

A Knowledge Based Technical Approach to Capability Development

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Introduction

This paper:

- Describes the challenges in acquisition based on gaps in knowledge; with a new DoD competitive prototyping policy
- Describes a technical approach to capability development to address these knowledge gaps, enabled by a competitive prototyping paradigm. Key tenets of the approach include:
 - The use of pre-planned knowledge points to inject knowledge into the Capability Development Document (CDD)
 - Expanded collaboration between the material and capability developers
 - Early use of systems engineering fundamentals
- Approach demonstrated on Joint Light Tactical Vehicle program, & now being replicated on other major programs

Challenges in Acquisition

- The Services need increasingly capable systems:
 - They are also typically more complex
 - And by the way, the Services need them faster and cheaper
- Moving goalposts during lengthy system development:
 - The enemy isn't interested in our timeline, they continue to adapt
 - The operational environment & fiscal situation evolves
- DoD Policy goals are introduced and must be met:
 - Energy, training, acquisition, etc.

- *Lack of knowledge by Capability & Material Developers:*
 - *What desired capabilities are technically feasible?*
 - *What technologies are mature?*
 - *What system cost is affordable?*

Background

- These challenges have resulted in:
 - Programs over budget and schedule, underperforming
 - Inadequate understanding in cost and technology risk
- September 2007, USD(AT&L) policy established:
 - Competitive prototyping in TD phase with 2 or more industry teams in Technology Development (TD) Phase
 - Purpose: firm requirements, mature technology, strong foundation on system cost and service affordability
 - Required for all ACAT 1 programs (the largest and most expensive)
 - The Joint Light Tactical Vehicle (JLTV) program was the first to implement this new policy during a 30 month TD phase with three competing industry teams

Capability Developer Challenges

- A competitive prototyping TD phase requires a more sophisticated capability developer than ever:
 - Understand operational *and technical* aspects of trade space
 - Access to diverse array of expertise (engineering, analysis, & test)
 - Mature understanding of PM engineering, cost and testing
- Requires close, ongoing collaboration with PM Office
- Requires early use of systems engineering fundamentals in capability development activities:
 - Capability Developer led trade-off studies
 - Linking Capability Development Document to System Specification; use of SE tool sets, such as DOORS
 - Ability to manage multiple, highly complex tradeoff studies where operational analysis is merged with engineering level analysis

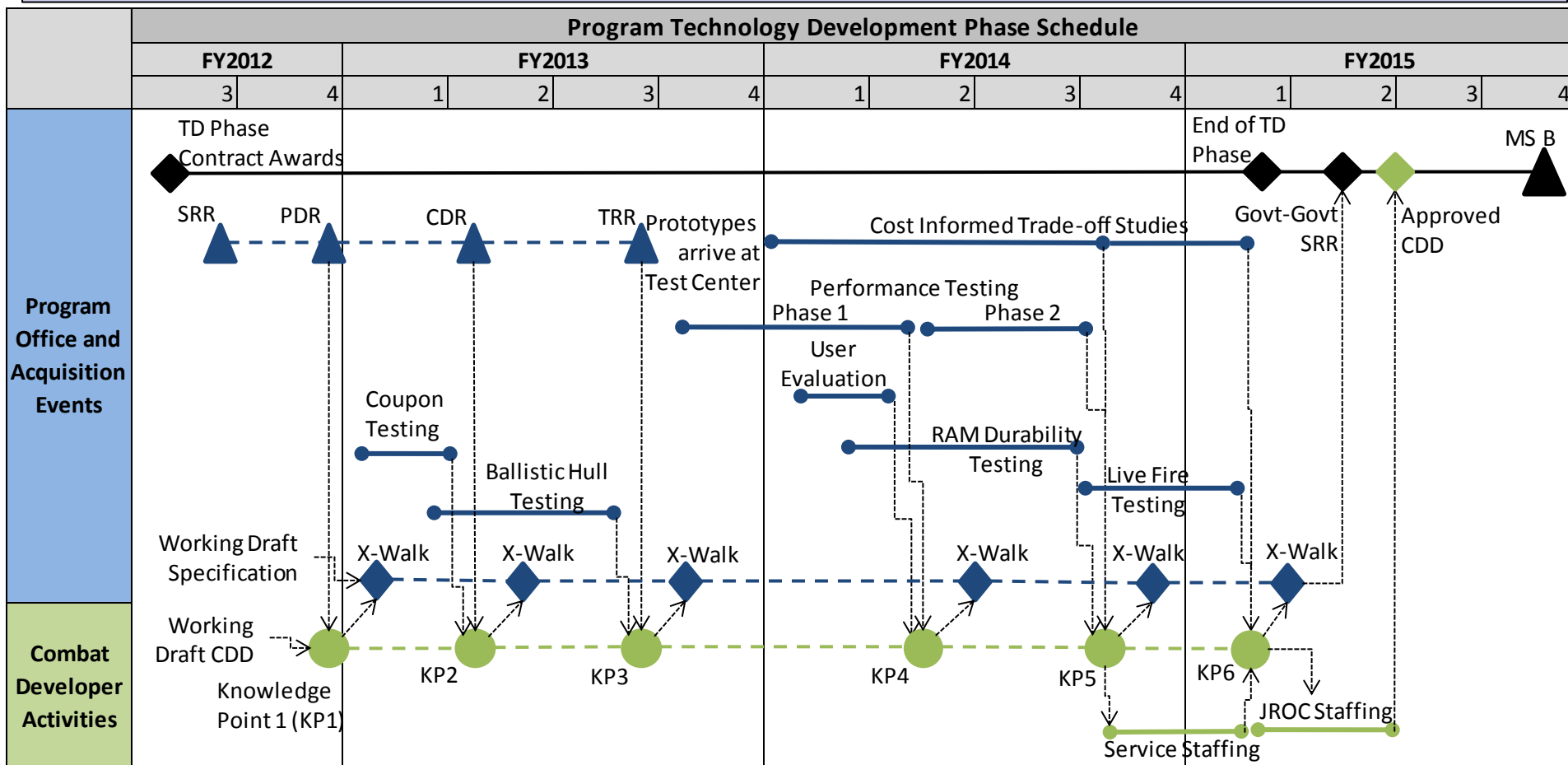
A Knowledge Point Approach:

- Determine key gaps in knowledge:
 - Which key requirements are high risk?
 - What are the system boundaries?
 - Cost / affordability estimates: what are they; when available
- Link gaps in knowledge to events in TD Phase:
 - Will events in competitive prototyping address these gaps in knowledge? (CDRL, test events, analyses)
 - Does the event timing line up w/ the CDD development timeline?
 - Where knowledge gaps are not addressed: work with the Program Manager (PM) to change the TD Phase plan
- “Big-Bang” vs. “Incrementally” updating the CDD

The primary goal of the capability developer in TD Phase: translate knowledge gained in the TD phase into a technically achievable, operationally relevant, and affordable set of required capabilities documented in a revised CDD.

Knowledge Points (KP)

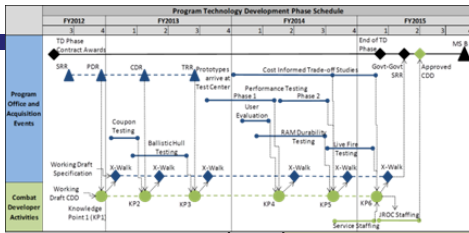
Knowledge Points (KP) are pre-determined, event-based CDD reviews where accumulated knowledge is injected into the CDD updating the requirements based on analysis or test results. Translate information into actionable knowledge



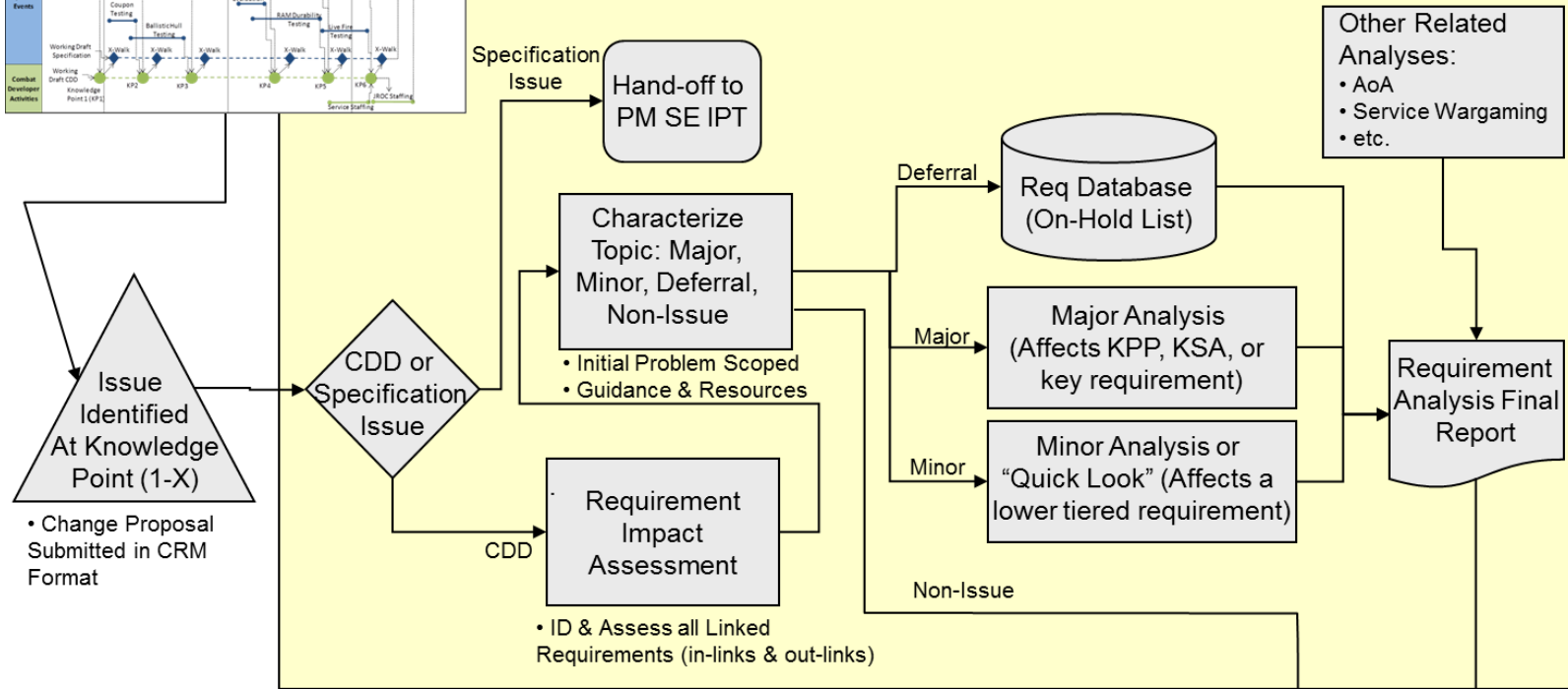
Executing a Knowledge Point

- Prior to each Knowledge Point (KP):
 - Comment forms used to propose CDD changes
 - Pre-work: comments rolled up, recommendation for each established
- KP are fundamentally decision briefs:
 - Given an identified issue, should the CDD be changed?
 - Null hypothesis: sufficient evidence to change the CDD, or more analysis required?
 - Intervening CD-IPT between KP used for deep dive discussion
- Ensure transparency
 - All key stakeholders understand decisions; input solicited
 - Sunlight ensures credible decisions, backed by analysis or test
- Follow select KP with a Senior Leader Review to validate key decisions

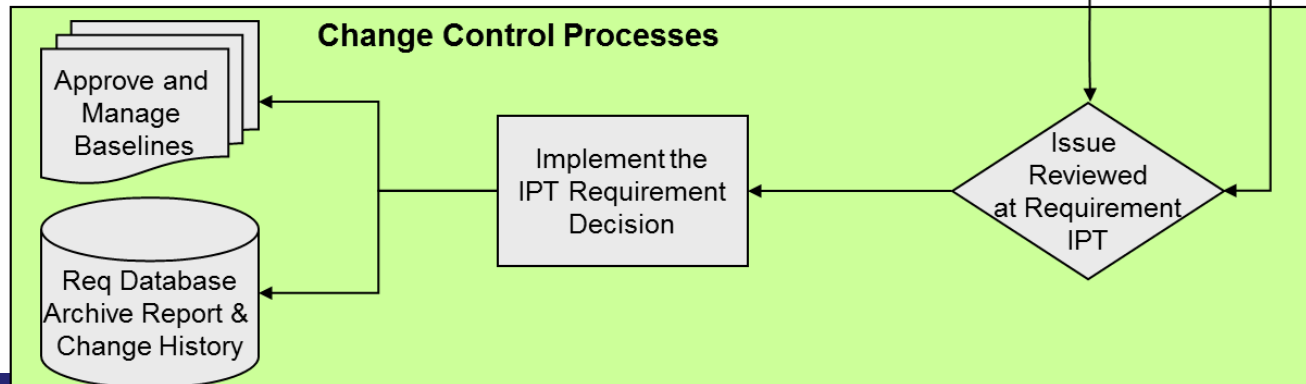
KP Execution: Macro Perspective



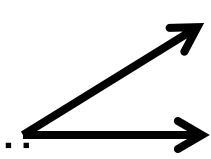
Requirements Analysis Processes



Change Control Processes



Knowledge Point Output

- Primary KP Decision:
 - Based on approved changes...  publish revised draft CDD or...
 - publish an errata
- Only change the CDD at Knowledge Points
 - Reduces dependent organizational churn
- Document the KP Results in an MFR
- Post relevant products on knowledge management website (e.g. ACE)
 - Ensures access to information
- Detailed tracking of issues and analysis

...transparency in capability decision making...

JLTV Requirements IPT

11 October 2011

From: Joint Light Tactical Vehicle (JLTV) Requirements IPT Chair and Co-Chair

Subj: JLTV KNOWLEDGE POINT EIGHT SUMMARY MEMORANDUM FOR RECORD

Ref: (a) JLTV Capability Development Document (CDD) v3.2
 (b) JLTV Requirements Management and Analysis Plan (RMAP)
 (c) JLTV Purchase Description (PD) v2.2

1. **Purpose.** This memorandum summarizes the results of JLTV Knowledge Point Eight and IPT decisions made regarding changes required to reference (a) in accordance with reference (b).

2. **General.** The JLTV Combat Development Team conducted Knowledge Point Eight (KP8) on 28 September 2011 in order to:

a. adjudicate comments received during MROC and AROC staffing;

b. finalize the JLTV CDD for Joint Staffing

3. **Specific**

a. 172 CDD-specific were submitted to the Requirements IPT during AROC and MROC via the JLTV standard change proposal (comment resolution) format and via CDTH (Capability Development Tracking and Management system). All of these changes are archived and tracked within the JLTV DOORS database. The table below summarizes the CDD-related comment adjudication results for KP1 - KP8.

CDD Comment Summary	KP 1	KP 2	KP 3	KP 4	KP 5	KP 6	KP 7	KP 8
Total Comments	65	12	114	215	64	313	194	172
Accepted	29	8	73	209	57	280	143	107
Rejected	1	1	14	0	3	23	31	66
Initiated Req Trade Study	0	0	0	0	2	0	0	0
On-Hold / Deferred	27	3	18	5	0	10	0	0
Open CDD Issues:	KP 1	KP 2	KP 3	KP 4	KP 5	KP 6	KP 7	KP 8
TBD	-	-	-	-	-	10	0	0
TRC	-	-	-	-	-	1	0	0
TBR	-	-	-	-	-	0	0	0

b. In collaboration with the senior materiel developer elements of the JLTV Program, the JLTV Requirements IPT Chair and Co-Chair:

1) Based upon USA and USMC affordability studies conducted since KP7, revised the Unit Cost RSA to reflect less

1 of 3

Early Use of SE Fundamentals (1)

Develop the Plan Up Front

- Comprehensive technical plan is essential:
 - Requirements Management and Analysis Plan (RMAP)
 - Determine the plan up front, sign and document it (archive)
 - Capability Developer owns the plan
- The RMAP should address
 - The knowledge gaps; KP timing, events, execution
 - Roles, responsibilities, and decision authority
 - Change management of key documents, including classified annex
 - How analyses initiated, tracked, burned down and results integrated into the CDD / Specification
 - Use of SE software

...requires commitment to follow the plan...



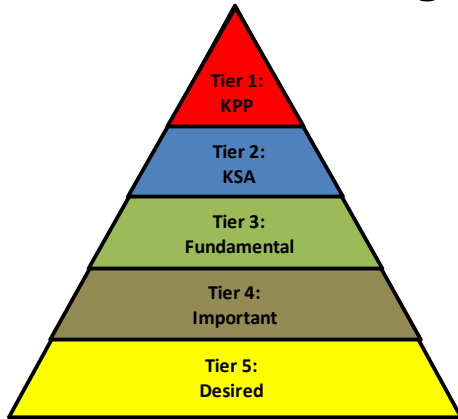
Early Use of SE Fundamentals (2a)

Application of Best Practices

- JCIDS (CJCS 3170) fosters use of SE best practices
- Attributes in CDD should include:
 - Decomposition & internal links: describe how a top level capability is supported by a lower level capabilities
 - Relative Priority: inform trade off decisions to preclude lower level attributes from causing undue performance or cost risk to high priority capability, such as a KPP. Relative priority also can be flowed down into the system specification.
- Routine, detailed CDD- Specification Crosswalks
 - Industry only sees the specification
 - Accurate and complete decomposition of CDD into specification
- Execute a Govt-Govt Systems Requirement Review (SRR)
- Establish a whole-system trade-off studies group

Early Use of SE Fundamentals (2b)

Tiering Concept and Definitions

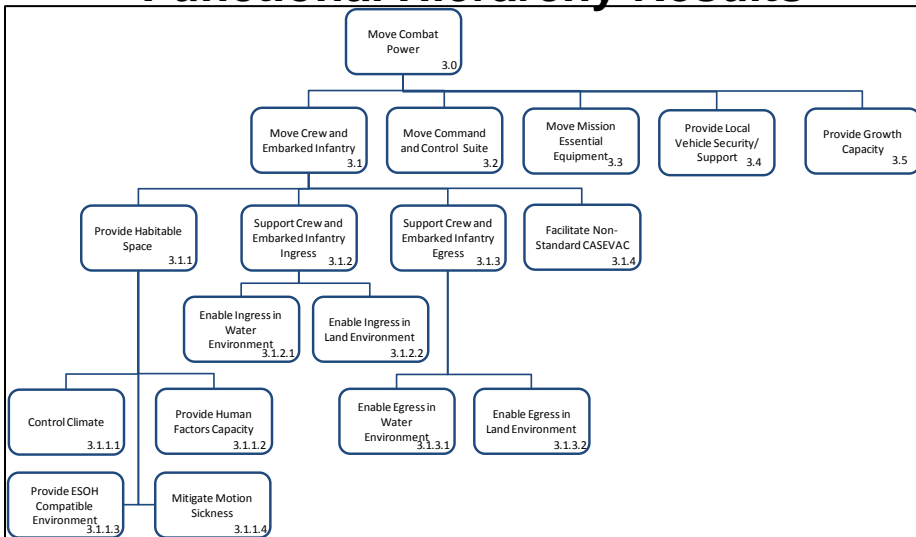


Attribute Tiering Results

Move Combat Power Function



Functional Hierarchy Results



Move Crew and Embarked Infantry 3.1
 Crew X & Y Marines

Provide Habitable Space 3.1.1
 Deliver Effective Marines

Move Mission Essential Equipment 3.3
 Marines Plus Gear

Provide Local Vehicle Security/Support 3.4
 Local Security

Provide Growth Capacity 3.5
 XXXX lbs Growth

Enable Egress in Land Environment 3.1.3.2
 Disembark XXXsec

Control Climate 3.1.1.1
 Heat / Cool Cabin

Provide ESOH Compatible Environment 3.1.1.3
 Safe Vehicle

Provide Human Factors Capacity 3.1.1.2
 5-95 Percentile Marine

Facilitate Non-Standard CASEVAC 3.1.4
 4 Litters in Emergency

Enable Egress in Water Environment 3.1.3.1
 Out Before Sinks

Early Use of SE Fundamentals (3,4)

Enterprise Level Use of Software

- Executing the knowledge point process requires rigor
- Requirements management software, (such as DOORS ©)
 - Enables varsity-level change control and issue tracking
 - Supports decomposition, internal linking and derivation
 - Supports tight coupling of the CDD – System Specification
 - The CDD and Specification should be in the same database

Access to Technical Resources

- Operational and engineering analyses required are typically beyond capabilities of combat developers...
- Government agencies and labs are an outstanding resource...use them!

Integrating Test Results

- Test results are the benchmark of achievability...
- Multiple prototypes, so a complex mapping of test results
- However, timing must support CDD
 - Testing can be prioritized in time to support early CDD decisions
 - Testing can be phased to support specific knowledge points
- The KP process ultimately changes requirements...
 - Should test to the 'new' requirement if possible...
 - ...since industry didn't design to the new requirement, what does a failure mean?
- Requires close coordination with testing authority

Early Use of SE Fundamentals (6)

Early and Ongoing Cost Integration

- The whole systems trade-off studies group:
 - Should include a cost estimating element
 - Can be used early on, to assess cost of capability versus the relative priority of the capability (monitor for high cost, low priority attributes)
- Execute cost informed trade-off analyses:
 - Establish a cost threshold beyond which system is at risk of becoming un-affordable
 - Near the end of TD Phase, when prototype cost CDRL available, re-examine cost to capability decisions to ensure affordability
- Cost decisions typically require senior leader input

The capability developer must be willing and able to make painful cost versus capability trade-off decisions!

Questions?

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