




# Lean Enablers for Managing Engineering Programs

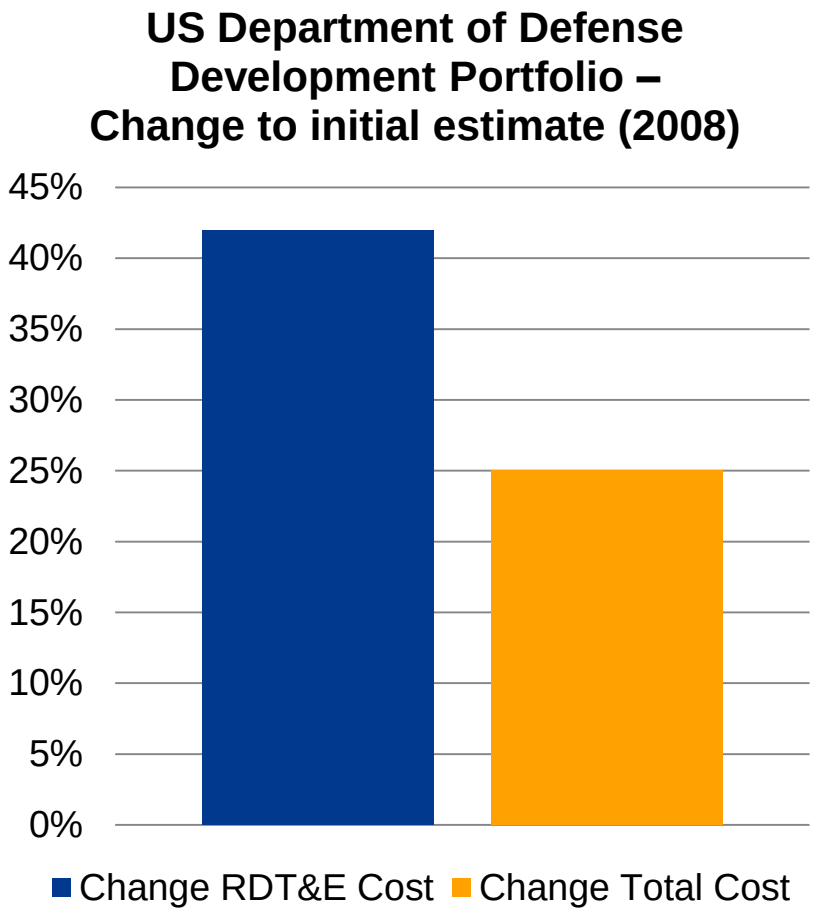
**Presentation at the NDIA Program Management Systems Committee**
**August 15 2012**

**Josef Oehmen**

# Agenda

- Introduction and Overview to the “Guide to Lean Enablers for Managing Engineering Programs”
- Example Best Practices
- Does It Work?
- Road Ahead

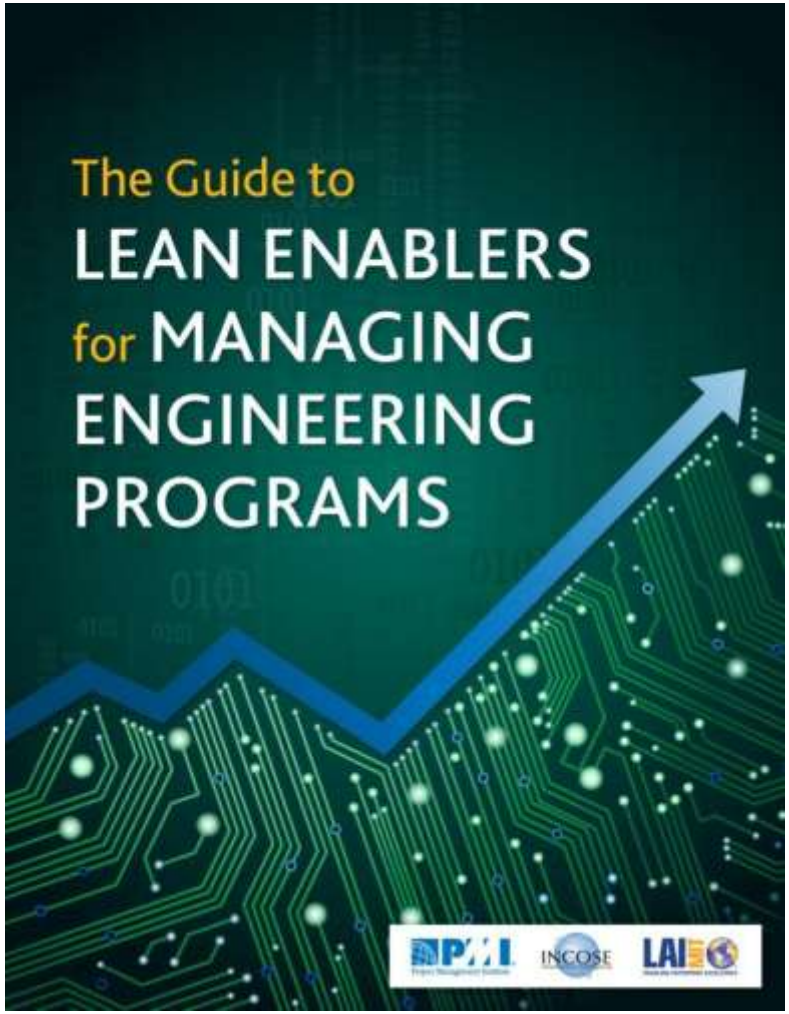
# Management of Large-Scale Engineering Programs: The US Department of Defense Example




- Total cost growth (until 2010): **$296 billion**
- Average schedule overrun: **22 months**
- Cost overrun 2011 alone due to program management challenges (RDT&E, production): **$45 billion**
- Similar situation in other industries

Sources: GAO 06-368, Bloomberg, GAO 10-374T, GAO-12-400SP

# Improvement opportunity: Better integrate Systems Engineering and Program Management through Lean Thinking




- Based on 15-month research project
- Identified 10 core engineering program challenges
- Describes 43 best practices in 6 areas
- Download e-book & sign up for mailing list at www.lean-program-management.org

# From 0 to …
## 180+ current members representing 50+ organizations


INCOSE
International Council on Systems Engineering

PMI
Project Management Institute

SAP

U·S AIRWAYS

CDC
Centers for Disease Control and Prevention

Pratt & Whitney
A United Technologies Company

LOCKHEED MARTIN

parc
Palo Alto Research Center

BOEING

Battelle

BAE SYSTEMS
Raytheon

Rockwell Collins

SIEMENS

PRICEWATERHOUSECOOPERS

THE AEROSPACE CORPORATION

ULA
United Launch Alliance

Booz | Allen | Hamilton

NORTHROP GRUMMAN

syncroness
innovative product development

Google

CORNING

Abbott
A Promise for Life

VOLVO

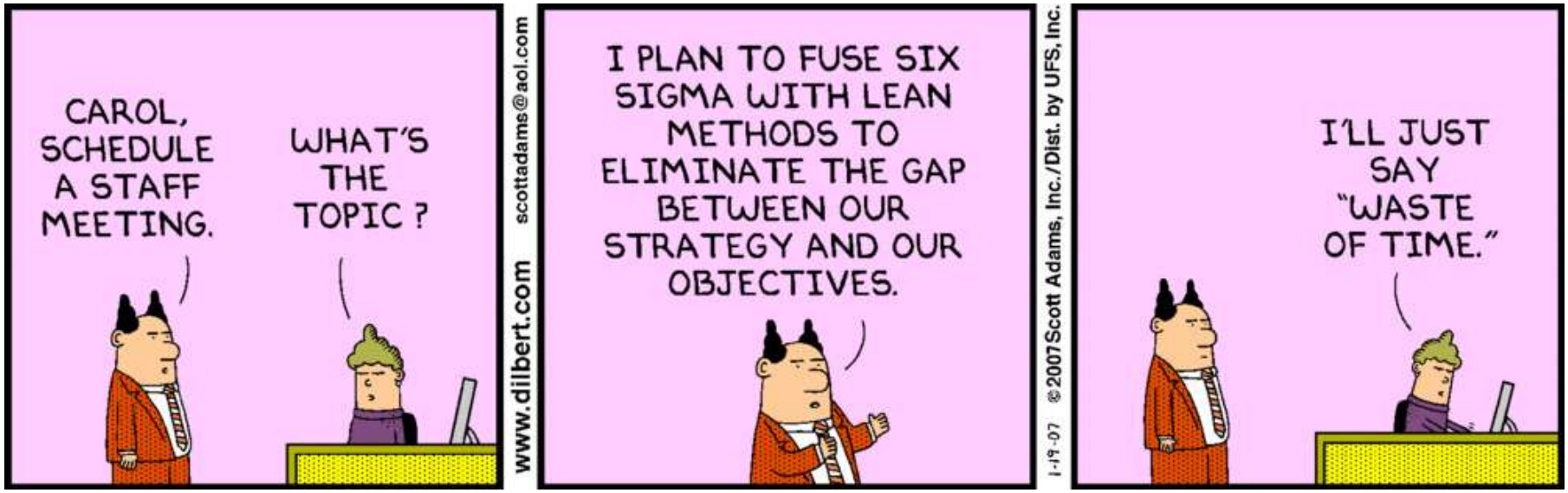
LMU|LA
Loyola Marymount University

Massachusetts Institute of Technology

# Identified core challenges: What is a serious engineering program challenge in your organization? Hands up!

1. Reactive Program Execution
2. Lack of stability, clarity and completeness of requirements
3. Insufficient alignment and coordination of the extended enterprise
4. Value stream not optimized throughout the entire enterprise
5. Unclear roles, responsibilities and accountability
6. Insufficient team skills, unproductive behavior and culture
7. Insufficient Program Planning
8. Improper metrics, metric systems and KPIs
9. Lack of proactive management of program uncertainties and risks
10. Poor program acquisition and contracting practices

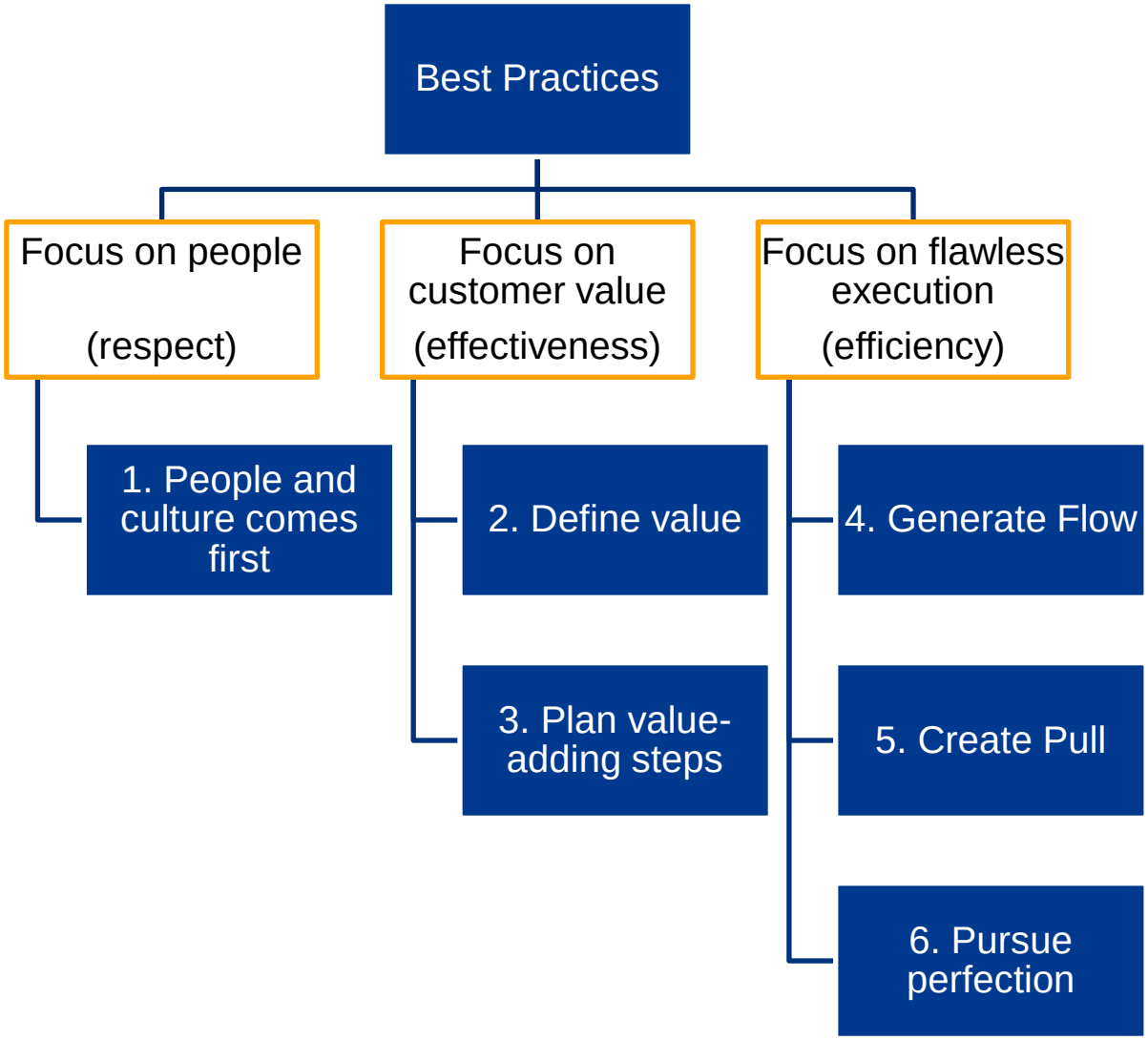
# Lean? Wait a minute…




Source: dilbert.com

- Hands up:
  - Experience with "Lean" in production
  - Experience with "Lean" outside of production
  - Positive contribution to organization through "Lean"
  - "Lean" was waste of time

# 6 areas of identified best practices

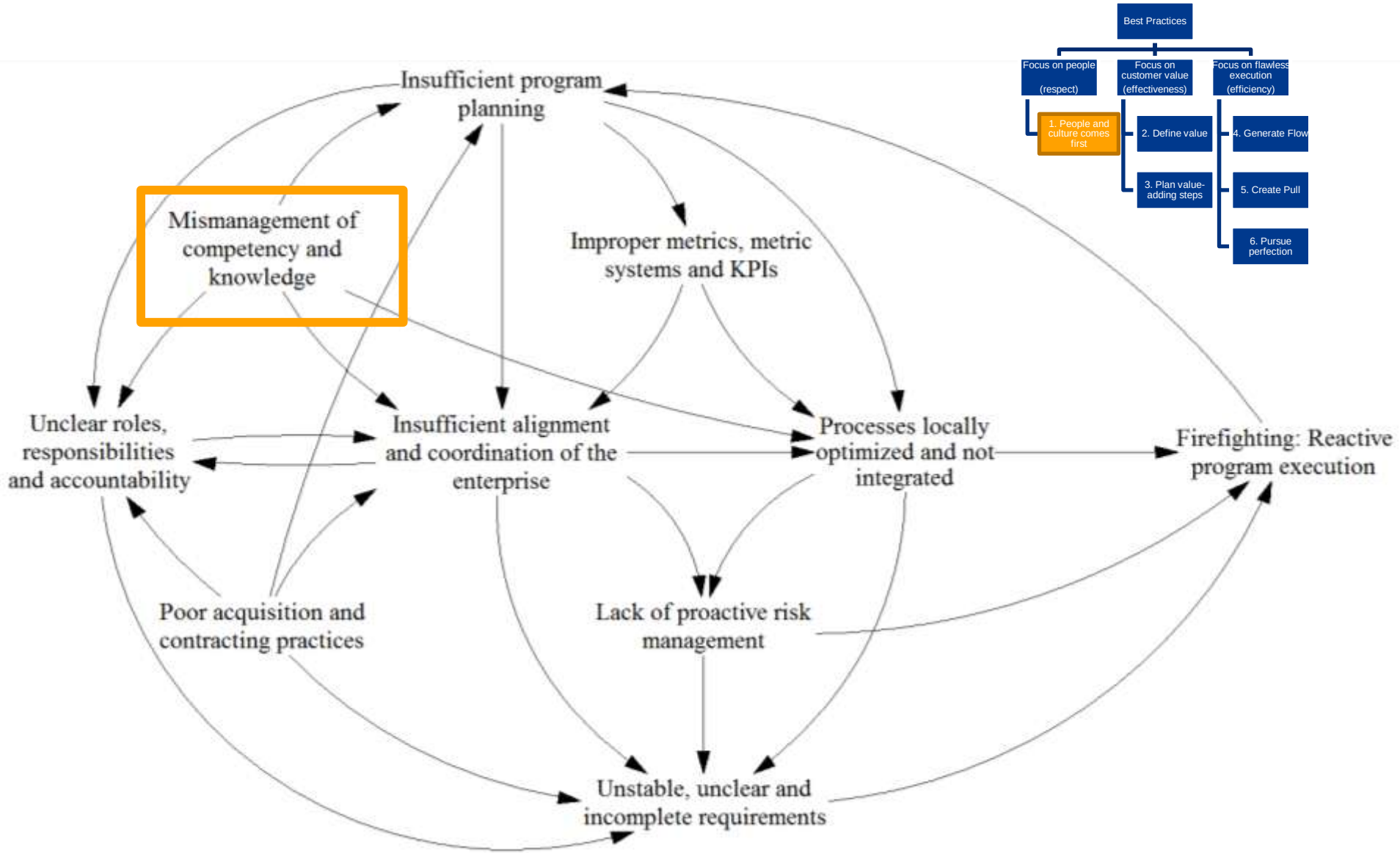


# Why did we chose Lean Thinking?

| Best Practice Area (Lean Principle) | Result |
|---|---|
| Base human relations on respect for people | Creates an energetic and positive environment by developing skills, behavior and culture |
| Define value to the program stakeholders | Builds the engineering program around benefits |
| Plan the value-adding stream of work activities during the product lifecycle, from the need to product delivery, until disposal, while eliminating waste | Focuses on cross-organizational and cross-functional integration |
| Organize the value stream as an uninterrupted flow of predictable and robust tasks, proceeding without rework or backflow | Establishes clear responsibilities, resilient interfaces, effective communication pathways |
| Organize the pull of the work-in-progress as needed and when needed by all receiving tasks | Simplifies information exchange |
| Make all imperfections visible and pursue perfection, i.e. the process of never ending improvement | Improves the engineering program (efficiency) and adapt to a changing environment (effectiveness) |

# EXAMPLES

# Example 1:
# Programs fail or succeed primarily based on people, not processes or tools



# What is the key to motivating knowledge workers?

- Money! Really?


Source: danpink.com

**Watch Dan Pink at**

http://www.youtube.com/watch?v=u6XAPnuFjJc
(or Google “Dan Pink RSA”)

# Example 1: Treat People as Your Most Important Asset (LE 1.x.x)

1.1.x Build a program culture based on respect for people

1.2.x Motivate by making the higher purpose of the program and program elements transparent

1.3.x Support an autonomous working style

1.4.x Expect and support people in their strive for professional excellence and promote their careers

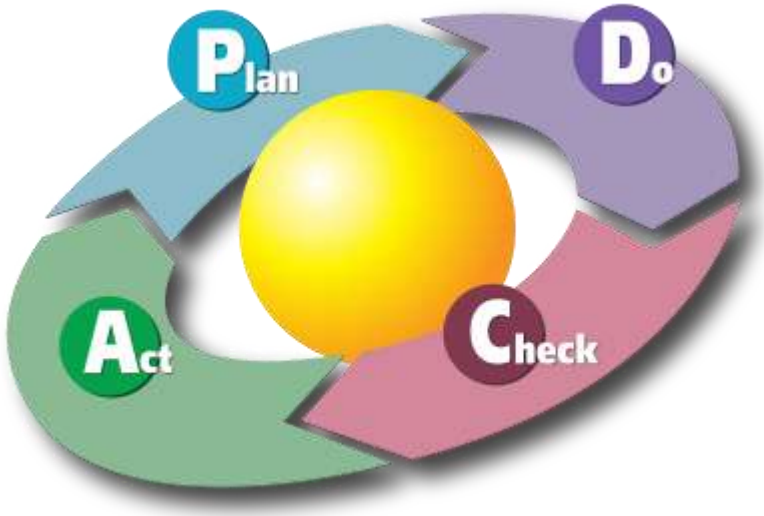

Source: danpink.com

1.5.x Promote the ability to rapidly learn and continuously improve

1.6.x Encourage personal networks and interactions

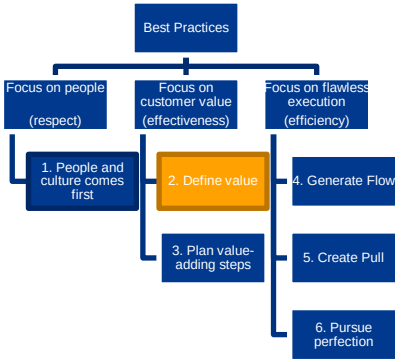
# Associated Lean Methods and Tools

- Mastery:
  - Create Specialist Career Path to develop towering (technical) competence
  - Communities of Practice (internal and external)
  - Mentoring
  - Hire for attitude, train for skill
- Autonomy:
  - Kaizen: Bottom-up continuous improvement processes
  - Responsibility-based planning and control
- Purpose:
  - Create a shared vision that draws out the best in people (e.g. through value stream mapping)




Source: Wikipedia

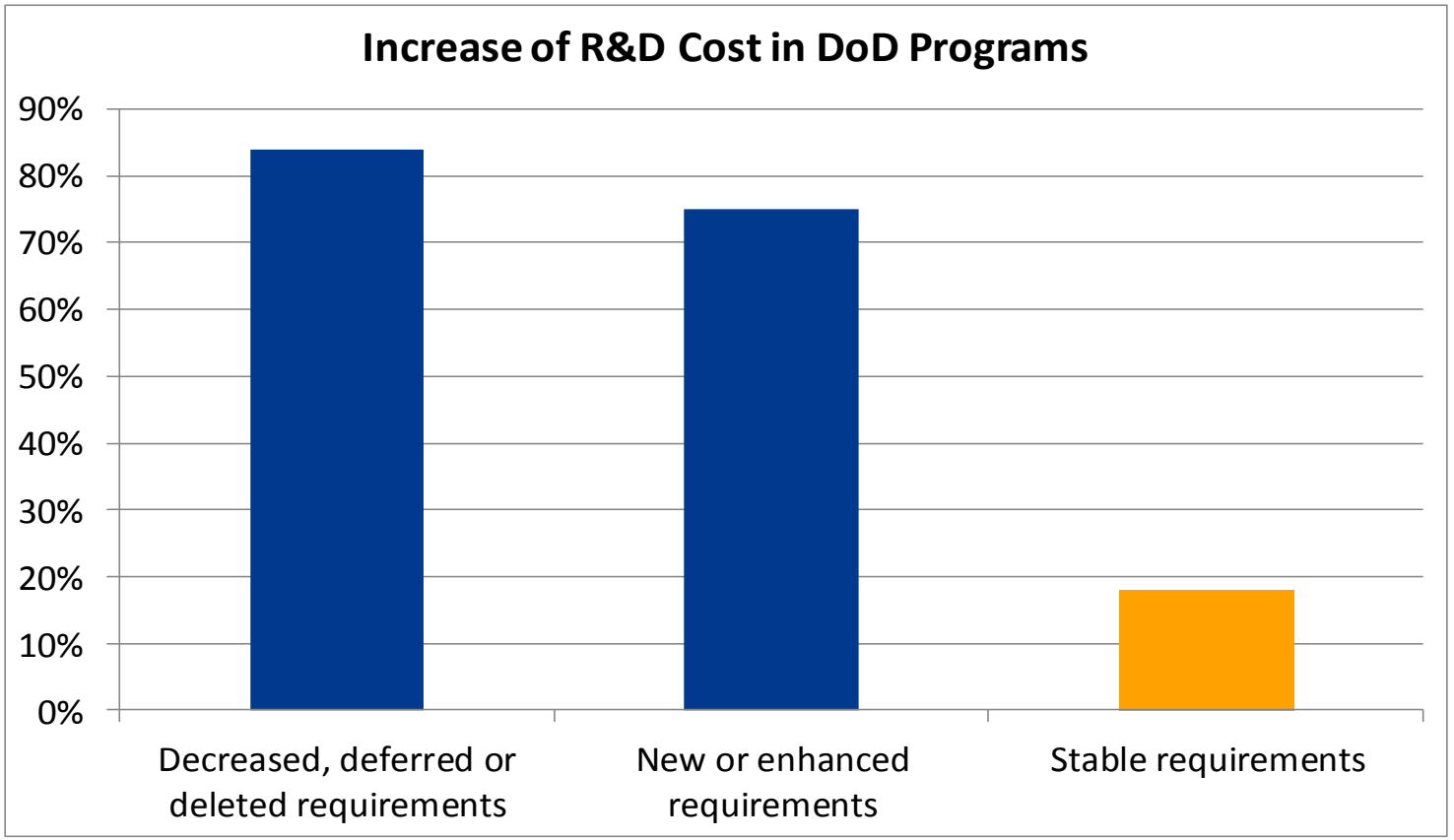
# Example 2: Understand and Define Program Value (LE 2.x.x)



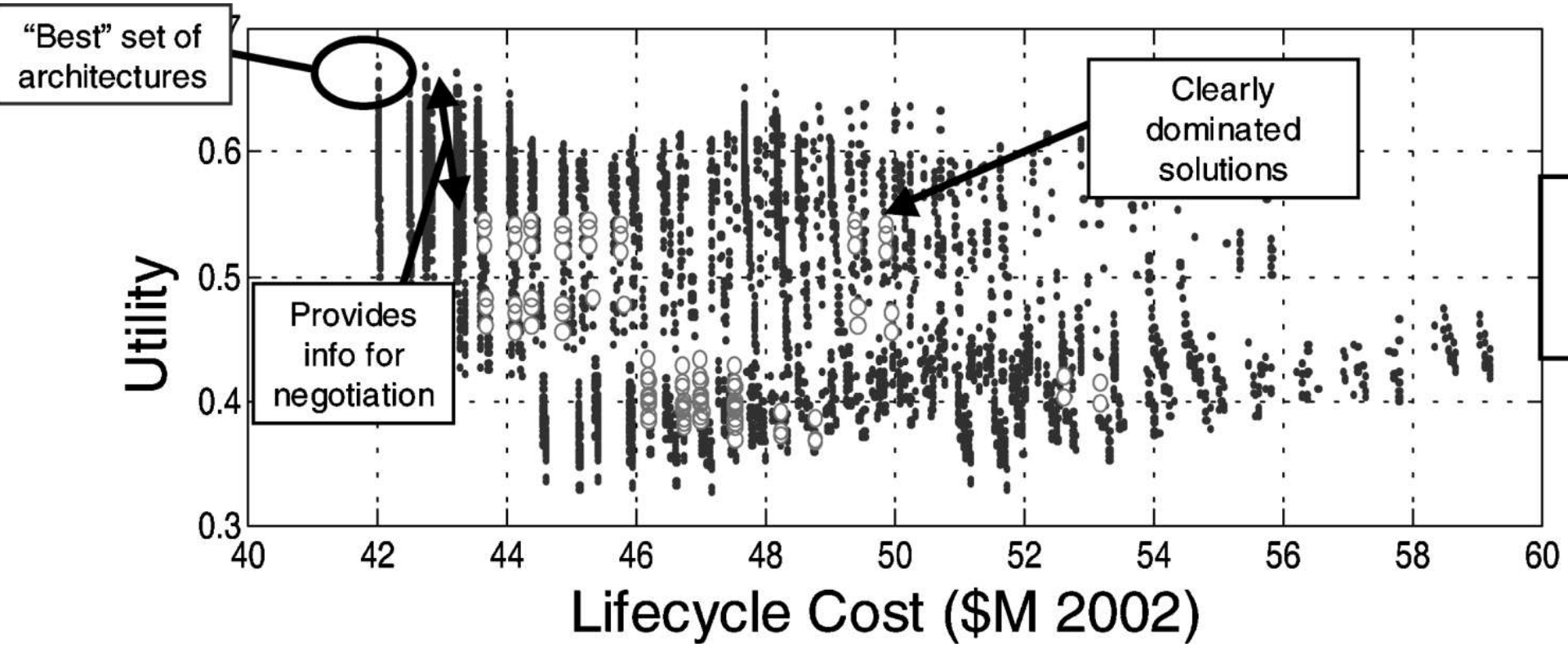

- Define value as the outcome of an activity that satisfies at least three conditions (LE 2.1.1):
  - External customer stakeholders are willing to pay for value.
  - Transforms information or material or reduces uncertainty.
  - Provides specified program benefits right the first time.
- Actively promote the maturation of stakeholder requirements, e.g., by providing detailed trade-off studies, feasibility studies, and virtual prototypes (LE 2.5.6)
- Fail early and fail often through rapid learning techniques (e.g., prototyping, tests, simulations, digital models, or spiral development). (LE 2.5.9)
- Up-front in the program, dedicate enough time and resources to understand what the key requirements and intended program benefits really are. (LE 3.5.2)

# Addresses lack of stability, clarity and completeness of requirements

- How bad are unstable requirements?

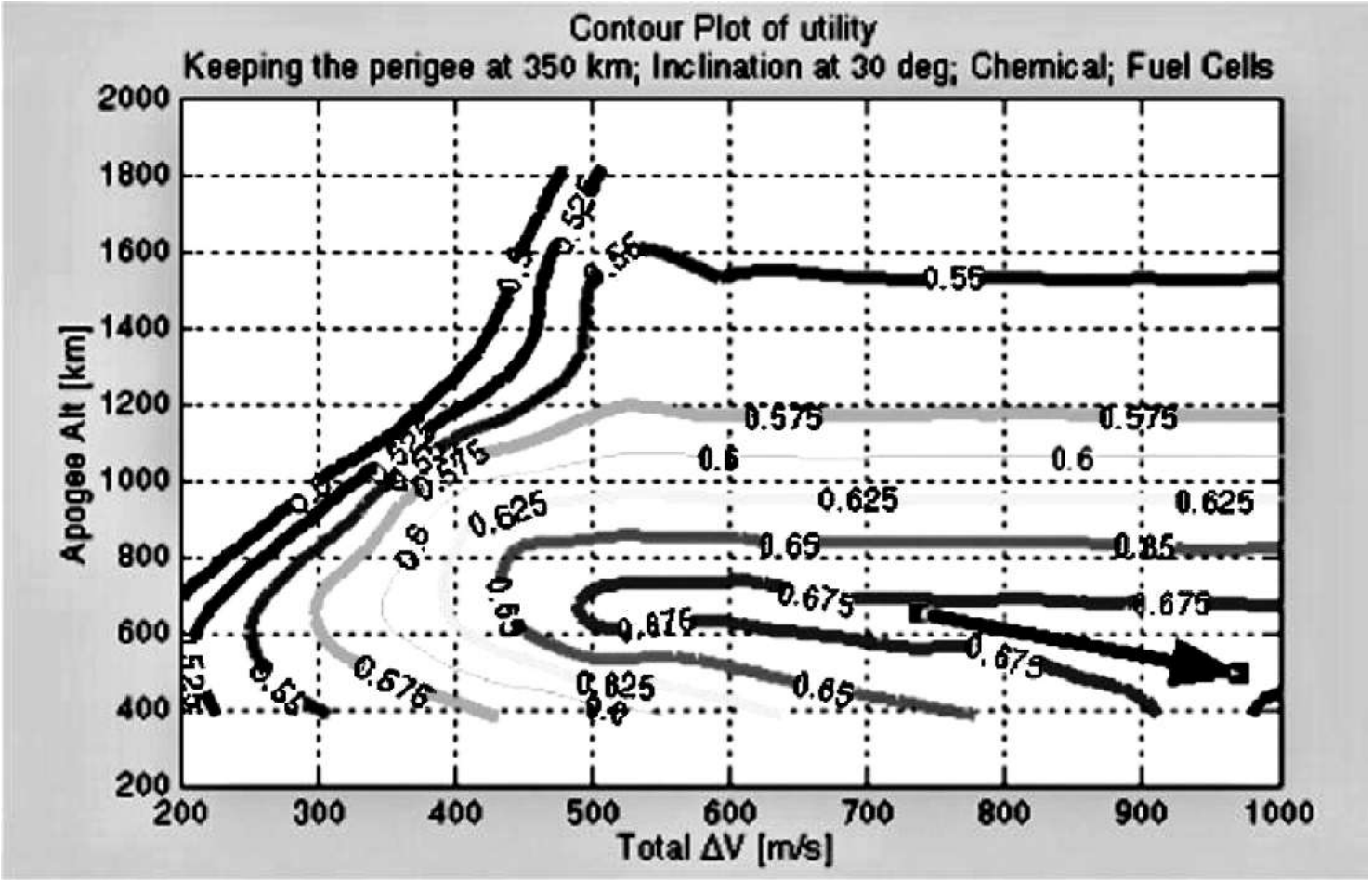


# Trade Space Exploration: Helping your customer figure out what they want



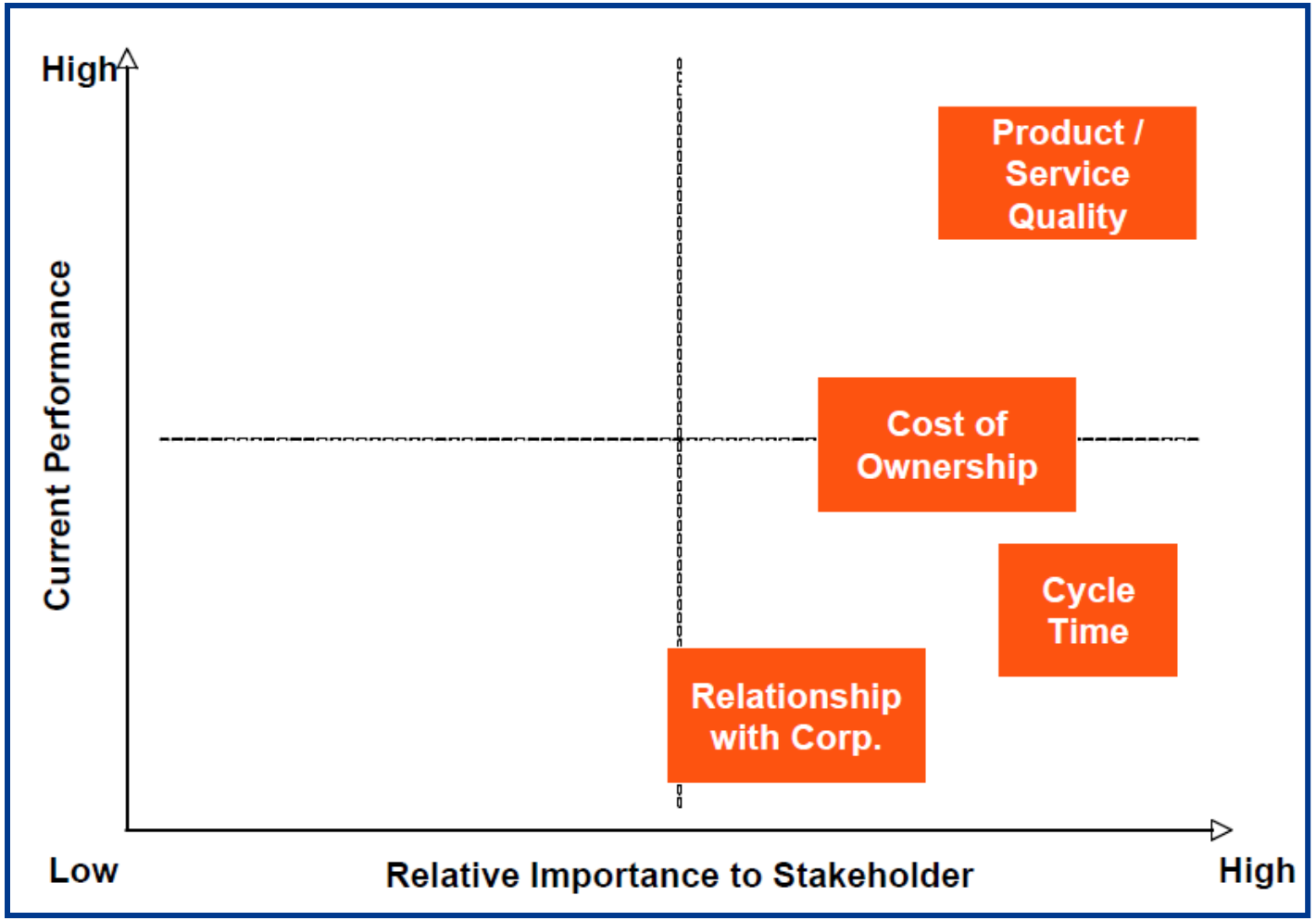

Source: Ross et al 2004

# Trade Space Exploration: Helping your customer figure out what they want




Source: Ross et al 2004

# Prioritizing value and benefits: Stakeholder Value Delivery Assessment

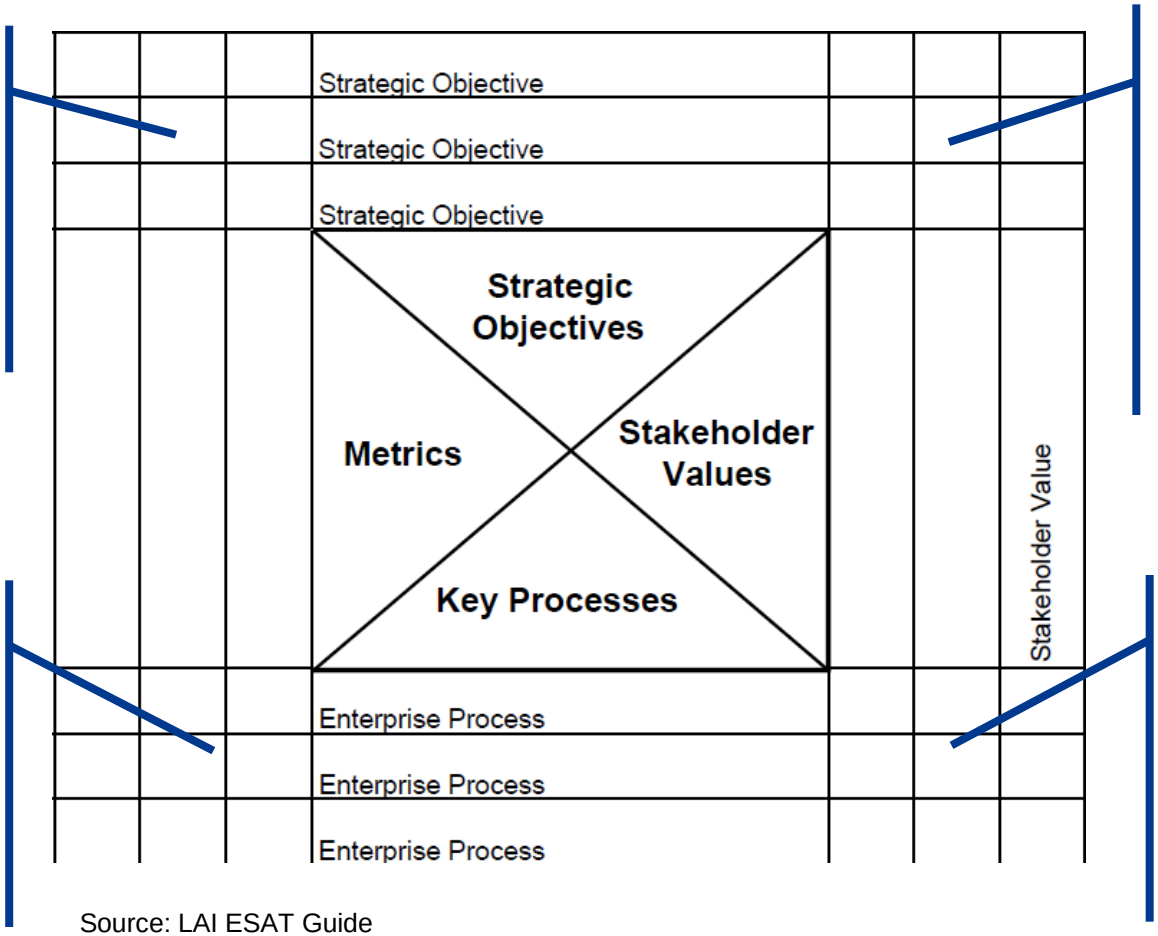



Source: LAI ESAT Guide

# Aligning Value and Program: X-Matrix

1. Is this strategic objective measured by this metric?

2. Does this metric measure performance of this process?

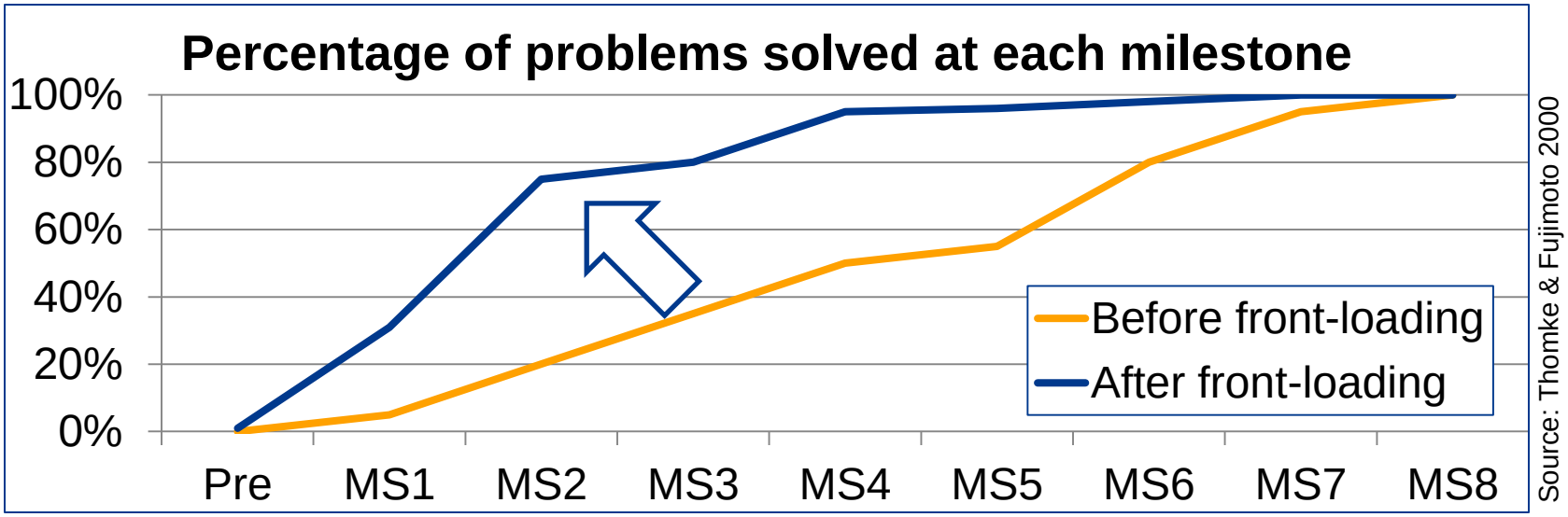



Source: LAI ESAT Guide

4: Is this stakeholder value represented by this strategic objective?

3. Does this process contribute to delivering this stakeholder value?

# Front-loading the engineering programs at Toyota: A 20 year journey

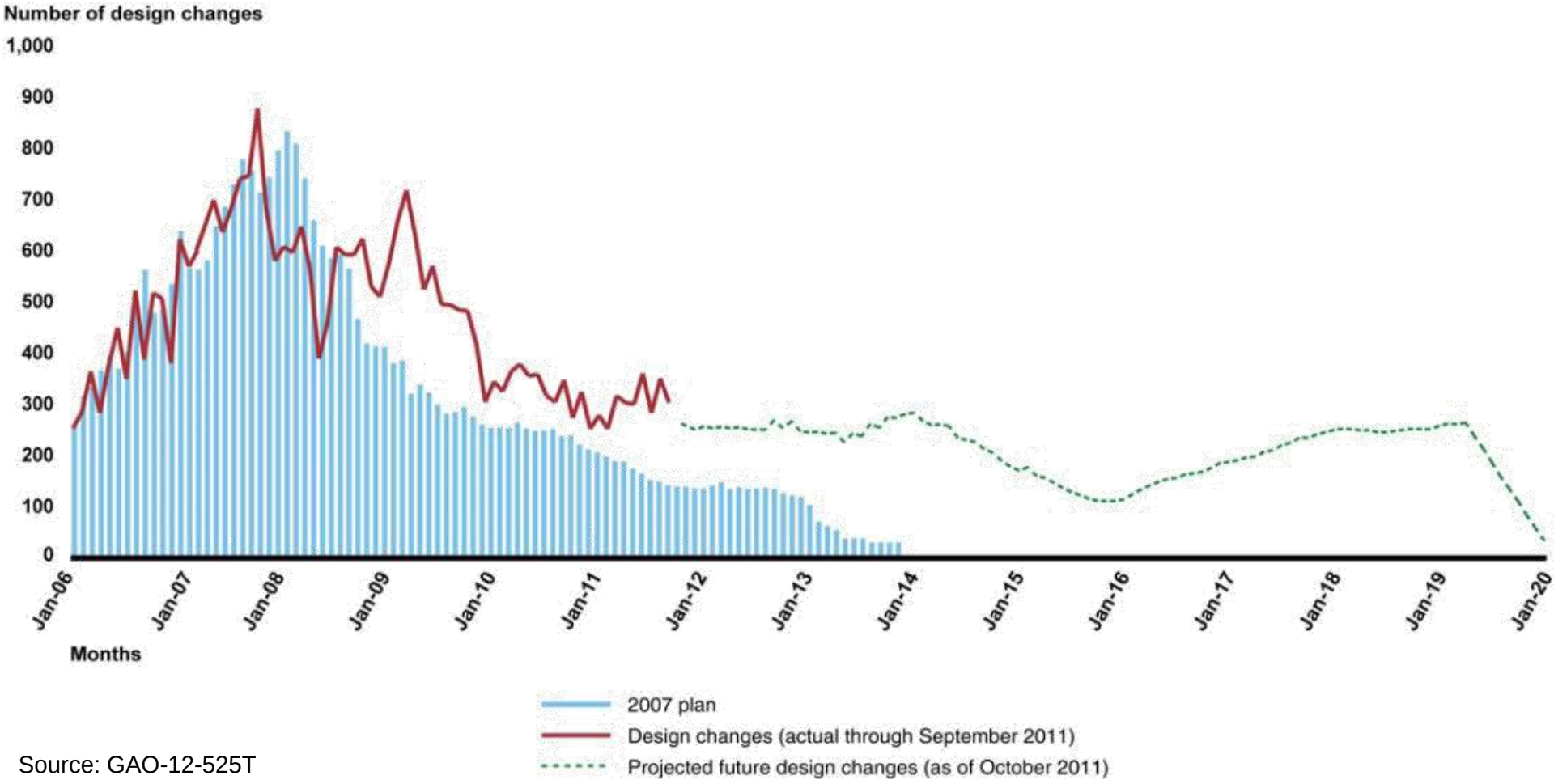



- Project-to-project knowledge transfer
- Rapid problem solving
  - Simulation
  - Computer-Aided Engineering
  - (cheap) Rapid Prototyping
  - Concurrent engineering
- Higher resource expenditure at front end

- **Stabilizes requirements**
- **Eliminated prototypes**
- **Avoided costly rework**
- **Reduced lead time**
- **Increased innovation**

# … vs JSF Design Changes

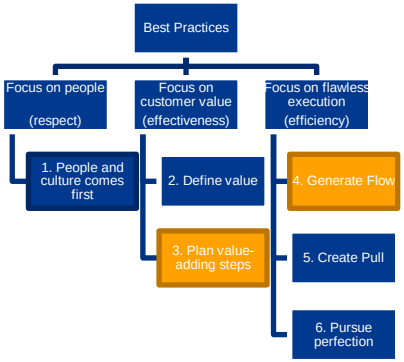
**Figure 4: JSF Design Changes Over Time**



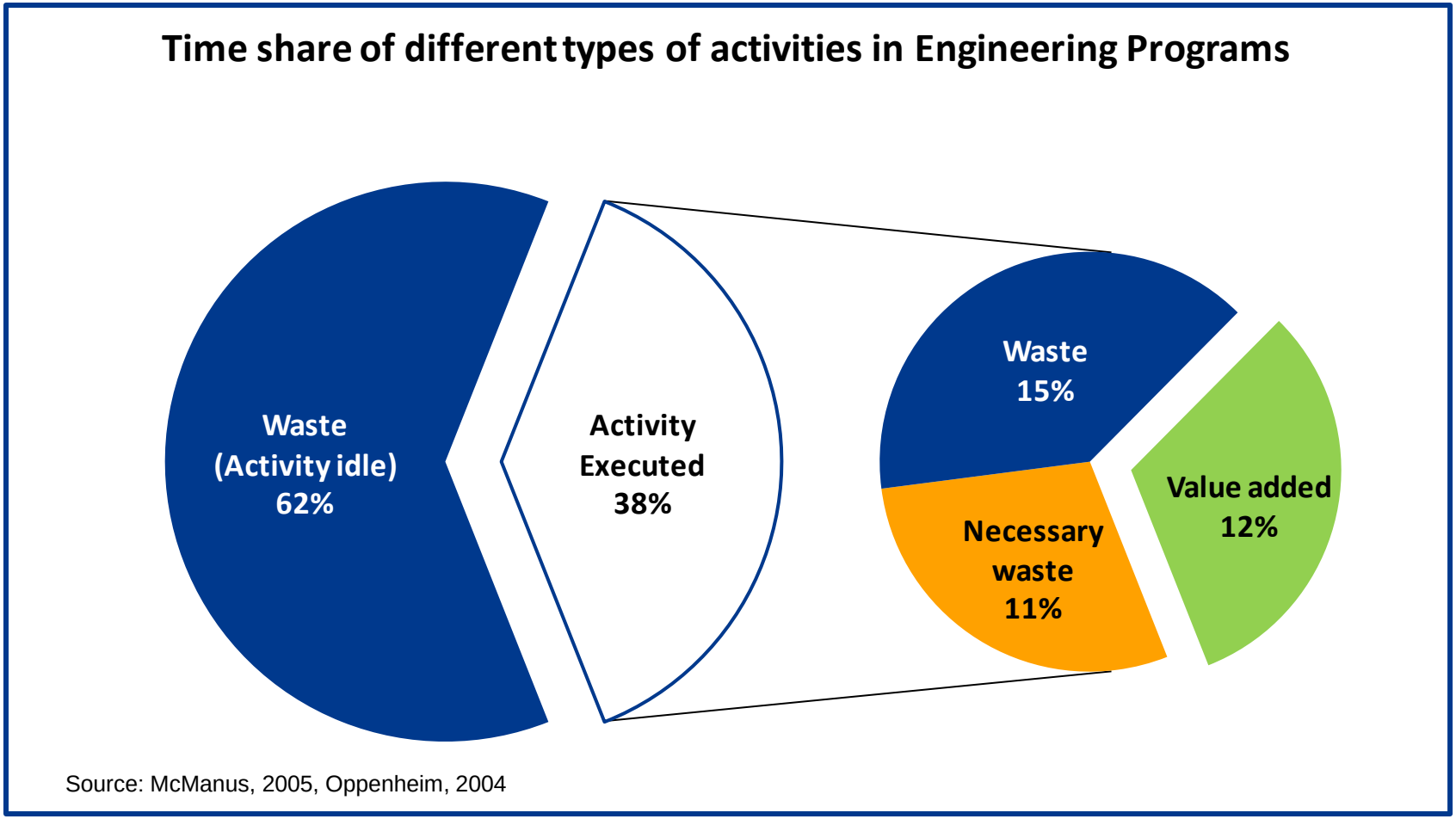

Source: GAO-12-525T

# Example 3: Optimize the value stream (LE 3.x.x) and create flow (LE 4.x.x)

- Use formal value stream mapping methods to identify and eliminate management and engineering waste, and to tailor and scale tasks. (LE 3.1.4)
- Use Lean tools to promote the flow of information and minimize handoffs. Implement small batch sizes of information, low information in inventory, low number of concurrent tasks per employee, small takt times, wide-communication bandwidth, standardization, work cells, and training. (LE 4.1.19)



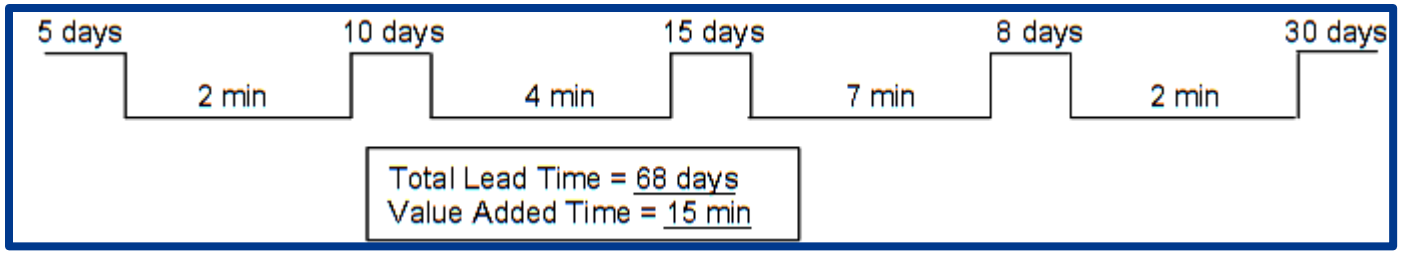
# Addresses challenge of value stream not being optimized throughout the entire enterprise



# Waste in Engineering Programs - Examples

| Seven Wastes | Engineering Program Examples |
|---|---|
| **Waiting** | • **Waiting for information or decisions**<br>• **Information or decisions waiting for people to act**<br>• Large queues throughout the review cycle<br>• Long approval sequences<br>• Unnecessary serial effort |
| **Over-Processing of Information** | • **Refinements beyond what is needed**<br>• **Point design used too early, causing massive iterations**<br>• Uncontrolled iterations (too many tasks iterated, excessive complexity)<br>• Lack of standardization<br>• Data conversions |
| **Inventory of Information** | • **Keeping more information than needed**<br>• **Excessive time intervals between reviews**<br>• Poor configuration management and complicated retrieval<br>• Poor 5 S's (sorting, straightening, systematic cleaning, standardizing, and sustaining) in office or databases |
| **Rework, Defects** | • **The killer "re's": Rework, Rewrite, Redo, Re-program, Retest...**<br>• **Unstable requirements**<br>• Uncoordinated complex task taking so much time to execute that it is obsolete when finished and has to be redone<br>• Incomplete, ambiguous, or inaccurate information<br>• Inspection to catch defects |
| **...** | |

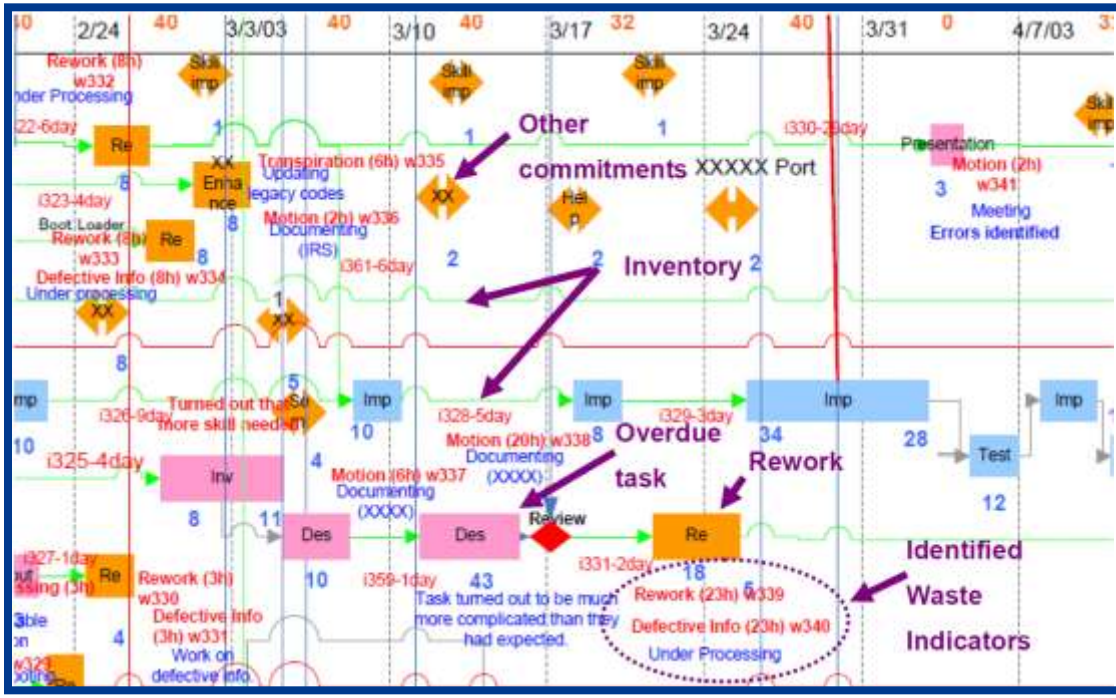
# Example Value Stream Maps: All shapes and sizes




Source: Wikipedia

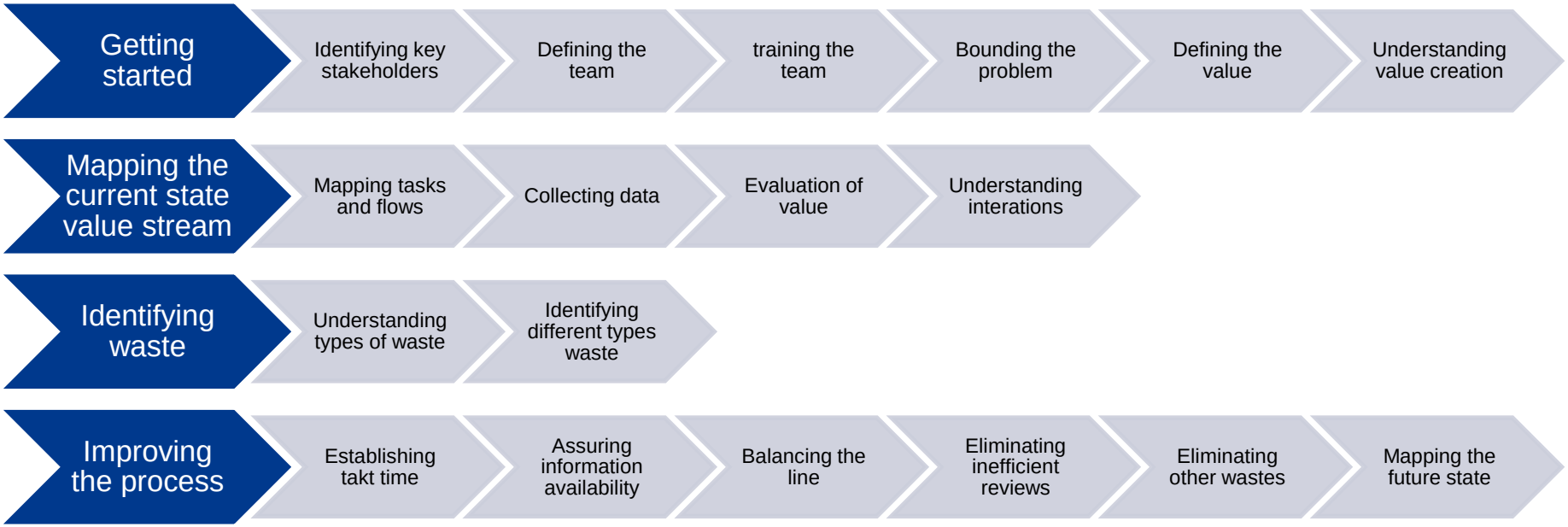
**1 type of waste, one value stream**

**7 types of waste, three coupled value streams**



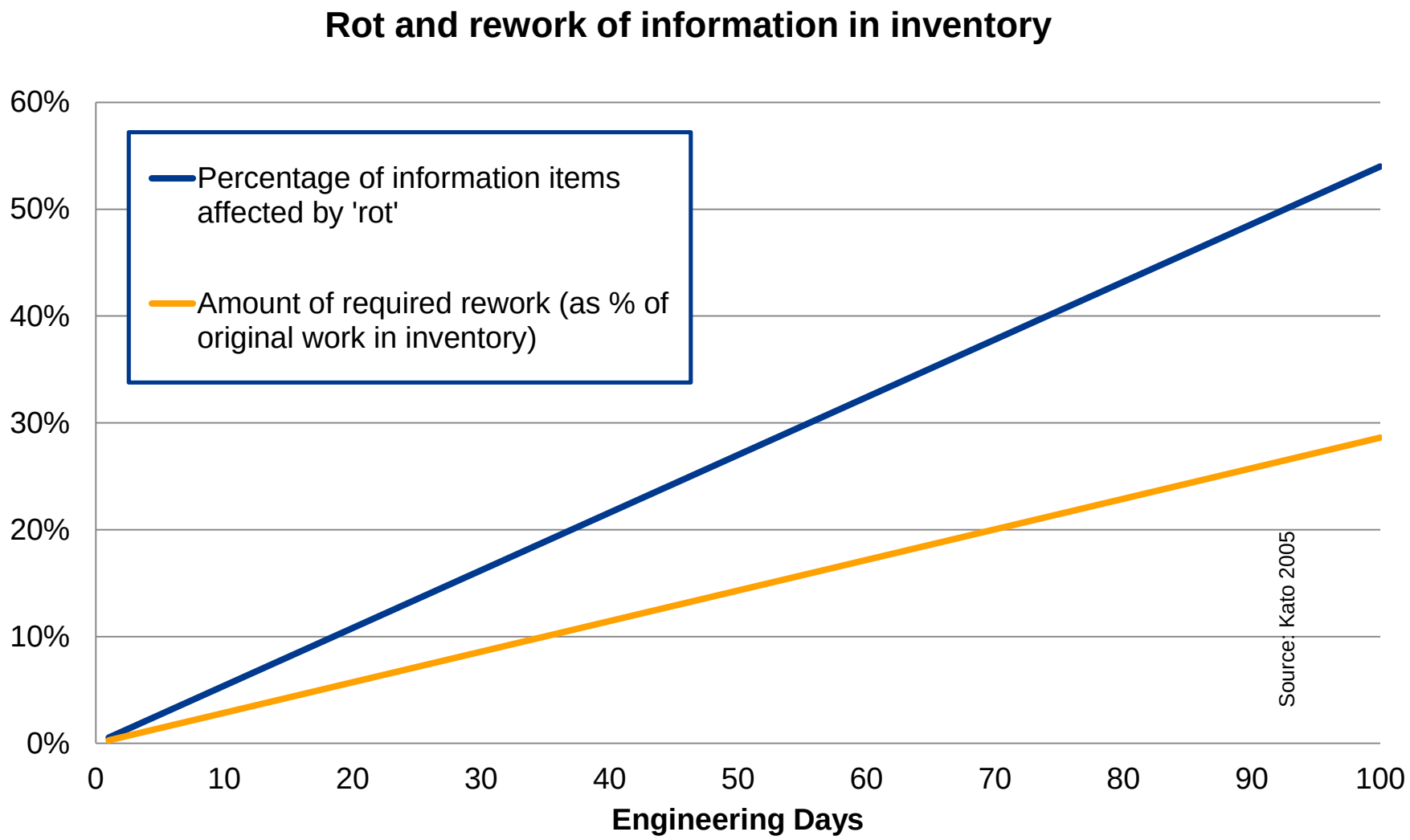

Source: Kato 2005

# Engineering Value Stream Mapping Process

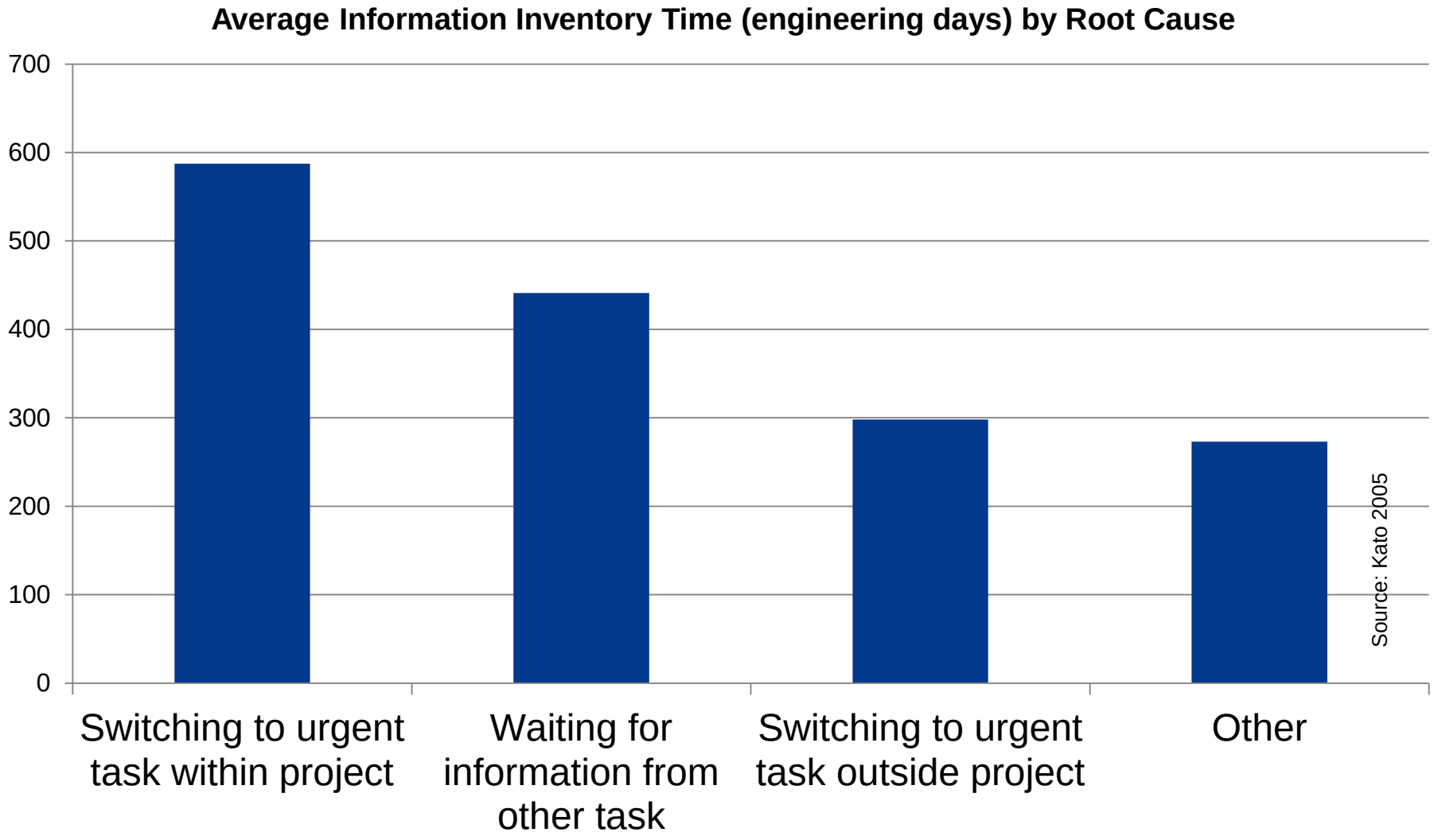



Source: McManus, 2005

# Why “Flow” is key: Information rots!



# How information inventory is created: Task switching

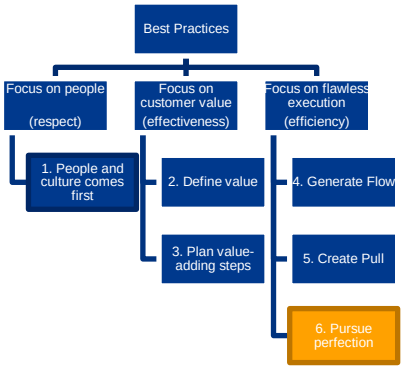


# Improving Flow and Reducing Work in Progress through simple visual management (and prioritization)

- Average from 972 cases at Boeing:
  - Reduction of work in progress: 69%
  - Improvement of quality (reduction of defects): 3.2x
  - Improvement of throughput (reduction of lead time): 3.4x
  - Time to implement method: 4 weeks

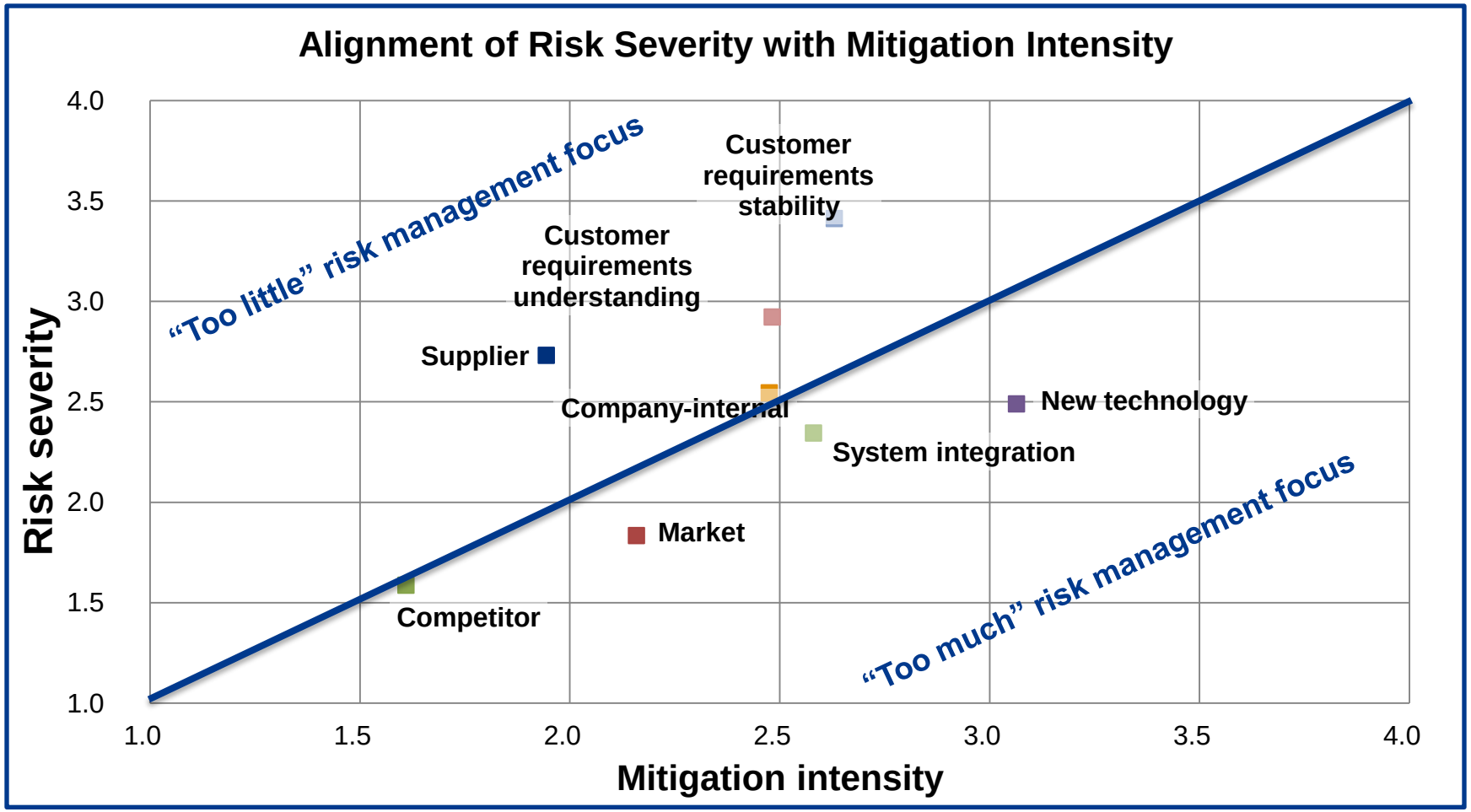
# Example 4: Pursue program perfection (LE 6.x)

- Proactively manage uncertainty and risk to maximize program benefits (LE 6.6)




- Focus on achieving the program benefits when selecting, customizing, and implementing program management standards, guidelines, and maturity models. (LE 6.1.2)
- Do not implement any standard purely for achieving any sort of mandated program certification. (LE 6.1.4)

# Risks and mitigation actions often misaligned



# Risk Management Best Practices


**Results-focused requirements**

1. Focus risk management on creating and protecting value
2. Create transparency regarding program risks
3. **Support all critical decisions with risk management results**
4. Minimize risks the program is exposed to
5. Maximize resilience of program towards risks

**Process-focused requirements**

6. Develop risk management skills and resources
7. Tailor risk management to and integrate it with program management
8. Contribute to continuous improvement of your organization
9. **Monitor and review your risks, risk mitigation actions, and risk management process**

# The Clash of Improvement Civilizations: Who is right?

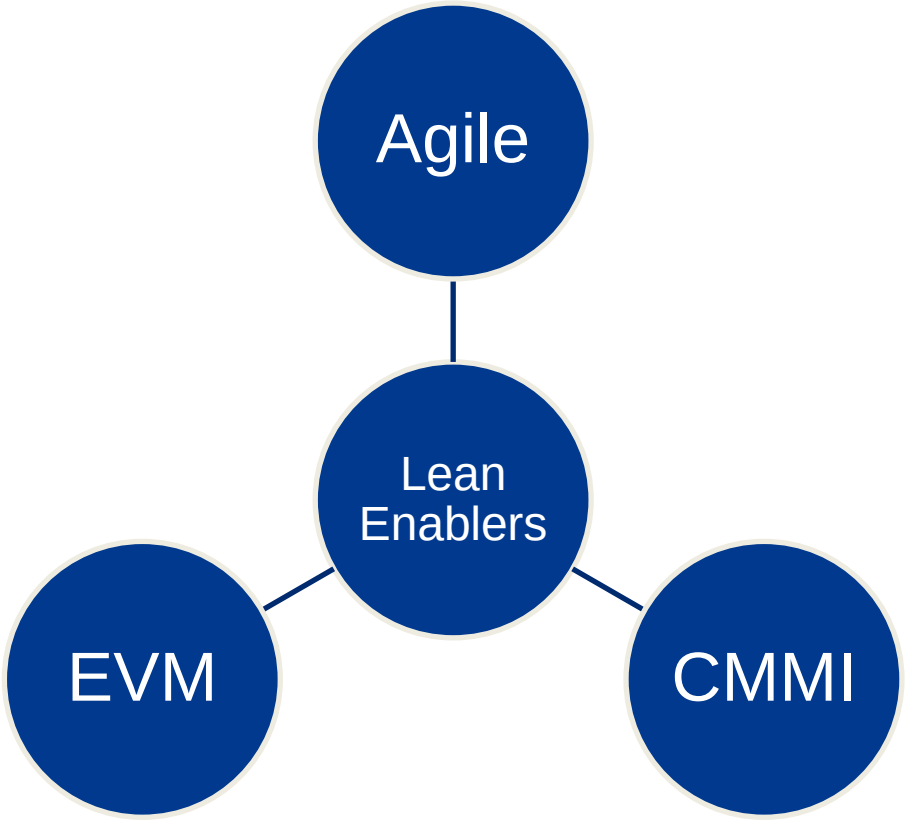
- Lean?
- Agile?
- CMMI?
- EVM?
- TQM?
- Six Sigma?
- OPM3?
- P3M3?
- …

- The customer is always right!

1. Get your people on board.
2. Identify your strategic objectives, break them down to the operating level and understand what needs to change in **your** program.
3. Drive systemic and cross-functional change top-down through dedicated projects.
4. Enable bottom-up continuous improvement.

# Lean Enablers and the Clash of Improvement Civilizations

## Discussion in the "Guide"

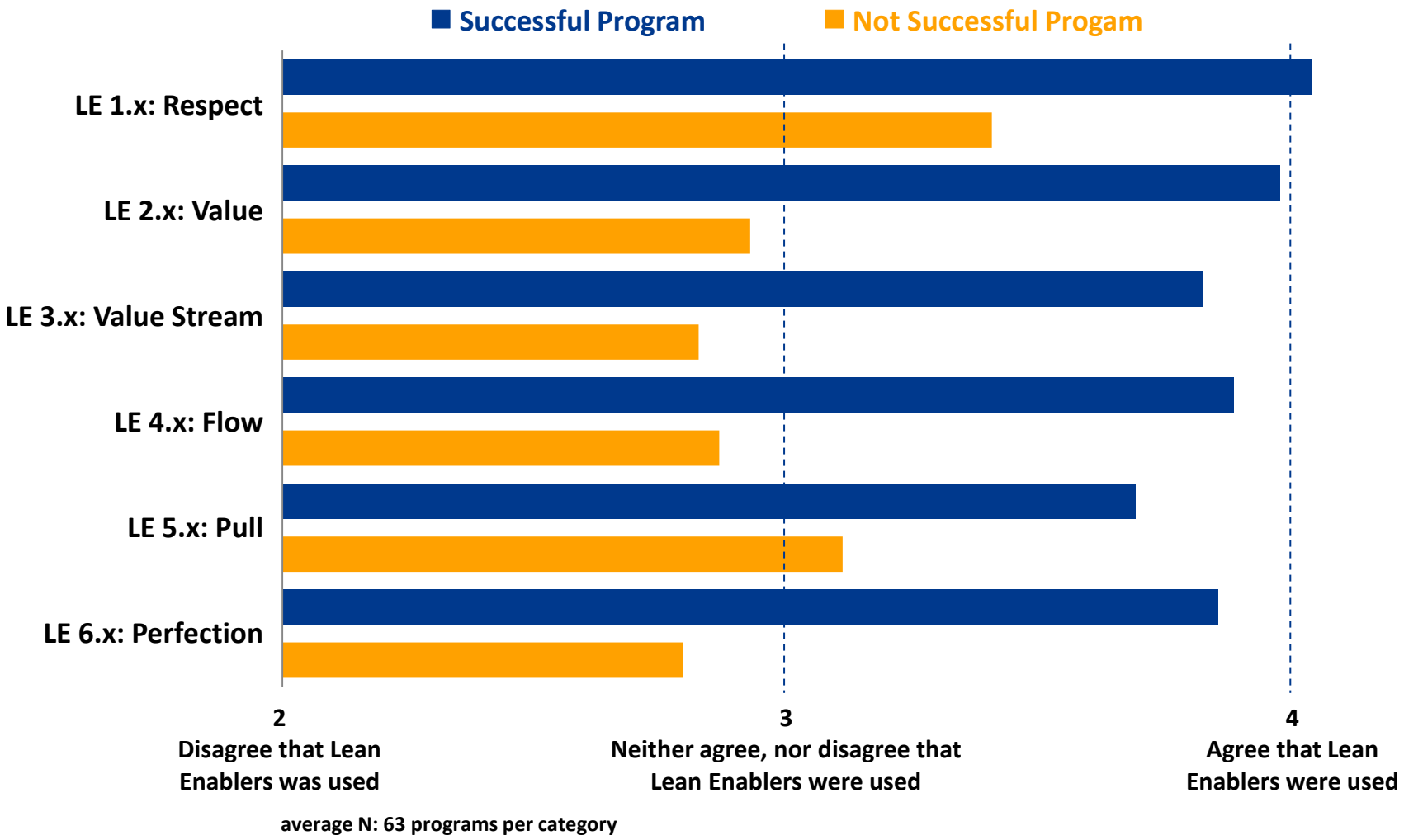



## Lean Enablers supporting EVM

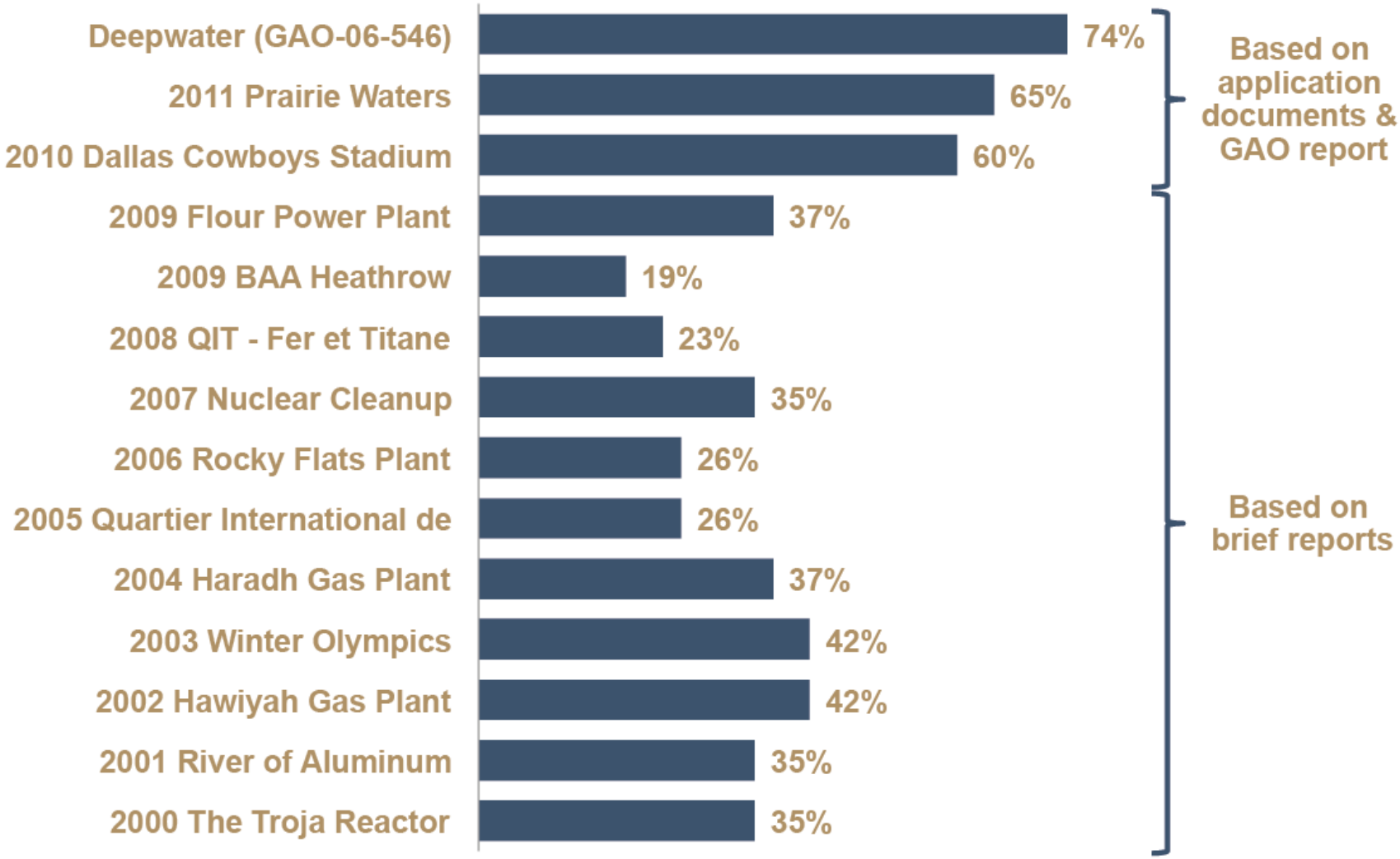
- 1.x: People – Creating a vibrant program culture
- 2.x and 3.x: Value and value stream – Focusing the program and WBS, integrating suppliers and customers, using effective metrics to drive program
- 4.x: Flow – Defining and clarifying responsibility, authority and accountability, minimizing hand-offs
- 6.x: Pursue perfection – Doing EVM "the right way" (i.e. not to tick a box)

# DOES IT WORK?

# Use of Lean Enablers in Successful and Unsuccessful Programs: Level of Agreement of Respondents



# Application of Lean Enablers in "Best Practice Programs"– The more detailed the reports, the more Enablers we found



# Most popular vs rarely used enablers

## Almost always found

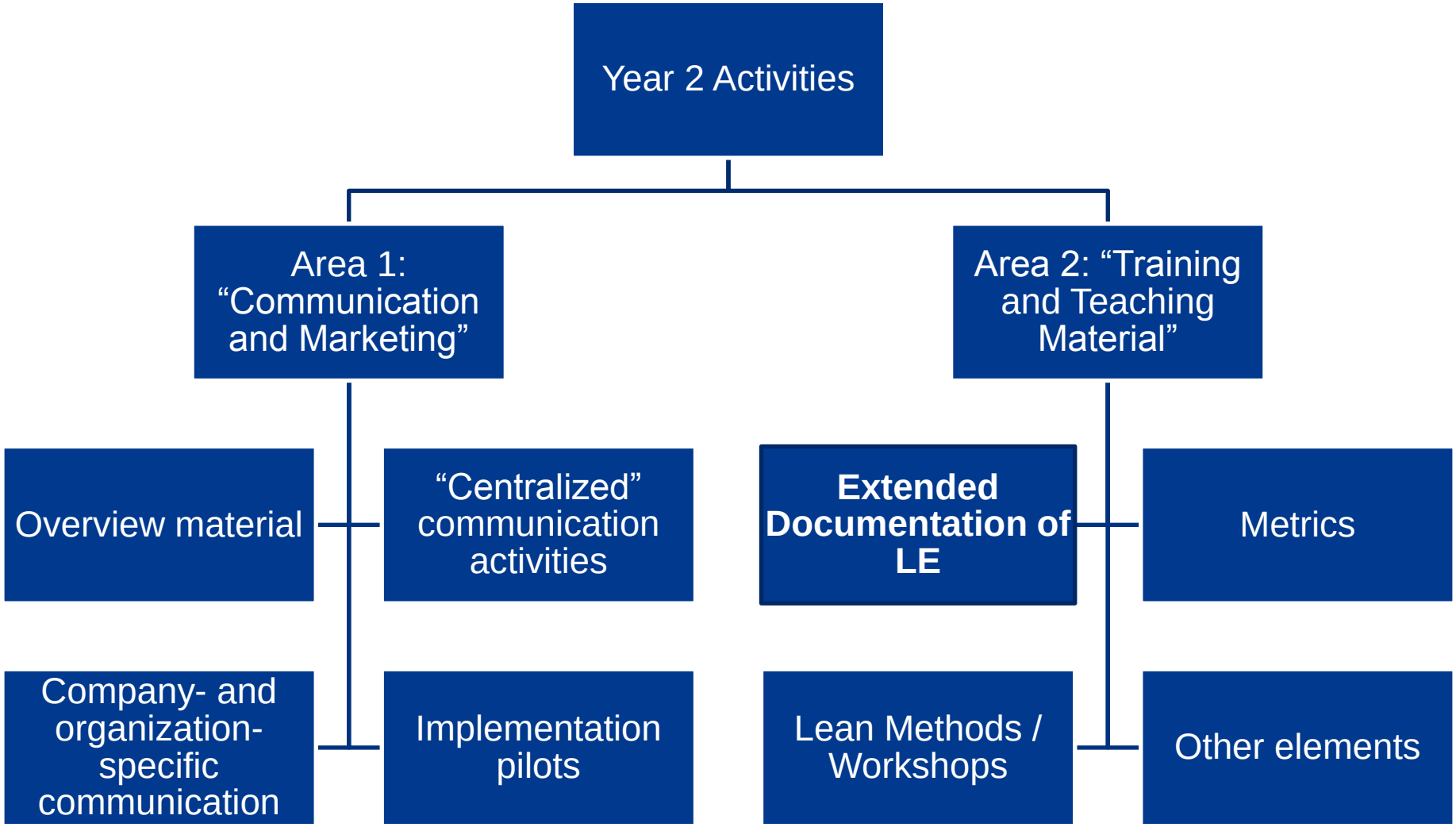
- Build a program culture based on respect for people
- For every program, use a program manager role to lead and integrate program from start to finish
- Frequently engage the stakeholders throughout the program lifecycle
- Develop a Communications Plan

## Rarely found

- Pull tasks and outputs based on need, and reject others as waste
- Pursue Lean for the long term
- Use probabilistic estimates in program planning

# THE ROAD AHEAD

# Overview of Year 2 Activities – Working Draft



# Overview of Year 2-4

| Lean Enablers for Managing Engineering Programs | Operationalize the Lean Enablers for Managing Engineering Programs | Establish Lean Engineering Program Success Stories | Make Lean Thinking part of Engineering Program Management DNA |
|---|---|---|---|
| • Year 1: January 2011 – May 2012 | • Year 2 (September 2012 – August 2013) | • Year 3 (September 2013 – August 2014): | • Year 4 (September 2014 – August 2015) |

# Join us at www.lean-program-management.org


- Steer and fund the MIT research through the LAI consortium
- Join the mailing list – one email and presentation per month.
- Become a subject matter expert – Monday, 1-2pm EDT