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United States Military Academy
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Are Lean and Six-Sigma the Only Tools Needed to Ensure Military Transformation?

MORS Symposium
United States Naval Academy
Annapolis, Maryland
11-14 June 2007

MAJ Ernest Wong
Department of Systems Engineering
United States Military Academy
Agenda

• Introduction
• Tools that Focus on **Doing Things Right**
  – Lean Thinking
  – Just-In-Time Planning
  – Six Sigma
• Tools that Focus on **Doing the Right Things**
  – Engineering Design Process Thinking
  – Just-In-Case Planning
  – Simulation
• A Yin-Yang Approach to Better
• Conclusions
Tools that Focus on Doing Things Right
Lean Six Sigma in the U.S. Army

Goal is to develop a more efficient and effective fighting force.
Lean / Just-in-Time Planning

Lean Techniques And Principles
- Workplace organization
- 5S
- Standardized work
- Value-stream mapping
- Team-based, multi-skilled workforce
- Kaizen events (one week)
- Jidoka (Error proofing)
- Poke Yoke (Mistake proofing)
- Just-in-time
- Cellular/Flow manufacturing
- One piece flow (takt time)
- Set-up time reduction (SMED)
- Pull system (kanbans)
- Production smoothing
- Balanced work flow
- Inventory Reduction
- Visual Management
- Waste identification & elimination (7 Wastes)
- Toyota Production System
- Total Productive Maintenance (TPM)

http://www.bmg.com/methodologies/methodologies_lean.aspx
# Six-Sigma

## M - Measure Phase: Measure the process to determine current performance; quantify the problem.
- Define Defect, Opportunity, Unit and Metrics
- Detailed Process Map of Appropriate Areas
- Develop Data Collection Plan
- Collect the Data
- Begin Developing Y=f(x) Relationship
- Determine Process Capability and Sigma Baseline

## A - Analyze Phase: Analyze and determine the root cause(s) of the defects.
- Define Performance Objectives
- Identify Value/Non-Value Added Process Steps
- Identify Sources of Variation
- Determine Root Cause(s)
- Determine Vital Few x's, Y=f(x) Relationship

## I - Improve Phase: Improve the process by eliminating defects.
- Perform Design of Experiments
- Develop Potential Solutions
- Define Operating Tolerances of Potential System
- Assess Failure Modes of Potential Solutions
- Validate Potential Improvement by Pilot Studies
- Correct/Re-Evaluate Potential Solution

## C - Control Phase: Control future process performance.
- Define and Validate Monitoring and Control System
- Develop Standards and Procedures
- Implement Statistical Process Control
- Determine Process Capability
- Develop Transfer Plan, Handoff to Process Owner
- Verify Benefits, Cost Savings/Avoidance, Profit Growth
- Close Project, Finalize Documentation
- Communicate to Business, Celebrate

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**Areas Under the Normal Curve**

- 68.26%
- 95.44%
- 99.73%

**Mean ± 6 Sigma**

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**Control Chart**
- Process Sigma Calculation
- Control Charts (Variable and Attribute)
- Cost Savings Calculations
- Control Plan

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**Histogram**
- Pareto Analysis
- Scatter Plot
- 5 Whys
- Statistical Analysis

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**Data Collection Plan/Example**
- Benchmarking
- Measurement System Analysis
- Voice of the Customer Gathering

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**Voice of the Customer Gathering**
- Process Sigma Calculation
- Process Map Review and Analysis
- Hypothesis Testing

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**Project Charter**
- Process Flowchart
- SIPOC Diagram
- Stakeholder Analysis
- DMAIC Work Breakdown Structure
- CTQ Definitions
- Voice of the Customer Gathering

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**http://www.isixsigma.com/library/content/c020617a.asp**

Courtesy of Larry Aft, Institute of Industrial Engineers
Lean Six-Sigma Approach

Key Inputs to Maximize LSS/DFLSS Business Impact

- Executive Ownership/Leadership Alignment
- Effective Support Infrastructure In-Place
- Integration w/Existing Bus. Improvement Initiatives
- Selecting the Right (Full-Time) People and Projects
- Integrated Training, Materials and Software
- Financial and Implementation Accountability
- Reward & Recognition
- Enterprise-Wide Knowledge Sharing
- Customer and Supply Chain Involvement
- Change Management and Cultural Strengths

Lean Six Sigma (LSS) and Design for Lean Six Sigma (DFLSS) Implementation

Better
Faster
Lower Cost

Lean Six Sigma and Design for Lean Six Sigma Realization

Customer Value
Intellectual Capital
Top Line Growth
Bottom Line Growth
Cultural Change

Value Stream Mapping
Project Plan
Change Readiness

Level Loading
Reduce Setups
Create Flow
Linking Suppliers
TPM

Create Flow
Eliminate Variation

Six Sigma Approach

Control
Define
Improve
Measure
Analyze

http://www.isixsigma.com/library/content/c030721a.asp
http://www.airacad.com/LeanSixSigmaImplementations.aspx
Lean Six-Sigma in the US Army

Lean Six Sigma Achievements
Culture of Innovation

Letterkenny Army Depot
- Reduced cost by $11.9 million
- Freed up 50,000 square feet of floor space

United States Army Security Assistance Command
- Foreign Military Sales
  - Avoided $3.2 million in administrative costs for FY 2005

Red River Army Depot
- Heavy Expanded-Mobility Tactical Trucks (HEMTTs)
  - Increased output 260% (from 5 to 18 vehicles/month)
  - Decreased cycle time 75% (from 120 to 30 days)

Armament Research, Development and Engineering Center
- M915 Projectiles
  - Reduced cost of munitions by 50%
  - Generated $1.2 billion future cost savings

Corpus Christi Army Depot
- T700 Engines
  - Increased mean time between overhauls 383% (from 300 to 1450 hours)
  - Reduced overhaul cycle time 69% (from 261 to 81 days)

Army Field Support Command Korea
- Prepositioned Stock
  - Reduced cycle time 71% for M1 tanks (from 105 to 30 days)

Tobyhanna Army Depot
- AN/TPS-75 Radar
  - Reduced repair cycle time 42% (from 12 to 7 months)

Source: U.S. Army Materiel Command

From Association of the U.S. Army, 2006
Tools that Focus on Doing the Right Things
“[Whereas] Just-in-Time is based on a more horizontal hierarchy, which consists of strong cooperation and interaction between works, and workers’ initiative, teamwork, and multi-functionality, Just-in-Case is more appropriate for a rigid, vertical hierarchical structure, requiring workers to specialize, thus, leading, possibility, to antagonism between workers and management.”


Simulation


--Chinese Proverb

Simulation Applications

- Designing and analyzing manufacturing systems
- Evaluating military weapon systems & their logistics requirements
- Determining hardware requirements or protocols for communication networks
- Determining hardware and software requirements for a computer system
- Designing and operating transportation systems
- Evaluating designs for service organizations
- Reengineering of business processes
- Determining ordering policies for an inventory system
- Analyzing financial or economic systems

Doing Things Right
&
Doing the Right Things
A Yin-Yang Approach to Better

• Yin (black) and Yang (white) energies co-exist in equilibrium
  – Not completely black and white
  – Opposing forces but also complementary ones

• Contrived to explain annual cycles and seasons (seminal “OR”)
  – Annual calendar determined at 365.25 days
  – Calendar divided into 24 segmented cycles
  – Moon represents Yin; Sun represents Yang

• Extensions of Yin Yang
  – Fitness: Diet and Exercise
  – Finance: Stocks and Bonds
  – Education: Sciences and Humanities
  – Design: Form and Function
  – Military: “Transform to win the war today, [as well as] prepare for future challenges.” –Harvey, Preston, & Schoomaker, 2006 Soldiers Almanac
Doing the Right Things & Doing them Right

Real-time communications at highly effective and efficient organizations

Semi-structures

Adaptive culture

Too much structure and processes

Loose structure

Follow all the rules

Break all the rules

Narrowly channeled communication

Lots of random communication

Bureaucratic Trap
Practices become overriding concern at expense of doing what is best for the organization.

Chaos Trap
No tools at all with which to leverage and generate organizational improvements.

Doing the Right Things & Doing them Right

Extraordinary Organizations that Balance Process Improvements with Long-Term Vision

Speeding the change

Critical mass of people

Too little novelty

Repeated layering

Constricted Configuration

Modularity

Blend old and new

Too much novelty

No critical mass of people

Chasm between old and new

Overconnect Trap
Practices become overriding concern at cost of innovation, creativity, and leadership.

Disconnect Trap
The lure of the latest and greatest leaves most of the organization behind.

“Extraordinary companies keep their eyes on the long term. [These] companies have an abundance mentality. They know that if they share, if they invest in growth, if they support one another, not only will there be enough pie to go around now, the pie will just get bigger.”

--Rhonda Abrams. 1999. Wear Clean Underwear: Business Advice from Mom

“The way to avoid mistakes is to gain experience. The way to gain experience is to make mistakes.”


“Constantly question—even the good stuff. There's no better way to improve. . . Expect change—and plan for it. Rather than seeing it as a potential threat or problem, welcome it as an opportunity. There's no risk in preserving the status quo, but there's no profit either.”

--Michael Dell. 1999. Direct from DELL

“Any enterprise is built by wise planning, becomes strong through common sense, and profits wonderfully by keeping abreast of the facts.”

--Proverbs 24: 3-4. The Living Bible
The DOD Business Transformation Approach

Set Priorities
- Identify / Revise Business Enterprise Priorities and Component priorities to provide:
  - Support for joint warfighting capability
  - Better information for strategic resourcing decisions
  - Reduced cost of business operations
  - Improved stewardship to the American people
- Identify business capabilities needed to achieve required outcomes

Assign Accountability to Provide Capabilities
- Determine functional scope and organizational span
- Analyze alternatives and identify options to provide necessary business capabilities
- Select Program to provide solution or identify gaps and alternatives to close gaps

Define and Fund Programs
- Engineer the solution
- Develop required acquisition documentation
- Review / certify that programs align with priority objectives and capabilities
- Align resources with PPBE

Build / Refine Required Architecture and Transition Plan
- Develop and refine architecture
  - Build / refine architecture products required to support identified Business Capabilities; define requirements, rules, and standards
  - Provide context for program interrelationships
  - Identify gaps in solutions (revisit Assign Accountability to Provide Capabilities)
- Develop and refine Transition Plans
  - Develop strategies
  - Identify schedule and milestones, resource needs, and performance metrics
  - Assess actual cost, schedule and performance
  - Integrate Enterprise and Component plans

Execute
- Manage execution
- Transform via program implementation
  - Test and Evaluation
  - Deployment
  - Track Cost / Schedule / Performance
- Assess using DoD Process Checkpoints:
  - IRB / DBSNC reviews
  - JCIDS
  - PPBE
  - DoD 5000 milestones

Conclusions

While some tools help us focus on *doing things right*.

Other tools help us focus on *doing the right things*.

The key is to select, leverage, and integrate the *right tools* for the *right problems*.

Tools such as Lean, Just-In-Time Planning, and Six-Sigma can become even more powerful tools for driving organizational efficiency and effectiveness when utilized in conjunction with other tools such as Engineering Design Processes, Just-In-Case Planning, and Simulation.
“Thus it is said that one who knows the enemy and knows himself will not be endangered in a hundred engagements. One who does not know the enemy but knows himself will sometimes be victorious, sometimes meet with defeat. One who knows neither the enemy nor himself will invariably be defeated in every engagement.”

--Sun Tzu

Questions?

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