Accelerating the Adoption of CMMI® and Earned Value Management

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Defense Mission Systems (DMS) Background

- **Leading developer and integrator of complex, mission-enabling C4I systems**
  - Division of Northrop Grumman Mission Systems
  - Geographically dispersed with a diverse customer base
    - **Over 6,000 people in 43 states and 9 countries**
    - **Mixture of large and small programs**
- **Process Maturity**
  - Created out of seven separate legacy organizations, January 2002; institutionalized a common OSSP, the DMS Integrated Enterprise Process
  - Tri-Service certified Program Management System and Earned Value System
  - S/W & SE CMMI® Level 5 – In November 2003 DMS was externally appraised at CMMI-SE/SW Level 5

Problem

- **Senior management recognizes the value of CMMI/EVMS**
  - Projects required by policy to implement CMMI and EVMS
  - Most successful projects have both CMMI credentials and a strong EVMS program
- **Issue is how to facilitate adoption of CMMI/EVMS by new projects throughout the organization**
  - Some sites do not have CMMI/EVMS background or local experts available
    - **These sites are reliant on out-of-town experts to help set up these programs**
    - **Result can be delay, rework, frustration for projects at these sites**
- **Six Sigma process improvement team formed to reduce the cycle time needed to implement CMMI/EVMS**

Why tackle CMMI and EVMS on the same Six Sigma project?

CMMI Synergy with EVMS

CMMI Process Area	No. of Practices* that Map to EVMS
All Project Process Areas - Generic Practices	
2.2 – Planning (Partial**)	17
2.3 – Resources (Partial**)	17
2.4 – Responsibility	17
2.8 – Monitoring and Control (Partial**)	17
Project Planning Process Area (PA)	5
Project Monitoring and Control PA	5
Measurement and Analysis PA	4
Integrated Project Management PA	2
Requirements Management PA	2
Process and Product Quality Assurance PA	4
Supplier Agreement Management PA	1
Requirements Development PA	1
Risk Management PA	2

* CMMI-SE/SW Model ** Partial - Elements related to budget, schedule, effort, and earned value

Strong CMMI/EVMS Relationships[1]

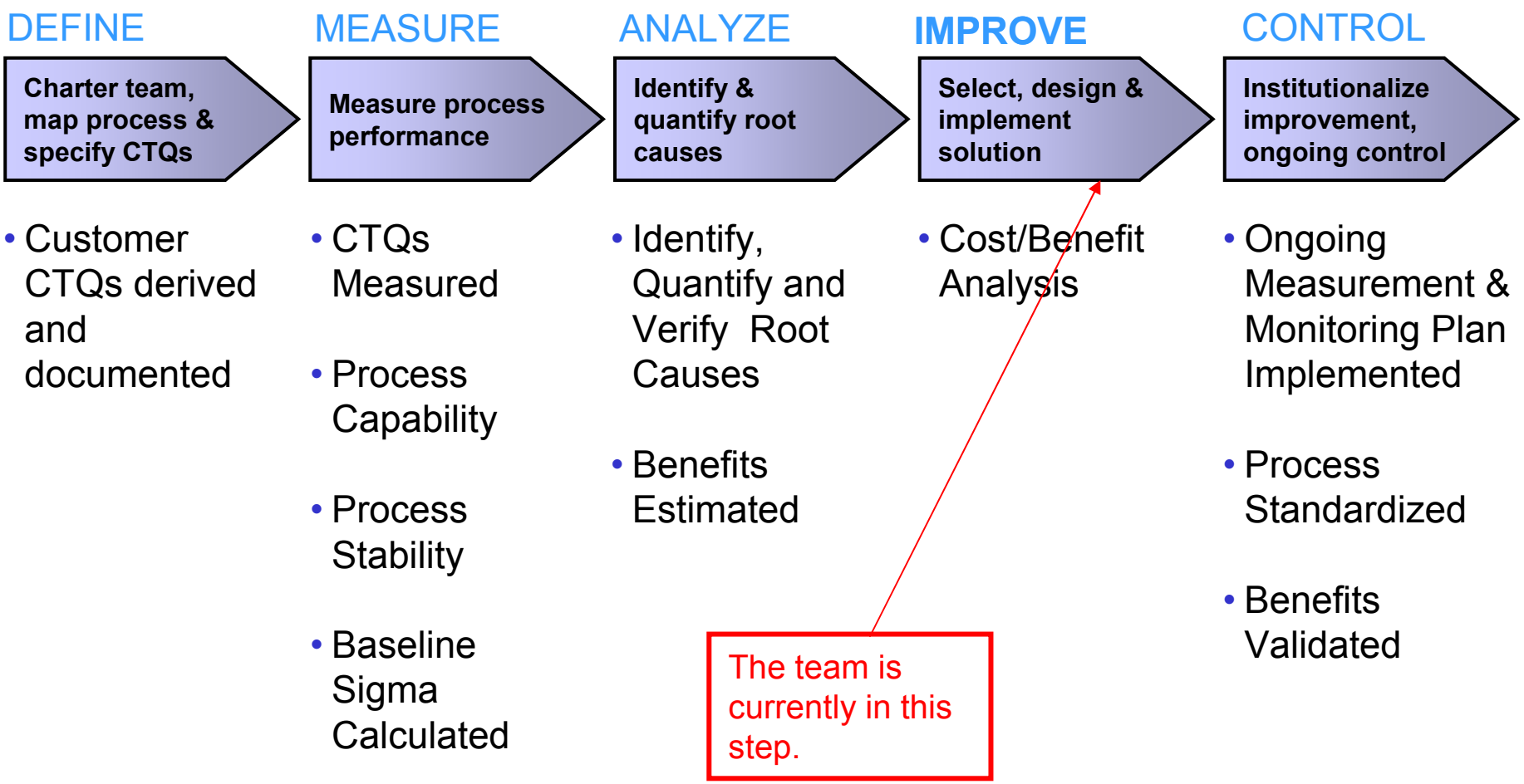
CMMI Process Area	EVMS Guideline from EIA-748-A, Earned Value Management Systems, Jan. 2002) [Earned Value Management Maturity Model® Goal]
Project Planning	2.1a Work Breakdown Structure (WBS) [L2, Organizational, Goal 1] 2.1b Organization structure [L2, Organizational, Goal 2] 2.2a Schedule of authorized work [L3, Planning, Goal 1] 2.2b Progress indicators [L3, Planning, Goal 2] 2.2c,d Control account budget baseline [L2, Planning, Goals 1; L3, Planning, Goal 3] 2.2e Work packages [L2, Planning, Goal 2]
Project Monitoring and Control	2.4a,b Schedule/cost variance analysis [L2, Analysis, Goal 1] 2.4c Indirect cost variance [Level 3, Analysis, Goal 3] 2.4d Element summary [Level 3, Analysis, Goal 4] 2.4e Managerial actions [Level 2, Analysis, Goal 3] 2.4f Estimate at completion [Level 3, Analysis, Goal 5]
Integrated Project Management	2.1c Integration of plan, schedule, budget [L3, Organizational, Goal 1] 2.1e Integrate WBS and org structure [L3, Organizational, Goal 3] 2.2a Identification of task dependencies [L3, Planning, Goal 1] 2.2d Budgets for authorized work [L3, Planning, Goal 3] 2.4 a-f (see Project Monitoring and Control) 2.5a Incorporation of changes into budget and schedule [L2, Revisions, Goal 1] 2.5e Changes to performance measurement baseline [L2, Revisions, Goal 4]
Measurement and Analysis	2.2b Progress indicators [L3, Planning, Goal 2]

[1]Solomon, Paul, Software Engineering Institute, *Using CMMI to Improve Earned Value Management*, CMU/SEI-2002-TN-016, October 2002; He also states that support relationships between CMMI and EVMS occur in the following process areas: Requirements Management, Process and Product Quality Assurance, Requirements Development, and Risk Management.

CMMI/EVMS Project Summary

- **Goal is to substantially reduce the cycle time for start up projects to reach CMMI Level 3 and implement an EVMS**
  - 6 months for CMMI Level 3 as measured by an independent internal appraisal conduct by EPG
  - 3 months for implementation of an EVMS as measured by an internal independent audit conducted by the EVMS group
- **Expected benefits**
  - Cost savings from reaping benefits of CMMI and EVMS earlier in the project life cycle
  - Reduction in rework in setting up EVMS
  - Increased award fees resulting from better management

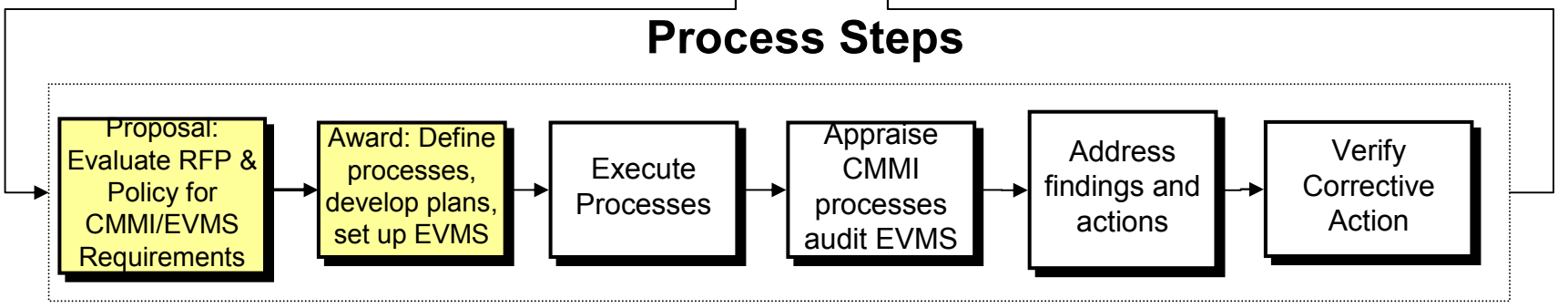
Process Improvement — DMAIC



Map Process/SIPOC

Suppliers	Inputs	Process	Outputs	Customers
Buyer	RFP, Contract	**Executing Program Start-up for CMMI and EVMS Processes**	Successful Integrated Baseline Review/ CMMI Appraisal	Project, Business & Senior Mgt.
Organization	Policies, Processes, Training		Cost Performance Reports	Program Control
Control Account Managers /Process Owners	Plans, project's defined process			
Engineering Process Group (EPG)	CMMI Appraisal Findings & Action Items			
Program Control	EVMS Findings & Discrepancy Reports			

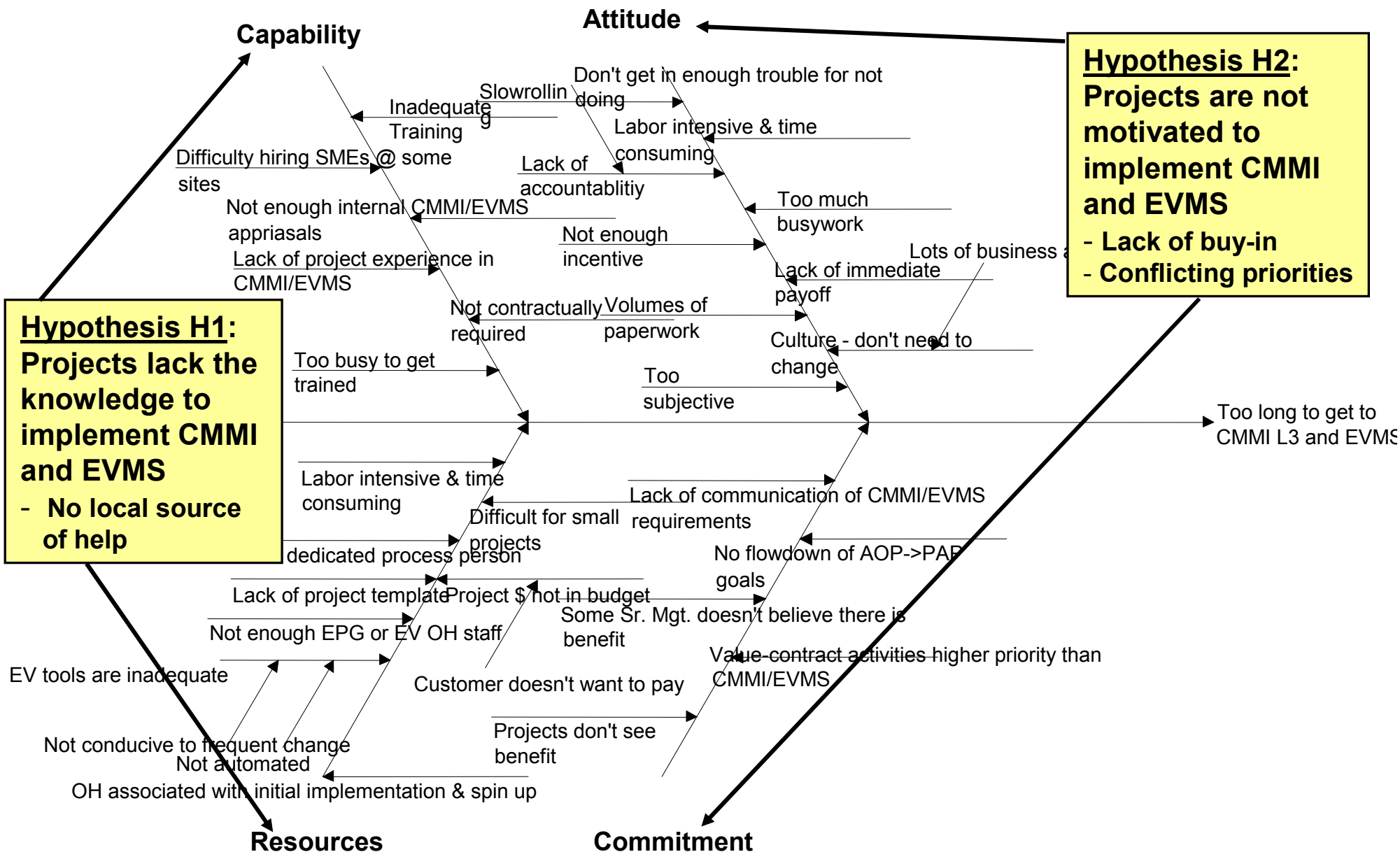
Process Steps



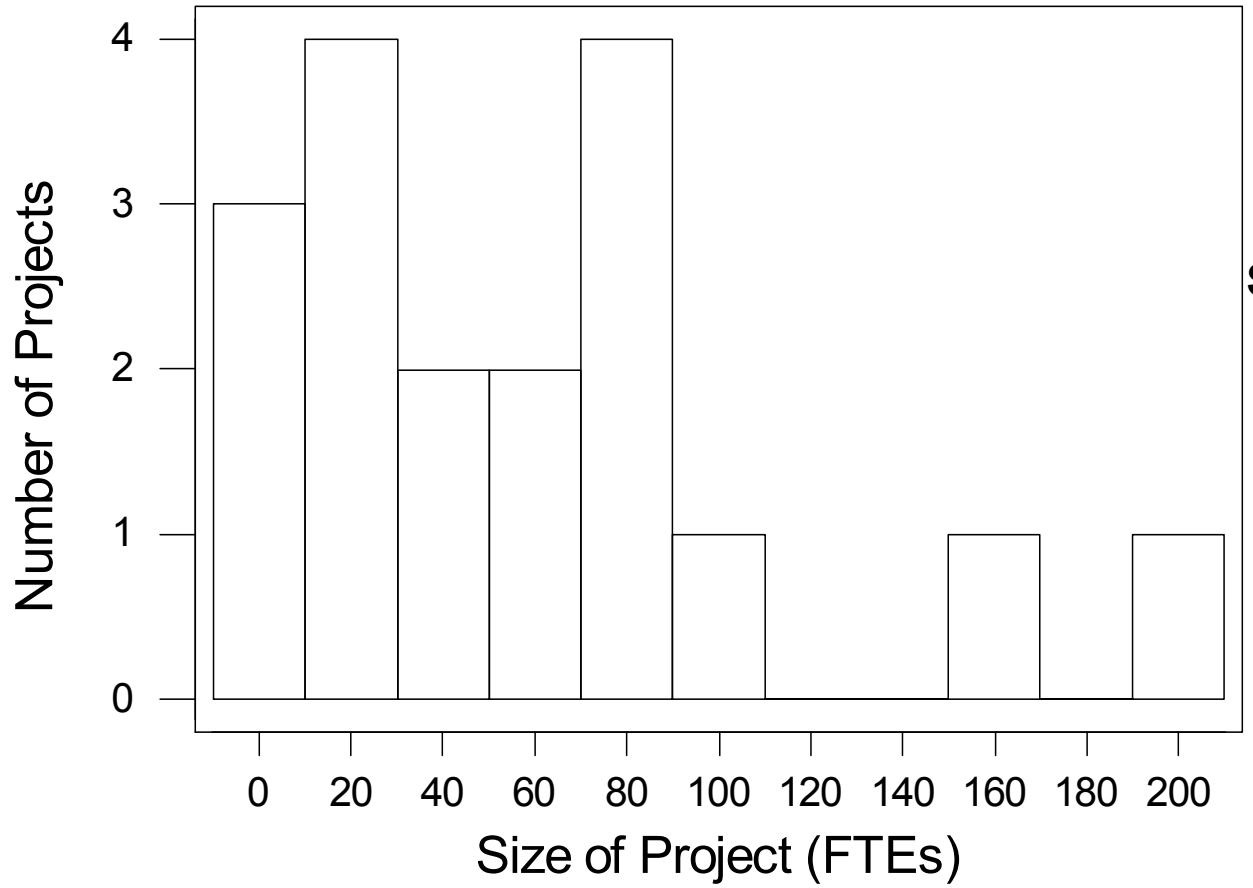
Voice of the Customer – Survey Findings

- **Issues with both CMMI and EVMS**
  - Value received vs. cost to implement
  - Degree of project-level CMMI/EVMS knowledge
  - Affordability, particularly for small projects
  - Degree of management buy-in
- **Issues with CMMI**
  - Lack of a simple roll-out procedure
  - Consistency between appraisers
  - Need for additional templates
  - Marginal value of some practices
- **Issues with EVMS**
  - Lack of integrated tools
  - High degree of paperwork
  - Inflexibility in making changes
  - Difficulty with complex contract structures

Cause and Effect Analysis

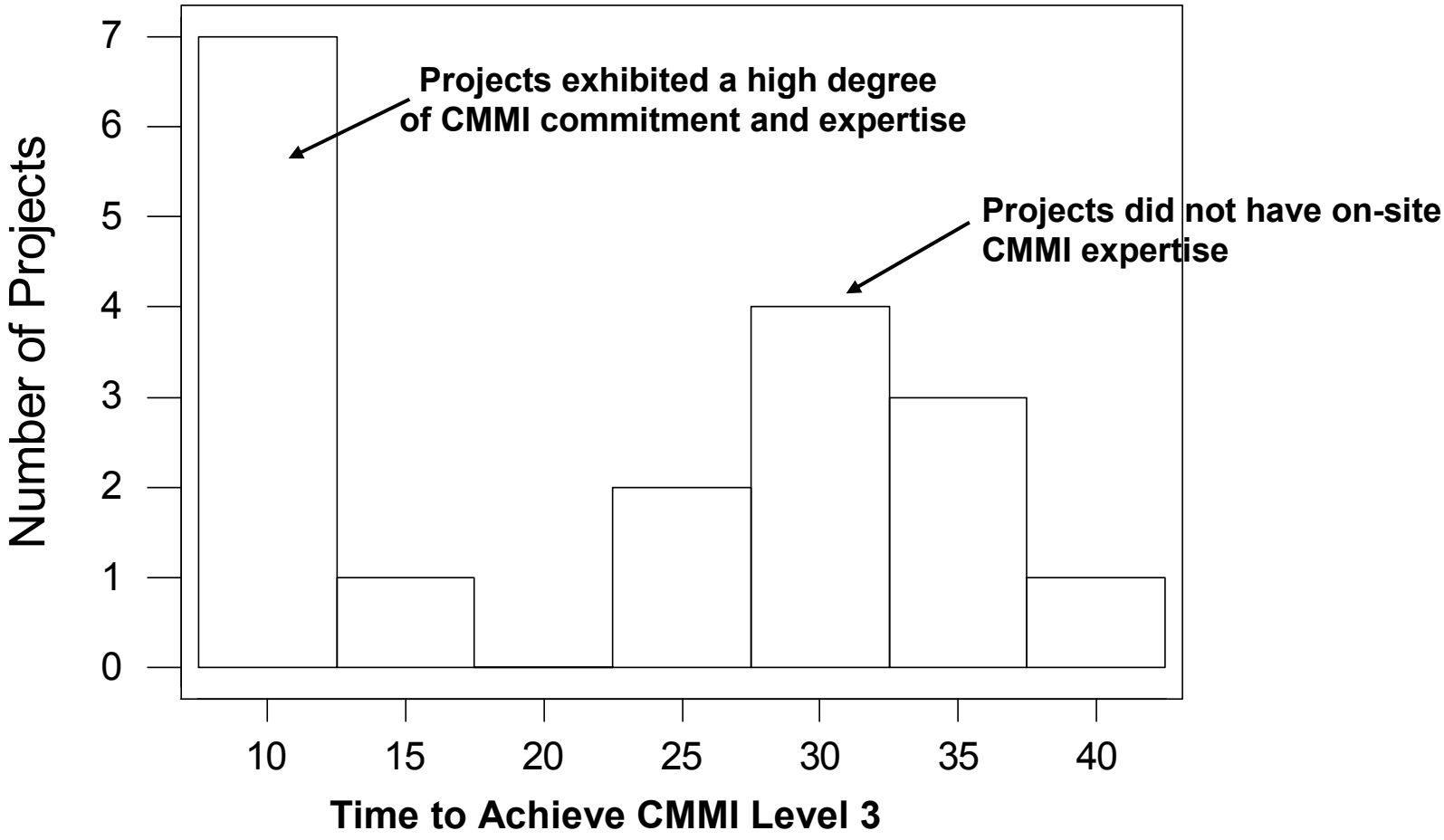


Distribution of Size – Measured Projects

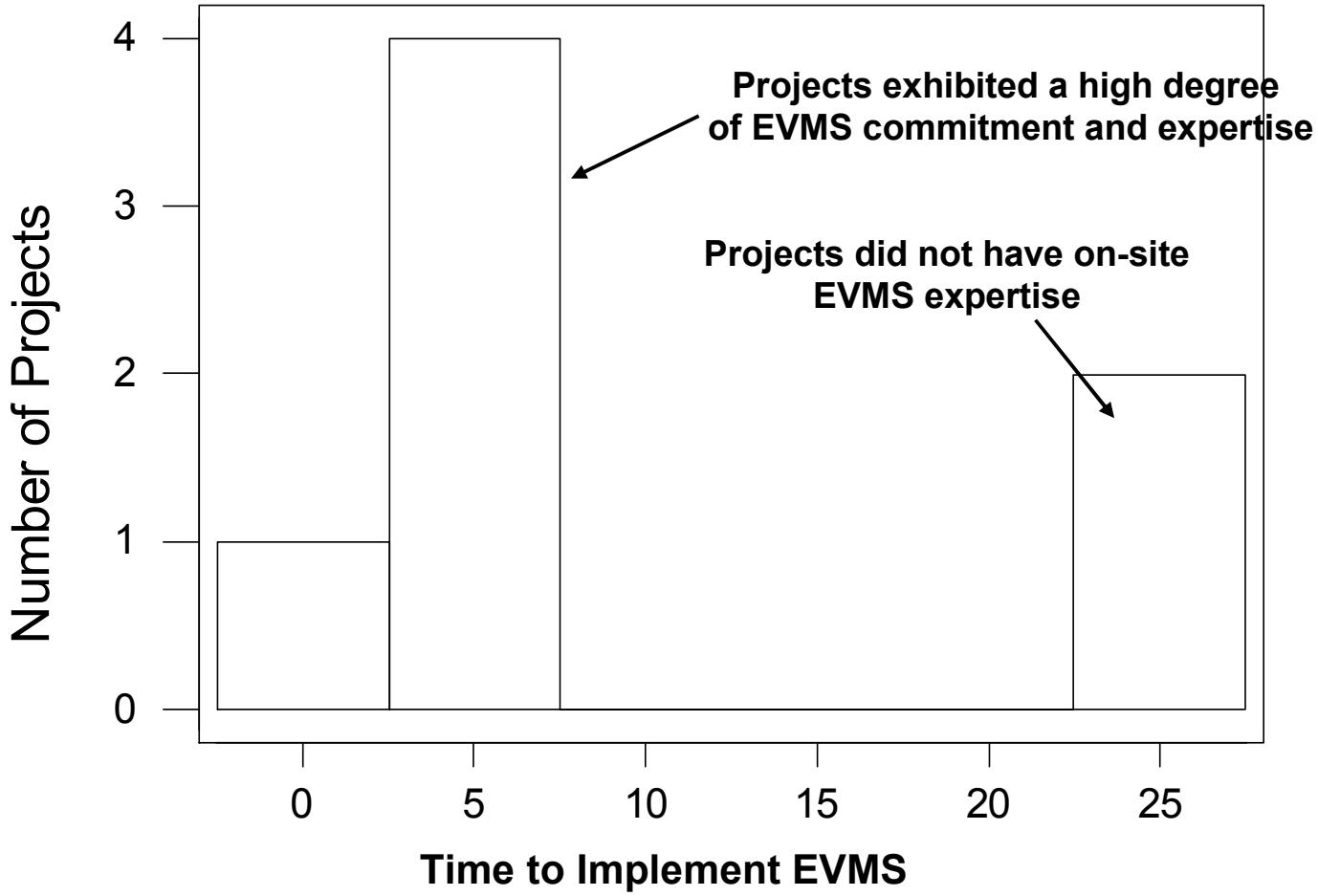


Small, medium, and large projects were measured

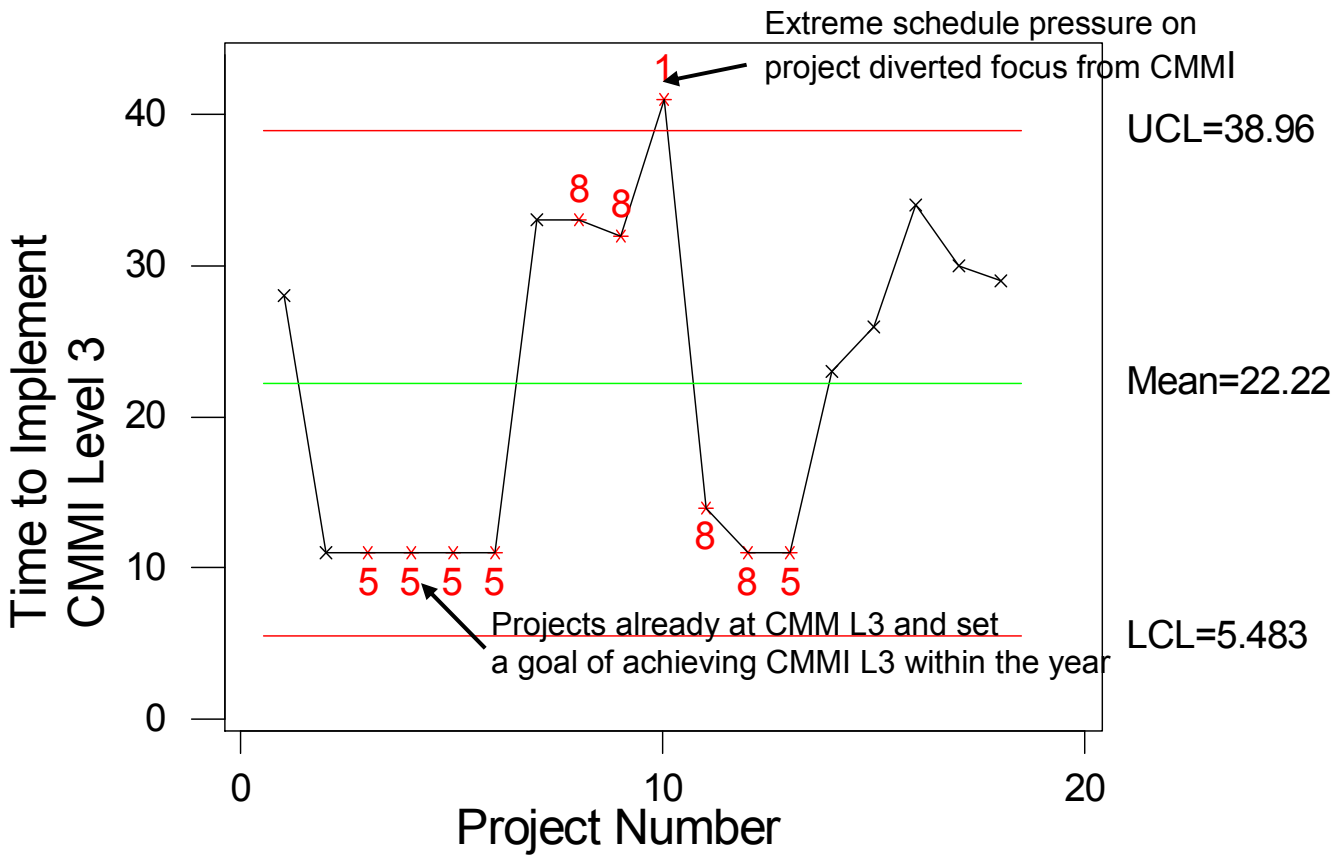
Distribution of Time to Achieve CMMI L3



Distribution of Time to Implement EVMS



CMMI Process Stability



TEST 1. One point more than 3.00 sigmas from center line.
TEST 5. 2 out of 3 points more than 2 sigmas from center line
TEST 8. 8 points in a row more than 1 sigma from center line

Root Cause Verification

- **Performed correlation analysis of 18 DMS CMMI projects and 7 DMS EVMS projects**
- **Results showed that projects implement both CMMI and EVMS more quickly when**
  - Expert help or other projects that have successfully implemented CMMI/EVMS is available at the project site (confirms H1)
  - Projects give CMMI/EVMS a high priority (confirms H2)
- **Projects implement CMMI L3 more quickly when**
  - Project is already at CMM L3 (Confirms H1)
  - Project sets a management goal to achieve achieve CMMI L3 by a given date (Confirms H2)
- **Projects implement EMVS more quickly when**
  - Project designates a single person responsible for implementing EVMS (Confirms H2)
  - Project size is smaller

Improvements Under Consideration

- **Develop a proactive integrated startup CMMI/EVMS startup process and schedule**
  - Contrasted with a project being reactive to appraisal/audit findings
- **Harmonize engineering (CMMI) and EVMS processes**
  - Ensure that processes are mutually aware and complementary
  - Eliminate conflicts and redundancies
- **Provide training for above processes**
  - Include benefits/ROI analysis of CMMI/EVMS to increase buy-in
- **Recommend that CMMI/EVMS experts be located at key development/integration sites**

Conclusions

- **Even if the organization has established CMMI/EVMS credentials and significant resources available, getting these capabilities to all sites will be a challenge**
- **CMMI and EVMS have enough in common to warrant a common startup approach**
- **The key barriers to successful implementation are lack of knowledge and lack of motivation**
  - Documented startup processes and training are ways to overcome these barriers