPI_{CUM})]

= ACWP_{CUM} + [(BAC - BCWP_{CUM}) / (CPI_{CUM} * SPI_{CUM})]

To Complete Performance Index (TCPI) = Work Remaining / Cost Remaining

TCPI_{EAC} = Remaining Backlog / (Velocity * Remaining Backlog)

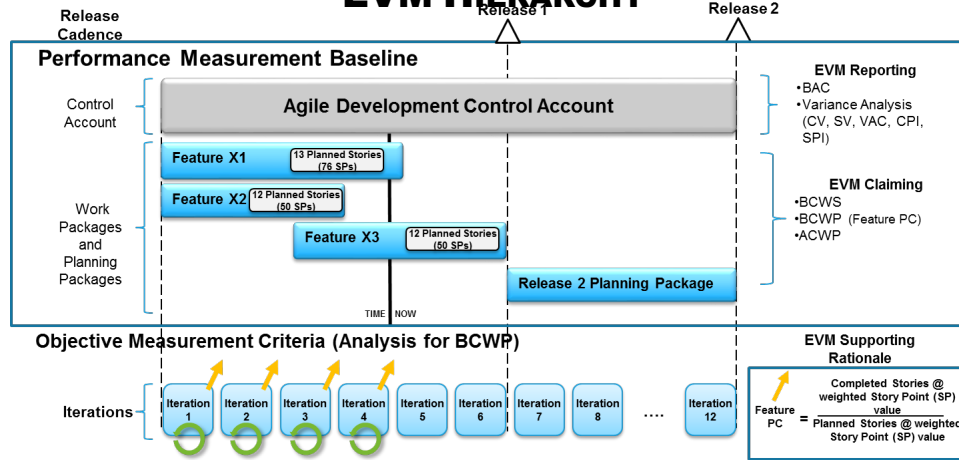
= (BAC - BCWP_{CUM}) / (EAC - ACWP_{CUM})

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Figure 9: Front side of example “Platinum Card” for Agile EVM, indicating both Agile (Burn-Up) and EVM (PMB) baseline plan and progress data.

AGILE DEVELOPMENT

EVM HIERARCHY



Agile Terminology

- Backlog** Collection of features and user Stories the agile team will work on at some point in the future
- Burn Up Chart** Representation of the amount of user Stories completed
- Feature** Coherent business function or attribute of the product or system. A single feature typically is implemented through many Stories. Features provide the basis for organizing Stories
- Iteration (Sprint)** Time period of fixed length during which the agile development team produces an increment of completed product
- Release Plan** Schedule for releasing products into productive use, made up of features and user Stories
- Stories (User)** Small system function with well-defined success criteria that can be developed by one team within one iteration. User Stories define the work that must be done to create and deliver a feature
- Story Points** Characteristics of a user Story; relative size measurement used by agile teams for work product estimation
- Velocity** Measures amount of work a team can complete in an iteration, typically in Story Points; used to measure how long it will take a particular team to deliver future outcomes by extrapolating on the basis of prior performance

Acronyms

ACWP	Actual Cost of Work Performed	Cost actually incurred in accomplishing work performed
PC	Percent Complete (BCWP)	BCWP claiming criteria for Feature (completed/planned Stories)
BAC	Budget At Completion	Total budget for contract through any given level
BCWP	Budgeted Cost for Work Performed	Value of completed work in terms of the assigned budget
BCWS	Budgeted Cost for Work Scheduled	Time-phased Budget Plan for work currently scheduled
CA	Control Account	Management point for planning/controlling scope/schedule/budget
EAC	Estimate At Completion	Estimate of total cost for contract through any given level
ETC	Estimate To Complete	Estimate of total cost for remaining work
MR	Management Reserve	Budget withheld by PM for unknowns/risk management
PMB	Performance Measurement Baseline	Contract time-phased budget plan, cost/schedule/technical objectives
PP	Planning Package	Far-term CA activities not yet defined into Work Packages
SPs	Story Points	Characteristics of a user Story. Relative size measurement
TAB	Total Allocated Budget	Sum of all budgets for work on contract
TCPI	To Complete Performance Index	Efficiency needed from 'time now' to achieve the EAC
WP	Work Package	Near-term, detail-planned activities within a CA

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Figure 10: Back side of example “Platinum Card” for Agile EVM.

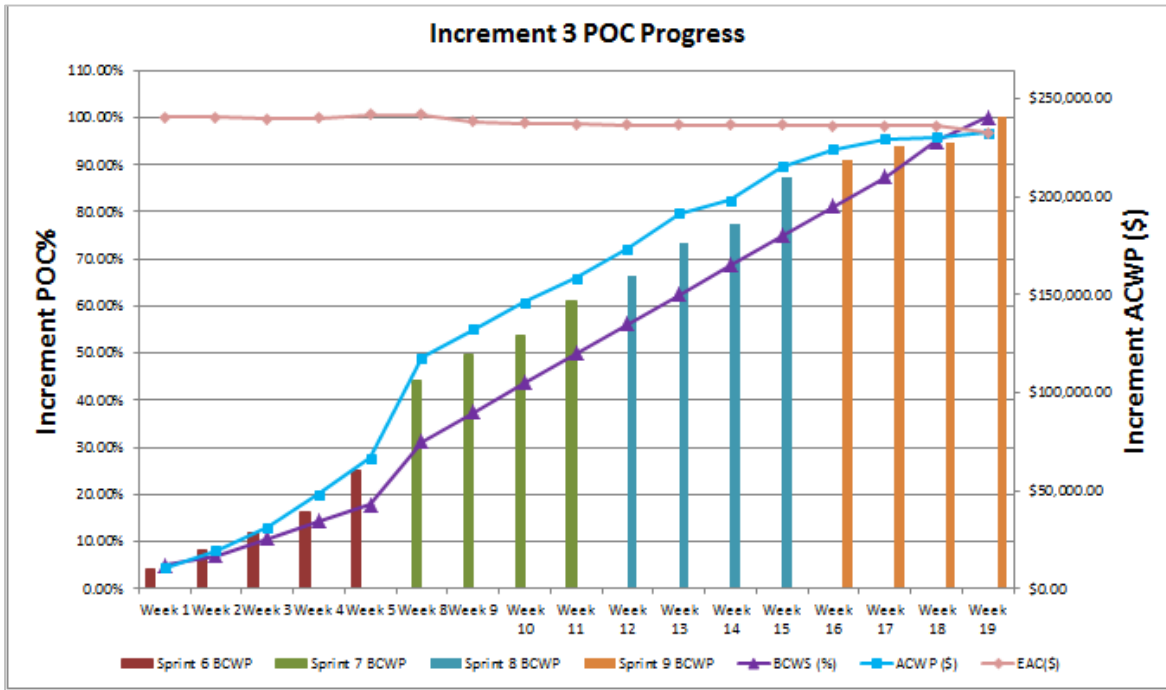


Figure 11: Example of a progress tracking report indicating both Agile and EVM progress data on graph.

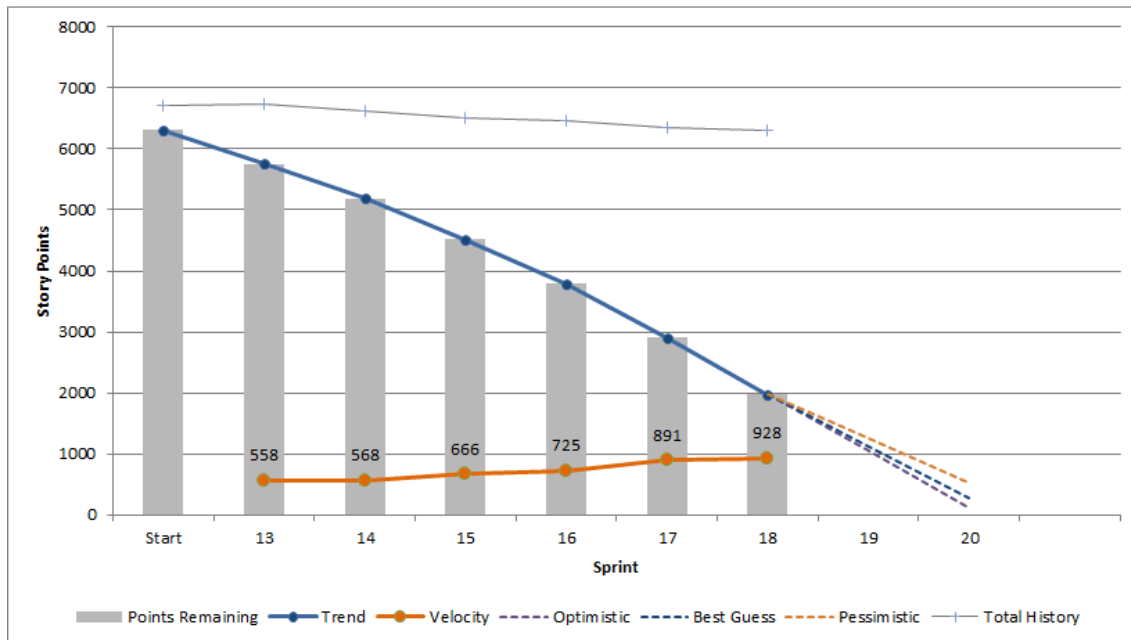


Figure 12: Example of a program level burndown chart across multiple teams, indicating overall status and predicted completion Sprint.

Appendix C - References

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Appendix D - Product Roadmap, Release Planning, and Rolling Wave Planning Products

This appendix elaborates on the Agile project planning process and integrating it with the EVM planning process introduced in Sections 2.1, 2.2, and 3.2.

Product Planning: Product Backlog and Product Roadmap

The Product Backlog is the prioritized list of system functionality required for the project or program. The Product Roadmap is the time-phased delivery plan for the functionality in the Product Backlog. The Product Roadmap is also referred to as the “Program Roadmap” or “Release Roadmap”.

The Product Backlog and Product Roadmap are created during Product Planning, the initial program planning performed, usually during the proposal time frame or at program start, at the latest. During Product Planning, the Product Owner(s) and customer representatives specify and prioritize the initial set of system Epics/Capabilities needed to deliver the contractually required system, thus forming the initial Product Backlog. The System Epics/Capabilities are then prioritized into Cadence Releases and aligned with the customer deliveries, thus forming the Product Roadmap. The Epics/Capabilities shown in the Roadmap reflect the full program scope (as defined in the Statement of Work or Statement of Objectives). Note that some Epics/Capabilities flow into Customer Deliveries with defined dates that may not coincide with the completion of a particular Cadence Release. See Figure 13 below for an example Product Roadmap.

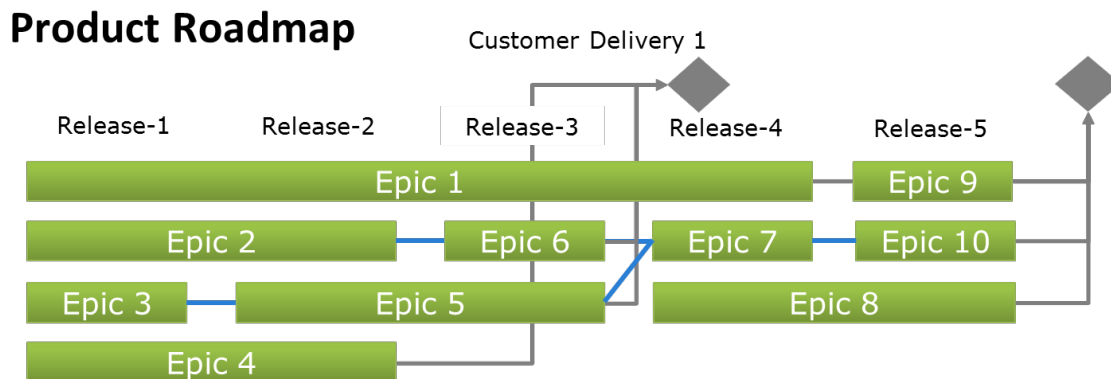


Figure 13: The initial Product Roadmap completes the Epics/Capabilities planning and incorporates customer delivery milestones.

Release Planning: Cadence Release Plan

With the initial Product Backlog and Product Roadmap established, the program conducts Cadence Release Planning. The objective of Release planning is to establish the functionality to be implemented within the program’s next Cadence Release. In Release planning, the Product Owner(s) decompose Epics/Capabilities from the Product Roadmap into a lower-level expression of system functionality called Features. A Feature is a piece of an Epic/Capability that can be completed within one Cadence Release. This sizing to one Cadence Release is what distinguishes the Feature from its associated Epic/Capability. The Release Plan then is the set of Features planned to be implemented in that Cadence Release. In Figure 14 the Product Roadmap includes the Features for the first Cadence Release.

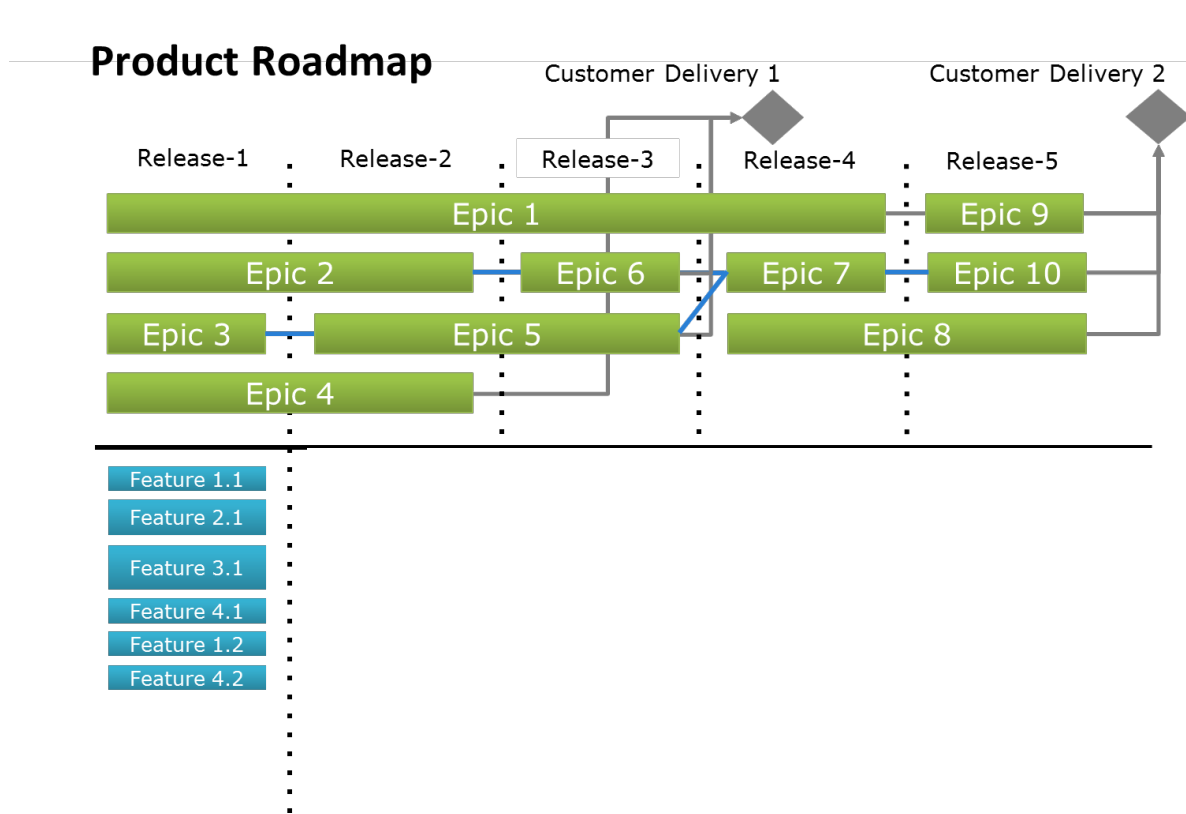


Figure 14: The updated Product Roadmap completes the Features planning for Release-1.

It is often the case that programs desire to have a Feature-level view of the Product Roadmap beyond the current or just-planned Cadence Release. In this case, the program establishes broadly-defined Features for future Cadence Releases. In Figure 15, the Product Roadmap shows the Release Plan for the Cadence Release as well as initial Features for Releases 2 and 3. Programs are cautioned that planning Features beyond the next Release can add unnecessary and wasteful work to keep the detailed plan up to date because of emerging or changing Customer needs and other knowledge gained from the execution of the earlier Cadence Releases. Where a program has well-defined, predictable, and stable product definition and customer needs for the duration of the program, it may be appropriate to plan to the Feature level of detail for the whole program, and periodically review the Roadmap at Release Planning events for currency and needed updates.

The roadmap must also be of appropriate detail to model key product dependencies (as shown with the Epic/Capability dependencies in Figure 15) to demonstrate the critical path. Roadmap updates may impact the EVM Performance Measurement Baseline and should be dealt with per the company's EVM System Description for baseline change management. As needed, results from Release Planning events are fed into subsequent IMS rolling wave planning activities to update and synchronize the Agile and EVM planning products.

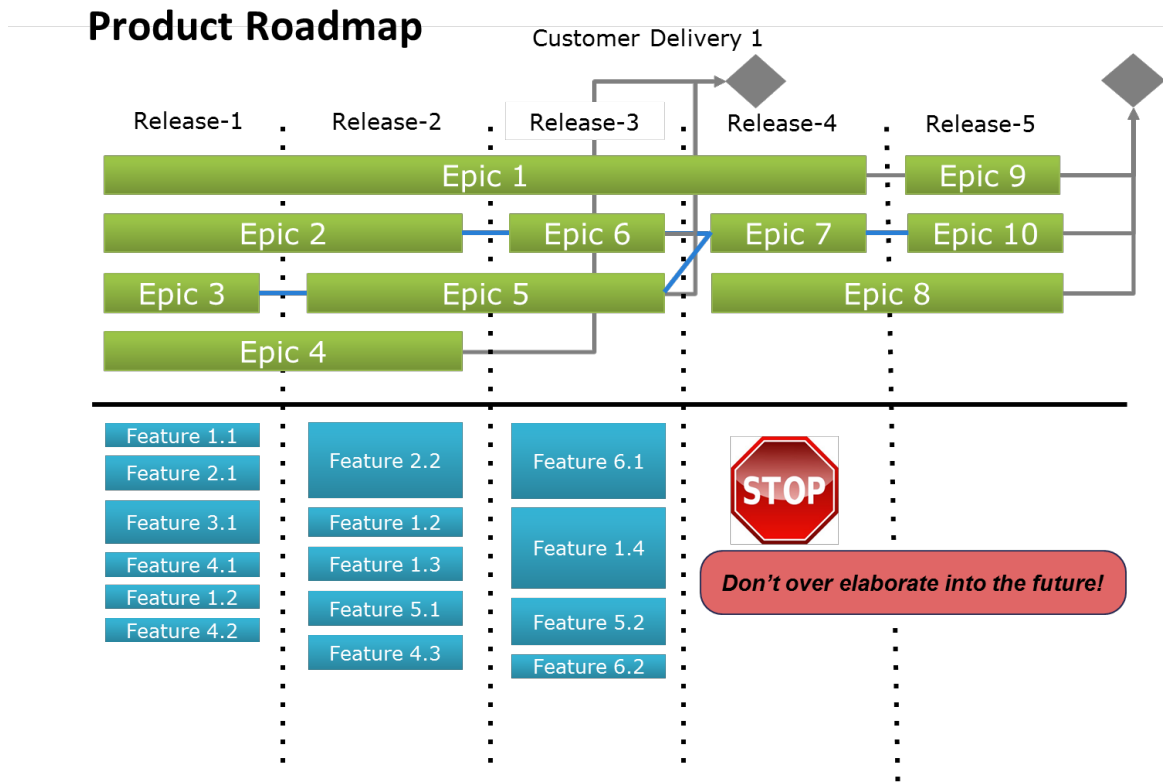


Figure 15: An alternate updated Product Roadmap with planning to three Releases out.

Figure 15 provides an alternative updated Product Roadmap that completes the Feature planning for Release-1 and provides initial Features for Release-2 and Release-3. Planning three releases out could be done given stable Epic/Capability plans.

The process to create and maintain a Product Roadmap includes the following steps:

1. Create, size, and prioritize Epics/Capabilities, which provide the highest level of product definition in the Product Backlog for the full scope of work.
2. Bin the Roadmap Epics/Capabilities into Cadence Releases based on factors such as priority (to maximize value delivery), product dependencies, and risk reduction. Include any fixed-date customer milestones and show product dependencies to support them.
3. Decompose, size, and prioritize near-term Epics/Capabilities into Features for the first 2-3 releases or longer as needed to understand key product dependencies.
4. Refine the roadmap with those decomposed products.
5. Review the roadmap with the customer and other key stakeholders to gain concurrence on this high level program plan.
6. Periodically review and update the Product Roadmap, nominally in alignment with Release Planning events, filling in upcoming releases with Epics/Capabilities decomposed into Features from the updated Product Backlog. Some Features in future Cadence Releases may not be completely decomposed; each ensuing Release Planning event for that release completes the Feature decomposition, updating both the Product Roadmap and Product Backlog.

Note the granularity of a Roadmap depends on the size of the program – a small program with one or two Agile teams may only need a single page roadmap while a 40-team SAFe™ -based program with multiple major value streams requires something much more substantial.

Aligning the Release Planning Results with the EVMS PMB

The following activities are generally necessary to define and maintain traceability between the Agile and the Performance Measurement Baseline to support EVM, and further validate the Product Backlog satisfies a program's contract Statement of Work or Statement of Objectives. Note the initial traceability and mapping of high level Agile products (e.g., Epics/Capabilities) to control accounts should have been established at program start to define the Performance Measurement Baseline. The activities listed below should be accomplished or revisited to maintain the performance measurement baseline upon completion of each Release Planning event. They should occur before the start of the Release planned work.

Product Backlog Activities:

--Mapping or re-Mapping of Features to Work Packages or Planning Packages (e.g. each Feature has a WP attribute, with the value set to the specific WP for that feature). This mapping/re-mapping activity is primarily an exercise in successive and iterative refinement to the established baseline.

--Optional: Mapping of Features to the Cadence Release (e.g. each Feature has a Cadence Release attribute, with the value set to the specific Cadence Release for that feature). This is useful for determining Feature status on a Cadence Release basis. For example you may want to know the Feature Percent Complete of all Features in Cadence Release 3.

--Update any tools used to determine EV percent complete with the new Features (e.g. Agile Management tool or Excel workbooks)

Integrated Master Schedule Activities:

--The IMS is updated with new work packages for the rolling wave; the rolling wave and IMS updates are aligned with Release Planning

--Rolling wave Baseline Change Requests are approved and Work Authorizations signed off

--Optional (but very helpful): Conduct a rolling wave outbrief with Control Account Managers/Product Owners (CAMs/POs) that reviews the mapping of WP to CAMs/POs, mapping of Features to work packages, as well as work package budgets and periods of performance. This sets the expectations of EVM impacts as a result of rolling wave planning, which was informed by the completed Release Planning event.

Prior to Starting a Work Package:

Verify stories have been created for all Features in the work package so that Percent Complete can be calculated.

Context and Role of the Product Roadmap, Relationship to the IMS

The Product Roadmap often forms the foundation for the IMS. The roadmap shows the planned sequence of product development, includes key product dependencies and relationships to customer milestones, and provides a basis for subsequent rolling wave planning. The different and complementary roles of the Product Roadmap and Integrated Master Schedule are summarized in this section.

The Product Roadmap can precede and inform IMP and IMS development, and even supplant the IMP when Definition of Done and assignment of Events, Accomplishments, and Criteria are completed. The Product Roadmap defines the sequence of work related to product elements or capabilities which require effort to complete along with their top level time-frames. Thus the initial Product Roadmap at the Epic/Capability level should be developed to define the required

work at a summary level before the IMS is developed to define activities and logic. As the lower level details in the Product Roadmap are generated, including Features for nearer-term Cadence Releases, the IMS can be generated shortly thereafter in an initial planning or rolling wave activity. The IMS is synchronized with the Product Roadmap in terms of major dependencies, sequences of work, and coordination of Release Planning events to rolling wave events.

The networking logic in the IMS, often at a work package detailed level in near term and at a planning package level in following rolling wave periods, allows critical path analysis. Equivalently the Product Roadmap captures dependencies and sequences at a top level throughout the program (Epic/Capability level). However the Product Roadmap sequence can, where no dependency dictates otherwise, also reflect a product element's priority for value delivery as well as its predecessors and successors.

The IMS tasks have a defined duration, which in the Product Roadmap is initially only defined at the Epic/Capability level (Epic/Capability duration defined as an integer number of releases). Features are binned into a particular Cadence Release and no duration is assigned. This dissociation of work from duration and restriction of detail planning to only the nearest few Cadence Releases originated from the low predictability for more detailed work and for work planned to take place in the longer term. Similarly, rolling wave planning to flesh out IMS planning package summary tasks reflects the lack of predictability in longer term and more detailed tasks. The IMS tasks only reflect the planned Features with baselined durations at the completion of Cadence Release planning and rolling wave planning for the upcoming release.

The process of reviewing and updating the Product Roadmap and the IMS should be designed to be synchronized and complementary. When a Release Planning event is completed, and the sequence and definition of work to build product elements/capabilities is documented, impacts to the IMS can be flowed into a subsequent rolling wave planning event or as a schedule change subject to approvals defined by the EVM System Description. Care must be taken to promptly recognize and capture impacts from the release planning events into the EVMS performance measurement baseline as needed before the pertinent work starts. This time-sensitive flow avoids timing conflicts with the freeze period (See Sections 3.5 and 5.5) and avoids significant lag between the work planned and the work contained in the performance measurement baseline. Reconciliation of planning and financial business rhythms, as well as review of the EVM System Description, is warranted to achieve a smooth and timely flow from work planning to execution.

Appendix E - Agile/EV Guide Contributors

This guide was compiled by the NDIA Integrated Program Management Division (IPMD) Agile/Earned Value Working Group. NDIA IPMD thanks the authors and reviewers from across industry and Government who contributed to the generation and improvement of this publication. Their diverse perspectives, expertise, and insight defined proven practices of Agile on Earned Value managed programs.