High Maturity Heresy! Doing Level 5 Before Level 4 Without Data?

Thomas Lienhard
17 November 2010
Where Do We Get Our High Maturity Knowledge?

The CMMI
- Upfront material
- Infamous page 80

Training Courses
- CMMI Overview
- Understanding CMMI High Maturity Practices
- Six Sigma

Conferences

Experiences

Appraisals
- Leads
- Mini Team partners

Others
- Consultants
- "Experts"
Where Do We Get Our High Maturity Knowledge?

The Emperor's New Clothes
[My] Evolution of High Maturity Understanding

Evolution of a High Maturity practitioner

- SW CMM
- Six Sigma Black Belt
- SW CMMI
- CMMI
- Understand High Maturity Practices
- Understand Business Objectives

peer reviews, analysis of variation, peer review defect density, control charts, identify what REALLY matters, predict performance
Nirvana at Level 5?

- Achieved SW CMM Level 5 in 2001
- Did not see the “promised” 8:1 ROI
- What went wrong?

- Is it about finding an iterative process to collect data so SPC can be applied?
- Is it about hanging a sticker on the wall?
- Is it about appeasing the SEI to avoid an audit?
- Or is it about meeting your primary business objectives?
  - Needed to understand our business and business objectives
  - Needed to understand which processes had the greatest impact on business objectives

When you think you have it right, talk with those responsible for cost and schedule
Understanding What’s Critical to Our Business

Production is where opportunity abounds.

Figure 1. Typical Product Development Cycle
Changing Our Approach

How to move from a Business that...

Understands Product Requirements → Designs A Product → Determines Suppliers → Decides Where To Build → Evaluate For Affordability → Redesigns

To a Business that

Understands The Use Of The Product → Makes Requirements Capability Trades Around Affordability → Determines A Build Strategy → Identifies Where To Buy From → Designs To Maximize This Strategy
High Maturity Timeline

1950–1970s

1980s–Present

Pre-Concept → Planning → Development → Manufacturing → Field

RMS

Product

Process

Org Objectives

Balance performance with producibility and affordability

Statistical techniques

SPC

HW → SW/SE

Models

Fielded System
Would you ever implement QPM before you have a contract?

Balance performance with producibility and affordability
How can you be confident something can be built, if it has never been “invented”? Balance performance with producibility and affordability.
Brain Shift

SW          SE          HW
SW          SE          HW
SW          SE          HW
SWSEHW
SyDe
SystDeve
System Development
Remember, What is Critical to the Business

- Production over Development
  - Production is where cost and time are either minimized or super-inflated
  - The organization is willing to invest more in development in order to streamline production

- Production
  - Software
    - Hit control C
    - Rarely impacts development decisions
  - Hardware
    - Extremely complex
    - Very much impacts development decisions

- Primary focus is HW/SE/SW (System Development)
- The life cycle includes:
  - pre-concept
  - development
  - manufacturing
  - fielding

Leveraging our capabilities to be innovative, fast, and effective
# Profound Shift in Focus

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Profound Shift in Focus

11/18/2010

Raytheon
Missile Systems
Profound Shift in Focus

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High Maturity “Epiphany”

SW/SE

Plan  Req  Design  Imp  Test

Finding “defects” earlier saves $
High Maturity “Epiphany”

Finding “defects” earlier saves $. 

Predicting

Plan  Req  Design  Imp  Test

Pre-Concept  Manufacturing  Field

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Breaking the Paradigm – Level 5
Before 4 Without “Data”

Start with business goals and drivers

Establish objectives for entire lifecycle (pre-concept through delivery)

Take a product centric, multi-discipline approach

Predict success prior to design

Results Driven - Product Centric – Full Life Cycle – Multifunctional Approach
EXAMPLE
Business Objective – Increase Margin Profit

- Cost of Poor Quality is Too High
  - Cost and schedule need to be reduced
  - Rework, scrap and support costs need to be reduced

Improving production yields greatly reduces costs, schedule, rework, and scrap
Case Study

- Multiple projects using a common seeker have an Average Unit Production Cost (AUPC) objective
- Sensitivity analysis showed which subprocess was the significant cost driver
- EOSPA predictive cost model was created to characterize the process performance based on organizational historical baseline data
- Prediction showed the current process was incapable of achieving the AUPC objective
- Causal analysis was done
- Process was characterized:
  - Process steps
  - Touch points/hours
  - Parts
  - Effort
- Improvements were identified and implemented
  - Eliminated non-value added process steps
  - Reduced number of touch points and touch hours
  - Reduced cycle time and touch labor
  - Eliminated parts
  - Substituted processes with new processes which had reduced touch points/hours
Predictive Analysis

- Probability of Noncompliance (PNC): Probability of exceeding either lower or upper specification limits
- Distribution fitted PNC = 30%
- Predicted estimated cost of scrap: $XXM Annually

Predictive Analysis Revealed:
- Out of Control conditions will occur
- Out of Spec conditions will occur
- Mean was too close to lower limit – need to center the distribution
- Variance was too large – identify / reduce sources of variation

Low yields predicted as a result of poor process capability
180 out of 600 units would be scrapped
Results

- Resulted in 59% fewer process steps
- 45% fewer parts
- 44% less time
- 78% improved throughput
- Predicted yields increased to over 90%
- Predicted rework reduced by over 50%
- Predicted scrap reduced by over 40%
- Initial inspection costs reduced by over 50%
- Warranty costs expected to be reduced by over 25%

Tech support? My predictive analysis is giving the wrong answer again – can you please fix it?
Summary

To meet business objectives, engineering must be more predictable

- Need to characterize process and product performance prior to implementation
- Need to establish and track design metrics that relate to business objectives (production yield and cost)
- MUST balance affordability and producibility as well as technical performance

Design for cost and producibility has become part of our DNA
Questions

Contact:
Thomas_G_Lienhard@Raytheon.com