estimate

estimate • analyze • plan • control

Applying Earned Value Management to Agile Software Development Programs

Bob Hunt

Michael Thompson

Galorath Federal Incorporated

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Agenda

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IT Project Success

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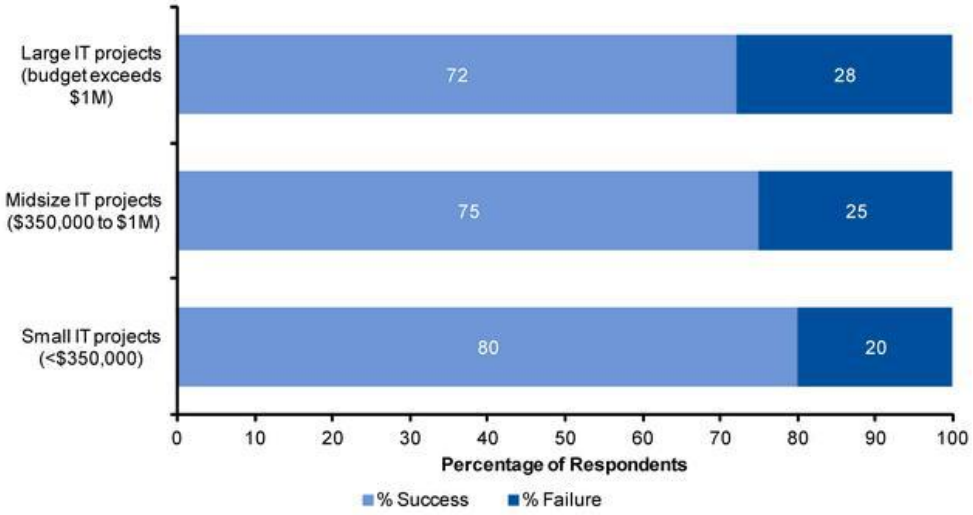

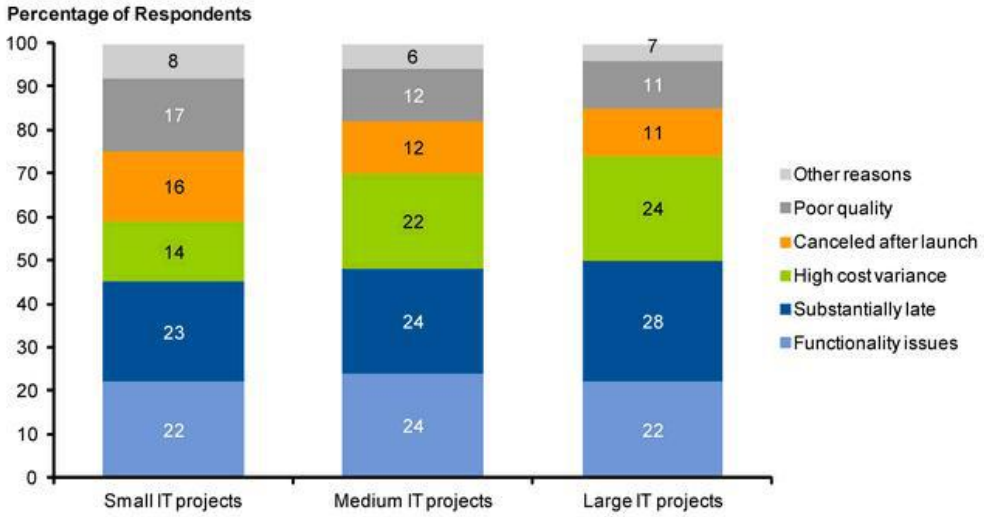

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Software Development

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- While there are many approaches to Software Development, they can generally be placed into 2 categories:
  - Plan Driven – following a version of the Waterfall Development Process
  - Iterative Driven – following a "version" of the Agile Development Process
- Plan Drive programs have an assumption of some reliable/realistic size metric, for example:
  - Source Lines of Code (SLOC)
  - Function Points
  - Use Cases, User Stories, Web Pages

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Software Development

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- Iterative Drive programs, by nature, start with a less well-defined metric
  - Therefore, they may require alternative estimating approaches
- This briefing will focus on the challenges of estimating an iterative program using Agile software development
- In practical experience the terms iterative, incremental and agile may be used interchangeably
- Look for terms like features, epics, time-boxes, releases

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Agile Software Development Key Terms

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- **IID** is an approach to building software in which the overall lifecycle is composed of iterations or sprints in sequence
  - Each Iteration is a self-contained mini project
  - It grew out of the increased application of Agile Development techniques
- In many Federal programs, **increments** are 6 -12 months in length and each increment is composed of multiple **iterations/sprints** of 1-6 weeks [1]
- Sprints can be combined into increments, releases, epics, themes; however, the Sprint is the key Work unit
- Time-boxing is the practice of fixing the iteration or increment dates and not allowing it to change
- This approach is gaining favor in large federal programs

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Each Iteration/Sprint is a Mini Project (in theory)

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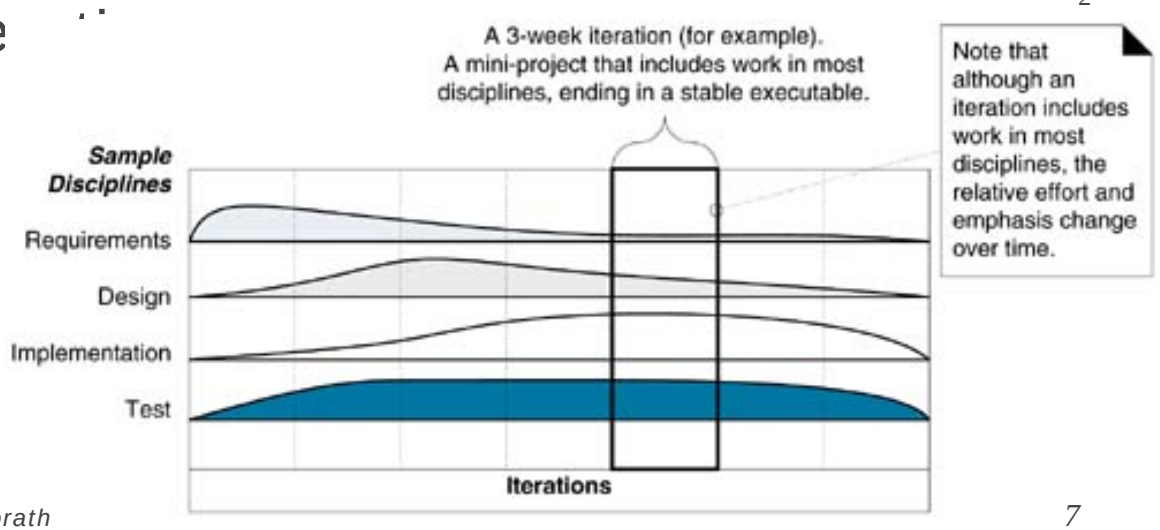
- Each iteration/sprint includes production-quality programming, not just, for example, requirements analysis
  - The software resulting from each iteration/sprint is not a prototype or proof of concept, but a subset of the final system
- More broadly, viewing an iteration as a self-contained mini project, activities in many disciplines (requirements analysis, testing, etc.) occur within a single ite



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IID

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- Although IID is in the ascendency today, it is not a new idea
  - 1950s “stage-wise Model” – US Air Defense SAGE Project
  - IBM created the IID method of Integration Engineering in the 1970s
- IID Programs tend to be less structured in the beginning, and therefore reliable estimates of cost and schedule may not be available until 10-20% of the project is complete[4]

(in a recent program I saw a cost variance during the first 4 increments of 45% per size metric)

- The current emphasis on agile software development processes maps directly into the IID Concept

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What is Agile Software Development?

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- In the late 1990s, several methodologies received increasing public attention
- Each had a different combination of old, new, and transmuted old ideas, but they all emphasized:
  - Close collaboration between the programmer and business experts
  - Face-to-face communication (as more efficient than written documentation)
  - Frequent delivery of new deployable business value
  - Tight, self-organizing teams
  - And ways to craft the code and the team such that the inevitable requirements churn was not a crisis

5

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How Formal Is Agile?

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Manifesto for Agile Software Development

"We are uncovering better ways of developing software by doing it and helping others do it.

Through this work we have come to value:

Individuals and interactions over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more."

Agile is NOT a Method – it's a mindset!
Individual Methods are Formal – sort-of

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The Agile "Life Cycle"
(Scrum Example)

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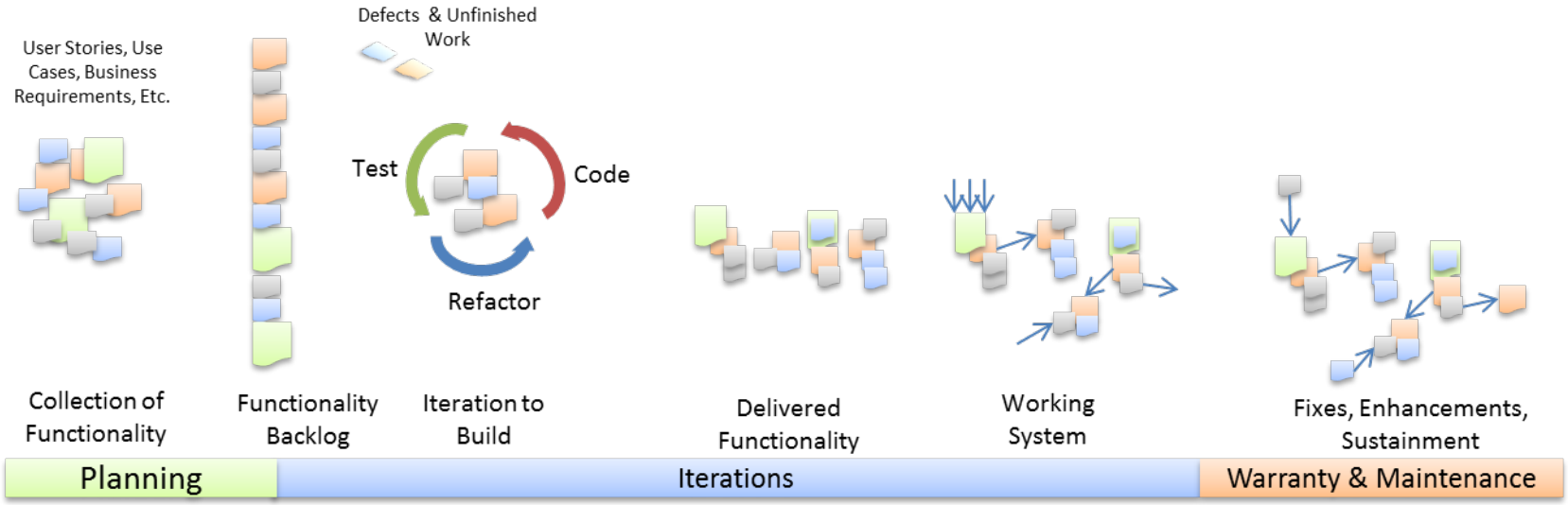
- Focus is on what features can be delivered per Sprint/Epic/…
- Defined what functionality will be delivered at the end?



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Hybrid Agile Development/Acquisition

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Requirements

Design

WATERFALL PROCESS

PREPARATION

- Business case and funding
- Contractual agreement
- Vision
- Initial product backlong
- Initial release plan
- Stakeholder buy-in
- Assemble team

Agile
SCRUM PROCESS

Testing and Sustainment ?

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Agile Building Blocks*

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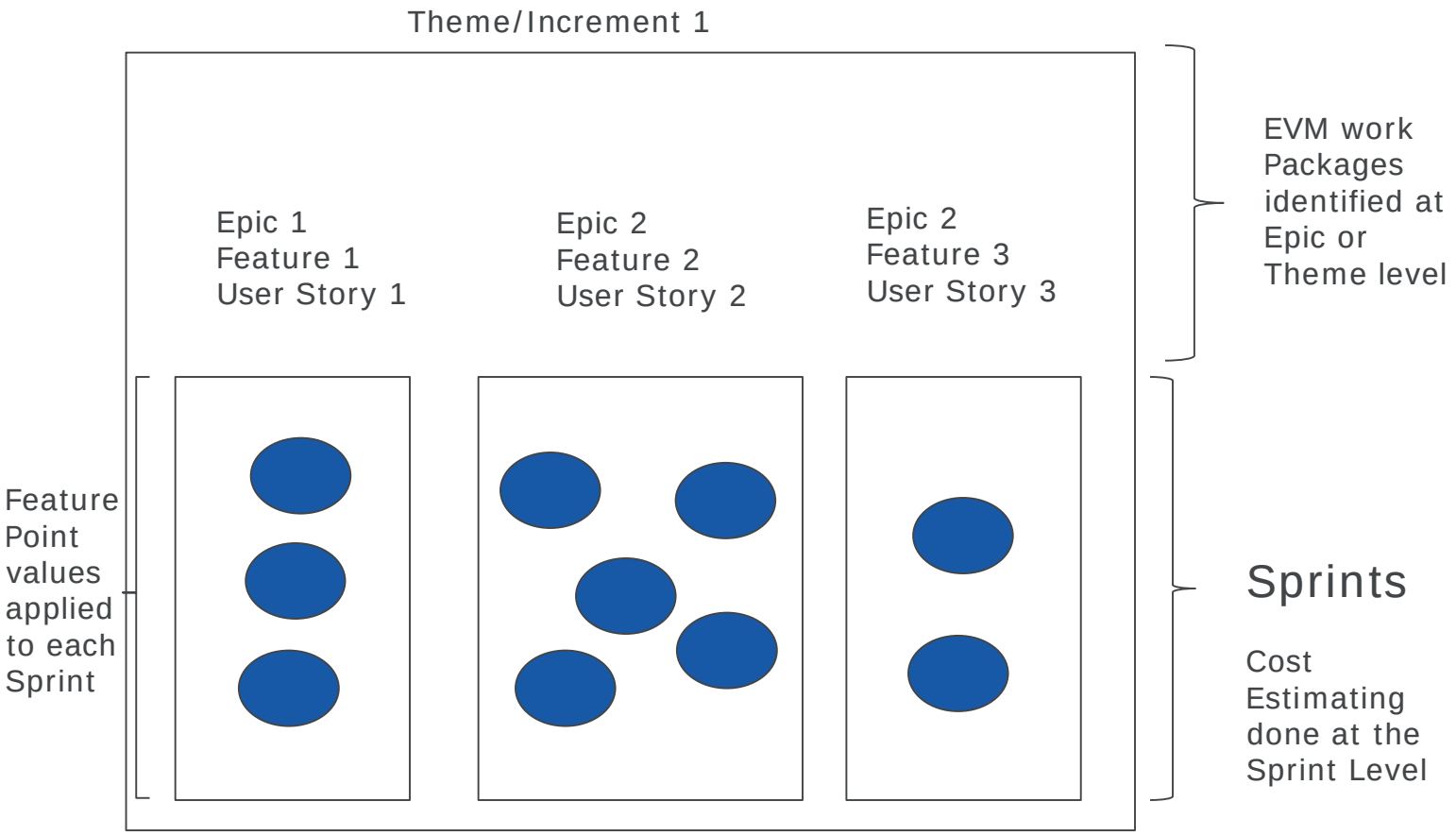
Release 1 (made up of multiple Themes/Increments



* These “building blocks” are program specific and may be called by different names

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Scrums and Sprints

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* I have Use Case, Feature Point, and other metrics for specific agile development programs, but I am not sure they are transferable

- Scrum Size:
  - 1-10 people (have seen up to **20**)
- Sprint Length:
  - 1-6 weeks (have seen up to **13** weeks) *(13 conveniently give 4 sprints per year)*
- Story Points* per Sprint:
  - 6-9 Story Points per Sprint
- There seems to be a real avoidance of using Function Points or SLOC in many of these efforts.
- (*But trust me a size metric exists somewhere within the development community*)

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People, Process, Technology are Keys

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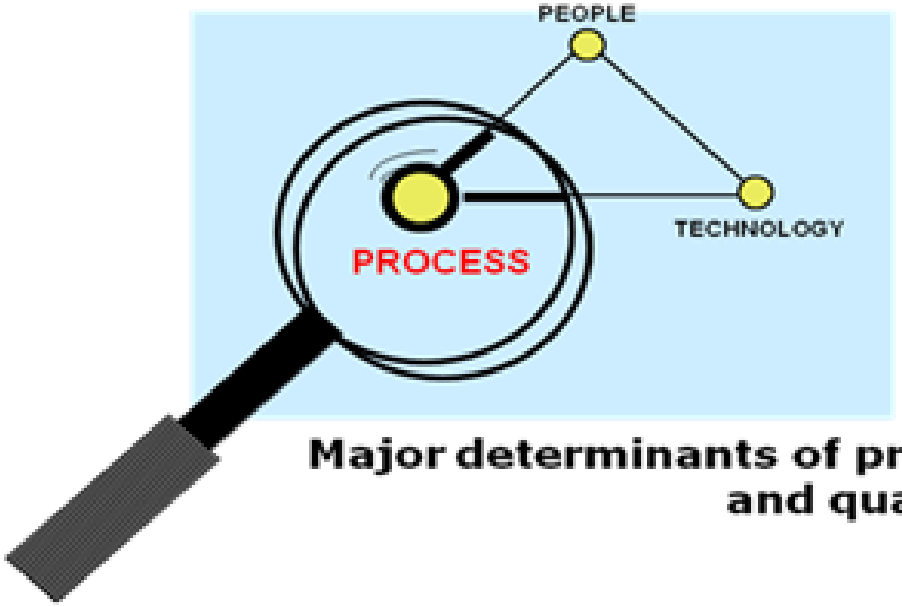
People, Process, Technology Are Keys

Source CMMI Tutorial

- Everyone realizes the importance of having a motivated, quality work force but…
- …even our finest people can't perform at their best when the process is not understood or operating "at its best."



There is no question about the quality of your people or technologies

Major determinants of product cost, schedule, and quality

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Galorath: Driving The State of the Art (10 Step Estimation Process)

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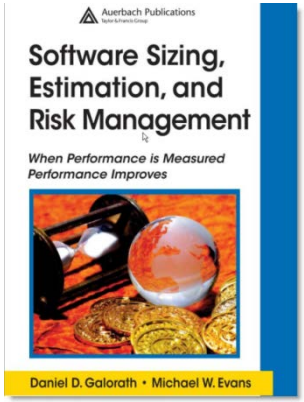
1. Establish Estimate Scope
2. Establish Technical Baseline, Ground Rules, Assumptions
3. Collect Data
4. Estimate and Validate Software Size
5. Prepare Baseline Estimates
6. Review, Verify and Validate Estimate
7. Quantify Risks and Risk Analysis
8. Generate a Project Plan
9. Document Estimate and Lessons Learned
10. Track Project Throughout Development



We will use these 10 steps in our Estimation Process Improvement Program (EPIP)

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What to measure

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WHAT TO MEASURE

Information Category Measure Mapping*

	Information Category	Measurable Concepts	Prospective Measures
1	Schedule and Progress	Milestone completion	Mileston Dates
		Critical Path Performance	Slack Time
		Work Unit Progress	Requirements Traced, Requirements Tested, Problem Reports Opened, Problem Reports Closed, Reviews Completed, Change Requests Opened, Change Requests Resolved, Units Desgined, Units Coded, Units Integrated, Test Cases Attempted, Test Cases Passed, Action Items Opened, Action Items Completed
		Incremental Capacity	Components Integrated, Functionality Integrated
2	Resources and Cost	Pewrsonnel Effort	Staff Level, Development Effort, Expereince Level, Staff Turnover
		Financial	BCWS, BCWP, ACWP, Budget, Cost
		Environmental/Support	Qualaity Needed, Quality Available, Time Available, Time Used
3	Product Size & Stability	Physical Size/Stability	Database Size, Compomnents, Interfaces, LOC
		Funtional Size	Requirements, Function Changes, Function Points
4	Product Quality	Functional Correctness	Defects, Age of Defects, Technical Performanmce
		Maintaniability	Time to Release, Cyclomatic Complexity
		Efficeincy	Utilization, Throughput, Response Time
		Portability	Stand Comp-0liance
		Usability	Operator Errors
		Realibility	MTTF
5	Process Performance	Process Cxompliance	Reference Maturity Rating, Process Audit Findings
		Process Efficiency	Productivity, Cycle Time
		Process Effectiveness	Defects Contained, Defects Escaping, Rework Effort, Rework Components
6	Technology Effectiveness	Technology Suitability	Requirements Coverage
		Technology Volatility	Baseline Changes
7	Customer Satisfaction	Customer Feedback	Satisfaction Rating, Award Fee
		Customer Support	Request for Support, Support Time

* Practical Software Measurement; McGarry, Card, Jones; Addison-Wesley2002

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Traditional Management vs. Earned Value Management

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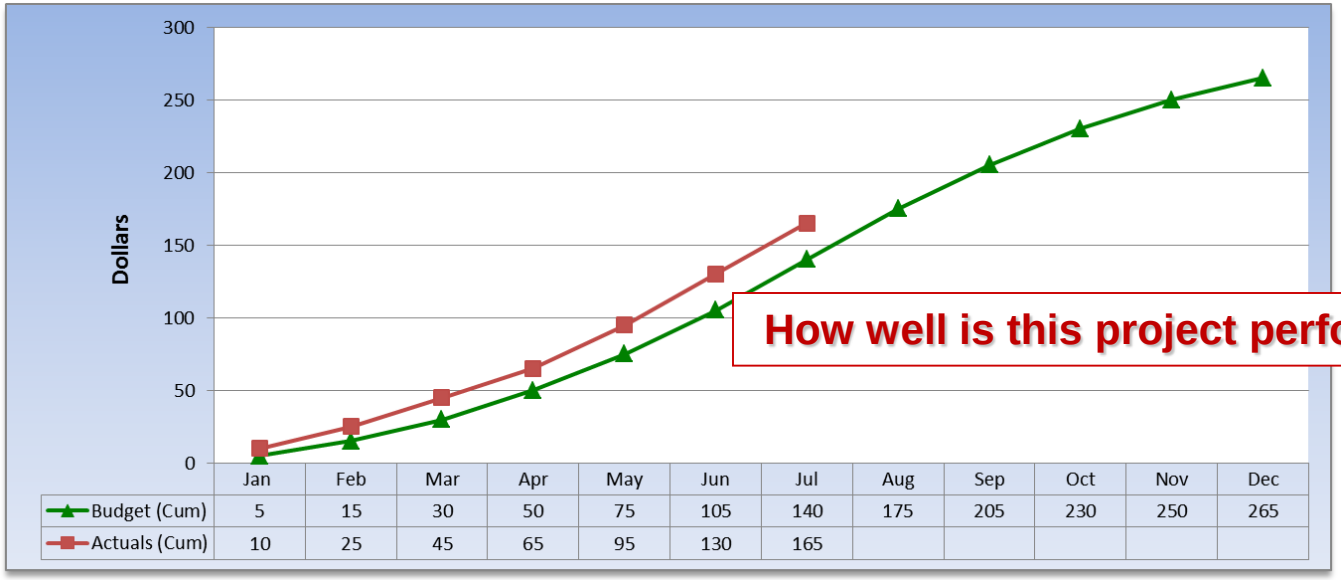
- Traditional Management has **two** sources of data:
  - The **Budgeted** expenditures schedules
  - The **Actual** expenditures completed



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Budget (Cum)	5	15	30	50	75	105	140	175	205	230	250	265
Actuals (Cum)	10	25	45	65	95	130	165					

- The comparison of budgeted versus actual expenditures merely indicates what was planned to be spent versus what was actually spent at any given time.

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Traditional Management vs. Earned Value Management

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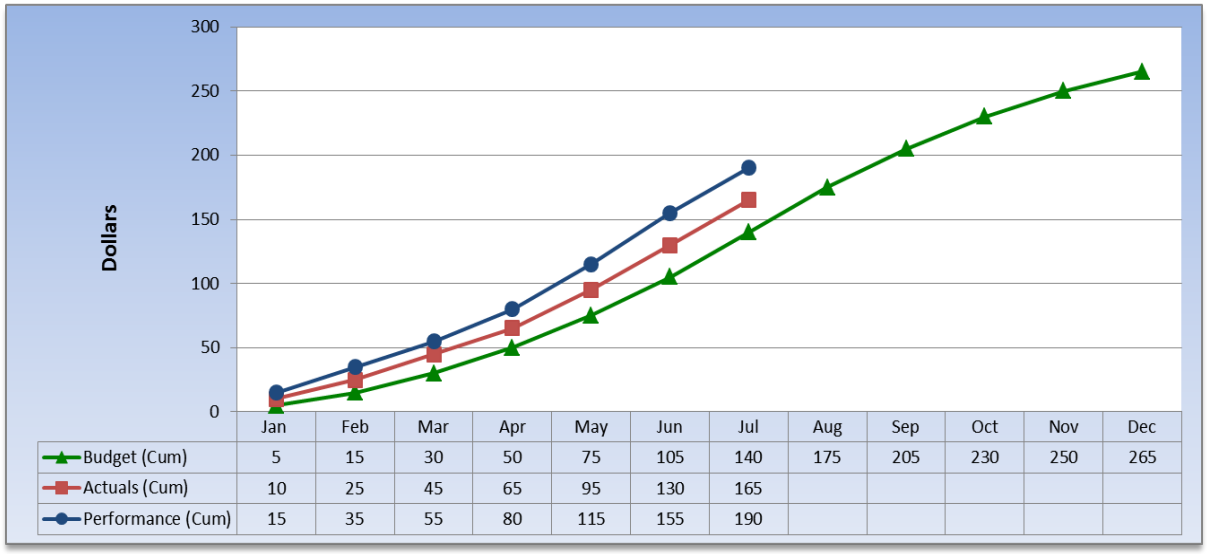
- Earned Value Management has **three** sources of data:

The **Planned Value (PV)** of work scheduled, otherwise known as ***Budgeted Cost of Work Scheduled (BCWS)***

The **Actual Cost (AC)** of work completed, otherwise known as ***Actual Cost of Work Performed (ACWP)***

The **Earned Value (EV)** of the work completed, otherwise known as ***Budgeted Cost of Work Performed (BCWP)***

How well is this project performing?



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Budget (Cum)	5	15	30	50	75	105	140	175	205	230	250	265
Actuals (Cum)	10	25	45	65	95	130	165					
Performance (Cum)	15	35	55	80	115	155	190					

- Adding the Earned Value of the work completed gives the project manager the insight for future decisions.

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EVM - Disciplined PM Tool for Decision Making

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EVM establishes a clear linkage between planned, actual, and projected accomplishments
Integrated technical, cost, and schedule
Early warning indicators and visibility into drivers of performance
Ability to forecast performance and construct corrective action plans
Tailor-able to needs of program

EVM supports all disciplines in their efforts to track progress
Communication and coordination across the team
Checks and balances for accountability
Objective information to allow proactive decision making and risk management
Does not replace other program management tools such as TPM's or risk management methods

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The WBS is the Cornerstone of the System

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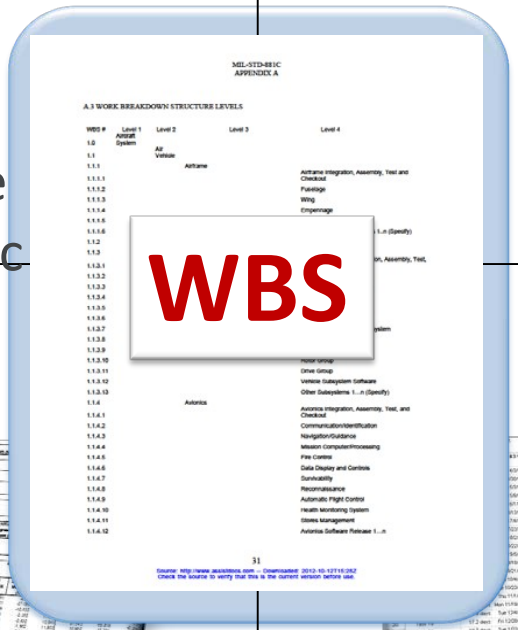
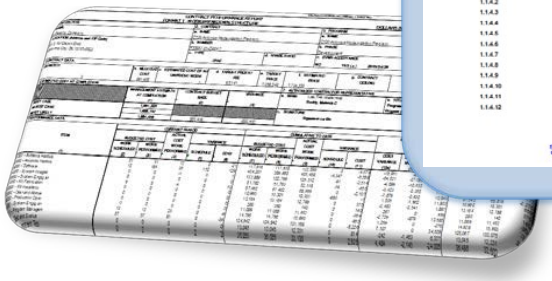
Technical
- TPMs
- Specifications
- Design Docs
- Performance Characteristic

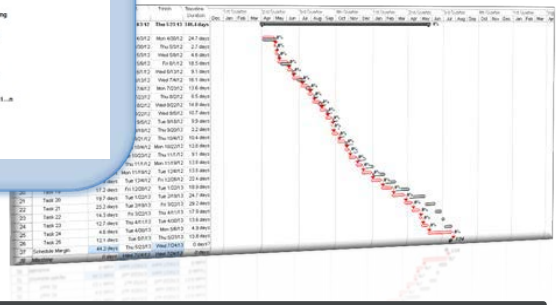
Risk & Risk Assessment
- Level of Detail
- Program Oversight level of detail



Earned Value
Cost and Schedule Status



Schedule
IMP / IMS



The WBS facilitates communication across the program

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The Earned Value Management Process

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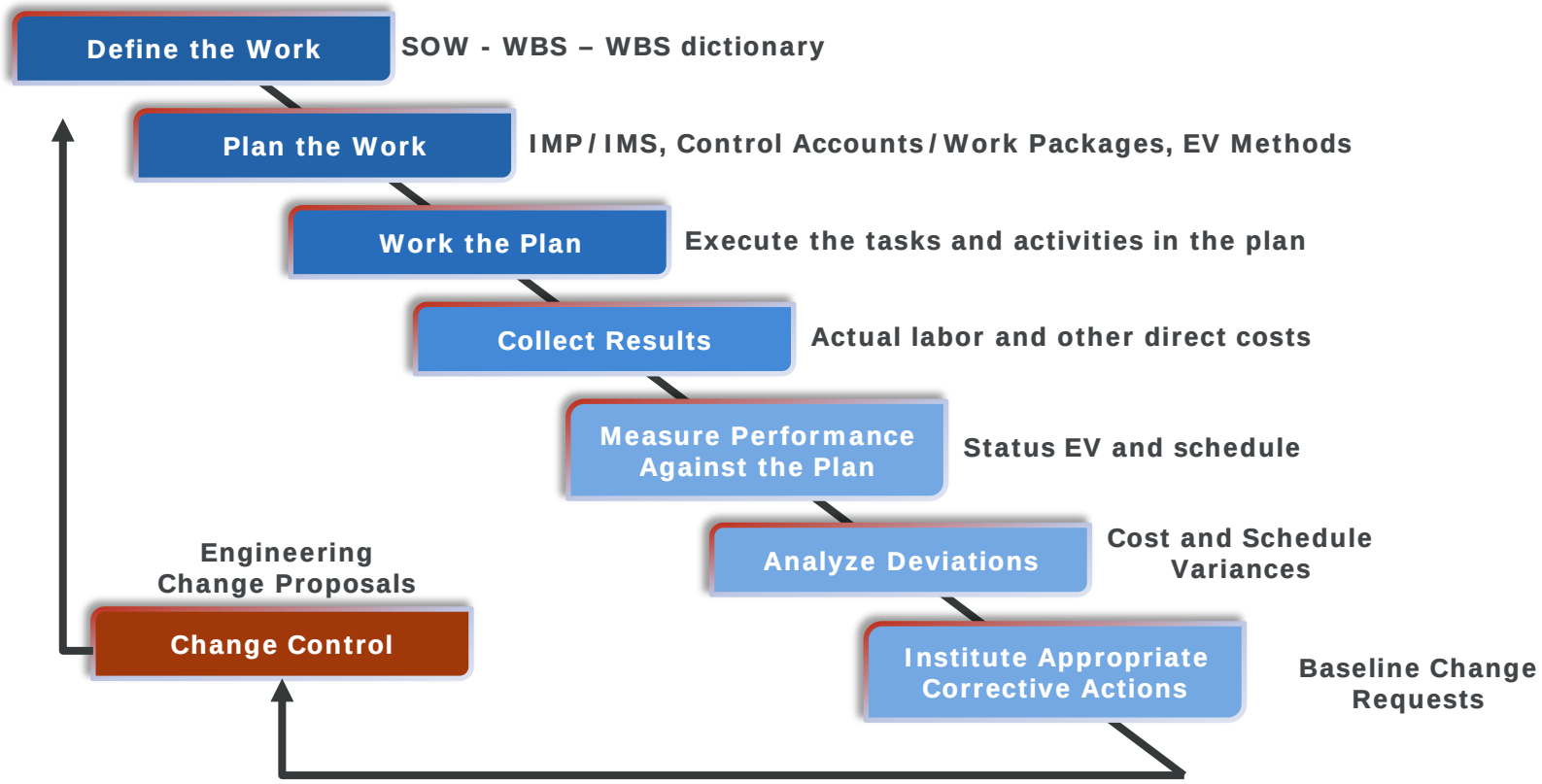
The Earned Value Management Process



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EVM Terminology

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Planned Value (BCWS): *How much work (person-hours) you planned to have accomplished at a given point in time.*

Actual Cost (ACWP): *How much work (person-hours) you have actually spent at a given point in time*

Earned Value (BCWP): *The value (person-hours) in terms of your base budget of what you have accomplished at a given point in time (or, % complete X Planned Value)*

Budget At Completion (BAC): *The total amount of scope as represented in dollars*

Estimate At Completion (EAC): *The estimate for the cost of the work to be performed*

Cost Variance (CV): *Difference between earned value (BCWP) and actual costs (ACWP)*

Schedule Variance (SV): *Difference between earned value (BCWP) and planned value (BCWS)*

Variance Analysis Report (VAR): *Analysis of cost and schedule issues, risks, and other programmatic information*

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Performance Measures and Metrics

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- Earned Value Management uses five basic variables:

Question	Answer	Acronym
How much work should be complete or what is planned?	Budgeted Cost of Work Scheduled (Planned Value)	BCWS (PV)
How much did the completed work cost?	(Actual Cost) of Work Performed	ACWP (AC)
How much work is complete?	Budgeted Cost of Work Performed (Earned Value)	BCWP (EV)
What was the total project budget?	Budget at Completion	BAC
What do we now expect the total project to cost?	Estimate at Completion	EAC

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EVM Techniques

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Earned Value Management Techniques

Apportioned / Discrete: Scope for which planned and earned value measurement is directly related to and in proportion to other measured effort control accounts/work packages

- 0 /100 Method
- 50/50 Method
- Equivalent Units Method
- Interim Milestone Method
- Percent Complete Method
- Apportioned Effort Method

➢ Typical uses: Quality assurance, production control, tooling inspection, planned material attrition, may also be used for LOE-type effort when the tasks correlate to measured Work Packages

Level of Effort: Scope of a general or supportive nature that is impractical to measure; therefore, earned value is set equal budget value with the passage of time

- Should be minimized to the extent practical

➢ Typical uses: Program Management, sustaining engineering

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Performance Measurement Baseline

Performance Measurement Baseline

Total time-phased budget for a program

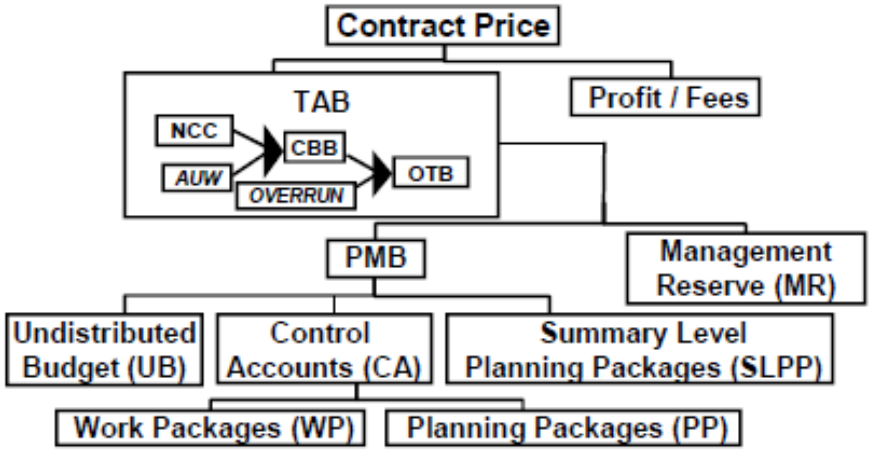
Schedule for expenditure of company resources to satisfy program scope and schedule objectives

Summation of:

Control Accounts (Work Packages and Planning Packages)

Undistributed Budget – Authorized but not yet assigned to specific work or planning packages

Does **not** include Management Reserve (MR)



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Management Reserve (MR)

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Management Reserve

- Amount of Total Budget withheld for management control
  - Not identified for a specific task
  - Amount is based upon contractor policy
  - Sometimes referred to as a “tax on CAMs” - challenge to work more efficiently
- Used for “unanticipated growth” within current work scope, rate changes, other unknowns (work that was overlooked at the time the budget was created)
- Not to be used to absorb cost of contract changes
  - Government can’t direct use
- Should **never** be used to offset overruns
- Contractor PM reports amount used, balance, and scope use
- Held at total contract level or distributed, controlled at lower management levels
  - Contractor Controls - Government Patrols

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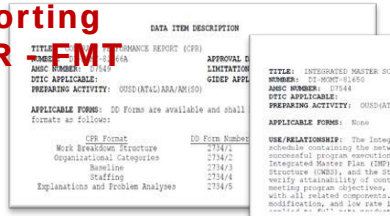
Integrated Reporting

- Integrated Project Management Report (IPMR)

Cost Reporting (CPR – FMT 1-5)

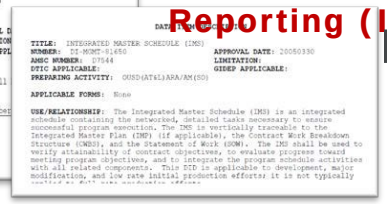

DATA ITEM DESCRIPTION

TITLE: ...FORMANCE REPORT (CPR)
...
AMSC NUMBER: D7547
DTIC APPLICABLE:
PREPARING ACTIVITY: OUSD(AT&L)ARA/AM(SO)
APPROVAL D...
LIMITATION
GIDEP APPL...

APPLICABLE FORMS: DD Forms are available and shall ... formats as follows:

CPR Format	DD Form Number
Work Breakdown Structure	2734/1
Organizational Categories	2734/2
Baseline	2734/3
Staffing	2734/4
Explanations and Problem Analyses	2734/5

Schedule Reporting (IMS)

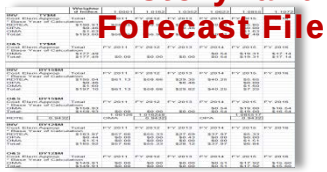

DATA ITEM DESCRIPTION

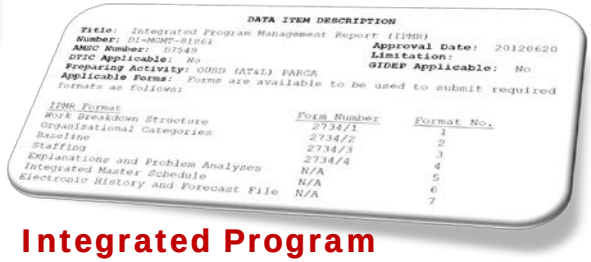
TITLE: INTEGRATED MASTER SCHEDULE (IMS)
NUMBER: DI-MGMT-81650
AMSC NUMBER: D7544
DTIC APPLICABLE:
PREPARING ACTIVITY: OUSD(AT&L)ARA/AM(SO)
APPROVAL DATE: 20050330
LIMITATION:
GIDEP APPLICABLE:

APPLICABLE FORMS: None

USE/RELATIONSHIP: The Integrated Master Schedule (IMS) is an integrated schedule containing the networked, detailed tasks necessary to ensure successful program execution. The IMS is vertically traceable to the Integrated Master Plan (IMP) (if applicable), the Contract Work Breakdown Structure (CWBS), and the Statement of Work (SOW). The IMS shall be used to verify attainability of contract objectives, to evaluate progress toward meeting program objectives, and to integrate the program schedule activities with all related components. This DID is applicable to development, major modification, and low rate initial production efforts; it is not typically

Electronic History and Forecast File




DATA ITEM DESCRIPTION

Title: Integrated Program Management Report (IPMR)
Number: DI-MGMT-81861
AMSC Number: D7549
DTIC Applicable: No
Preparing Activity: OUSD (AT&L) PARCA
Applicable Forms: Forms are available to be used to submit required formats as follows:
Approval Date: 20120620
Limitation:
GIDEP Applicable: No

IPMR Format	Form Number	Format No.
Work Breakdown Structure	2734/1	1
Organizational Categories	2734/2	2
Baseline	2734/3	3
Staffing	2734/4	4
Explanations and Problem Analyses	N/A	5
Integrated Master Schedule	N/A	6
Electronic History and Forecast File	N/A	7

Integrated Program Management Report (IPMR)

PAST

Are we on schedule?
Are we on cost?
What are the significant variances?
Why do we have variances?
Who is responsible?
What is the trend to date?

PRESENT

FUTURE

When will we finish?
What will it cost at the end?
How can we control the trend?
How to affect corrective or mitigating action most effectively?

We analyze the past performance…….to help us control the future

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Integrated Program Management Report

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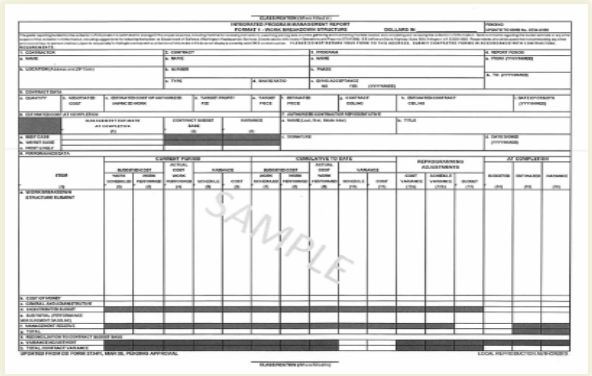
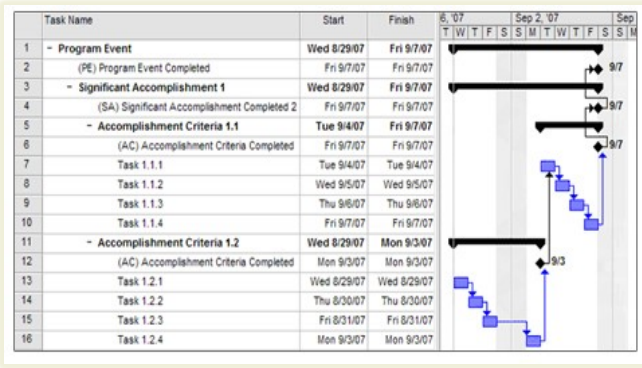
Cost Reporting



- WBS EVM data (Format 1)
- OBS EVM data (Format 2)
- Changes to baseline (Format 3)
- Staffing Plan (Format 4)
- Variance Analysis (Format 5)
- Annual historical & future plan spread (Format 7)

Schedule Reporting



	Task Name	Start	Finish
1	Program Event	Wed 8/29/07	Fri 9/7/07
2	(PE) Program Event Completed	Fri 9/7/07	Fri 9/7/07
3	Significant Accomplishment 1	Wed 8/29/07	Fri 9/7/07
4	(SA) Significant Accomplishment Completed 2	Fri 9/7/07	Fri 9/7/07
5	Accomplishment Criteria 1.1	Tue 9/4/07	Fri 9/7/07
6	(AC) Accomplishment Criteria Completed	Fri 9/7/07	Fri 9/7/07
7	Task 1.1.1	Tue 9/4/07	Tue 9/4/07
8	Task 1.1.2	Wed 9/5/07	Wed 9/5/07
9	Task 1.1.3	Thu 9/6/07	Thu 9/6/07
10	Task 1.1.4	Fri 9/7/07	Fri 9/7/07
11	Accomplishment Criteria 1.2	Wed 8/29/07	Mon 9/3/07
12	(AC) Accomplishment Criteria Completed	Mon 9/3/07	Mon 9/3/07
13	Task 1.2.1	Wed 8/29/07	Wed 8/29/07
14	Task 1.2.2	Thu 8/30/07	Thu 8/30/07
15	Task 1.2.3	Fri 8/31/07	Fri 8/31/07
16	Task 1.2.4	Mon 9/3/07	Mon 9/3/07

- Integrated Master Schedule (Format 6)
  - Critical Path / Driving Path
  - Milestones
- Schedule Risk Analysis (SRA)
- Schedule Analysis

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Feature Delivery

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Plan for Delivery of Features Versus Actual Delivery
(This chart will provide a good "Top Level" assessment)

	INCREMENT 1 (2/6/13 - 5/7/13)	INCREMENT 2 (5/8/13 - 8/6/13)	INCREMENT 3 (8/7/13 - 11/5/13)	INCREMENT 4 (11/6/13 - 2/4/14)	INCREMENT 5 (2/5/14 - 5/6/14)	INCREMENT 6 (5/7/14 - 8/5/14)	INCREMENT 7 (8/6/14 - 11/4/14)	INCREMENT 8 (11/5/14 - 2/3/15) Exports & Tech Services	INCREMENT 9 (2/4/15 - 5/5/15) Cargo Release	INCREMENT 10 (5/6/15 - 8/4/15)	INCREMENT 11 (8/5/15 - 11/3/15) Entry Summary & PGA	INCREMENT 12 (11/4/15 - 2/6/16) Manifest & Support Services
Plan to Achieve Baseline (Increment)	24	24	30	30	66	78	78	78	66	66	48	24
Completed (Increment)	24	24	24	24								
Plan to Achieve Baseline (Cumulative)	24	48	78	108	174	252	330	408	474	540	588	612
Completed (Cumulative)	24	48	72	96								
Planned vs Completed %	100%	100%	92%	89%								
Performance Based Estimate				96	155							
Program Based Estimate				96	174							
Actual Teams	4	4	5	6	11							

Summary:

- **Use a chart like this and the following two charts for estimating feature velocity/work performance.**

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Governing Agencies

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- **DAU –** Defense Acquisition University is a Department of Defense (DoD) training establishment authorized by Congress under the Defense Acquisition Workforce Improvement Act of 1990 and established by DoD Directive 5000.57 on October 22, 1991, that trains the approximately 150,000 military and civilian DoD personnel in the fields of acquisition, technology, and logistics (AT&L). (http://www.dau.mil/)
- **DCMA –** Defense Contract Management Agency DOD Directive 5105.64, signed Sept. 27, 2000, formally established DCMA's purpose and mission and, except for specific exceptions detailed in the Defense Federal Acquisition Regulation Supplement, required all DOD contract administration functions to be delegated to DCMA. (http://www.dcma.mil/)
- **PARCA –** The Office of Performance Assessments and Root Cause Analyses is the central office for major defense authorization performance assessment, root cause analysis, and earned value management within the Department of Defense. Established by section 103 of the Weapons System Acquisition Reform Act of 2009 (P.L. 111-23), PARCA issues policies, procedures, and guidance governing the conduct of such work by the Military Departments and the Defense Agencies. (http://www.acq.osd.mil/parca/)

- **DFARS Clauses**
  - 252.234-7001 "Notice of EVMS" for Solicitations
  - 252.234-7002 "EVMS" for Solicitations & Contracts
  - 252.7005 "Contractor Business Systems" for Solicitations & Contracts
- **DIDs and Standards**
  - DI-MGMT-81861 "Integrated Program Management Report"
  - MIL-STD-881-C "WBS for Defense Materiel Items"

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DAU Earned Value Management 'Gold Card'

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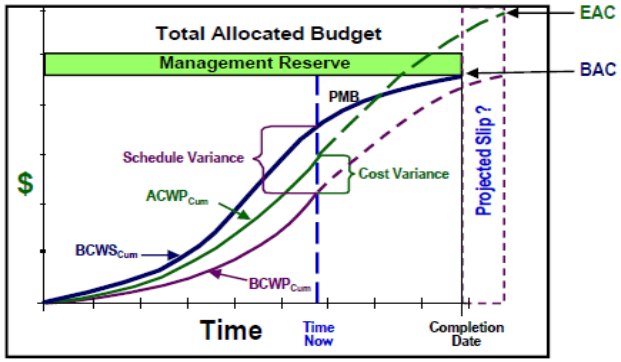
EARNED VALUE MANAGEMENT 'GOLD CARD'



VARIANCES Positive is Favorable, Negative is Unfavorable

Cost Variance	CV	= BCWP – ACWP
	CV %	= (CV / BCWP) * 100
Schedule Variance	SV	= BCWP – BCWS
	SV %	= (SV / BCWS) * 100
Variance at Completion	VAC	= BAC – EAC
	VAC %	= (VAC / BAC) * 100

OVERALL STATUS

% Schedule	= ($BCWS_{CUM}$ / BAC) * 100
% Complete	= ($BCWP_{CUM}$ / BAC) * 100
% Spent	= ($ACWP_{CUM}$ / BAC) * 100

EFFICIENCIES

Cost Efficiency	CPI	= BCWP / ACWP Favorable is > 1.0, Unfavorable is < 1.0
Schedule Efficiency	SPI	= BCWP / BCWS Favorable is > 1.0, Unfavorable is < 1.0

BASELINE EXECUTION INDEX (BEI) & Hit Task %

BEI = Total Tasks Completed / (Total Tasks with Baseline Finish On or Prior to Current Report Period)

Hit Task % = 100 * (Tasks Completed ON or PRIOR to Baseline Finish / Tasks Baselined to Finish within Current Report Period)

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

EAC_{CPI} = $ACWP_{CUM}$ + [(BAC – $BCWP_{CUM}$) / CPI_{CUM}]

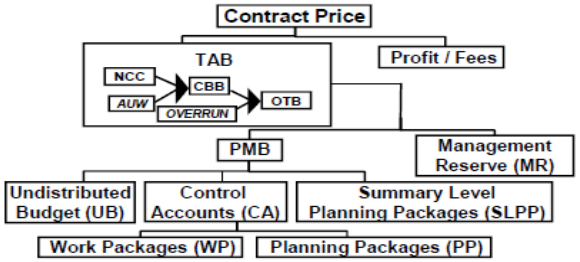
$EAC_{Composite}$ = $ACWP_{CUM}$ + [(BAC – $BCWP_{CUM}$) / (CPI_{CUM} * SPI_{CUM})]

TO COMPLETE PERFORMANCE INDEX (TCPI) § #

$TCPI_{Target}$ = Work Remaining / Cost Remaining = (BAC – $BCWP_{CUM}$) / (Target – $ACWP_{CUM}$)

§ To Determine the TCPI for BAC, LRE, or EAC Substitute TARGET with BAC, LRE, or EAC

To Determine the Contract Level TCPI for EAC, You May Replace BAC with TAB



ACRONYMS

ACWP	Actual Cost of Work Performed	Cost actually incurred in accomplishing work performed = ACTUAL COST
AUW	Authorized Unpriced Work	Work contractually approved, but not yet negotiated / definitized
BAC	Budget At Completion	Total budget for total contract thru any given level
BCWP	Budgeted Cost for Work Performed	Value of completed work in terms of the work's assigned budget = EARNED VALUE
BCWS	Budgeted Cost for Work Scheduled	Time-phased Budget Plan for work currently scheduled = PLANNED VALUE
CA	Control Account	Lowest CWBS element assigned to a single focal point to plan & control scope / schedule / budget
CBB	Contract Budget Base	Sum of NCC & AUW
EAC	Estimate At Completion	Estimate of total Cost for total contract thru any given level generated by Ktr, PMO, DCMA, etc. = $EAC_{Ktr\ /\ PMO\ /\ DCMA}$
LRE	Latest Revised Estimate	Ktr's EAC or EAC_{Ktr}
MR	Management Reserve	Budget withheld by Ktr PM for unknowns / risk management
NCC	Negotiated Contract Cost	Contract Price Minus profit or fee(s)
OTB	Over Target Baseline	Sum of CBB + additional budget approved for remaining work
PAC	Price At Completion	EAC Plus Adjusted Profit or Fee(s)
PMB	Performance Measurement Baseline	Contract time-phased budget plan
PP	Planning Package	Far-term CA activities not yet defined into WPs
SLPP	Summary Level Planning Package	Far-term contract activities not yet defined into CAs
TAB	Total Allocated Budget	Sum of all budgets for work on contract = NCC, CBB, or OTB
TCPI	To Complete Performance Index	Efficiency needed from 'time now' to achieve a Cost Target = BAC, LRE, or EAC
UB	Undistributed Budget	Broadly defined activities not yet distributed to CAs or SLPPs
WP	Work Package	Near-term, detail-planned activities within a CA

EVM POLICY: DoDI 5000.02, Enclosure 1, Table 8.

EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-government work agreements, & other agreements valued ≥ $20M (TY $). Contracts ≥ $50M (TY $) require that the EVMS be formally validated by the cognizant contracting officer.

EVM is discouraged on Firm-Fixed Price, Time & Material Contracts, & LOE activities regardless of cost.

Refer to the IPMR Implementation Guide for IPMR Tailoring Guidance.

DoD's EVM CONTRACTING REQUIREMENTS:

DFARS CLAUSES	252.234-7001 "NOTICE OF EVMS" FOR SOLICITATIONS
	252.234-7002 "EVMS" FOR SOLICITATIONS & CONTRACTS
	252.242-7005 "CONTRACTOR BUSINESS SYSTEMS" FOR SOLICITATIONS & CONTRACTS
CONTRACT PERFORMANCE REPORT	DI-MGMT-81466A 5 FORMATS = WBS, ORGANIZATION, BASELINE, STAFFING, EXPLANATIONS & PROB ANALYSES
INTEGRATED MASTER SCHEDULE	DI-MGMT-81650 MANDATORY FOR DOD EVMS CONTRACTS
Integrated Program Mngt Report	DI-MGMT-81861 * 7 FORMATS = WBS, OBS / IPT, BASELINE, STAFFING, EXPLANATIONS & PROB ANALYSES, IMS, HISTORY / FORECAST COST
INTEGRATED BASELINE REVIEW	MANDATORY FOR ALL EVMS CONTRACTS
WBS For Defense Materiel Items	MIL-STD-881-C

* Combines & Supersedes DI-MGMT-81466A & 81650; Effective July 1, 2012

EVM CoP: https://acc.dau.mil/evm
eMail Address: EVM.dau@dau.mil
Revised February 2015

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Feature Point Delivery

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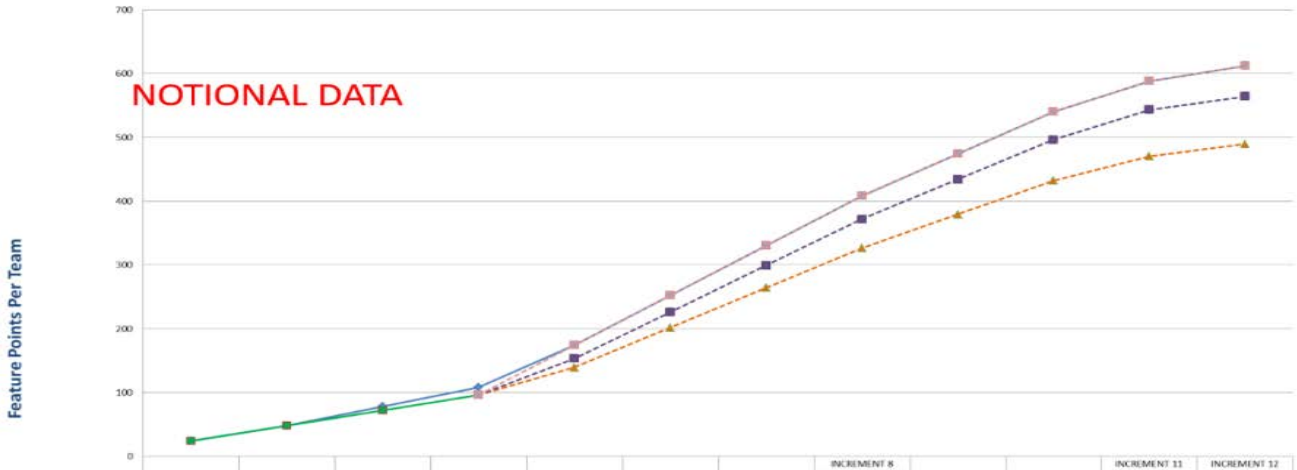
Feature Point Plan & Performance
(This Chart provided an assessment of "Technical" accomplishment)



	INCREMENT 1 (2/6/13 - 5/7/13)	INCREMENT 2 (5/8/13 - 8/6/13)	INCREMENT 3 (8/7/13 - 11/5/13)	INCREMENT 4 (11/6/13 - 2/4/14)	INCREMENT 5 (2/5/14 - 5/6/14)	INCREMENT 6 (5/7/14 - 8/5/14)	INCREMENT 7 (8/6/14 - 11/4/14)	INCREMENT 8 (11/5/14 - 2/3/15) Exports & Tech Services	INCREMENT 9 (2/4/15 - 5/5/15) Cargo Release	INCREMENT 10 (5/6/15 - 8/4/15)	INCREMENT 11 (8/5/15 - 11/3/15) Entry Summary & PGA	INCREMENT 12 (11/4/15 - 2/6/16) Manifest & Support Services
Plan to Achieve Baseline (Cumulative)	24	48	78	108	174	252	330	408	474	540	588	612
Completed (Cumulative)	24	48	72	96								
Per Team Average	6.0	6.0	5.6	5.2								
Feature Point Per Team %	100%	100%	80%	80%								
Performance Based Estimate (% Based CUM)				96.0	139.2	201.6	264.0	326.4	379.2	432.0	470.4	489.6
Performance Based Estimate (Average Based CUM)				96.0	153.2	226.0	298.8	371.6	434.0	496.4	543.2	564.0
Program Based Estimate				96	174	252	330	408	474	540	588	612

Summary: Overall the teams are currently operating at a 5.2 Feature Point velocity per Increment which equates to slightly less than planned.

- **Performance Based Estimate (Average) – This projection is based on a 5.2 Feature Point average.**
- **Performance Based Estimate (%) – This projection is based on an 80% efficiency.**
- **Program Based Estimate – This projection is based on team expectations.**

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Feature Velocity

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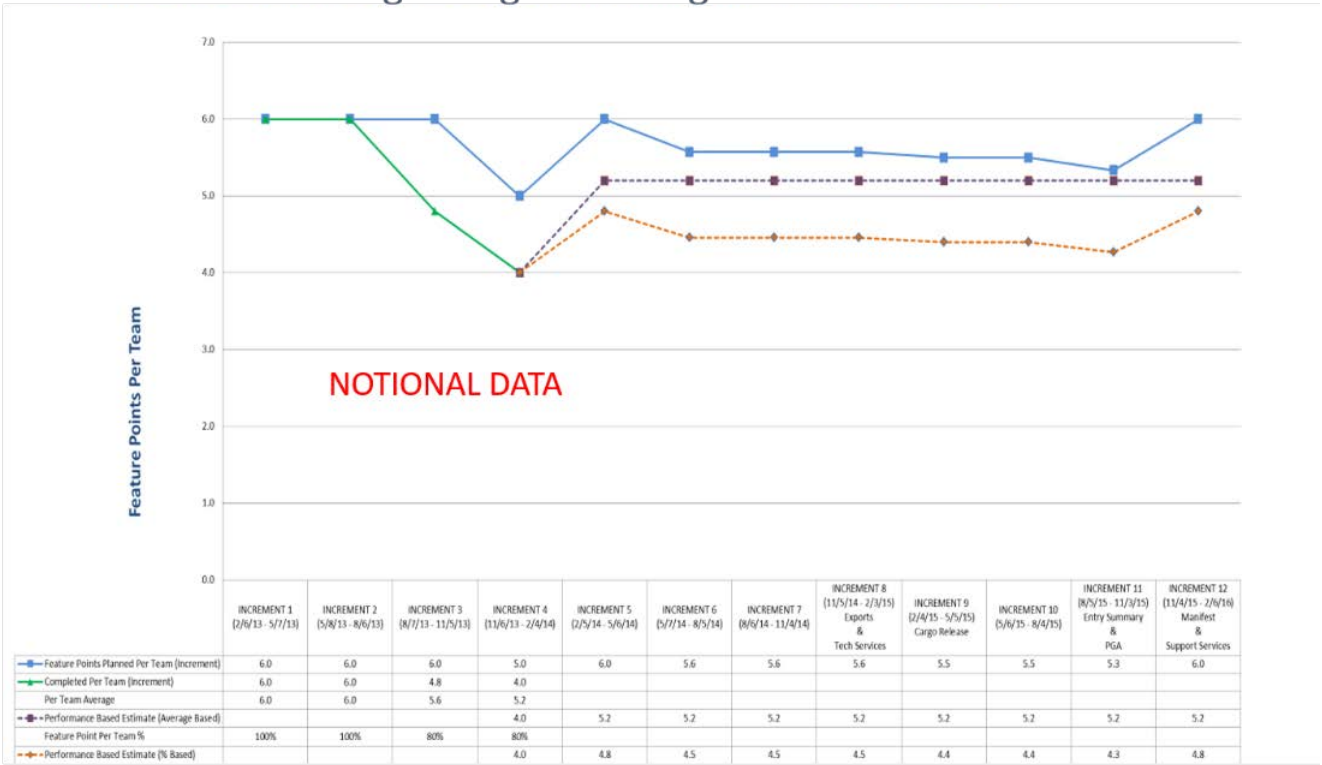
A Rate at which Features Will be Accomplished (Velocity) will be established and Progress against that goal will be tracked



	INCREMENT 1 (2/6/13 - 5/7/13)	INCREMENT 2 (5/8/13 - 8/6/13)	INCREMENT 3 (8/7/13 - 11/5/13)	INCREMENT 4 (11/6/13 - 2/4/14)	INCREMENT 5 (2/5/14 - 5/6/14)	INCREMENT 6 (5/7/14 - 8/5/14)	INCREMENT 7 (8/6/14 - 11/4/14)	INCREMENT 8 (11/5/14 - 2/3/15) Exports & Tech Services	INCREMENT 9 (2/4/15 - 5/5/15) Cargo Release	INCREMENT 10 (5/6/15 - 8/4/15)	INCREMENT 11 (8/5/15 - 11/3/15) Entry Summary & PGA	INCREMENT 12 (11/4/15 - 2/6/16) Manifest & Support Services
Feature Points Planned Per Team (Increment)	6.0	6.0	6.0	5.0	6.0	5.6	5.6	5.6	5.5	5.5	5.3	6.0
Completed Per Team (Increment)	6.0	6.0	4.8	4.0								
Per Team Average	6.0	6.0	5.6	5.2								
Performance Based Estimate (Average Based)				4.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Feature Point Per Team %	100%	100%	80%	80%								
Performance Based Estimate (% Based)				4.0	4.8	4.5	4.5	4.5	4.4	4.4	4.3	4.8

Summary: Overall the teams are currently operating at a 5.2 Feature Point velocity per Increment which equates to slightly less than planned.

- **Performance Based Estimate (Average) – This projection is based on a 5.2 Feature Point average.**
- **Performance Based Estimate (%) – This projection is based on an 80% efficiency.**

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Well Defined EVM

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1. The plan is driven by product quality requirements.
2. The focus is on technical maturity and quality, in addition to work units delivered.
3. The focus is on progress toward meeting success criteria of technical reviews.
4. The program adheres to standards and models for systems engineering, software engineering, and project management.
5. The plan is based on smart work package planning.
6. The plan enables insightful variance analysis.
7. The plan ensures a lean and cost-effective approach.
8. The plan enables scalable scope and complexity depending on risk.
9. The plan integrates risk management activities with the performance measurement baseline.
10. The plan integrates risk management outcomes with the Estimate at Completion.

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Summary

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- Fixed Price and/or LOE contracts in the early phases should be written so that key “value-added” metrics are collected and reported during each increment
- Estimators may have to employ a variety of software estimating methodologies within a single estimate to model the blended development approaches being utilized in today’s development environments
  - An agile estimating process can be applied to each iteration/sprint
  - Future Increments can be estimated based on most recent/successful IID performance
- Cost estimators will have to scrutinize these programs like a schedule analyst might to determine the most likely IOC capabilities and associated date
  - The number of increments are an important cost driver as well as an influential factor in uncertainty/risk modeling

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Summary

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- All of the estimation methods are susceptible to error, and require accurate historical data to be useful within the context of the organization
- When developers and estimators use the same "proxy" for effort, there is more confidence in the estimate

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Recommended Reading

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- “The Death of Agile” blog
- “Agile Hippies and The Death of the Iteration” blog
- Story Point Inflation

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Endnotes

- *1, 2, 4, 10, 11:* Larman, C. (2010). *Agile and Iterative Development: A Manager's Guide.*
- *3:* Kilgore, J. (2012). Senior Associate, Kalman & Company, Inc.
- *5, 6, 7, 8:* Agile Alliance. (2012). *Agile Alliance*. Retrieved 2012, from http://www.agilealliance.org
- *9:* Coaching, T. L. (n.d.). Rally Software Scaling Software Agility.
- *12:* Bittner, K., & Spence, I. (2006). *Managing Iterative Software Development Projects.* Addison-Wesley Professional.

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- Gack, G. (2010). *Managing the Black Hole.*
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- Royce, W., Bittner, K., & Perrow, M. (2009). *The Economics of Iterative Software Development: Steering Towards Better Business Results.* Addision Wesley Professional.
- Smith, G., & Sidky, A. (2009). *Becoming Agile in an Imperfect World.*

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