Lean Process Design

A Concept of Process Quality

David N. Card
dca@q-labs.com

Agenda

- Background and Objectives
- Concepts of Lean
- Lean Process Design Process
- Summary

Background

- CMMI® requires the definition of processes that cover certain goals and practices
  - Requires “sufficiency”
  - Does not provide criteria for a “good” process – not an appraisal consideration
- Lean principles provide “goodness” criteria for processes
- Lean usually applied as a re-engineering technique, e.g., Kaizen

Objectives

- Identify the process “goodness” criteria implicit in Lean principles
- Explain how these can be applied during the design and initial definition of processes
- Minimize later rework and re-engineering

The Lean Misconception

- Lean is not about “light weight” processes
- “Lean” refers to reducing inventory and “work in progress”
- Lean is accomplished through robust processes
  - Simple
  - Reliable
  - Standardized
  - Enforced

Caveat: many flavors of Lean

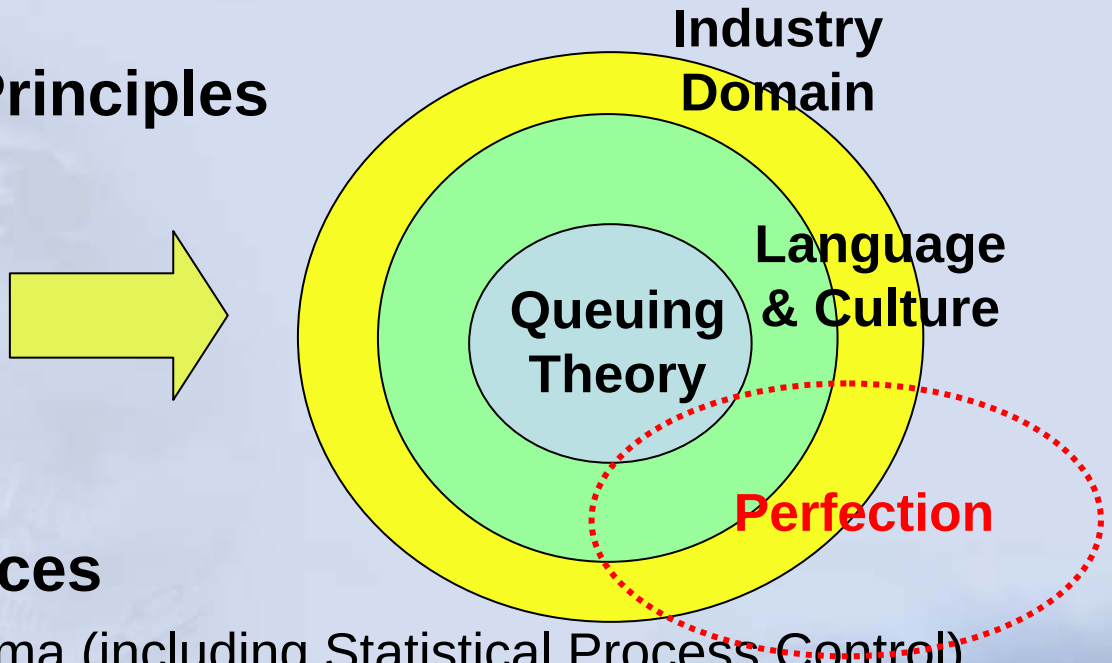
Five Lean Principles

- *Value* – identify what is really important to the customer and focus on that
- *Value Stream* – ensure all activities are necessary and add value
- *Flow* – strive for continuous processing through the value stream
- *Pull* – drive production with demand
- *Perfection* – prevent defects and rework

Value Stream = Business Process

Views of Lean

- **Five Observed Principles**
  - Value
  - Value Stream
  - Flow
  - Pull
  - Perfection
- **Technical Practices**
  - Similar to Six Sigma (including Statistical Process Control)
  - Adds queuing theory perspective

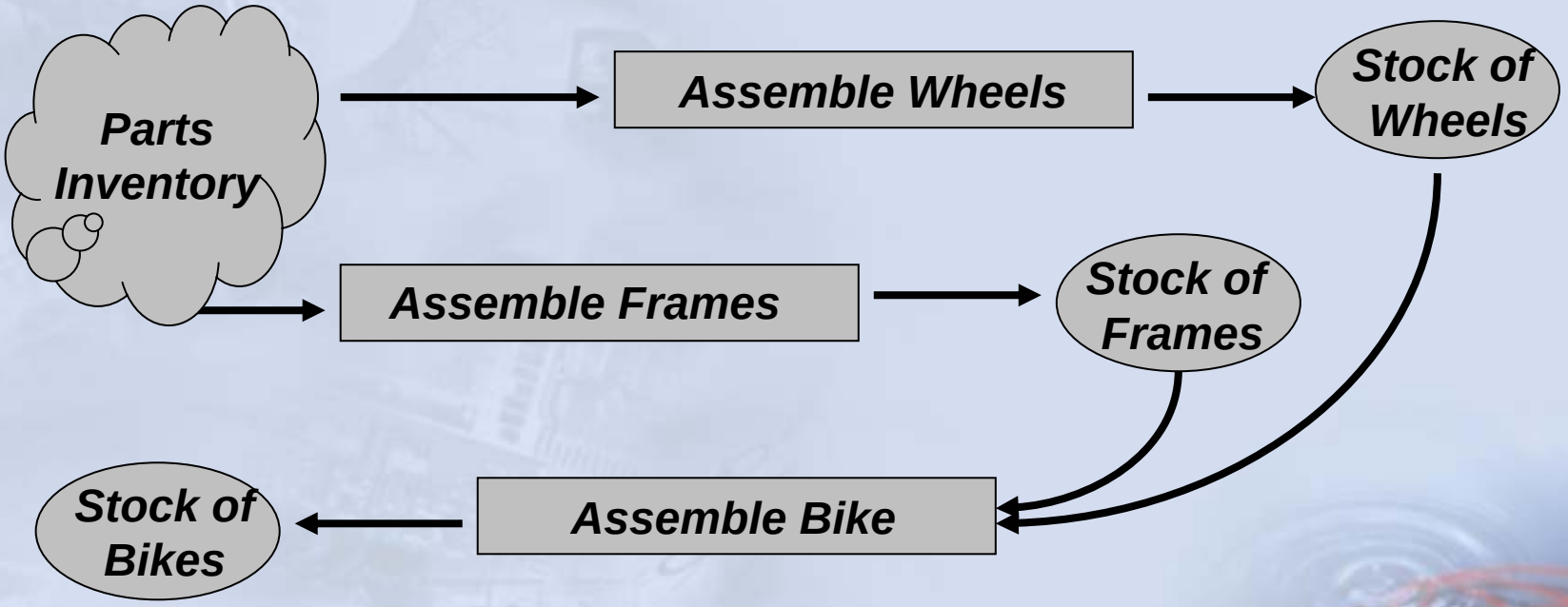


Lean Techniques

- Realize the principles of Lean
  - Methods and tools for defining, analyzing, and improving processes
  - Criteria for efficient and effective processes
  - Dimensions of process performance subject to control
- Based on queuing theory (a process may be viewed as a system of queues)

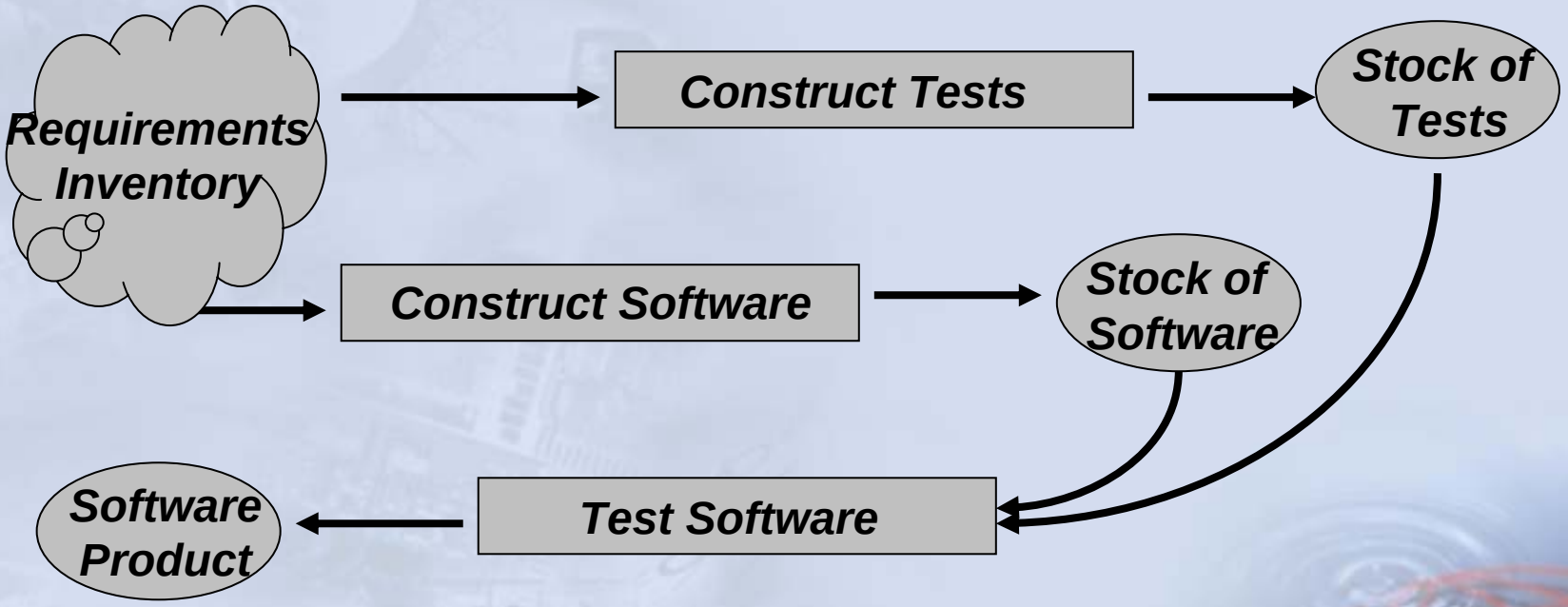
Lean is not just an attitude!

Example Manufacturing Process



Inventory and Work in Progress Enable Inefficient and Unreliable Processes!

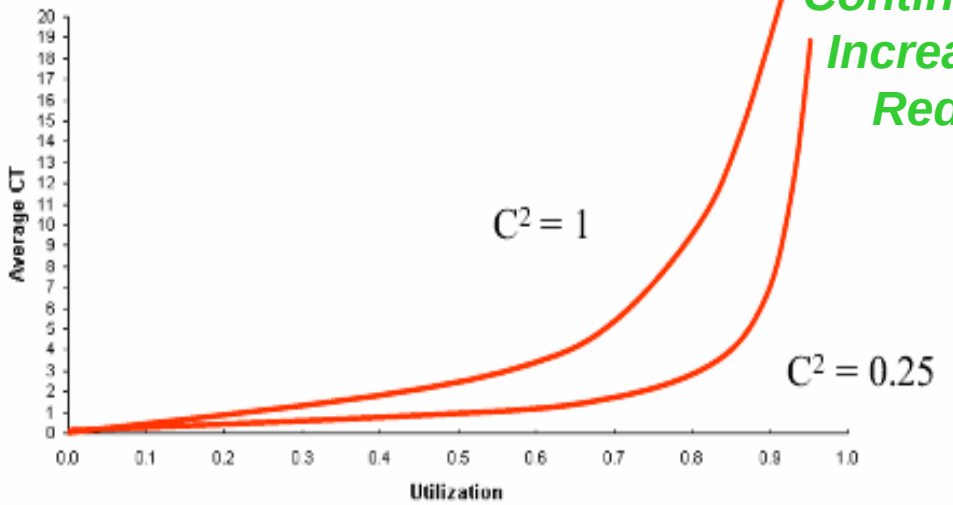
Example Software Process



Waterfall model implies large WIP;
Incremental and agile imply smaller WIP,
but are they "robust" enough?

Limits to Performance

Queuing Theory



Continuous Improvement Increases Capacity and Reduces Variability

Capacity Utilization and Variability

Variability

Capacity Utilization

$$CT_q = \left(\frac{Ca^2 + Ce^2}{2}\right)\left(\frac{u}{1-u}\right)te$$

High levels of variability further exacerbates the effects of capacity utilization

From P. Middleton, Lean Product Development, 2005

Implications of Queuing Theory

- Broadens concerns for managing the capacity of organizations
- Leads to design criteria for process definition
  - Queues with certain properties operate more efficiently
- Suggests candidate measures
  - Properties of queues are measurable

The Capacity Myth

- Most engineering organizations behave as if their system/software development capacity is elastic
  - Capacity expands to accommodate the need
  - Projects are planned in isolation
- Systems have limits to performance
  - Organizational performance must be managed to facilitate project success
  - Organizational performance is not simply an aggregation of individual projects

Lean Process Design

- Why – begin the process improvement journey with efficient and effective processes, not just compliant processes
- How – use Lean concepts to make decisions about the organization and composition of processes, more than human factors considerations
- When – during process design and initial definition, not just as later rework

Kaizen

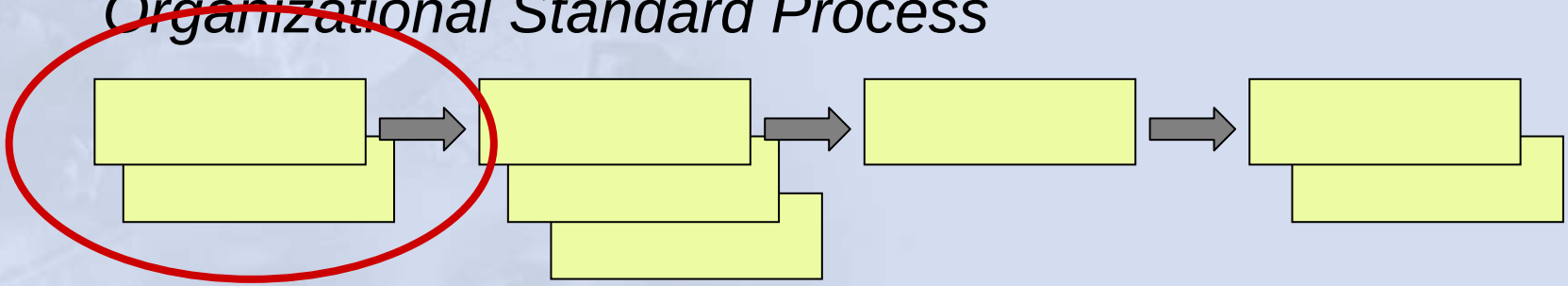
- A facilitated team activity
- Focused on improving an existing process or (more commonly) subprocess
- Applies Lean principles
- Typically involves tools such as
  - Quality Function Deployment
  - Process Mapping
  - Value Stream Analysis

Process Size as a False Trail

- Lean is not about the “size” or “volume” of the process definition
- Process definition includes
  - Organizational standard process
  - Organizationally-defined alternatives
  - Project-defined alternatives
- Volume of alternatives and variations often exceed the volume of the basic organizational process – focus on these!

Process Proliferation

Organizational Standard Process

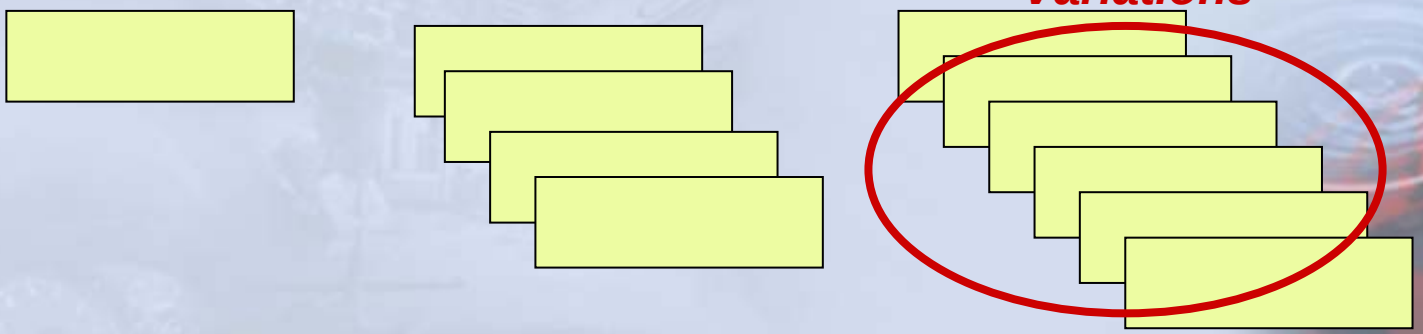


Eliminate OSP Element

Organizationally Defined Alternatives

Projects Defined Processes

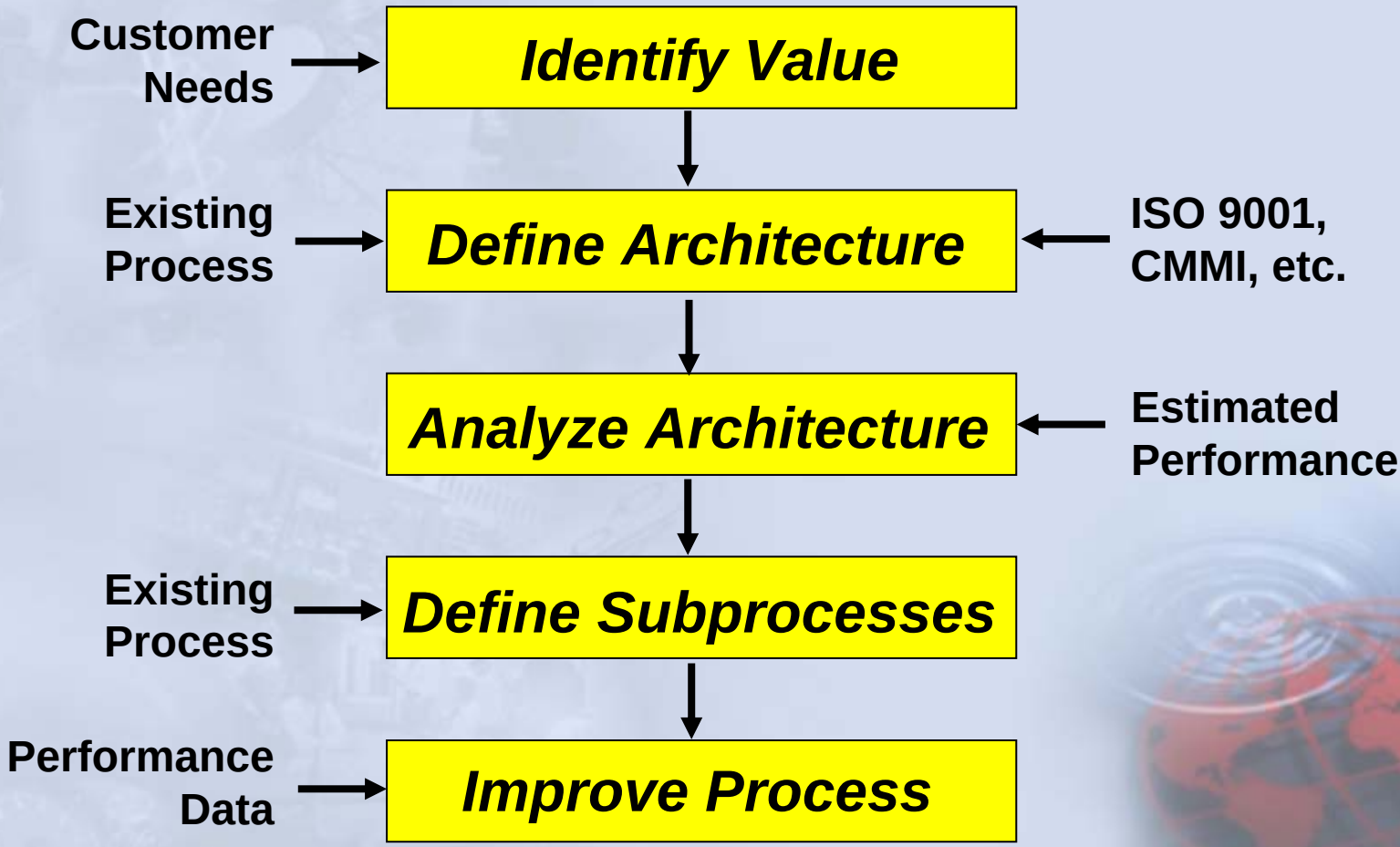
Eliminate Project Variations



Lean Process Design Process

- Requires a focus on the architecture or "system design", as well as the design of subprocesses
- Provides common and specific criteria for each level of design
- Use estimates of process performance to help make design decisions
- Incorporates traditional process definition conventions and notations

Lean Process Design Process



Lean Process Design Criteria

- Break work into “small” packages
- Process small packages of work continuously
- Distribute work evenly across subprocesses
- Minimize subprocess variations
- Minimize hand-offs between subprocesses
- Reuse subprocesses within the architecture
- Avoid redundant or duplicative tasks
- Eliminate “just in case” activities
- Minimize waiting and delays
- Identify and mitigate performance constraints
- Understand downstream demand

Lean Subprocess Design Criteria

- Use proven subprocesses
- Ensure subprocess are followed
- Keep subprocesses simple
- Plan for control of subprocess performance
- Build quality assurance into each subprocess
- *Avoid redundant or duplicative tasks*
- *Eliminate "just in case" activities*
- *Minimize waiting and delays*
- *Identify and mitigate performance constraints*

Human Factors Criteria

- Process definitions are intended for human users, must be
  - Understandable
  - Natural/Intuitive
  - Accessible
  - Effectively supported by tools
  - Etc.
- Process definitions are only one element of a process instantiation (also, people, tools, and input)

Lean Software Management Case Study: Timberline Inc

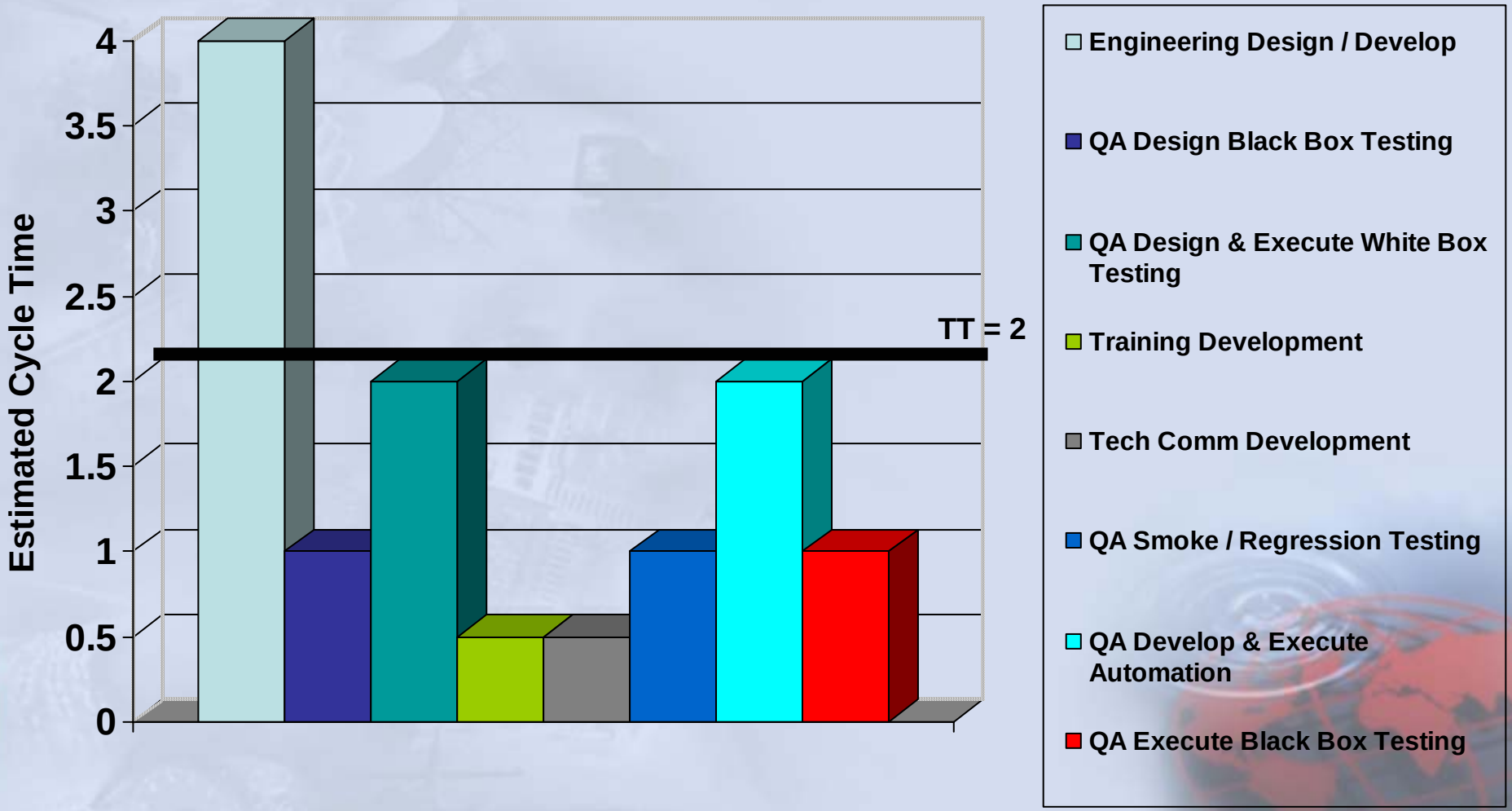
Peter Middleton

Amy Flaxel

Ammon Cookson

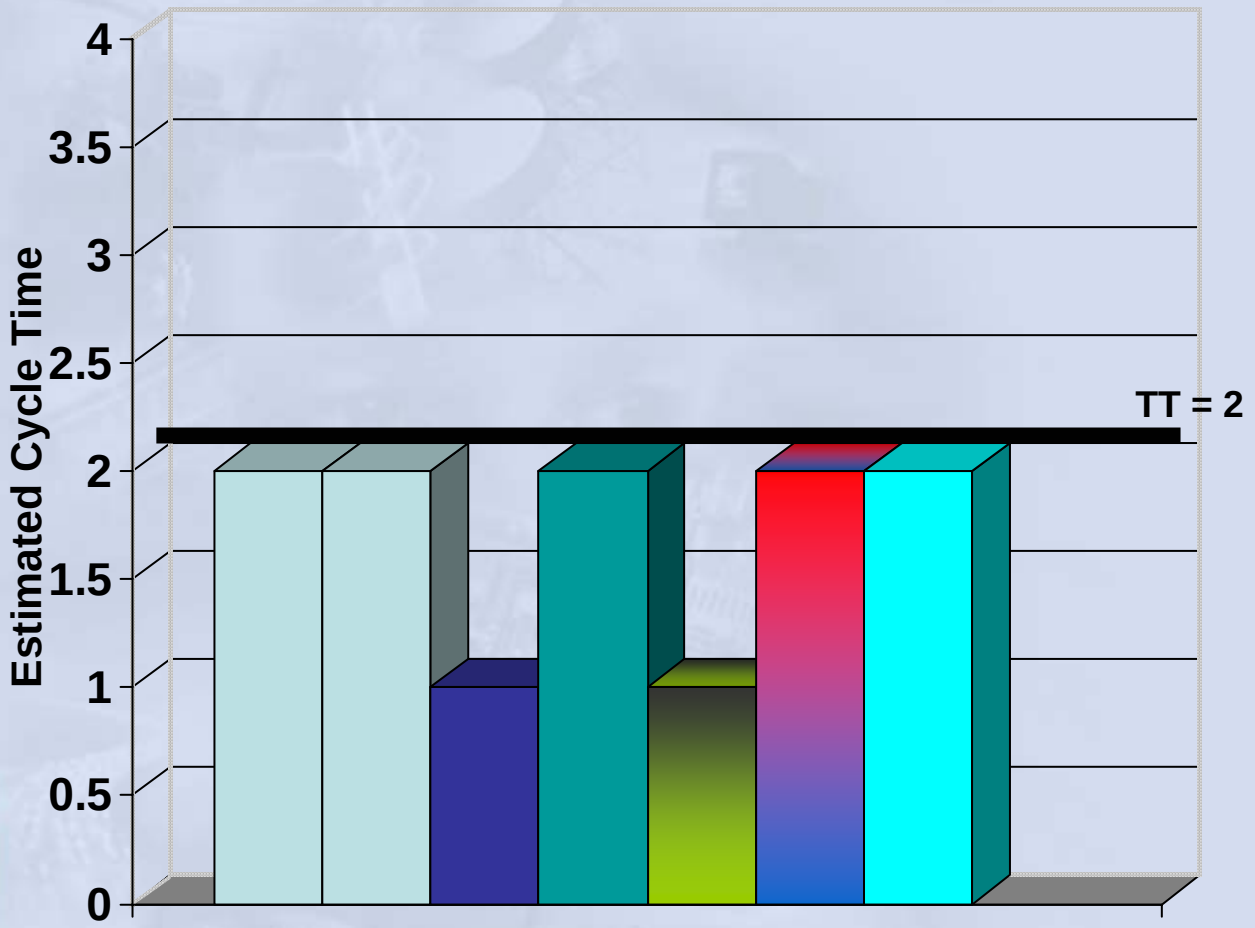
Used with Permission

Work Balance Chart - Initial



Middleton, Flaxel, Cookson

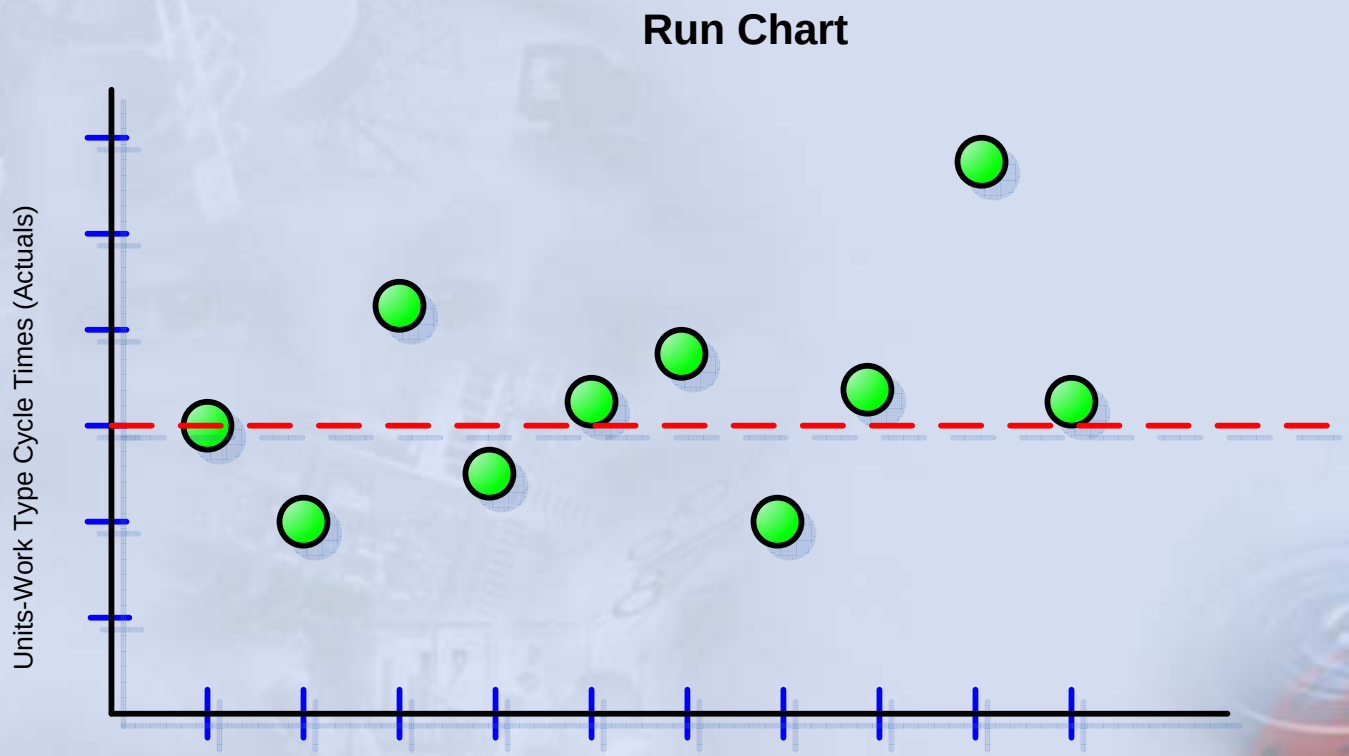
Work Balance Chart – Post Adjustment



- Engineering Design / Develop
- Engineering Design / Develop
- QA Design Black Box Testing
- QA Design & Execute White Box Testing
- Tech Comm Development - Training Development (1/2)
- QA Execute Black Box Testing - QA Smoke / Regression Testing
- QA Develop & Execute Automation

Middleton, Flaxel, Cookson

Example: Cycle Time Analysis



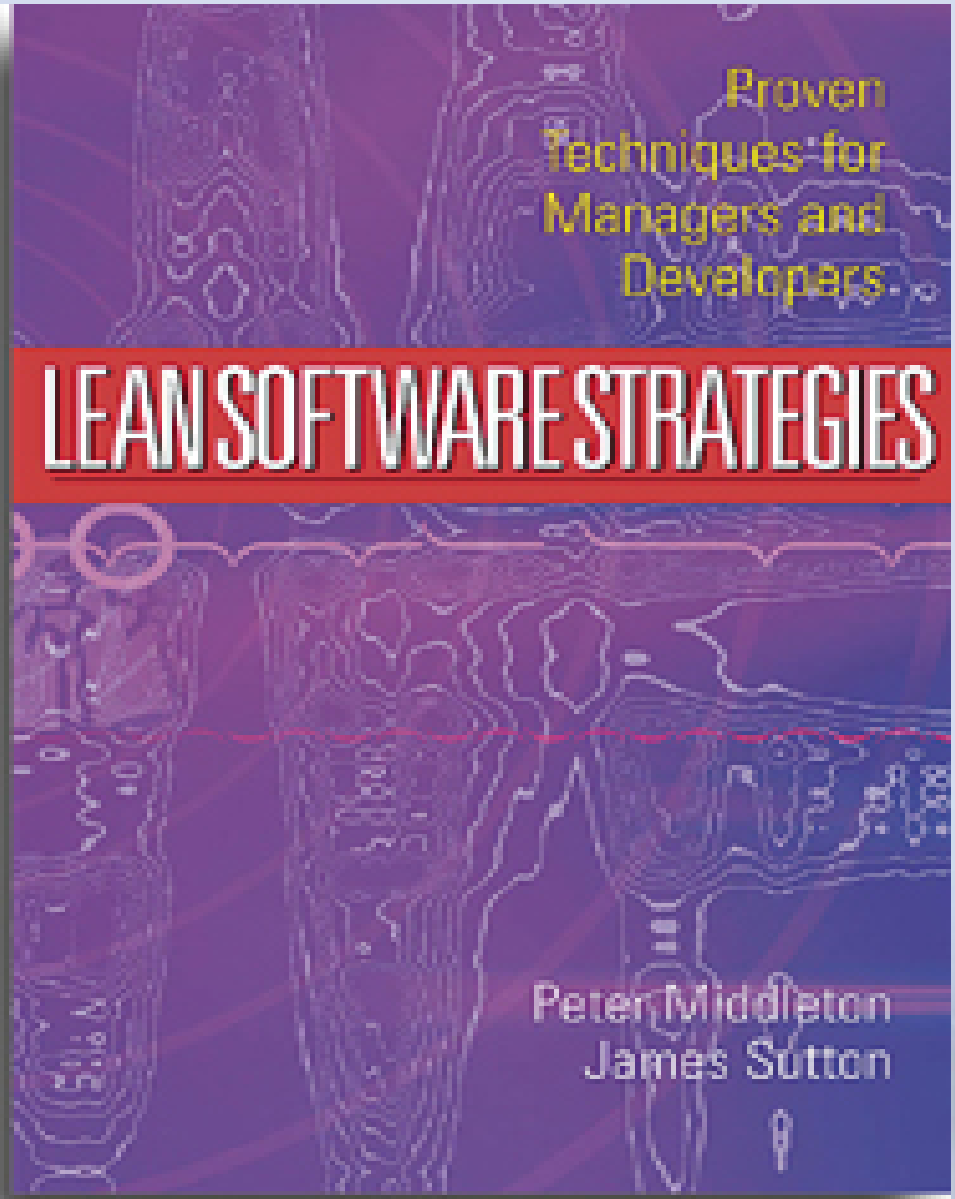
Middleton, Flaxel, Cookson

Performance Dimensions

- Task size
- Work arrival rate
- Cycle time
- Effort
- Delay/Waiting
- Defects
- Rework

Summary

- Lean is not about the volume of process definitions
- Processes can be designed, up front, to be more efficient and effective with Lean principles
- Good process design requires engineering at both the system (overall process) and subprocess levels
- Lean helps identify the critical measures of performance


Proven Techniques for Managers and Developers
LEAN SOFTWARE STRATEGIES
Peter Middleton
James Sutton

About Q-Labs

- Consulting, Training and Appraisals in:
  - Software Measurement
  - CMM/CMMI
  - Lean/Six Sigma
  - ISO 15504/SPICE
  - ISO (001
- 150 employees
- ISO 9001 Certified

- A broad international client base, e.g.
  - Alcatel, Bouygues Telecom, France Telecom, Orange
  - AXA, BNP Paribas, Banques Populaires
  - ABB, R. Bosch, EDF, IBM, Siemens, Schneider Electric, Thomson Detexis, Volvo, Sony
  - Atomic Energy Board of Canada, FAA, Norwegian Ministry of Justice, Swedish Civil Aviation Administration
  - Thales, Thomson, FMV, US Army TACOM