New Synergy Group
Systems Thinking... Enterprise Performance

Turbo-Charging Agile Software Development
with
Lean Methods and Systems Thinking

Technical Seminar
NJ SPIN Meeting
96 Frelinghuysen Road
Rutgers University, Piscataway, NJ
14 March 2012

Dr. Satish Thatte

CEO, New Synergy Group

Kendall Park, NJ
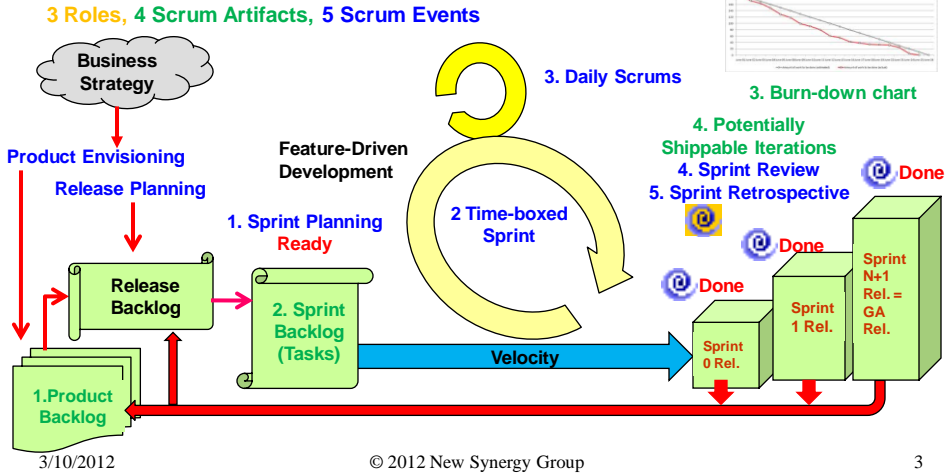
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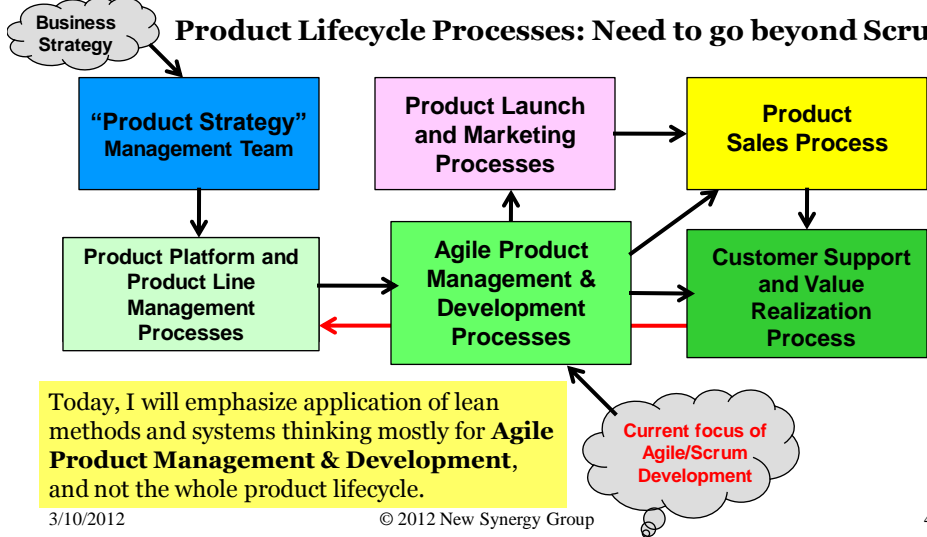New Synergy Group
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Agenda

- Overview of Agile/Scrum Framework
- Business need to go beyond Agile-Scrum framework
- Overview of Lean Framework
- Journey from Waterfall/Ad hoc to Agile to Agile-Lean
- Overview of Systems thinking
- Synergies among Agile/Scrum, Lean and Systems Thinking
- Tactical improvements with sprint retrospectives → Strategic improvements with systems thinking
- Complying with agile-lean methodologies is *not* the end goal; Pleasing customers and growing the business *is*!
- **Strategy** and **Operations** must be well-aligned to make a difference

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Scrum Framework: In Action

3 Roles, 4 Scrum Artifacts, 5 Scrum Events

Business Strategy

3. Daily Scrums

3. Burn-down chart

Product Envisioning

Release Planning

Feature-Driven Development

4. Potentially Shippable Iterations

4. Sprint Review

5. Sprint Retrospective

Done

1. Sprint Planning Ready

2 Time-boxed Sprint

@

@ Done

Release Backlog

2. Sprint Backlog (Tasks)

@ Done

Sprint N+1 Rel. = GA Rel.

Sprint 1 Rel.

Velocity

Sprint 0 Rel.

1.Product Backlog

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Business Strategy

Product Lifecycle Processes: Need to go beyond Scrum

"Product Strategy" Management Team

Product Launch and Marketing Processes

Product Sales Process

Product Platform and Product Line Management Processes

Agile Product Management & Development Processes

Customer Support and Value Realization Process

Today, I will emphasize application of lean methods and systems thinking mostly for **Agile Product Management & Development**, and not the whole product lifecycle.

Current focus of Agile/Scrum Development

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Lean Framework

- *Lean* is the English term given by MIT researchers to describe the system of the *Toyota Way*

- Refers to *Lean production*, as opposed to *Mass production*
- Viewed as a set of operating principles and policies, not as a prescriptive step-by-step methodology.
- Does not mean "lean and mean" – or fire and downsize

Lean Principles & Policies

- Minimize waste
- Level the work (small work batches)
- *Stop Starting, Start Finishing*
- *Kanban* – Visual signaling
  - Work-in-Progress (WIP) limits
  - Increase the value flow
  - Pull management
- *Kaizen* – Continuous improvement

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Most Products are Wastefully Over-Engineered
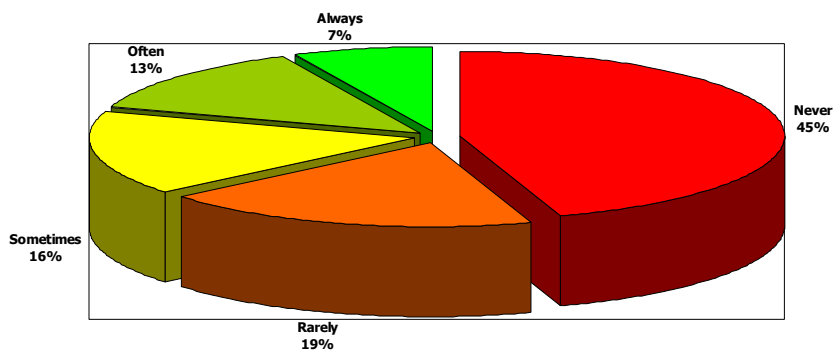
Source: Jim Johnson of the Standish Group, Keynote Speech XP 2002

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Value Ratio, and its Shocking Truth!

- **Value:** The time periods of actions while developing the product that the customer is willing to pay for. Value is in the eyes of (external) customer.
- **Waste:** All other time periods that do not add value, but take resources
  - Multi-tasking, context-switching workers
  - Waiting in queues: Design review, code review, integration, regression, defect fixing, …
  - Bottlenecks: single experts pulled for every crisis; narrow specializations
  - Hand-offs (in sequential waterfall process)
  - Undo-Redo cycles (due to poor communication, poor understanding, etc.)
- **Value Ratio** = Value time / Lead time (concept to consumption time)
  - Value ratio is 7% (or less) in many product development organizations! [Sources: "Scaling Lean & Agile Development" by Larman & Vodde; "Implementing Lean Software Development" by Poppendiek; "Lean Product and Process Development" by Ward]
- Small value-adding moments (7%), but huge amounts of waste (93%)
  - Improvement strategy needs to be subtractive and not additive
- Requires mindset change and need to develop "Eyes for Waste"

"There is nothing so useless as doing something efficiently that need not be done at all." -- Peter Drucker

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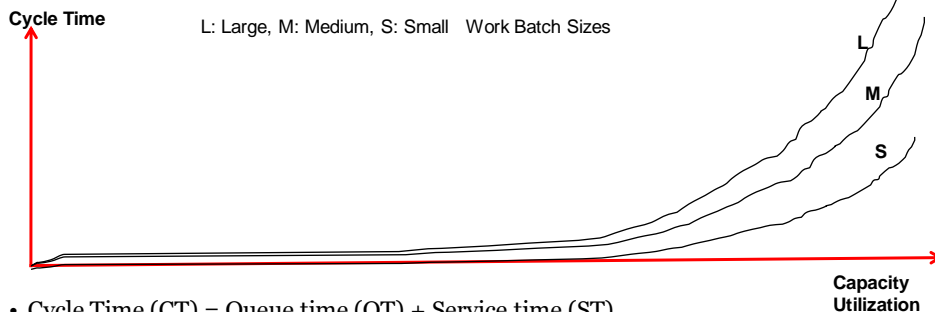Systems Thinking... Enterprise Performance

Cycle Time vs. Capacity Utilization and Batch Sizes

Cycle Time

L: Large, M: Medium, S: Small   Work Batch Sizes

L

M

S

Capacity Utilization

- Cycle Time (CT) = Queue time (QT) + Service time (ST)
- As capacity utilization or batch size increase, queue time increases non-linearly
- Decompose large features into smaller sub-features hierarchy; at the leaf level, no feature taking more than N/4 staff-weeks of effort for N-week sprint [adapted from "Scaling Lean and Agile Development" by Larman & Vodde, 2009, page 120]
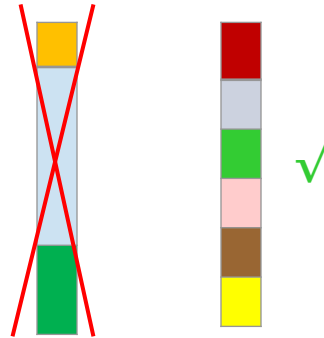
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Leveling the Work: Small Work Batches

1. Features split vertically: Each <= N/4 staff-week effort

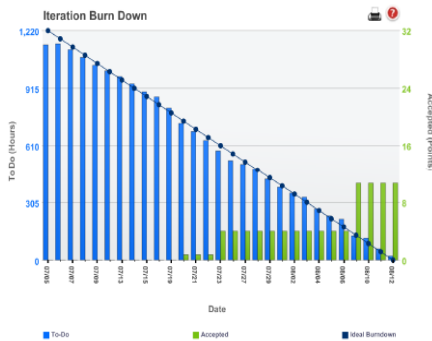**2. Tasks in a feature are leveled with Parts of 4 hours or less**
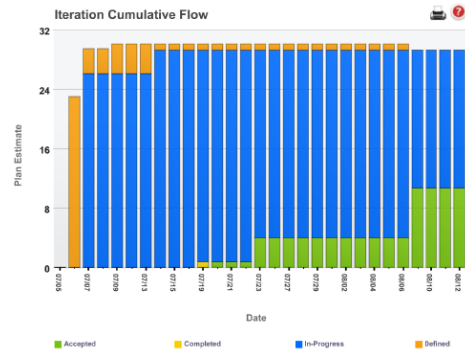

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Scrum Team 1: No Emphasis on Lean Mantra – *Stop Starting Start Finishing*
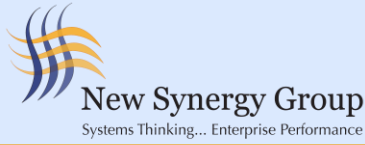
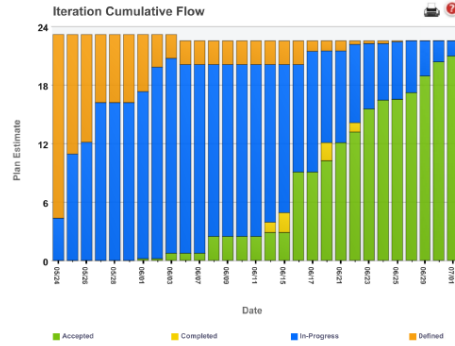**Burn-Down, Burn-Up Charts**   **Sprint Cumulative Flow**
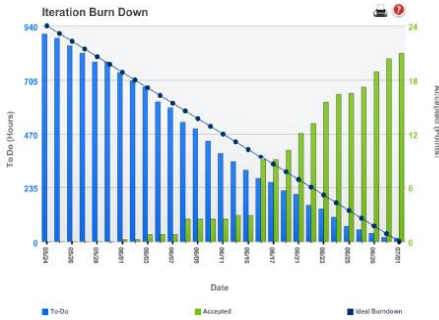

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Scrum Team 2: Emphasis Lean Mantra –
Stop Starting Start Finishing
Burn-Down, Burn-Up Charts   **Sprint Cumulative Flow**
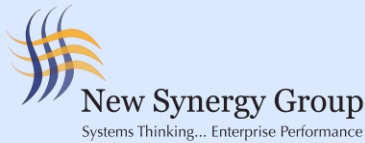

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Kanban Visual Signaling; Pull Management; WIP & Queue Limits

Sprint Backlog	Design (WIP Limit: 2)		Development, Defect Fixing (WIP Limit: 2)		Test Case Design, Testing (WIP Limit: 2)		Acceptance Testing by Product Owner
3 Features, 2 Defects	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
1. DS,DV,TC, TS, DF, AT							
2. DS,DV,TC, TS, DF, AT							
3. DS,DV,TC, TS, DF, AT							
A. DF, TS							
B. DF, TS							

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix   AT: Acceptance Test

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3 Software Engineers: Scott, John, Jake   2 QA Testers: Susan, Clyde   Product Owner: PO ScrumMaster: SM

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Kanban Visual Signaling; Pull Management; WIP, Queue Limits

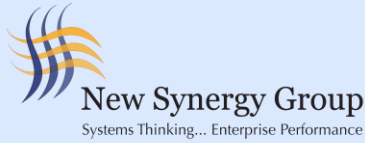| Sprint Backlog	Design (WIP Limit: 2)		Development, Defect Fixing (WIP Limit: 2)		Test Case Design, Testing (WIP Limit: 2)		Acceptance Testing by Product Owner
1 Feature, 1 Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
	1. Scott DS,DV,TC, TS, DF, AT				1. Susan DS,DV,TC, TS, DF, AT		
	2. John DS,DV,TC, TS, DF, AT				2. Clyde DS,DV,TC, TS, DF, AT		
3. DS,DV,TC, TS, DF, AT							
			A. Jake DF, TS				
B. DF, TS							

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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3 Software Engineers: Scott, John, Jake   2 QA Testers: Susan, Clyde   Product Owner: PO ScrumMaster: SM

Kanban Visual Signaling; Pull Management; WIP, Queue Limits

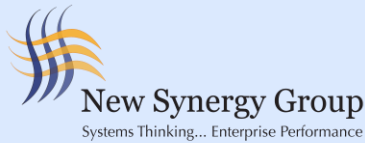| Sprint Backlog	Design (WIP Limit: 2)		Development, Defect Fixing (WIP Limit: 2)		Test Case Design, Testing (WIP Limit: 2)		Acceptance Testing by Product Owner
0 Feature, 0 Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
Jake working on 2 concurrent tasks			1. Scott DS,DV,TC, TS, DF, AT		1. Susan DS,DV,TC, TS, DF, AT		
			2. John DS,DV,TC, TS, DF, AT				
	3. Jake DS,DV,TC, TS, DF, AT				3. Clyde DS,DV,TC, TS, DF, AT		
				A. DF, TS			
	B. Jake DF, TS						

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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o Feature, o Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
			1. Scott DS,DV,TC, TS, DF, AT				
			2. John DS,DV,TC, TS, DF, AT				
	3. Jake DS,DV,TC, TS, DF, AT						
					A. Susan DF, TS		
					B. Clyde DF, TS		

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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3 Software Engineers: Scott, John, Jake   2 QA Testers: Susan, Clyde   Product Owner: PO ScrumMaster: SM

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o Feature, o Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
			1. Scott DS,DV,TC, TS, DF, AT				
			2. John DS,DV,TC, TS, DF, AT				
		3. DS,DV,TC, TS,DF, AT					
					A.Susan, Jake DF, TS		
					B. Clyde DF, TS		

Cross-Functional Team

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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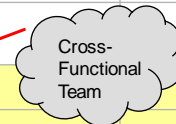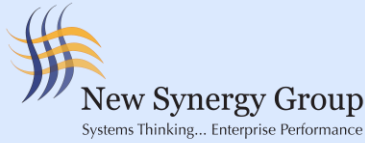3 Software Engineers: Scott, John, Jake   2 QA Testers: Susan, Clyde   Product Owner: PO ScrumMaster: SM

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Kanban Visual Signaling; Pull Management; WIP, Queue Limits

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o Feature, o Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
	Joint work				1. Susan, Scott DS,DV,TC, TS, DF, AT		
				2. DS,DV,TC, TS, DF, AT	Cross-Functional Team		
			3. John, Jake DS,DV,TC, TS, DF, AT				
						A. DF, TS	
					B. Clyde DF, TS		

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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o Feature, o Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
			1. Scott DS,DV,TC, TS, DF, AT				
					2. Clyde DS,DV,TC, TS, DF, AT		
					3. Susan DS,DV,TC, TS, DF, AT		
						B. DF, TS	

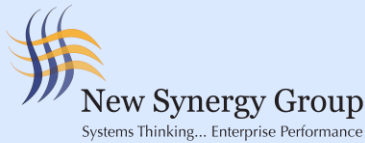**DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test**

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3 Software Engineers: Scott, John, Jake   2 QA Testers: Susan, Clyde   Product Owner: PO ScrumMaster: SM

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o Feature, o Defect	WIP	Done Queue	WIP	Done Queue	WIP	Done Queue	
					1. Susan DS,DV,TC, TS, DF, AT		
						2. DS,DV,TC, TS, AT	
							3. PO DS,DV,TC, TS, AT

DS: Design DV: Development TC: Test Case Design TS: Testing DF: Defect Fix AT: Acceptance Test

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Kanban Visual Signaling; Pull Management; WIP, Queue Limits

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							1. PO DS,DV,TC, TS, DF, AT
							2. PO DS,DV,TC, TS, AT

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Lean-Kanban Action Plan for Turbo-Charging Agile Development

- **Improve quality:** automated testing, code review, design patterns and reuse, TDD
- **Deliver often:** develop trust and credibility
- **Prioritize the backlog using DIVE:** only after you have some mastery over predictable delivery
- **Reduce WIP:** reduced lead time, increases business agility and reduces defects
  - Stop Starting Start Finishing
  - Formal WIP limits with Kanban signaling

- **Reduce variability:** common (chance) cause variation often internal to the system, vs. special (assignable) cause variation external to the system
  - Eliminate special cause variations at their root cause level
  - Minimize common cause variations by work item size, work type, class of service, irregular flow, and rework due to defects
  - Work item size variation: Story size <= N/4 staff-week for N week sprint
- *Kaizen* (Continuous improvement)
  - Slack allows people to learn and improve
  - Tight WIP limits invite swarming team action
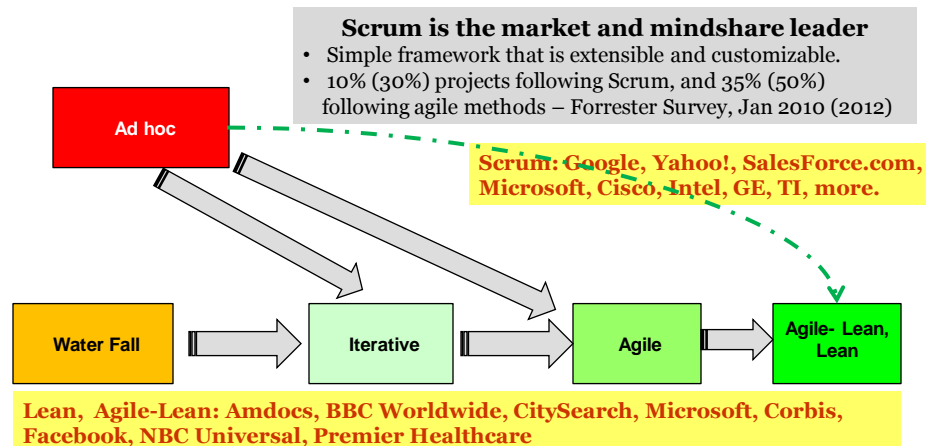
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Journey to Agile to Agile-Lean

Scrum is the market and mindshare leader
- Simple framework that is extensible and customizable.
- 10% (30%) projects following Scrum, and 35% (50%) following agile methods – Forrester Survey, Jan 2010 (2012)

Ad hoc

Scrum: Google, Yahoo!, SalesForce.com, Microsoft, Cisco, Intel, GE, TI, more.

Water Fall → Iterative → Agile → Agile- Lean, Lean

Lean, Agile-Lean: Amdocs, BBC Worldwide, CitySearch, Microsoft, Corbis, Facebook, NBC Universal, Premier Healthcare

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Introduction to Systems Thinking

- **System**: interacting components or subsystems forming an integrated whole.
  - **Purpose or function:** Usually deduced by observing system behavior, involving inputs (information, material or energy), processing, and outputs (information or material or energy).
  - **Components:** People, principles and values, processes and workflows
  - **Interactions:** Functional and structural relationships among components allowing them to interact
  - **Structure:** Defined by components and their interconnections

- A **model** is used to represent a system, capturing only the key aspects
  - **Causal Loop Diagrams (CLDs)** consisting of cause-effect-cause **feedback loops** are great for qualitative understanding and reaching consensus; they cannot be simulated
  - **Stock-and-Flow Networks (SFNs):** Can be simulated for quantitative analysis and *what-if* experiments; require more effort to build and validate

Note: We are *not* talking about only software system to be developed, but *systems* in general…specifically *organizational* systems.

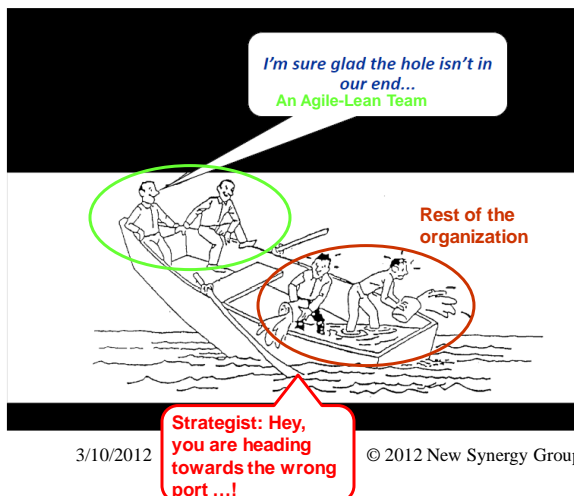3/10/2012   © 2012 New Synergy Group   23

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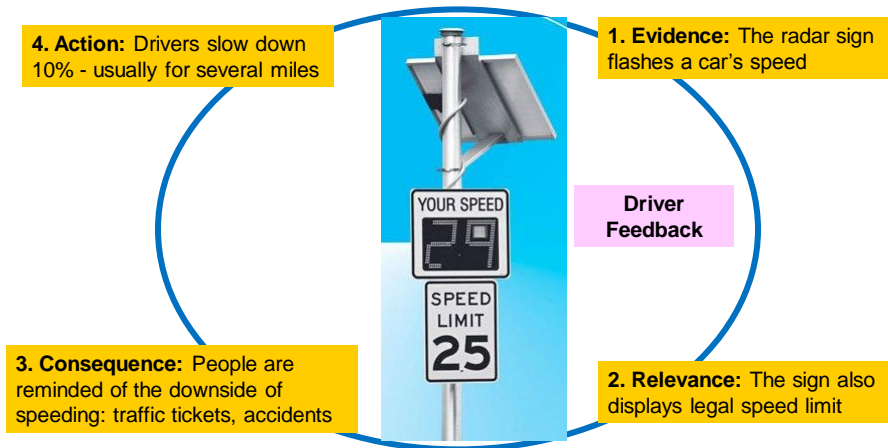## Applying Systems Thinking to Agile-Lean Development & Beyond

I'm sure glad the hole isn't in our end...
An Agile-Lean Team

Rest of the organization

Strategist: Hey, you are heading towards the wrong port …!

- **Make agile-lean methods work well with all organizational processes**
- **Change the *organizational system* to change the *culture***
  - *A bad system, will defeat a good person, every time.* – Edward Deming
- **Strategy and operational processes must be well-aligned**

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Feedback Loop in Action: An Example that Works Real Well

4. Action: Drivers slow down 10% - usually for several miles

1. Evidence: The radar sign flashes a car's speed

Driver Feedback

YOUR SPEED 29

SPEED LIMIT 25

3. Consequence: People are reminded of the downside of speeding: traffic tickets, accidents

2. Relevance: The sign also displays legal speed limit

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Adapted from: "The feedback loop" by Thomas Goetz, *Wired* magazine, July 2011

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CLD for Relationship between Release Cycle Time and Number of High Priority Features

S

(R)

Number of High Priority Features

Release Cycle Time

S
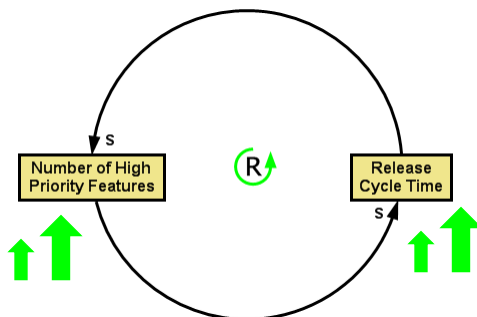
R: Reinforcing (positive) feedback loop
B: Balancing (negative) feedback loop

Notation
Cause and **Effect** variables are shown in rectangular boxes, with links showing causal relationships
• **S** (Supports): If the cause **increases**, the effect **increases** *above what it would otherwise have been*, and if the cause **decreases**, the effect **decreases** *below what it would otherwise have been*.
• **O** (Opposes): If the cause **increases**, the effect **decreases** *below what it would otherwise have been*, and if the cause **decreases**, the effect **increases** *above what it would otherwise have been*.
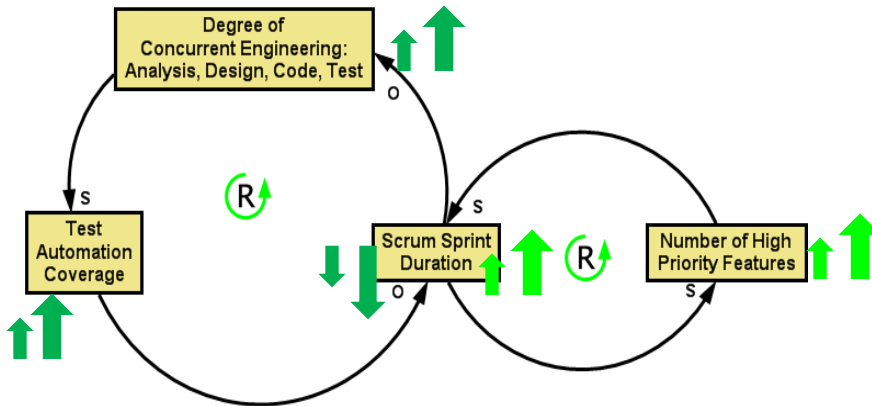
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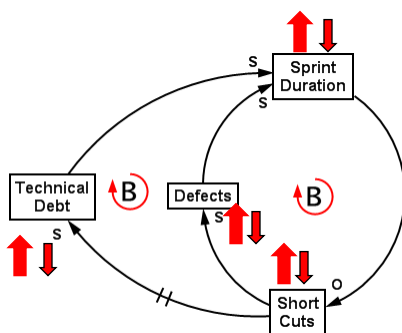## CLD for Relationship among Sprint Duration, Test Automation, Number of High Priority Features

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CLDs: Short-cuts and Sprint Duration, Scrum Team Effectiveness

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Systems Thinking Perspective on Sprint Duration

Sprint Planning and Analysis Workshop	RR	2-week Sprint (End-to-End)	DD	Sprint Retrospective and Review	Likely lower quality and effectiveness of Sprint retrospectives and reviews, if done every two weeks!
1-day		8-days of Sprint work		1-day	
Actual Engineering Work	48%	Next Sprint Backlog Grooming (12.5%), Daily Scrum (5%), Contingency (7.5%), Context-Switching and Non-Availability (15%) = Total (40%)	52%	"Overhead"	

Sprint Planning and Analysis Workshop	RR	5-week Sprint (End-to-End)		DD	Sprint Retrospective and Review; and Implement Action Plan	Systems thinking provides economic basis and larger context.
3-day		20-days of Sprint work			2-day	
Actual Engineering Work	56%	Next Sprint Backlog Grooming (5%), Daily Scrum and Weekly Plan (7.5%), Contingency (7.5%), Context-Switching and Non-Availability (10%) = Total (30%)		44%	"Overhead"	

Sprint Planning and Analysis Workshop	RR	7-week Sprint (End-to-End)		DD	Sprint Retrospective and Review; and Implement Action Plan
3-day		30-days of Sprint work			2-day
Actual Engineering Work	62%	Next Sprint Backlog Grooming (5%), Daily Scrum and Weekly Plan (7.5%), Contingency (7.5%), Context-Switching and Non-Availability (7.5%) = Total (27.5%)	38%	"Overhead"	

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Synergies among Agile/Scrum, Lean & Systems Thinking

	Agile/Scrum	**Lean, Systems Thinking**
Time-boxing	Yes	No → Great for maintenance work, IT operations
Reduce end-to-end feature cycle time	No	Yes; Level features to reduce avg. cycle time; *Stop Starting, Start Finishing* mantra
Value Flow	No	Yes
Visibility	Burn charts, Impediment log	Cumulative flow, Visible queues, Kanban board
Optimization and scalability	Automation, Refactoring, Scrum of Scrum, Meta Scrum	System of systems (Systems thinking); Optimize the *whole system* (not parts)
Control mechanism	Daily Scrums, Sprint Review, Sprint Retrospective	WIP limits, Queue reduction
Validation and Verification	Acceptance test as part of feature specification, Test-driven development	Reduce the total cost of (Defect prevention + Defect detection and correction); Find the root cause and fix it (*5-Why's* may not always work)
Overall	Somewhat revolutionary framework for process change	More evolutionary framework with which to extend your current processes

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Wisdom from Systems Thinking

- **Faster is slower; slower is faster: Rush job → defects, delays**
  - Work in sustainable steady sprints...avoid death march
- **There are Cause ... delay →Effect ... delay → Cause feedback loops; but avoid causation fallacy**
  - Every effect has a cause... but don't assume you can tell which is which!
  - *5-Why's* method is a popular method for the root cause analysis
- **Cause and effect are often far removed in space and time**
  - Consecutive things in order may not have cause-effect relationships
  - Today's problems often come from yesterday's "solutions"
- **Avoid short-termism**
  - Short-term pain vs. long-term gain | Short-term gain vs. long-term pain
- **If it hurts, do it more frequently, and bring the pain forward**
  - Early testing, Continuous integration, Continuous delivery
- **Optimize the whole system, not sub-optimize its parts**
  - Optimize the total cost of (Anticipatory design + Adaptive design)
  - Optimize the total cost of (Defect prevention + defect correction)
  - Take a broader view of *all* organizational systems and their interactions
- **Without lasting behavioral changes, Agile-lean benefits will be limited**

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Unproductive to Productive Behavior Transition
Requires Application of Systems Thinking

Avoid Unproductive Behavior Patterns	Promote Productive Behavior Patterns
Scrum teams of narrow specialists	Cross-functional, Self-organized Scrum teams
Release and Sprint Planning starts bottom-up very tactically. Connection with company strategy is not understood by Scrum teams	Release and Sprint Planning starts with business strategy driving product vision from upper management
Planning is dictated by a manager or at best done by narrow specialists for their narrow areas	Release and Sprint planning is done by the entire team taking full ownership
Estimates are routinely lowered and planning exercise is short-changed to pack a boatload of stories	Estimates are done by the team rigorously and are honored by all; Planning is a first-class citizen done by all team members
Often quality is sacrificed to gain "productivity"	No trade-off between quality and productivity
Each sprint release tests mostly new features, and most regression testing is done in a long hardening sprint	Each sprint release is a potentially shippable release with full-regression testing done with a very high degree of test automation

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Tactical to Strategic Improvements Transition Requires Application of Systems Thinking

Tactical Improvements with Sprint Retrospectives

- Improving user stories
- Improving leveling of the work
- Improving effectiveness of unit testing with test-driven development
- Improving effectiveness of design reviews and code reviews
- Increasing the degree of automated testing
- Improving the build process, continuous integration and continuous delivery
- Measuring and improving defect rates, defect latencies and time to fix
- Improving effectiveness of Daily Scrum meetings
- Improving effectiveness of Sprint retrospectives

But these improvements are unlikely to be enough to make a strategic business impact

Strategic Improvements need Organizational Systems Thinking

- Meeting the real requirements of users
- Improving time to market
- Leaving the competition in dust
- Improving customer satisfaction: quality, performance, support, price
- Improving "Productivity x Quality"
- Aligning business strategy, product vision, and product lifecycle

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Business Strategy & Operations Alignment Requires Systems Thinking

Business strategy: What is the right thing to do?

Operations: How to do things right?

Mission, Values BHAGs

Big Hairy Audacious Goals

Strategic Themes

A common pattern that appears across many elements of strategy

Strategic Objectives

Strategic maps show cause-effect links among strategic objectives and/or initiatives

Strategic Initiatives

Product Lifecycle Operations

Agile-Lean methods

All Other Operations

Lean methods, with Scrum-style process improvements

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More Information

- **Two-day public course on "Agile, Scrum and Lean Methods and Practices" offered through Agile University, NYC, March 29-30, and Philadelphia, April 12-13**
  - 25 hands-on exercises, 17 instrumented templates, 16 PDUs
  - http://www.agileu.org/course_details.jsp?courseid=550
  - **$100 fee rebate for NJ SPIN members or attendees at the NJ SPIN Technical Seminar given on 14 March 2012**

- **Private on-site training and workshops available**
  - Agile-Scrum and Lean Methods
  - Release Planning and Sprint Planning workshops
  - Strategy-driven agile-lean organization

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