



# **The Roots of Scrum: How Japanese Manufacturing Changed Global Software Development Practices**

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*Co-Chair, HL7 Orders and Observations Technical Committee*

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# Jeff Sutherland

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- Agile Systems Architect
  - CTO/VP Engineering for 9 software companies
  - Prototyped Scrum in 4 companies
  - Conceived and executed first Scrum at Easel Corp. in 1993
  - Rolled out Scrum in 5 companies 1993-2005
  - Helped Ken Schwaber roll out Scrum to industry
  
- Signatory of Agile Manifesto and founder of Agile Alliance
  
- Available 1/3 time for Scrum training, mentoring, peer review, and consulting

# Roots of Scrum

- Team process – Silicon Valley entrepreneurs
- Takeuchi and Nonaka – Japanese manufacturing
- Making the world a better place – inner vision
- Object technology and Easel Smalltalk product
  - OOAD design tool experts, vendors, customers
- Evolutionary biology and complex adaptive systems
- Process and productivity research
  - Software Productivity Research
  - Surgical Team (Mythical Man Month, IBM)
  - Wicked Problems, Righteous Solutions
  - Borland Quattro Pro project
- iRobot – subsumption architecture

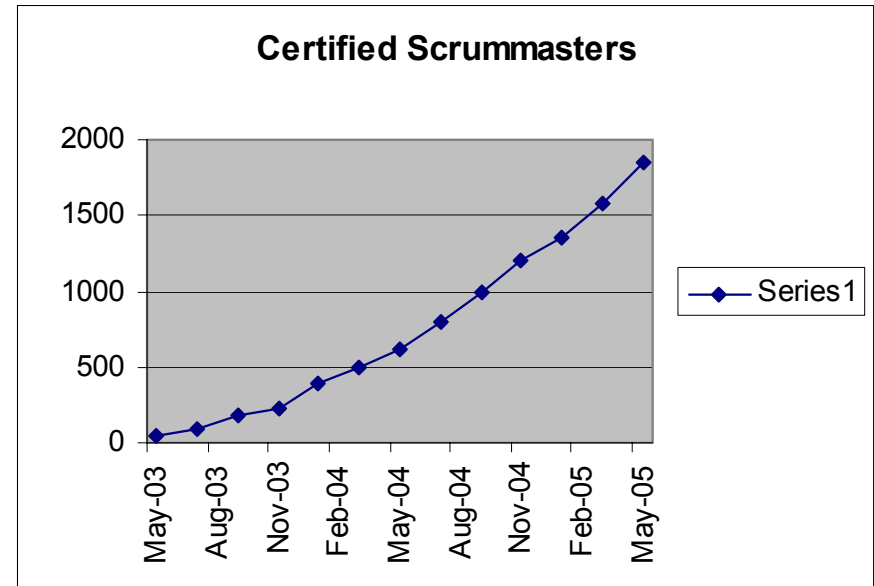


# Toyota Motor Manufacturing North America Mission

1. As an American company, contribute to the economic growth of the **community** and the United States.
2. As an independent company, contribute to the **stability and well-being of team members**.
3. As a Toyota group company, contribute to the overall growth of Toyota by **adding value to our customers**.

# Scrum Community of Practice

- At start was 80/20 external to internal developers
- Currently ratio has reversed to 20/80
- Scaling # of instructors



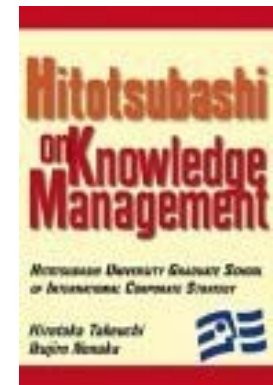
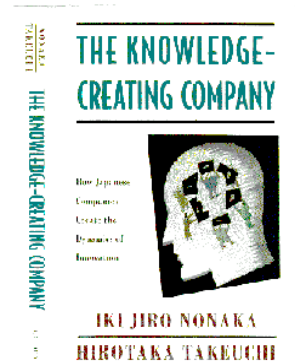
Computerworld estimates that over 2/3 of Internet projects in the U.S. use Agile methods, about 167,000 projects. (Sliwa, 2002)

# Godfathers of Scrum: Hirotaka Takeuchi and Ikujiro Nonaka

Takeuchi, Hirotaka and Nonaka, Ikujiro. 1986. The new new product development game. Harvard Business Review 64:1:137-146 (Jan/Feb), reprint no. 86116.

Takeuchi, Hirotaka and Nonaka, Ikujiro. 1995. The Knowledge-Creating Company : How Japanese companies create the dynamics of innovation. New York, Oxford University Press.

Takeuchi, Hirotaka and Nonaka, Ikujiro. 2004. Hitotsubashi on Knowledge Management. Singapore: John Wiley & Sons (Asia).



## Theory: Scrum Origins

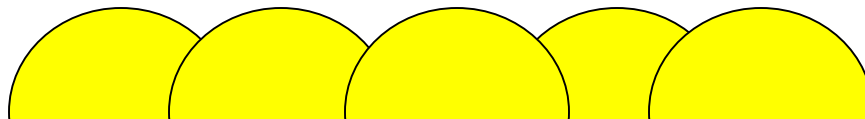
# Project Management Styles

Requirements      Analysis      Design      Implementation      Testing



**Type A – Isolated cycles of work**

**NASA Waterfall**



**Type B – Overlapping work**

**Fuji-Xerox Scrum**



**Type C – All at once**

**Honda Scrum**

*The overlapping of phases does away with traditional notions about division of labor. Takeuchi and Nonaka (1986)*



# Rugby Scrum

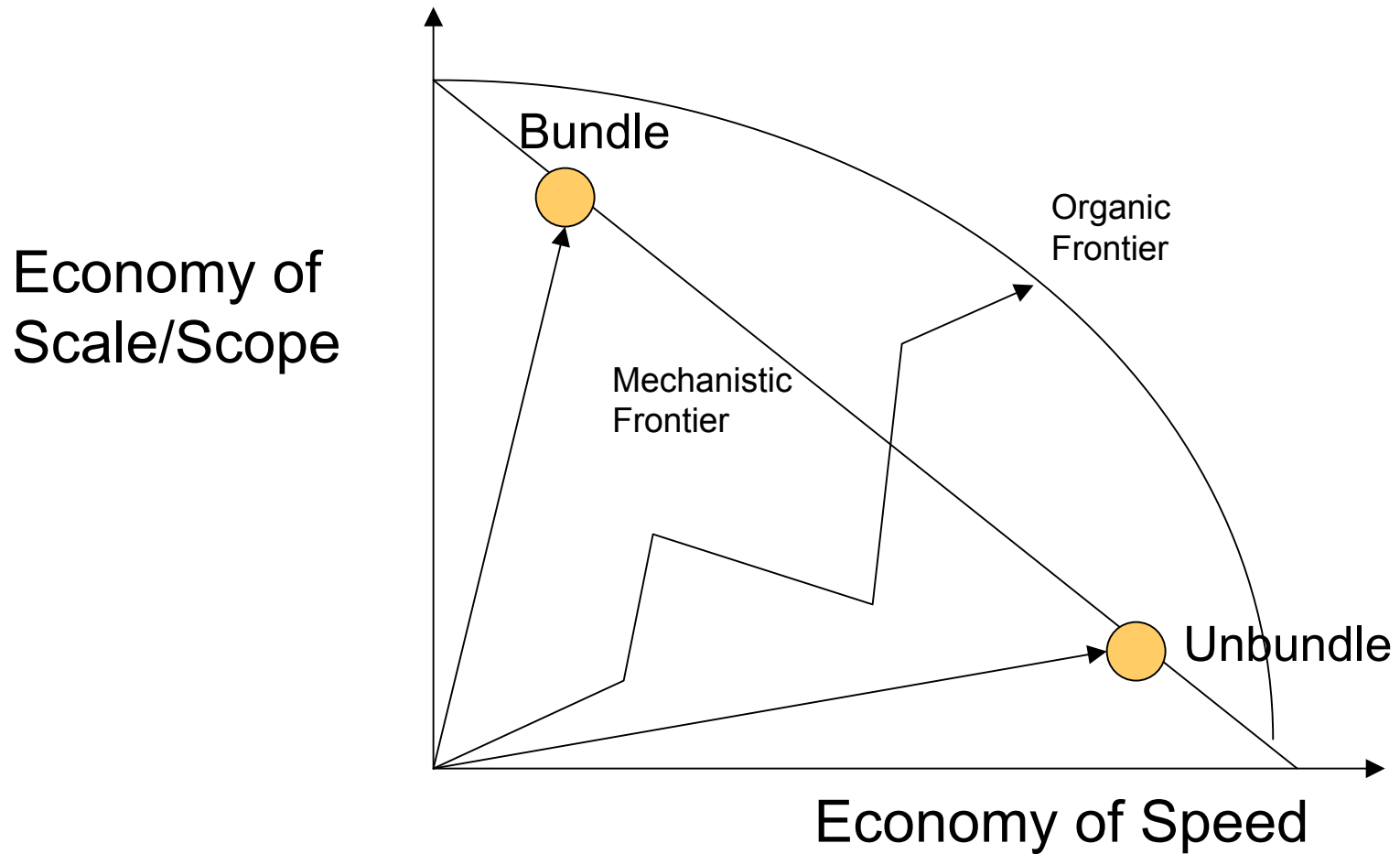




# Toyota synthesis of constraints

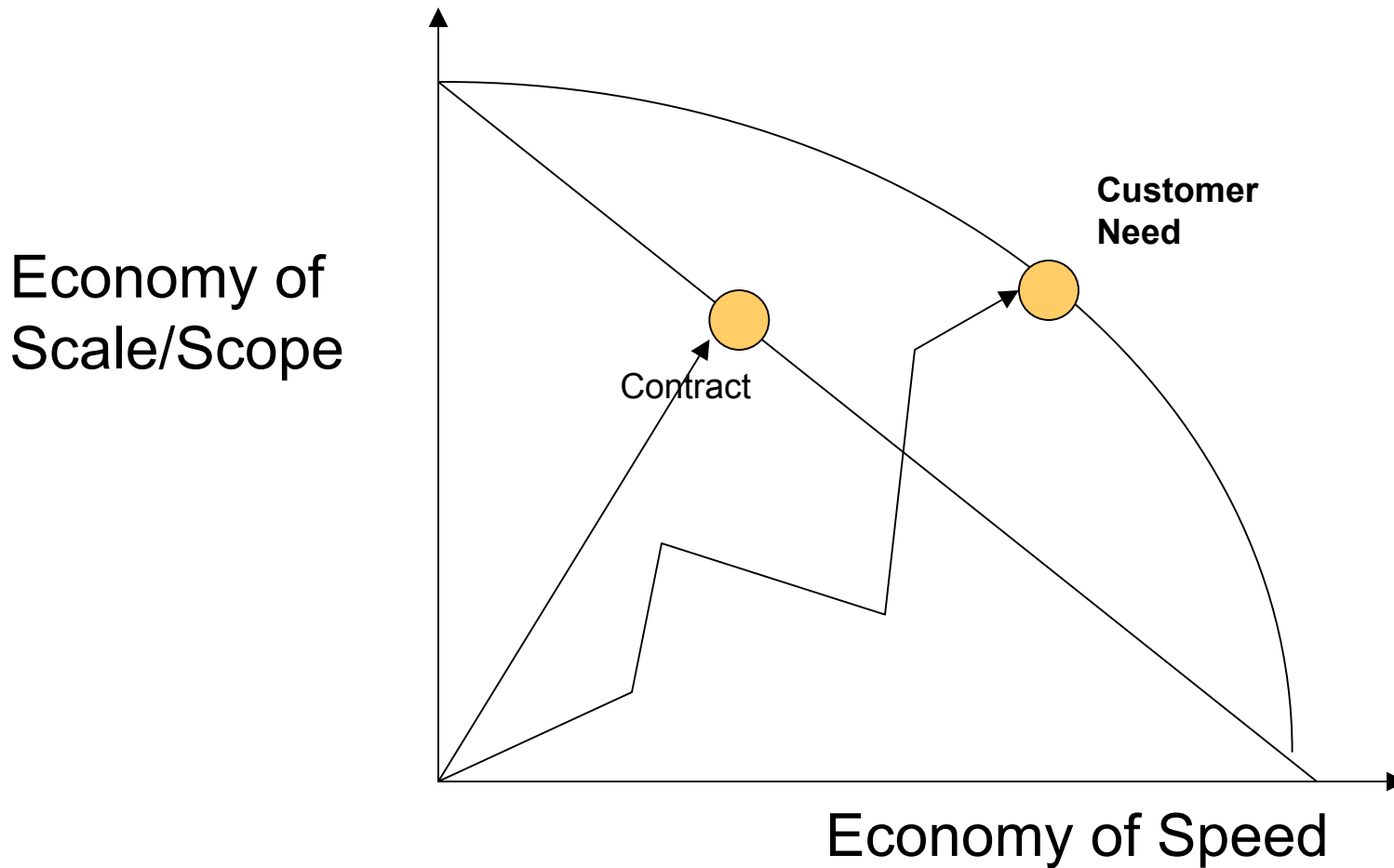
- Historical assumption is that high quality, product variety, and low cost cannot be achieved simultaneously.
- Toyota production system is based on totally different way of thinking.
- Through knowledge creation by synthesis of contradictions, Toyota pushes the envelope.
- High quality, high variety, and low cost all at once.

# Synthesize, not Optimize



Takeuchi, Hirotaka and Nonaka, Ikujiro. 2004. Hitotsubashi on Knowledge Management. Singapore: John Wiley & Sons (Asia).

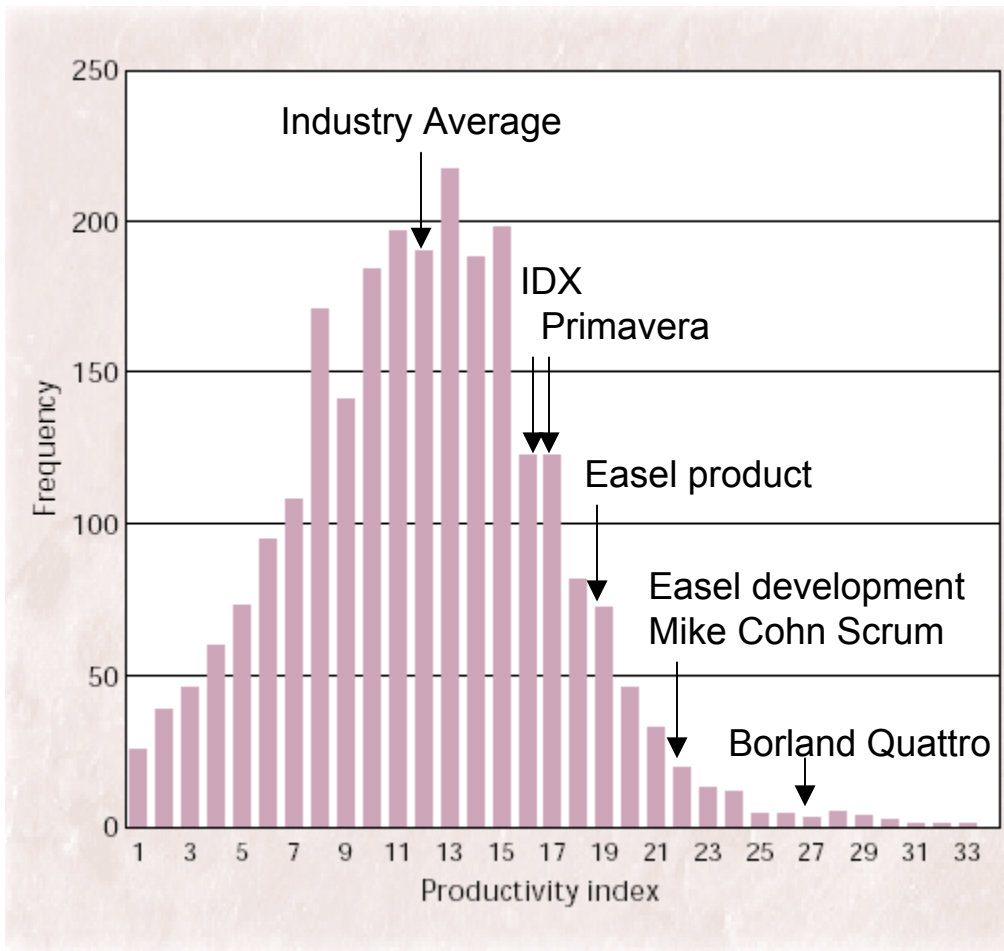
# What the Customer Wants



# Scrum cuts through cost, time, functionality barriers

- Agile process – adapt and inspect
- Iterative, incremental – close to customer
- Used to manage complex projects since 1990;
- Delivers business functionality every 30 days;
- Extremely simple but very hard

# We simultaneously want FASTER: Putnam Process Productivity Index



■  $N = 1.27^{*(N-1)}$

■ 33 is 2098 times 1

Myers, W., Why Software Developers Refuse to Improve. Computer, 1998. 31(4) 110-112

# And BETTER

- Productivity – product backlog requirements completed per 100,000 investment

<b>Months since Type B Scrum implemented</b>	<b>3</b>	<b>12</b>	<b>24</b>
<b>Productivity</b>	<b>4.5</b>	<b>9.0</b>	<b>12.2</b>
<b>Quality</b>	<b>100+</b>	<b>100</b>	<b>5</b>

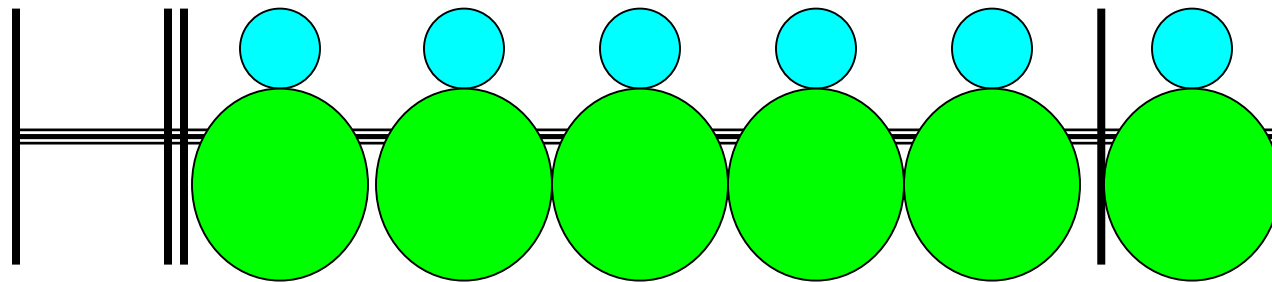
Source: Primavera



# And MORE for LESS

1. Welcome changing requirements, even late in development.
2. Deliver working software frequently.
3. Business people and developers must work together daily.

**Scrum is ITERATIVE, customer can CHANGE requirements, and solution EMERGES through self-organization**



Scaling  
Planning      Developing      Implement

# Cultural Change – The Hard Part

<i>Old Organization</i>	<i>New Organization</i>
Centralized	Distributed
Unified perspective	Diversified perspective
Original meaning	Emergent meaning
Analytical	Creative
Analysis to action	Learning by doing
Rational	Redundant
Certain	Uncertain
Strategy concept	Local action
Authoritative	Participative
Hierarchical	Flat

# Breaking down command and control

- Strategy is developed centrally in traditional companies.
- Emergent strategy self-organizes through local actions.
  - Distributed cognition and actions
- Scrum team must be allowed to self-organize
  - Autonomous
  - Transcendent
  - Cross-fertilization
- Team chooses own work
  - Individuals manage their own work
  - Management gets out of the way

# Google strategy:

## Getting management out of the way

- When Rosing started at Google in 2001, "we had management in engineering. And the structure was tending to tell people, No, you can't do that." So Google got rid of the managers. Now most engineers work in teams of three, with project leadership rotating among team members. If something isn't right, even if it's in a product that has already gone public, teams fix it without asking anyone. *Agile Principle #5, 9, 12*
- "For a while," Rosing says, "I had 160 direct reports. No managers. It worked because the teams knew what they had to do. That set a cultural bit in people's heads: You are the boss. Don't wait to take the hill. Don't wait to be managed." *Agile Principle #1, 3*
- And if you fail, fine. On to the next idea. "There's faith here in the ability of smart, well-motivated people to do the right thing," Rosing says. "Anything that gets in the way of that is evil." *Agile Principle #5, 12*

*Fast Company. April, 2003.*

# Diversified perspective

- Cross-functional teams
- Scrum team has product knowledge, business analysts, user interface design, software engineers, QA
- Advanced Scrum pulls in additional stakeholders – management, customers, installation, and support.

# Toyota Prius – emergent strategy

- Revolution in product, technologies, and process
  - Does not fit any product line. Designed for new perspective.
- Uses many technologies
  - Engine, motor, battery, braking combine into hybrid system
- Developed in record time
  - 15 months instead of four years
- Overlapping phases
  - Research, development, design, production
- Leaders built, utilized, and energized “*ba*”



# Concept of *ba*:

## *the zen of Scrum*

- Dynamic interaction of individuals and organization creates a synthesis in the form of a self-organizing team.
- It provides a shared context in which individuals can interact with each other.
- Team members create new points of view and resolve contradictions through dialogue.
- *Ba* is shared context in motion where knowledge as a stream of meaning emerges.
- *Emergent knowledge codified into working software self-organizes into a product.*

# Prius project team managed “Ba”

- Leaders can “find” and utilize spontaneously formed *ba*
- Leaders can build *ba* by providing space for interactions
  - Physical space such as meeting rooms
  - Cyberspace such as computer network
  - Mental space such as common goals
- Fostering love, care, trust, and commitment forms the foundation of knowledge creation (self-organization)
- *Scrum is based on TRUTH, TRANSPARENCY, and COMMITMENT*

# Energy of ba is given by its self-organizing nature

- *Ba* needs to be “energized” with its own intention, direction, interest, or mission to be directed effectively.
- Leaders provide autonomy, creative chaos, redundancy, requisite variety, love, care, trust and commitment.
- Prius creative chaos was generated by demanding goals. Uchiyamada demanded that his team question every norm on new car development.
- Top management put Prius project team under great time pressure which caused extreme use of simultaneous engineering
- Equal access to information at all levels was critical
- *ScrumMaster and management must “energize” ba through facilitating colocation, dynamic interaction, face to face communication, transparency, and audacious goals.*

# SCRUM Sprint Cycle

## Product Backlog:

Prioritized list of features required by the customer



## Sprint Backlog:

Features to be done this sprint.  
Features are expanded into smaller tasks.



Workday:  
One Day

Every Day, a 15-minute meeting is held, and the SCRUM Master asks the 3 questions:

- 1) What have you accomplished since the last meeting?
- 2) Are there any obstacles in the way of meeting your goals?
- 3) What will you accomplish before the next meeting?

Sprint:  
One Month

## New Functionality

is demonstrated at the end of each sprint.



Graphic by Conchango, Ken Schwaber, and Microsoft UK

# Toyota Way: Learn by Doing

Fujio Cho, President, 2002

- We place the highest value on actual implementation and taking action. *Agile Principle #1*
- There are many things one doesn't understand the therefore, we ask them why don't you just go ahead and take action? *Agile Principle #3, #11*
- You realize how little you know and you face your own failures and redo it again and at the second trial you realize another mistake ... so you can redo it once again. *Agile Principle #11, #12*
- So by constant improvement ... one can rise to the higher level of practice and knowledge. *Agile Principle #3*

# Toyota way allows for redundancy and failures

- Emergent processes, like biological evolution, produces failures
- Fail early and often for rapid learning and faster evolution
- Rational and efficient approaches to emergent solutions will cause train wrecks
  - Large systems 65% failure rate – Caper Jones, 1993
  - DOD systems 75% failure rate – Jarzombek, 1999
  - UK systems 87% failure rate – Thomas, 2001

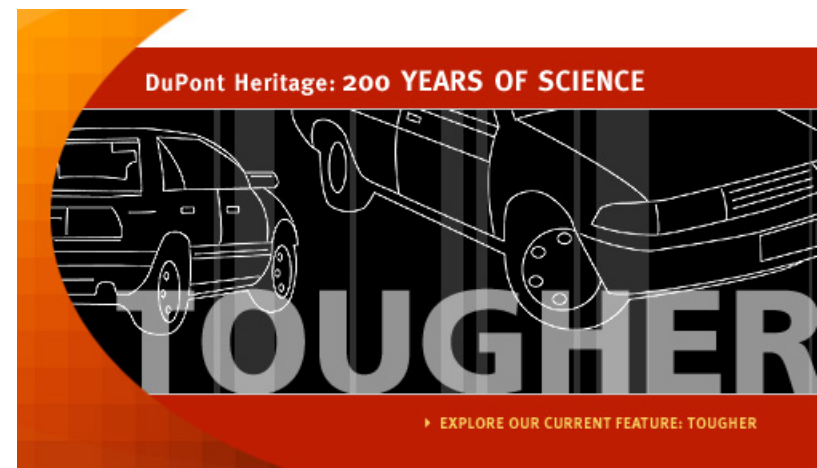


## Theory: Process

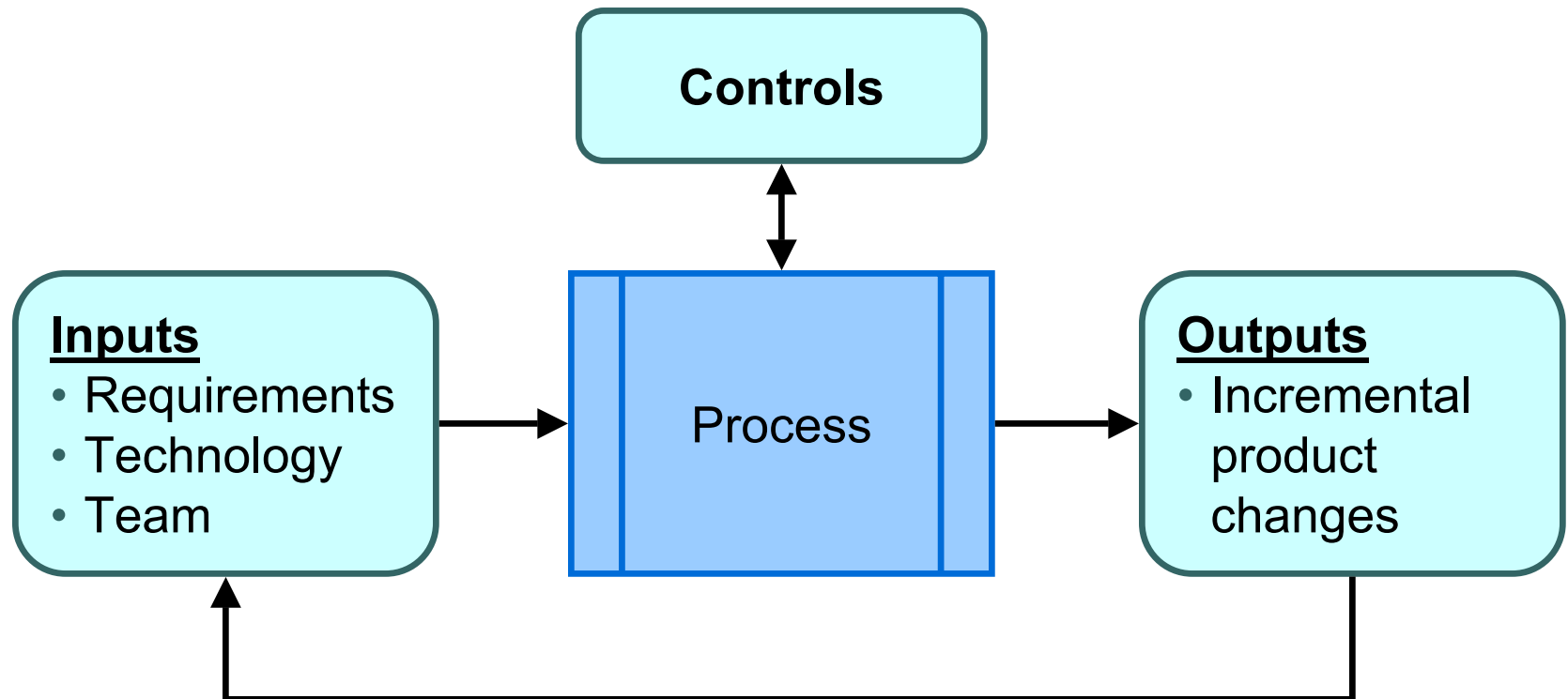
# Defined vs. Empirical Process

- It is typical to adopt the defined (theoretical) modeling approach when the underlying mechanisms by which a process operates are reasonably well understood. When the process is too complicated for the defined approach, the empirical approach is the appropriate choice.

*Process Dynamics, Modeling, and Control.* Ogunnaike and Ray, Oxford University Press, 1992



# Uncertainty demands Empirical process control



Adapted from *Agile Software Development with Scrum* by Ken Schwaber and Mike Beedle. Courtesy of Mike Cohn, Mountain Goat Software

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# Local action forces self-organization

- Individual self-organizes work
- Team self-organizes around goals
- Architecture self-organizes around working code
- Product emerges through iterative adaptation
- Requires participative approach as opposed to authoritative approach
- Flat organizational structure

# First Scrum – Easel 1993

- Abandoned GANTT charts
- Abandoned job titles
- Created ScrumMaster
- Created Product Owner
- Daily meetings to foster self-organization
- Shielded team from interference during Sprint
- Sprint planning, Sprint review, demo, retrospective
- Agnostic about engineering practices
- Used XP engineering practices

# Scrum Influence on eXtreme Programming

From: Kent Beck To: Jeff Sutherland <jsutherland>

Reply: 70761.1216@compuserve.com

Date: Mon, 15 May 1995 18:01:15 -0400 (EDT)

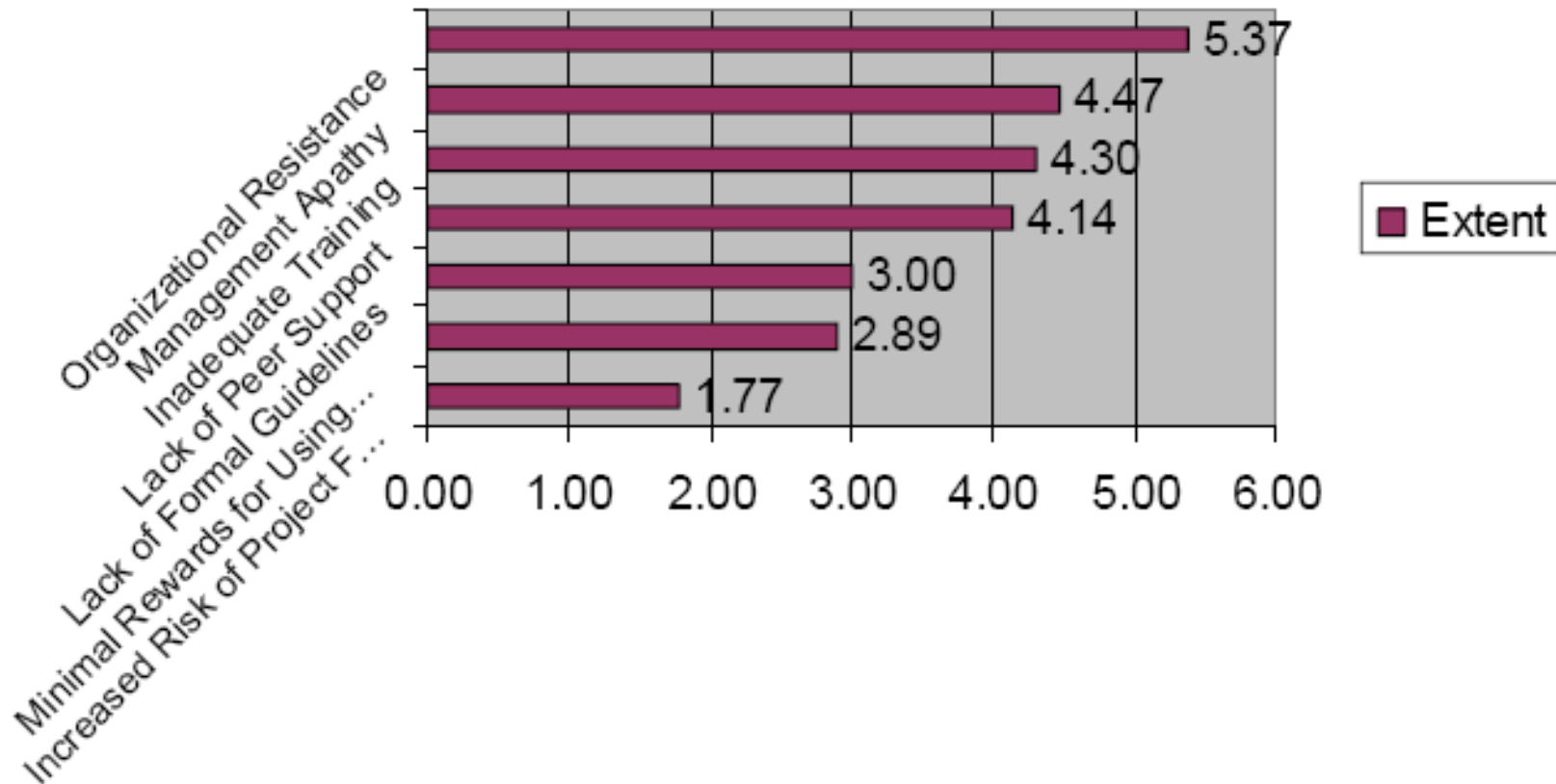
Subj: HBR paper

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Is there a good place to get reprints of the SCRUM paper from HBR? I've written patterns for something very similar and I want to make sure I steal as many ideas as possible.

Kent

# Problems / Challenges Adopting & Using Agile



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154 Rockwell Hall, Department of Computer Information Systems, Colorado State University  
Fort Collins, Colorado 80523-1277

# Key Roles and Responsibilities



## Product Owner

- ▶ Defines the features of the product, decides on release date and content
- ▶ Is responsible for the profitability of the product (ROI)
- ▶ Prioritizes features according to market value
- ▶ Can change features and priority every 30 days
- ▶ Accepts or rejects work results



## ScrumMaster

- ▶ Ensures that the team is fully functional and productive
- ▶ Enables close cooperation across all roles and functions and removes barriers
- ▶ Shields the team from external interferences
- ▶ Ensures that the process is followed. Invites to daily scrum, iteration review and planning meetings



## Team

- ▶ Cross-functional, seven plus/minus two members
- ▶ Selects the iteration goal and specifies work results
- ▶ Has the right to do everything within the boundaries of the project guidelines to reach the iteration goal
- ▶ Organizes itself and its work
- ▶ Demos work results to the Product Owner

# **Toyota Way applied to best of lean U.S. companies (industrial sensor company)**

- 93% reduction in lead time to product product
- 83% reduction in work-in-progress inventory
- 91% reduction in finished goods inventory
- 50% reduction in overtime
- 83% improvement in productivity



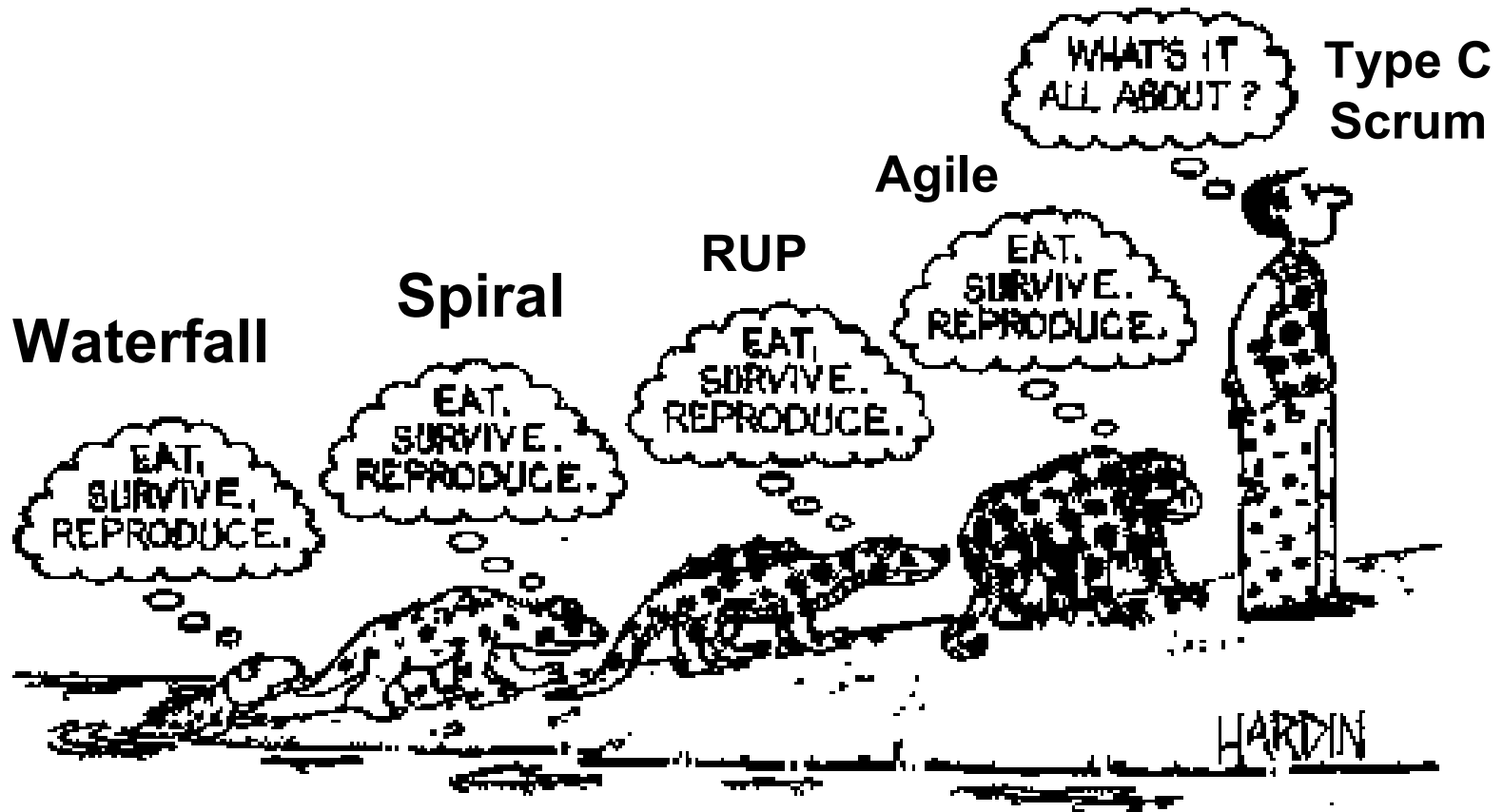
# Toyota is insourcing to the U.S.

- Average reduction in cost by U.S. company outsourcing is 20%.
- Toyota gets 80% gain in productivity with U.S. workers in U.S. manufacturing plants.
- WildCard began insourcing in the U.S. six months after starting Scrum.
  - Acquired within 12 months
  - Major reason was Scrum process

# Lexus *Ba* Creates Market Share

	1989	1995	2000
Lexus	1.5	7.5	12.25
Infinity	0.2	3.9	3.88
Acura	5.8	3.4	6.94
Mercedes	6.8	7.3	12.22
BMW	5.8	8.3	9.67
Cadillac	24.0	17.1	11.24
Lincoln	18.0	14.2	11.47

# Climbing out of the tar pit ...

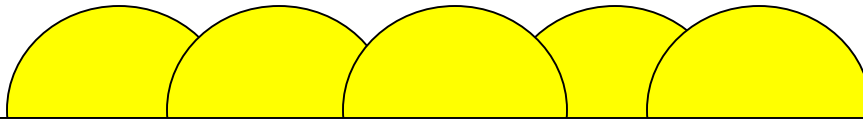


## Theory: Scrum Evolution

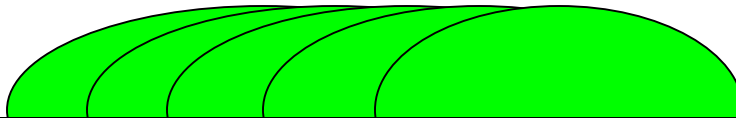
# Type A, B, C Sprints



**Type A – Isolated cycles of work**



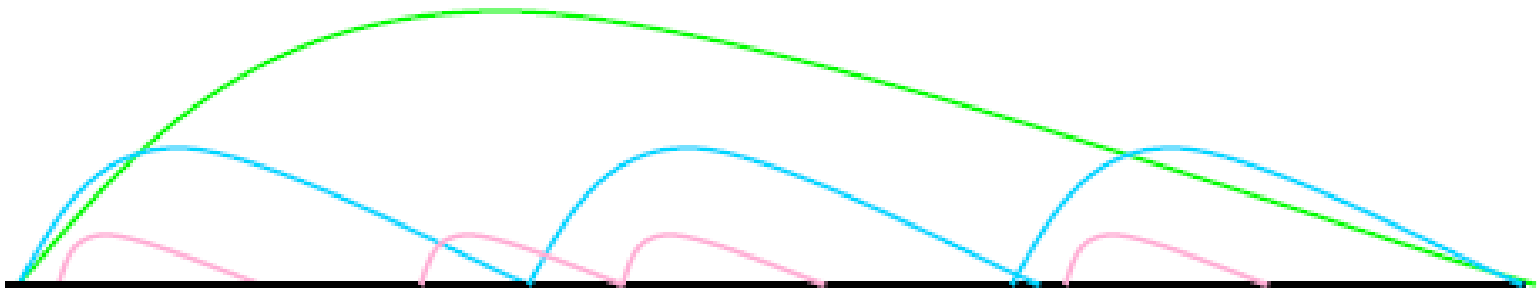
**Type B – Overlapping iterations**



**Type C – All at once**

*The overlapping of phases does away with traditional notions about division of labor. Takeuchi and Nonaka (1986)*

# Simultaneous Overlapping Sprints



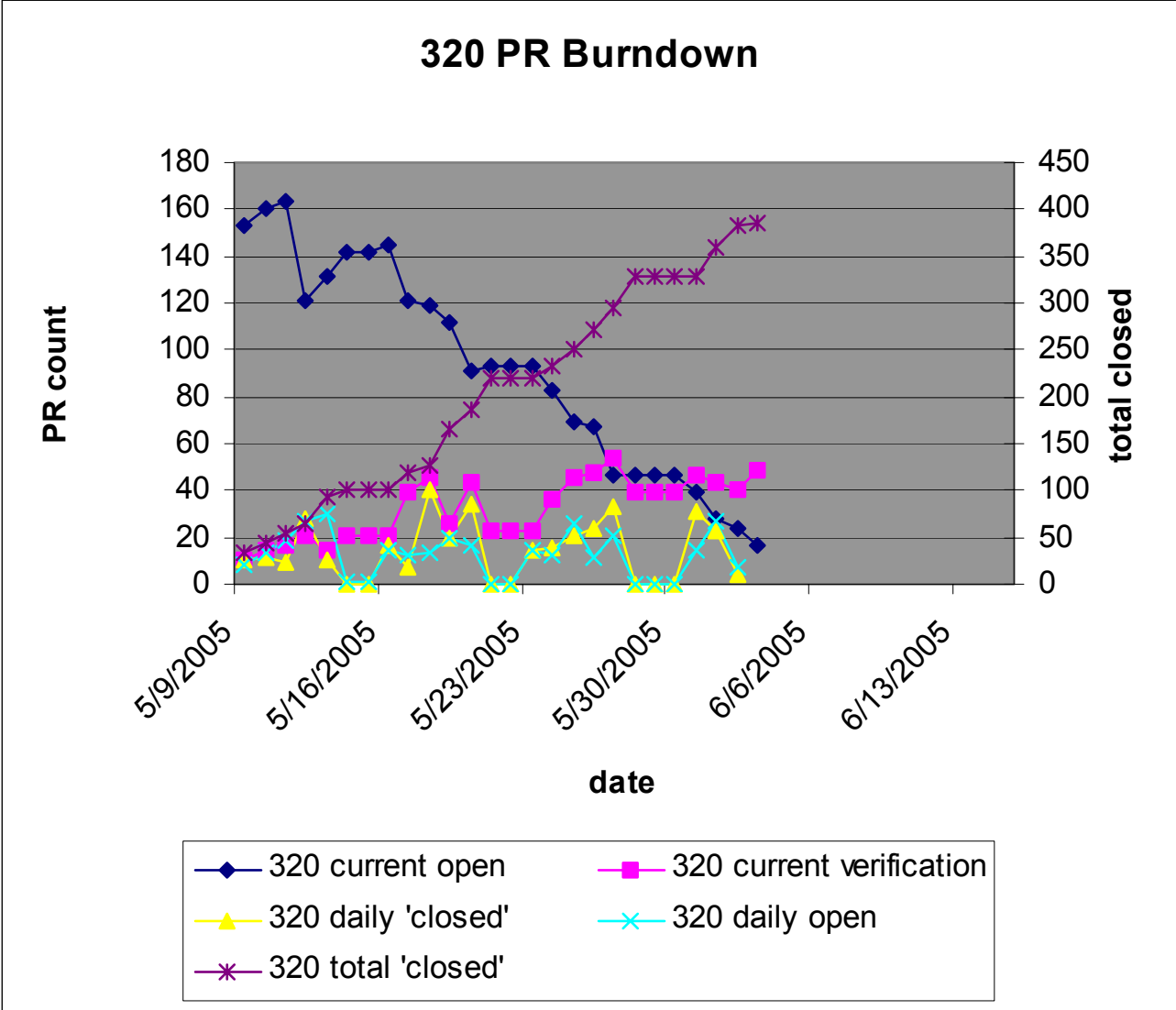
Red - weekly

Blue - monthly

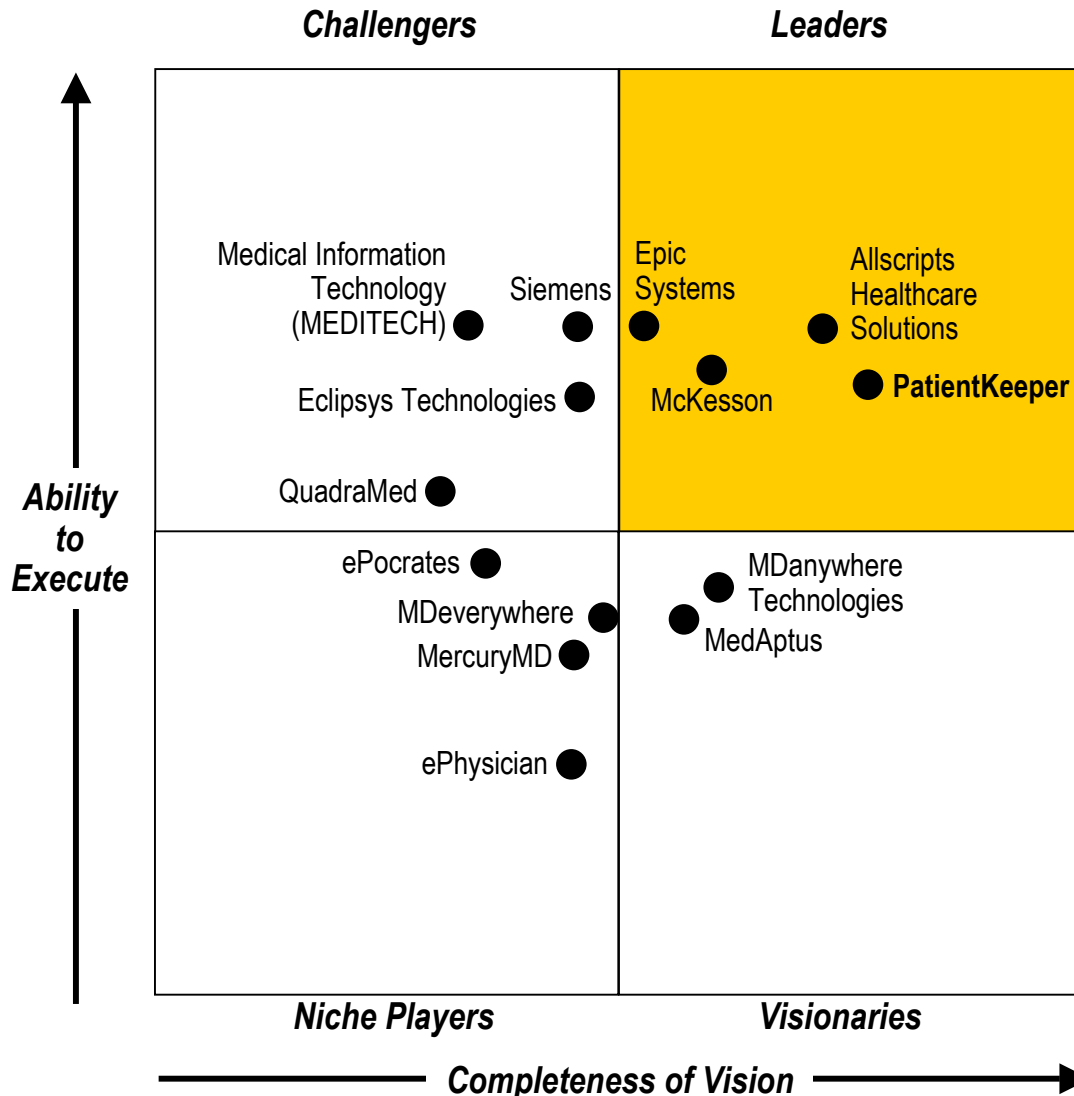
Green - quarterly

*PatientKeeper delivered 45 production releases of quality code to large healthcare systems in 2004.*

# Project Reporting



# Practice: Agility Using Scrum Type C to Capture Industry Leadership



## Gartner Magic Quadrant

"PatientKeeper is one of the best-funded and strongest vendors in the mobile/wireless healthcare market. It is one of the few to market itself as providing a mobile computing infrastructure and development environment for which it, and other vendors, system integrators and users, can develop their own mobile applications. It supports both the Palm and Pocket PC platforms."

— Ken Kleinberg, Gartner Research



Questions?



# References

1. Schwaber, K., *Agile project management with Scrum*. 2004, Redmond, Wash.: Microsoft Press.
2. Schwaber, K. and M. Beedle, *Agile software development with scrum*. Series in agile software development. 2002, Upper Saddle River, NJ: Prentice Hall. xvi, 158 p.
3. Takeuchi, H. and I. Nonaka, *The New New Product Development Game*. Harvard Business Review, 1986(January-February).
4. Sutherland, J., *Agile Development: Lessons Learned from the First Scrum*. Cutter Agile Project Management Advisory Service: Executive Update, 2004. 5(20): p. 1-4.
5. Sutherland, J., *Agile Can Scale: Inventing and Reinventing SCRUM in Five Companies*. Cutter IT Journal, 2001. 14(12): p. 5-11.
6. Kleinberg, K. and T. Berg, *Mobile Healthcare: Applications, Vendors and Adoption*, in *Strategic Analysis Report*, R-17-7369, Editor. 2002, Gartner Group. p. 1-44.
7. Sutherland, J. *Future of Scrum: Pipelining of Sprints in Complex Projects*. in *AGILE 2005 Conference*. 2005. Denver, CO: IEEE.