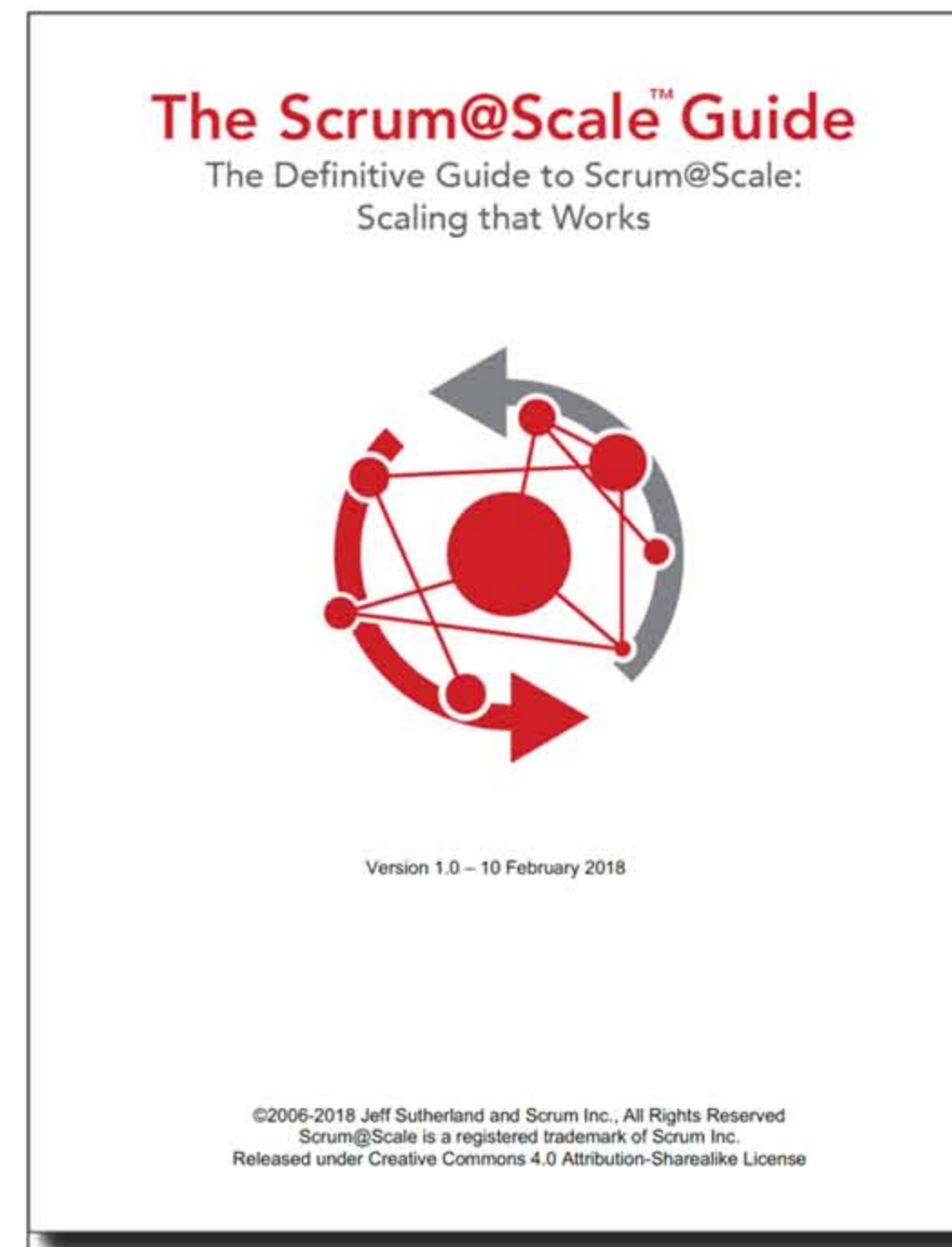
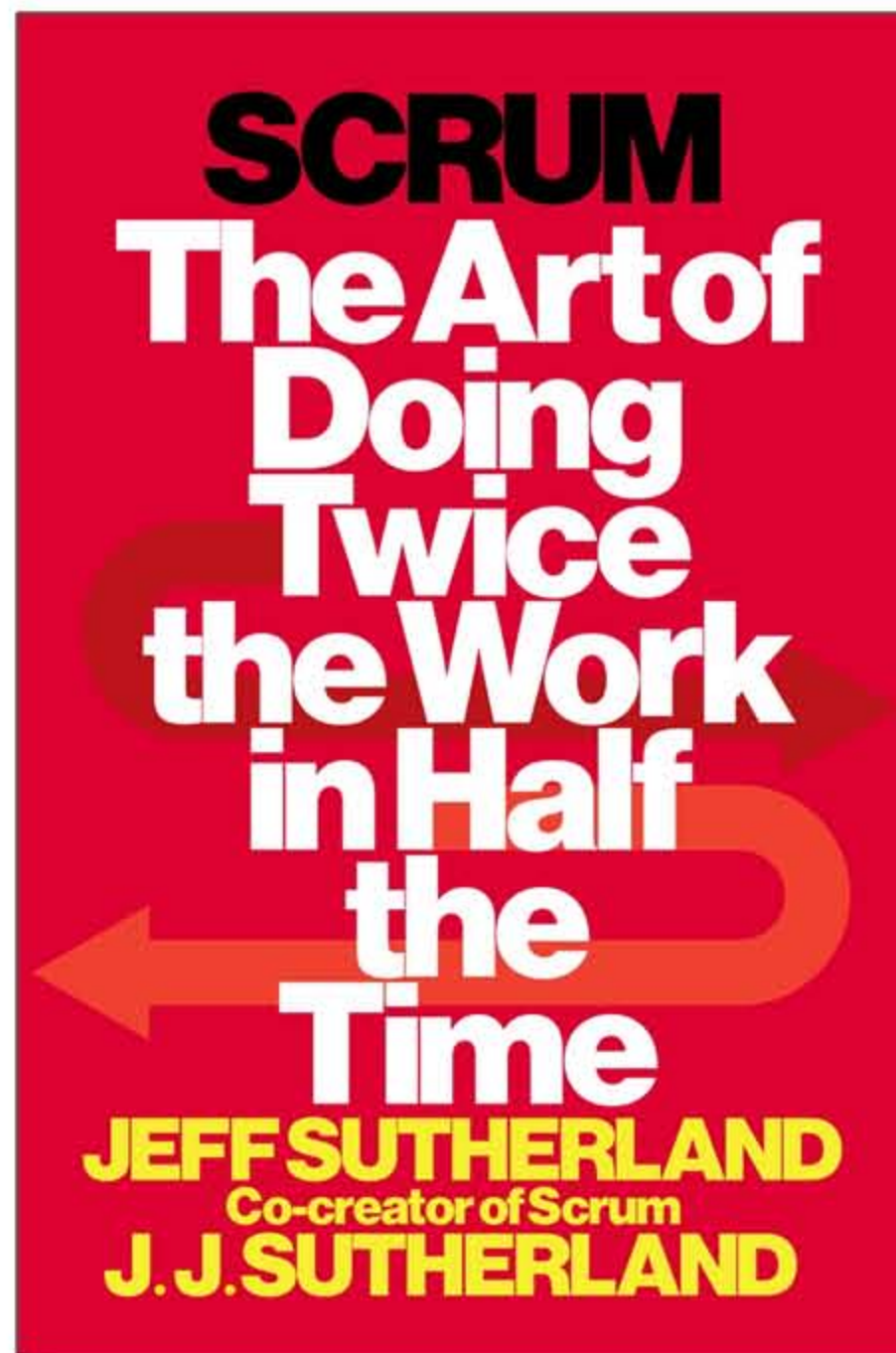


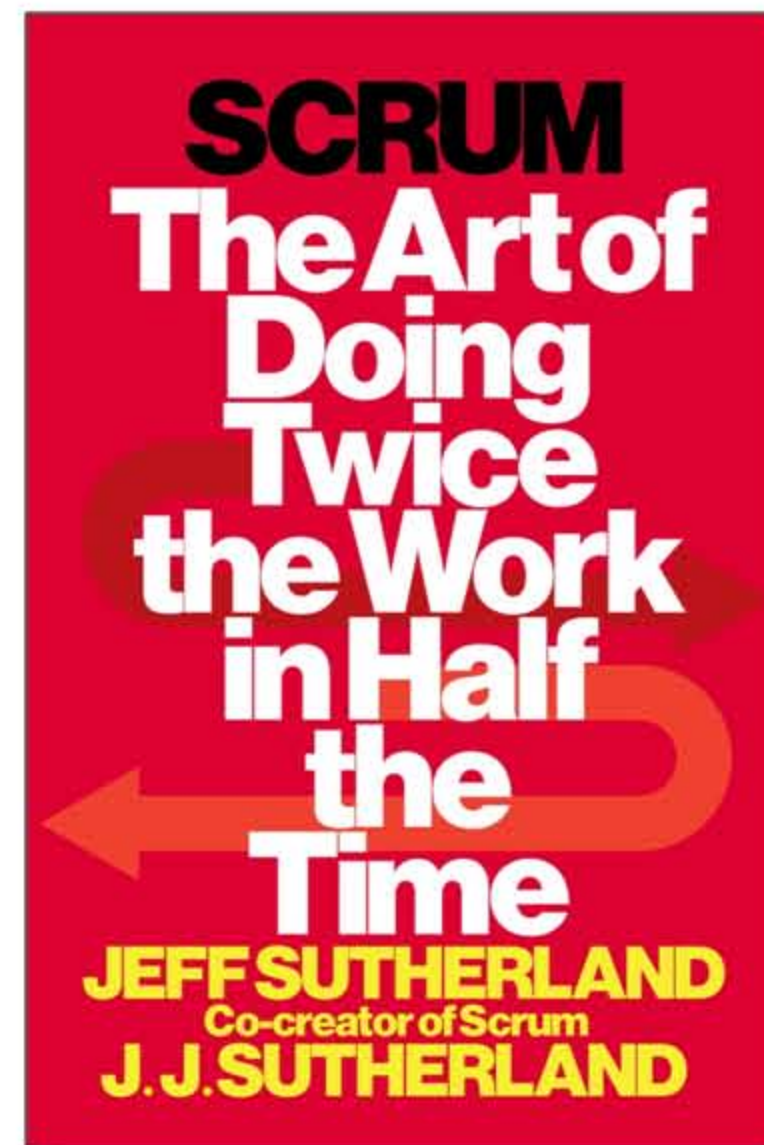
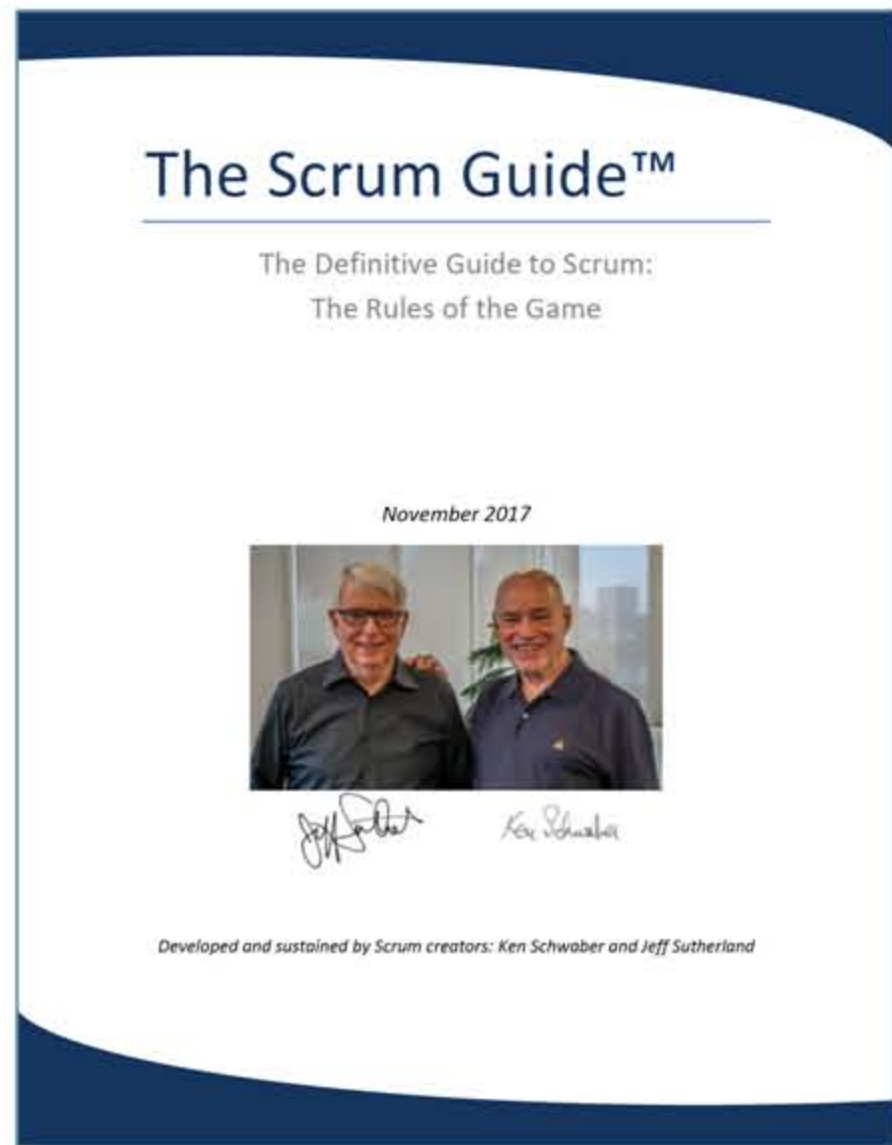


Linear Scalability: The Holy Grail of Agile Project Management

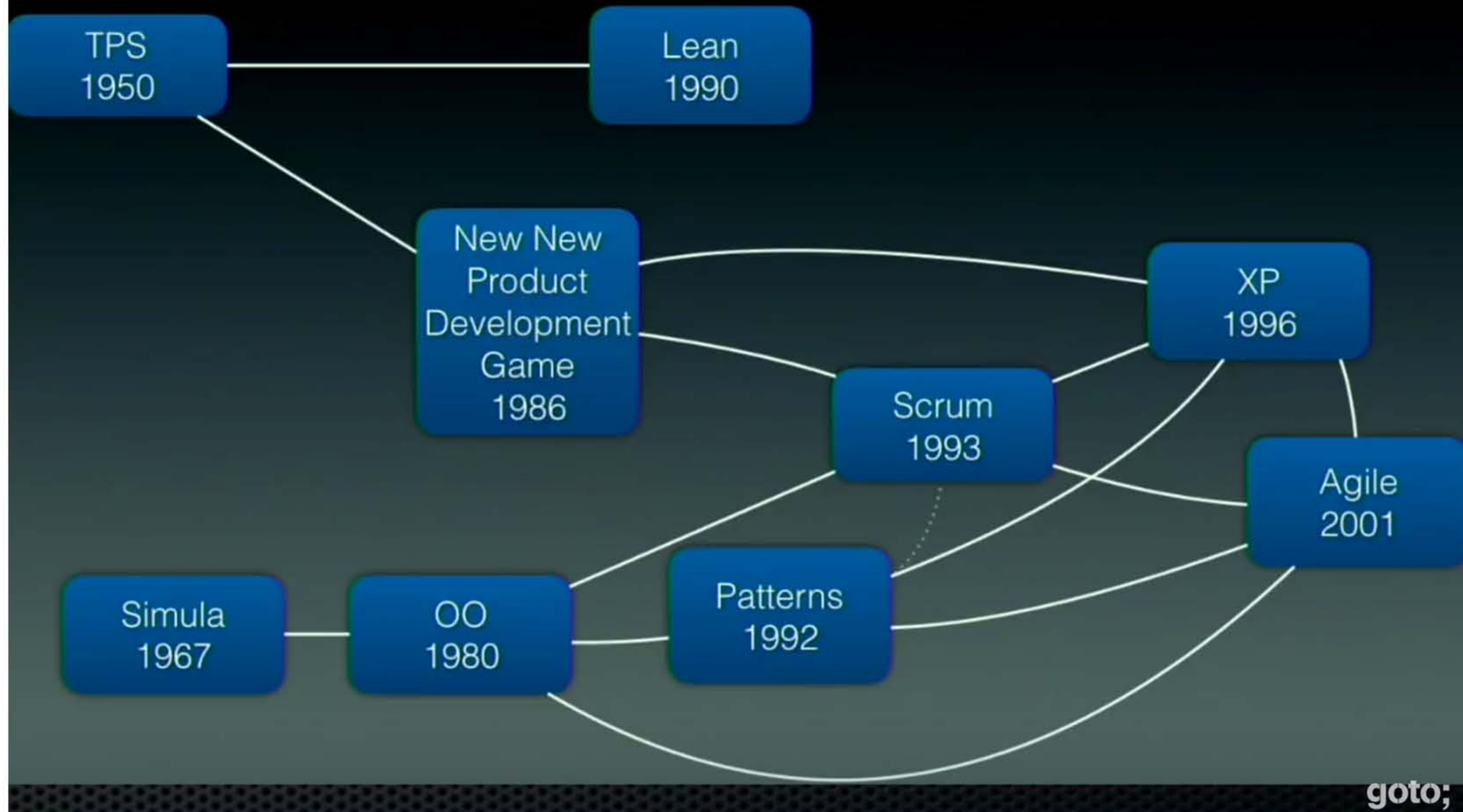


Agile New England – 4 April 2019 - Jeff Sutherland

Scrum Inc: Enhancing the Knowledge and Deployment of Scrum



A Family Tree

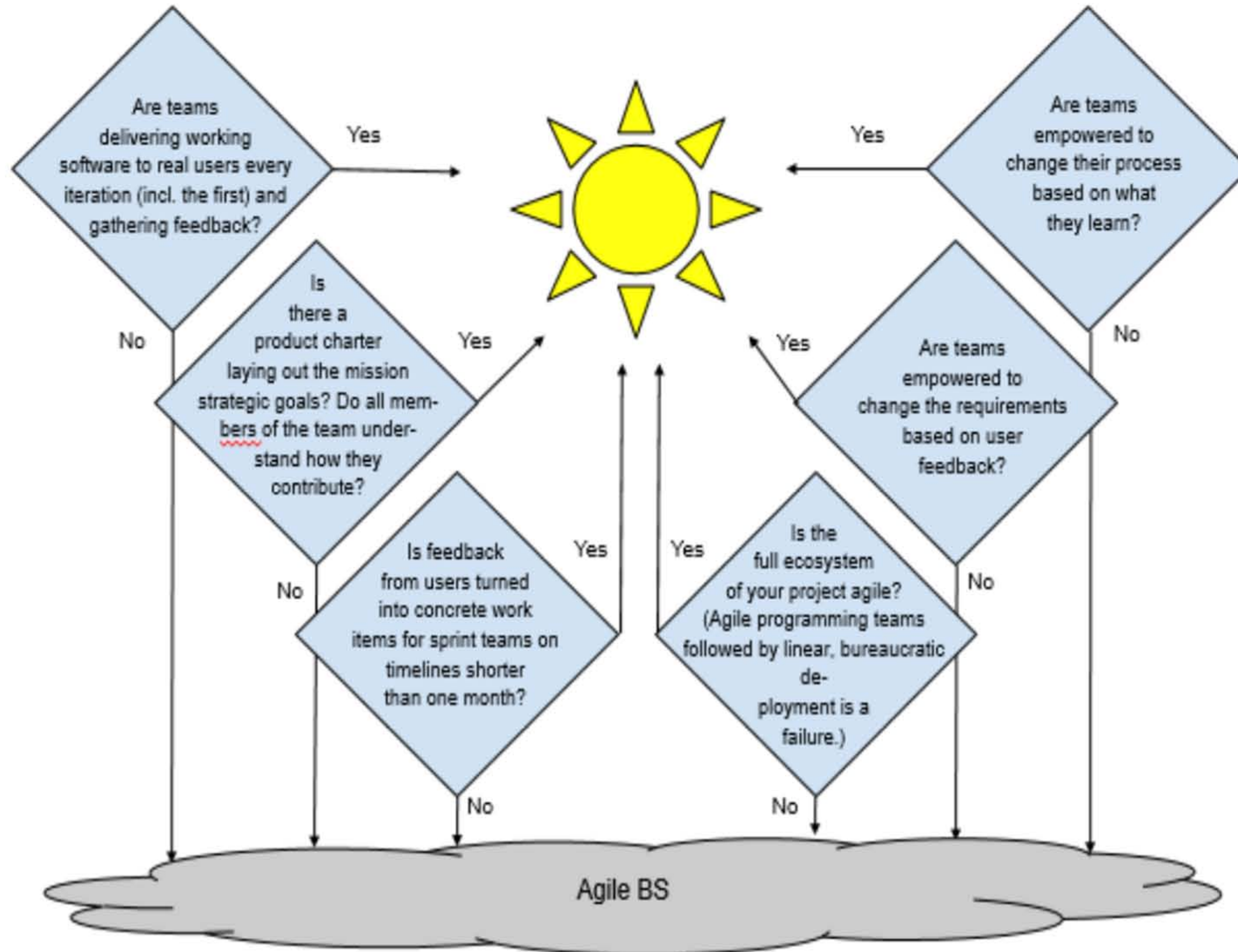


Source: Jim Coplien (2017)
The Dehumanization of Agile
and Objects. GOTO, Berlin.



Defense Innovation Board Guide: Detecting Agile BS

U.S. Department of Defense, Version 0.4 Working Draft



Meet the Board

The DIB members are distinguished leaders with a track record of leading large, innovative organizations or conducting groundbreaking research in technical areas relevant to DoD. Dr. Eric Schmidt, former Executive Chairman of Alphabet, Inc., chairs the DIB, whose members include prominent business leaders, scholars, entrepreneurs, inventors, scientists, and technologists.



MILO MEDIN
Vice President, Wireless Services, Google



MICHAEL MCQUADE
Vice President for Research, Carnegie Mellon University



ERIC SCHMIDT
Technical Advisor, Alphabet, Inc



ADAM M. GRANT
Professor, Wharton School of Business



RICHARD MURRAY
Professor, California Institute of Technology



MARY "MISSY" CUMMINGS
Professor in the Department of Mechanical Engineering and Materials Science, Duke University



ERIC LANDER
President and Founding Director, The Broad Institute



JENNIFER PAHLKA
Founder & Executive Director, Code for America



WALTER ISAACSON
Former President and CEO, Aspen Institute



MARK SIRANGELO
Entrepreneur Scholar in Residence, University of Colorado



NEIL DEGRASSE TYSON
Director, Hayden Planetarium



DANNY HILLIS
Computer Theorist & Co-Founder, Applied Inventions



REID HOFFMAN
Co-founder, LinkedIn & Partner, Greylock Partners



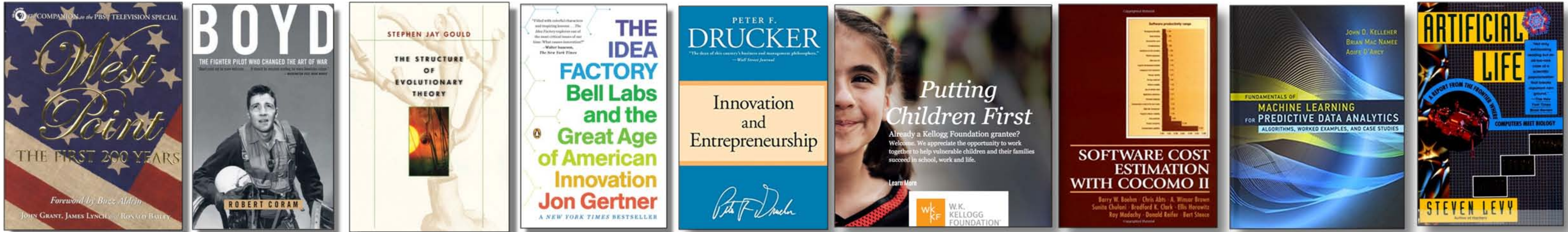
MARNE LEVINE
Chief Operating Officer, Instagram



KURT DELBENE
Chief Digital Officer and Executive Vice President, Microsoft

Scrum Is a Massive Research Project: 1983-2019

USMA USAF UCSM Bell Labs MidContinent Kellogg Saddlebrook Individual Graphael ODB iRobot Grameen Bank Easel VMARK IDX PatientKeeper OpenView Venture Partners ScrumInc



Scrum Concepts

Scrum Prototypes

Jeff Sutherland

19.6 · Institute of Electrical and Electronics Engineers

Department
Scrum Inc

Skills and Expertise

Scrum · Software · Agile Software Development

70

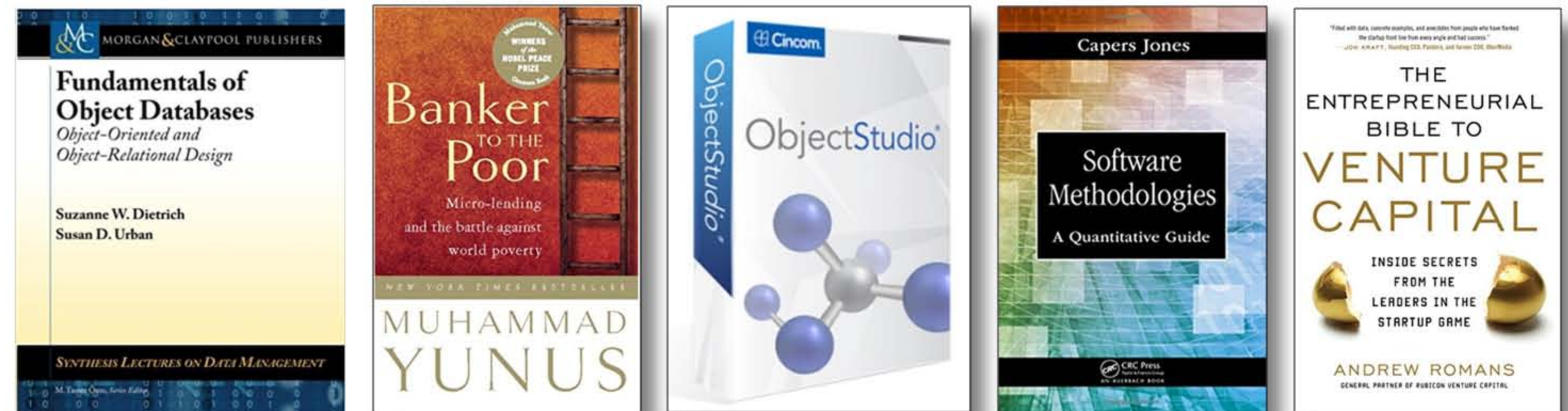
Research items

23,814

Reads ⓘ

1,335

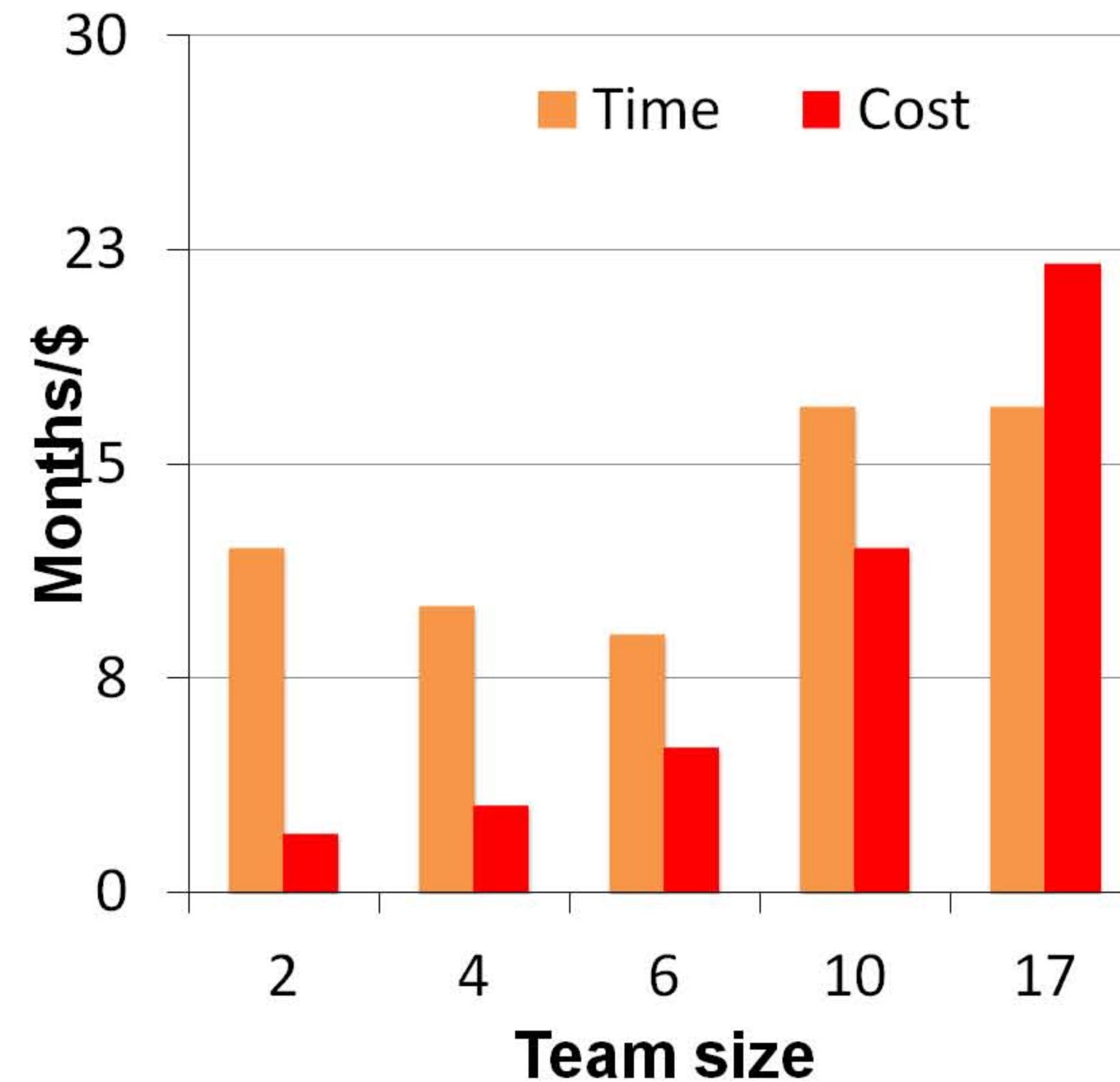
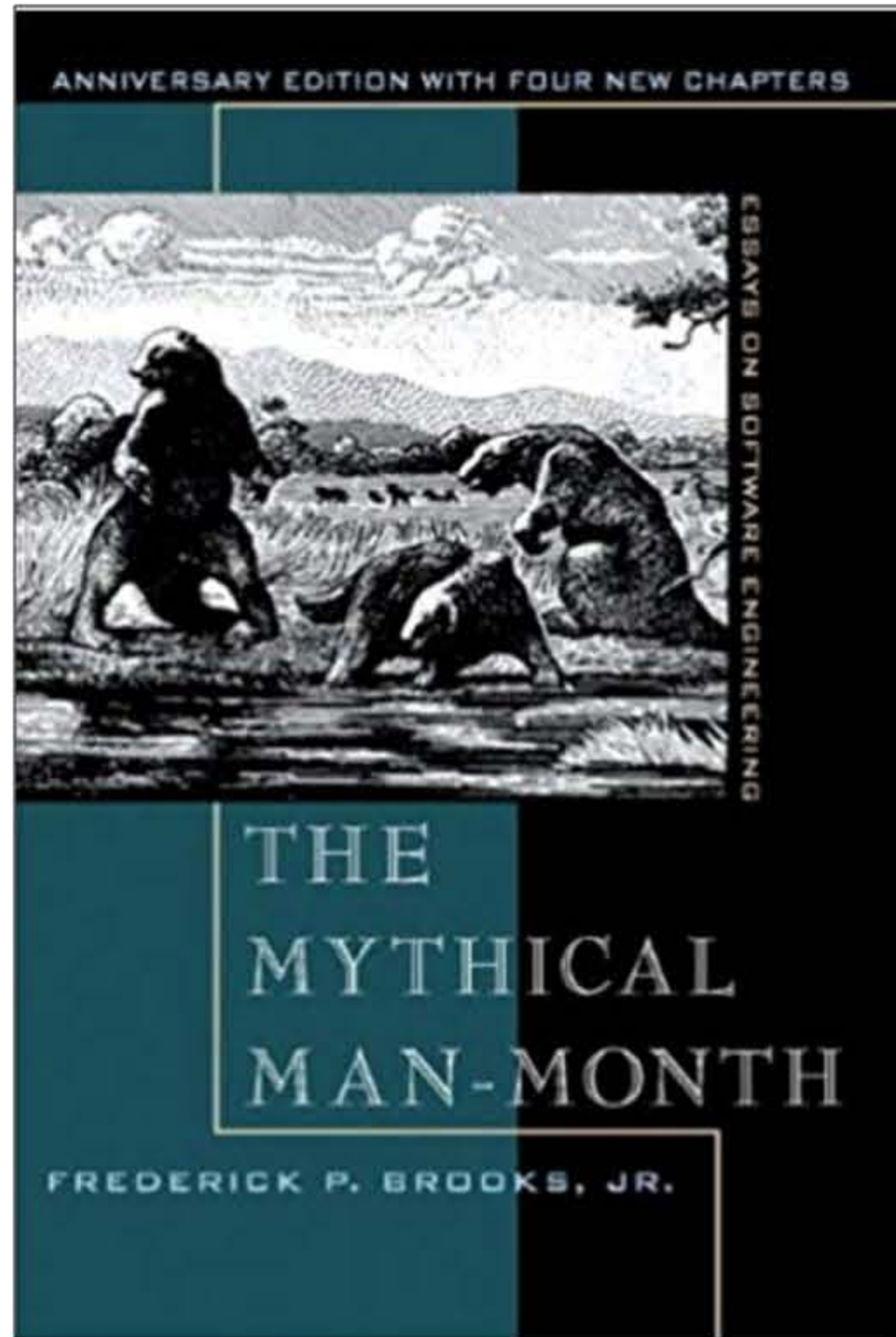
Citations



Scrum Refinement

It took at least \$250M to invent Scrum because it is designed to solve a very tough problem. And billions of dollars to deploy it in every major technology company in the world.

Brooks Law: Adding People to a Late Project Makes It Later!



All research prior to 2007 showed productivity per person decreased as project size increased.

Source: http://www.qsm.com/process_01.html (491 projects)

When and Where Was Linear Scalability First Achieved?



Proceedings of the 40th Hawaii International Conference on System Sciences - 2007

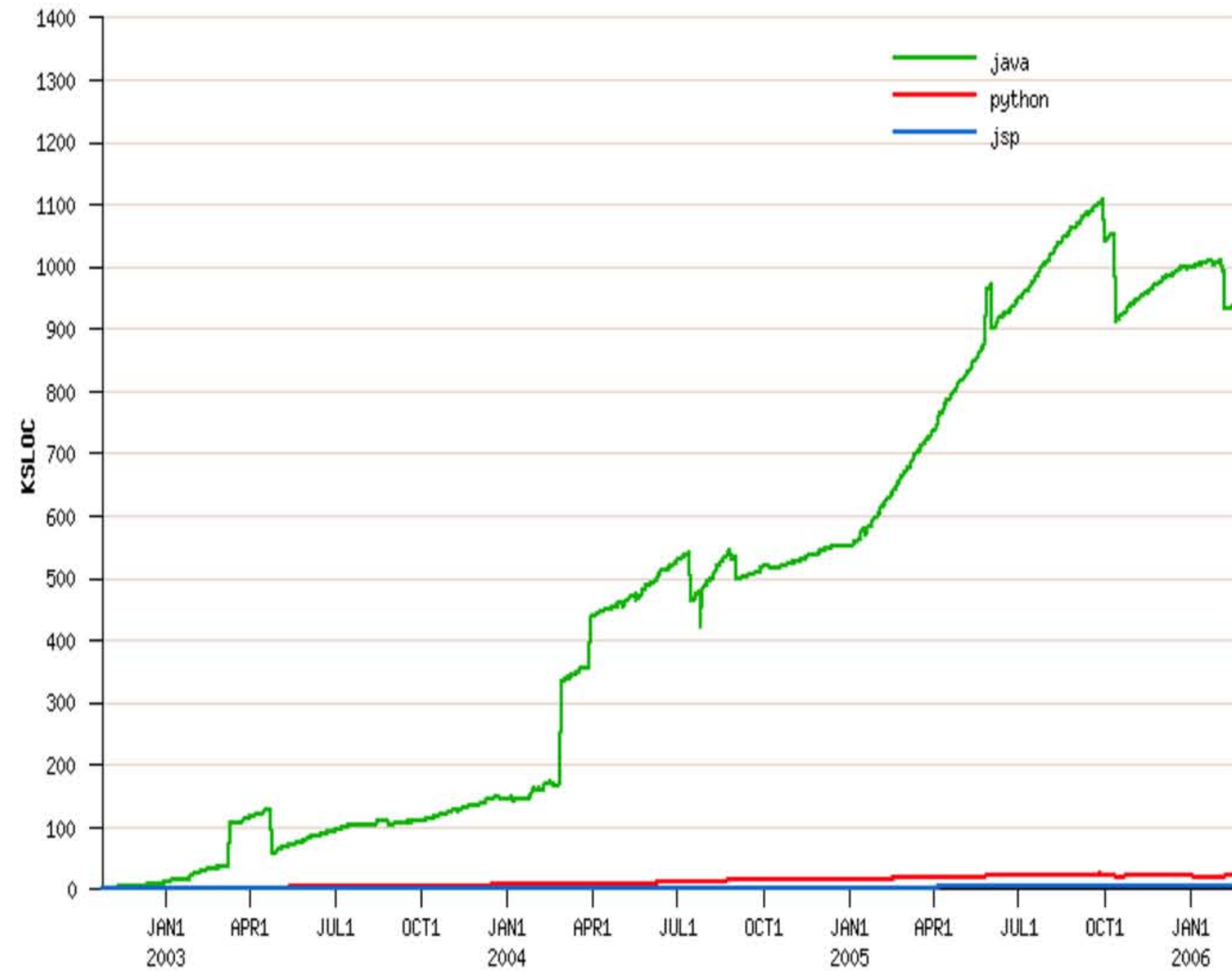
Distributed Scrum: Agile Project Management with Outsourced Development Teams

Jeff Sutherland, Ph.D.
Patientkeeper
Newton, MA, US
jeff.sutherland@computer.org

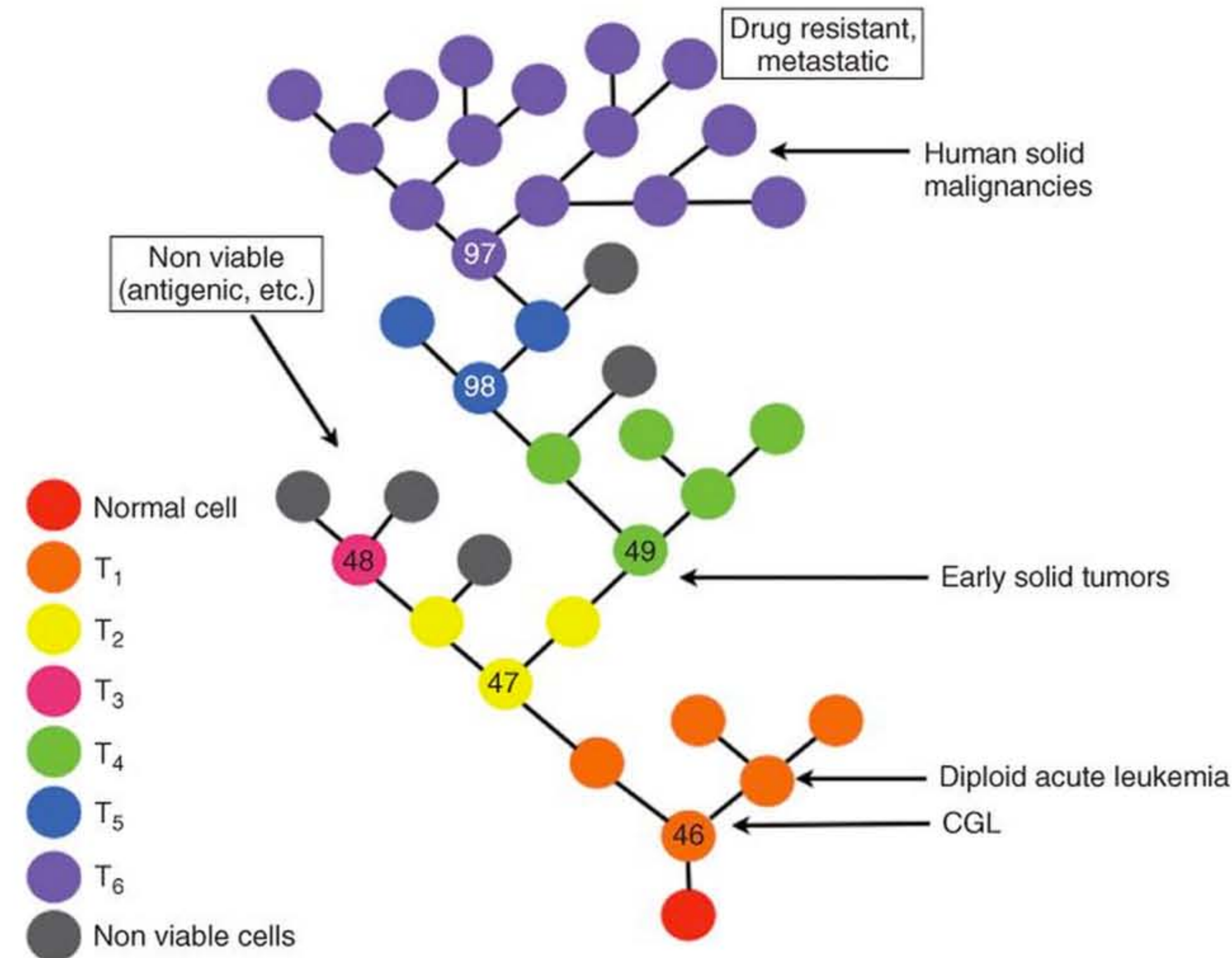
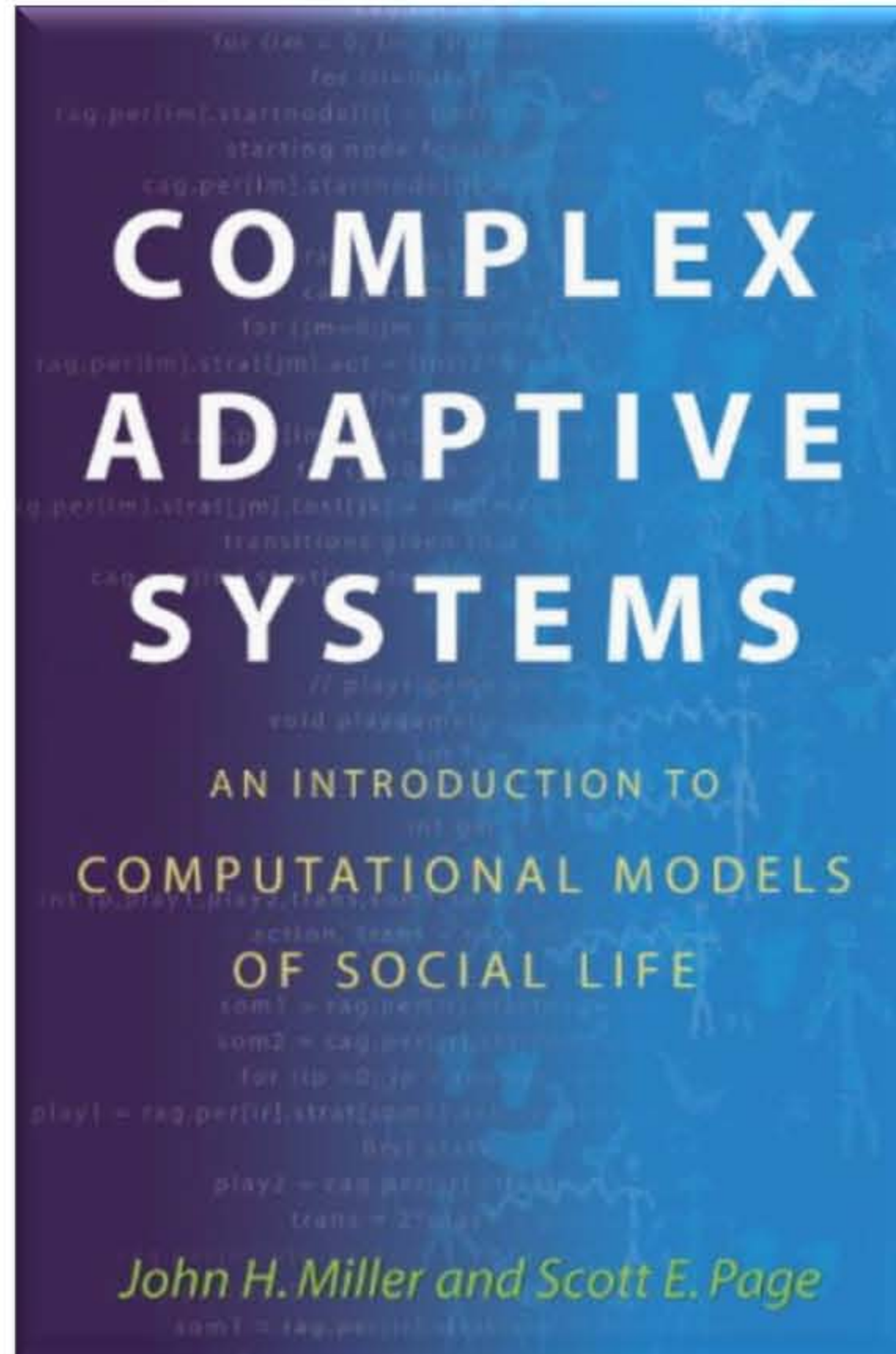
Anton Viktorov
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St. Petersburg, Russia
nick@starsoftlabs.com



Scrum is a Set of Experiments to Change a Complex Adaptive System into a Better State



Mammographic screening: a reappraisal of benefits and risks. Bailar JC 3rd. Clin Obstet Gynecol. 1978 Mar;21(1):1-14



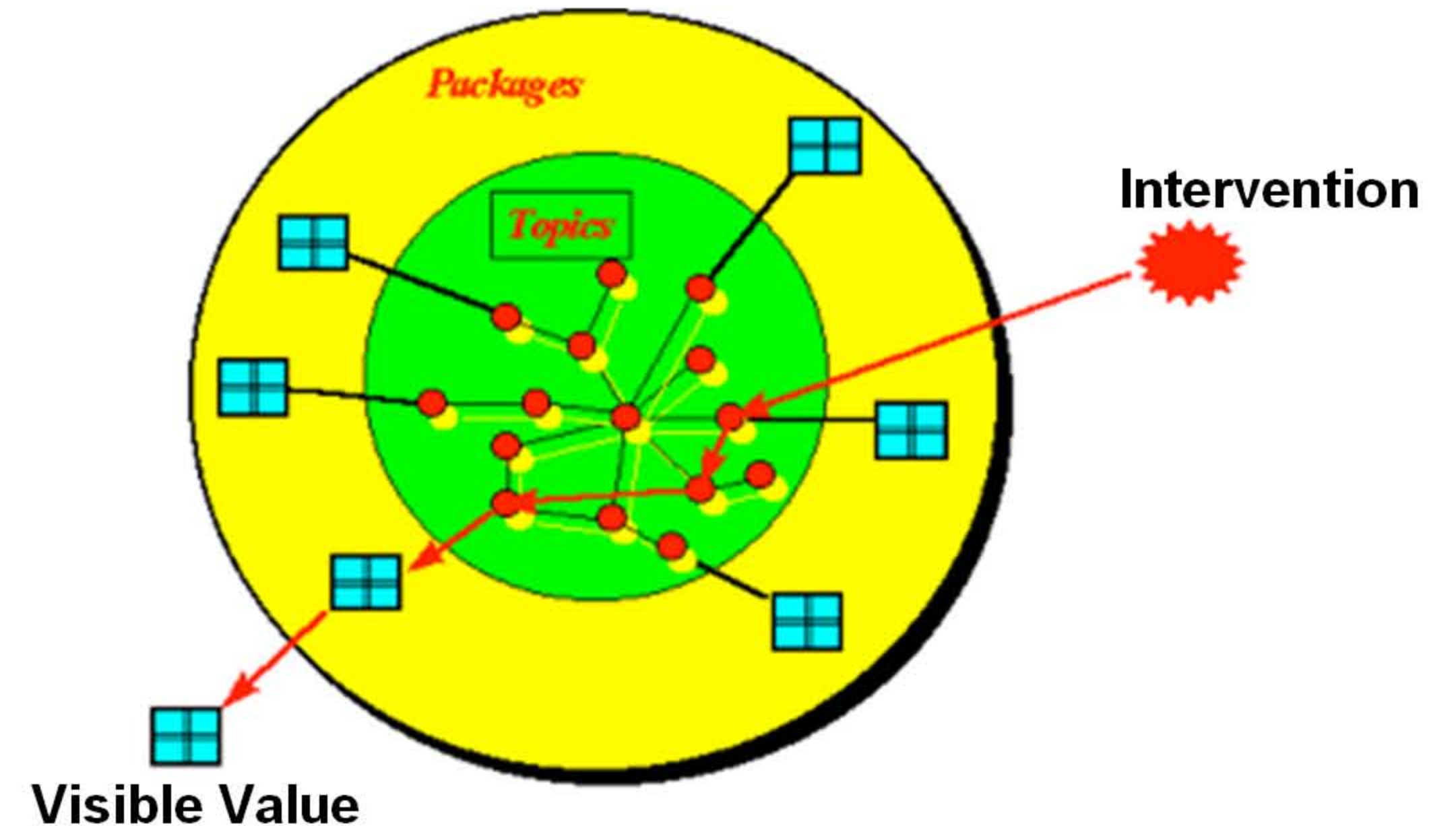
Mammography screening is harmful and should be abandoned
J R Soc Med September 2015 108: 341-345

Experimentally Improving the System State

“All complex systems evolve through a series of stable states.”

Herbert Simon. The Sciences of the Artificial, Third Edition. MIT Press, 1996

- **Needed Continuous Integration**
 - Test inside the sprint
- **Evolved into Continuous Deployment**
 - Deploy inside the sprint
- **“The Future of Scrum” as “DevOps”**
 - Run operations inside the sprint



Future of Scrum: Parallel Pipelining of Sprints in Complex Projects

Found in Agile Development Conference (ADC'05)

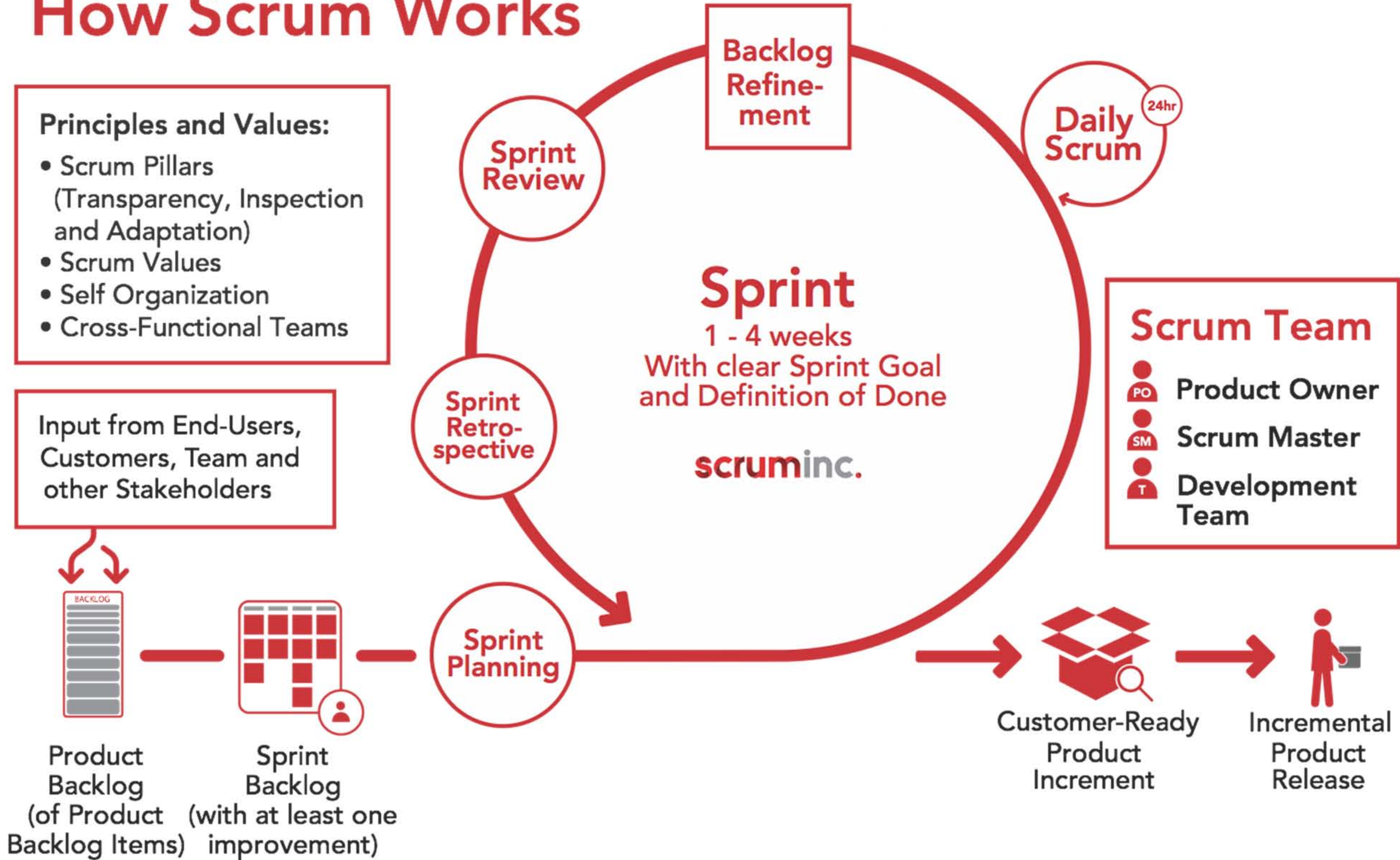
By Jeff Sutherland

Issue Date: 2005-07

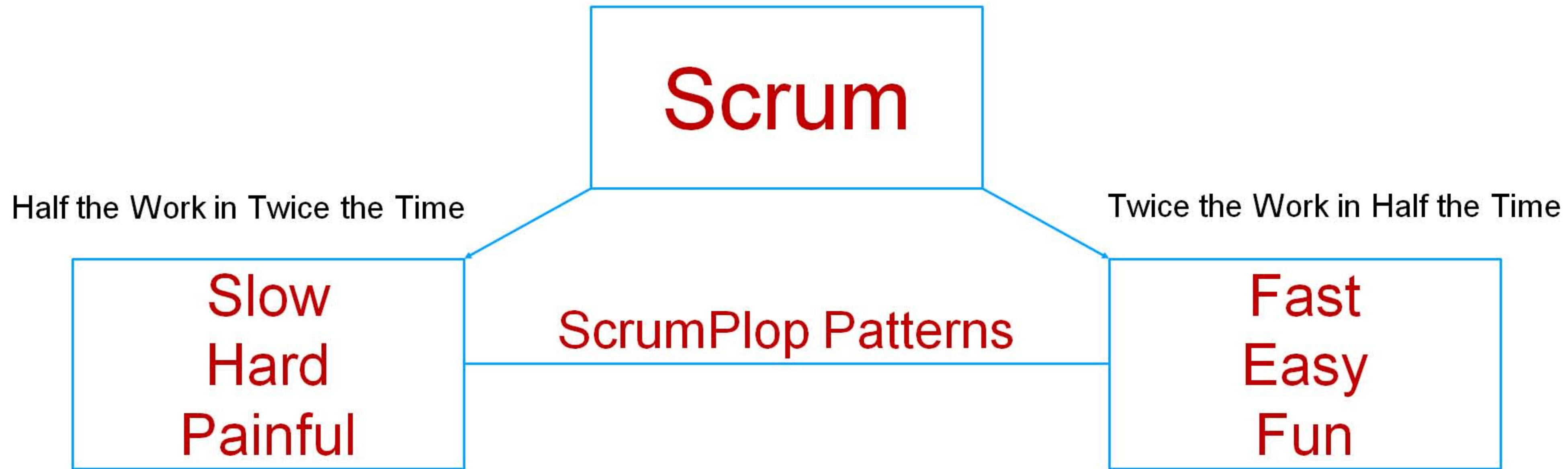
The Scrum Agile development process was invented to rapidly drive new product to market. Here, one of the inventors of Scrum goes back to Scrum basics, throws out preconceived notions, and designs Advanced Scrum using multiple overlapping Sprint.....

pp-90-102

How Scrum Works



Why Your Scrum Sucks!



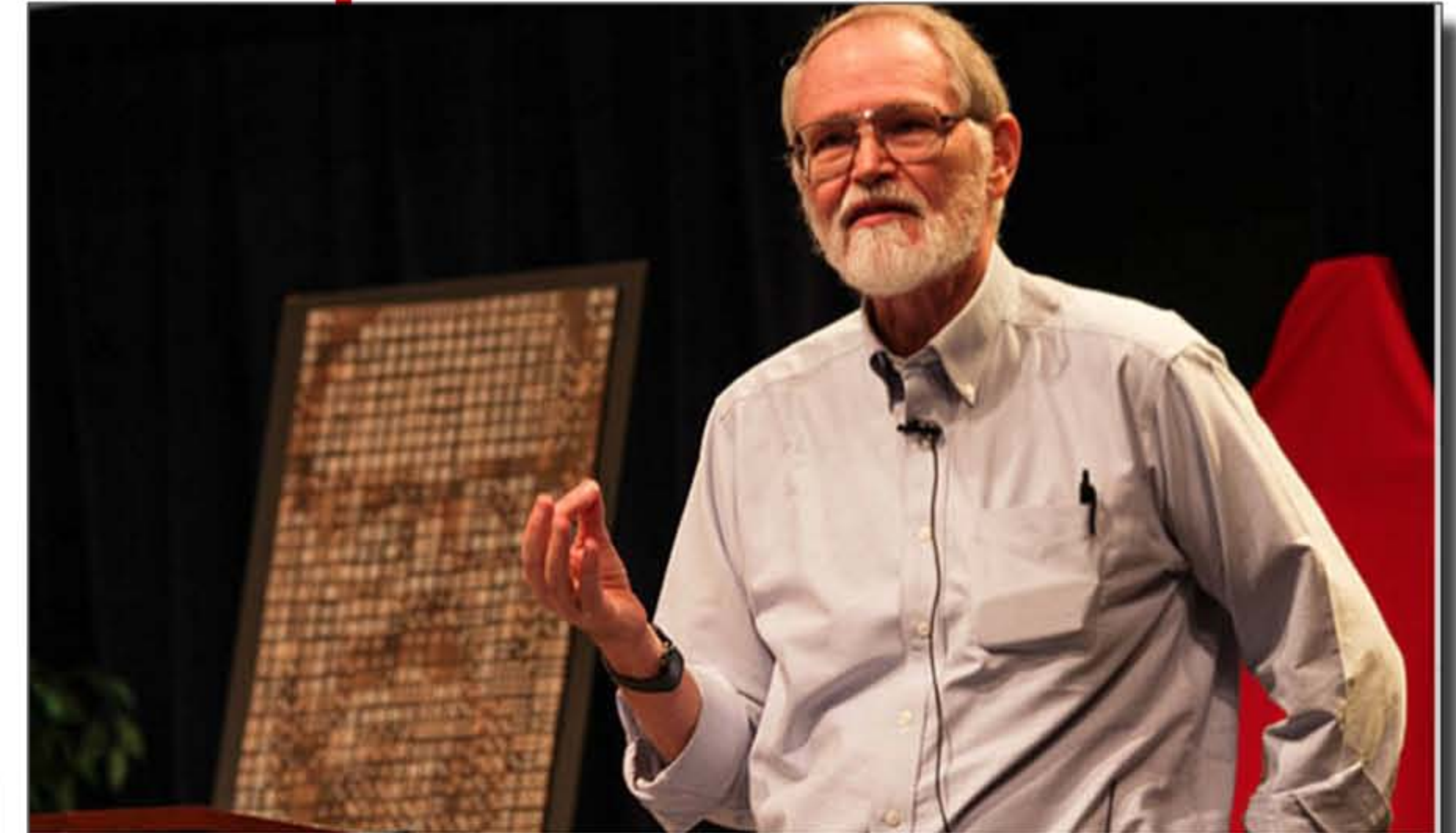
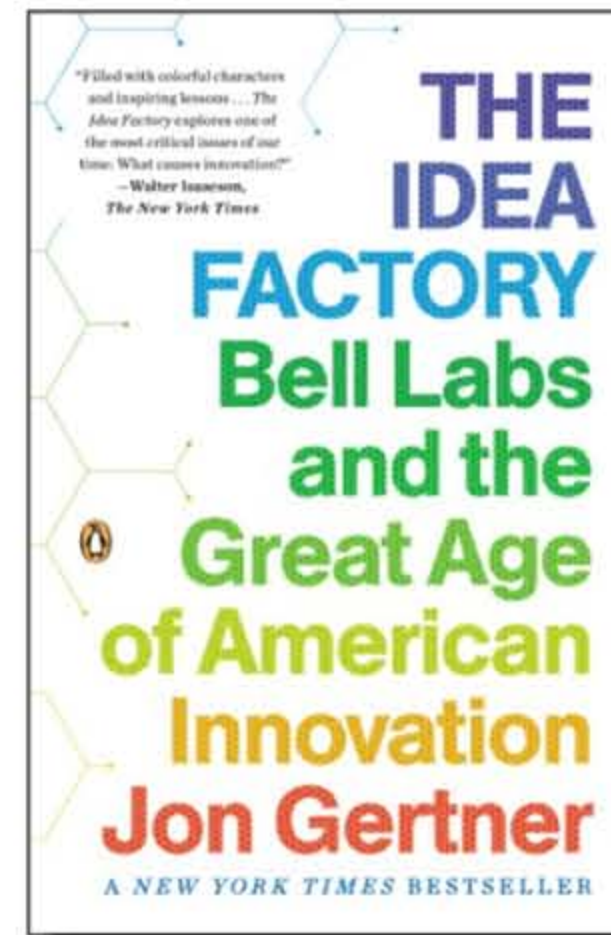
- Big, unstable teams
- Bad backlog
- Individual silos
- No plan for interrupts
- No continuous improvement
- Not done at end of sprint
- ...

- Small, stable, dedicated teams
- Ready backlog
- Swarming
- Interrupt Buffer
- Kaizen
- Finish Early
- ...

University of Colorado School of Medicine 1975-1986

Bell Labs Tools and Techniques

- Small (4-5 people), cross-functional teams
- Working production prototypes in short iterations
- One job title:
Member, Technical Staff
- The right tools can spawn a radically better new operating environment

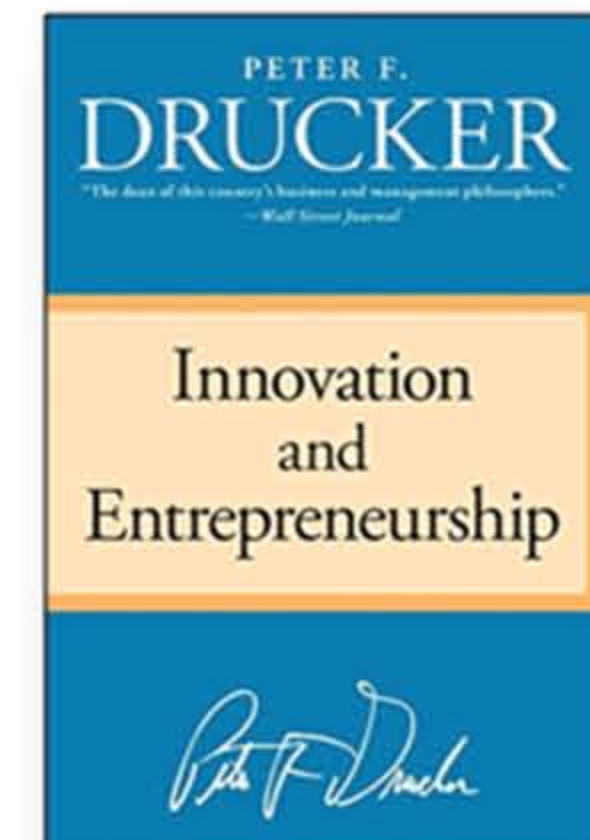
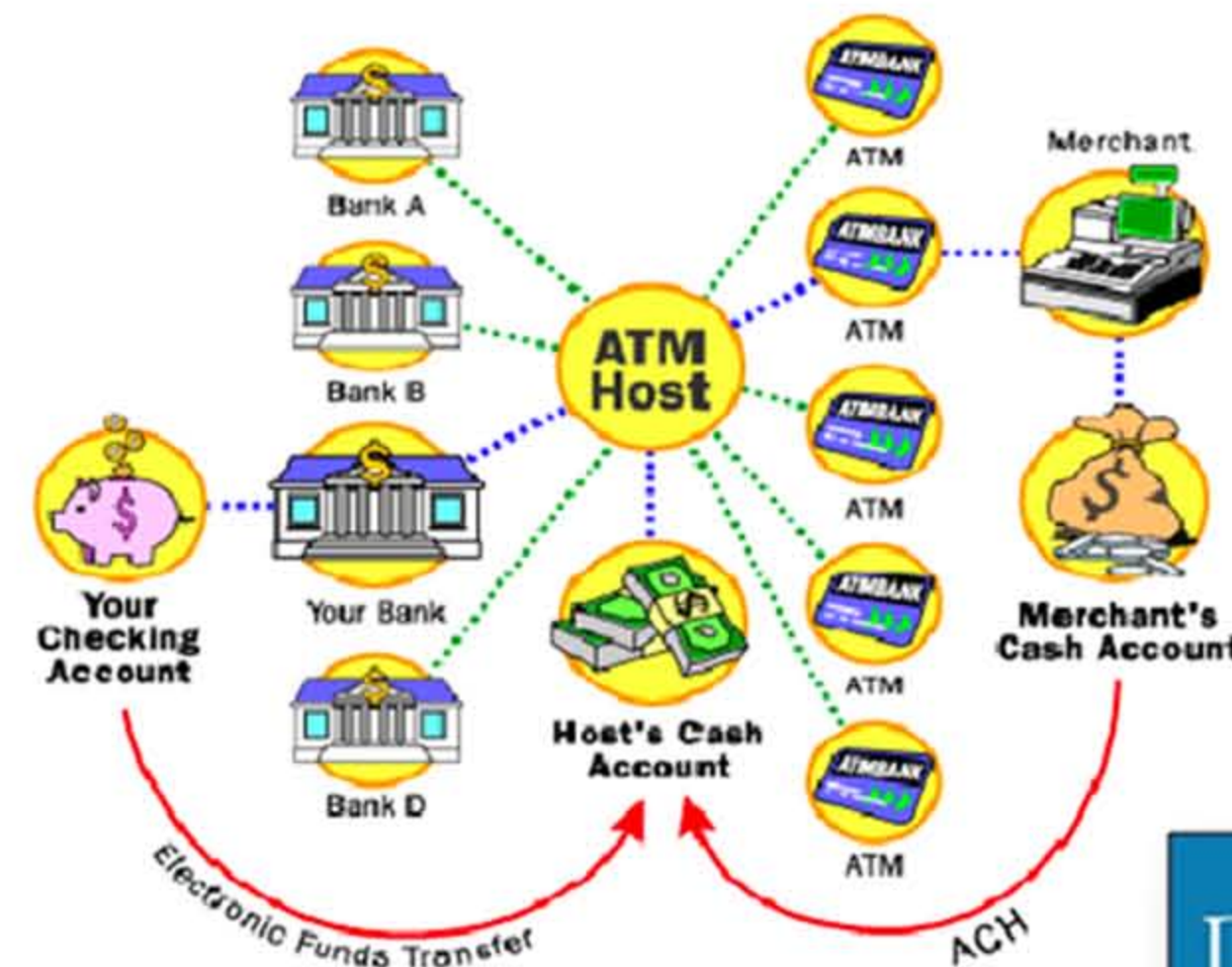


Brian Wilson Kernighan is a Canadian computer scientist who worked at Bell Labs alongside Unix creators Ken Thompson and Dennis Ritchie and contributed to the development of Unix. He is also coauthor of the AWK and AMPL programming languages.

First Scrum@Scale Prototype

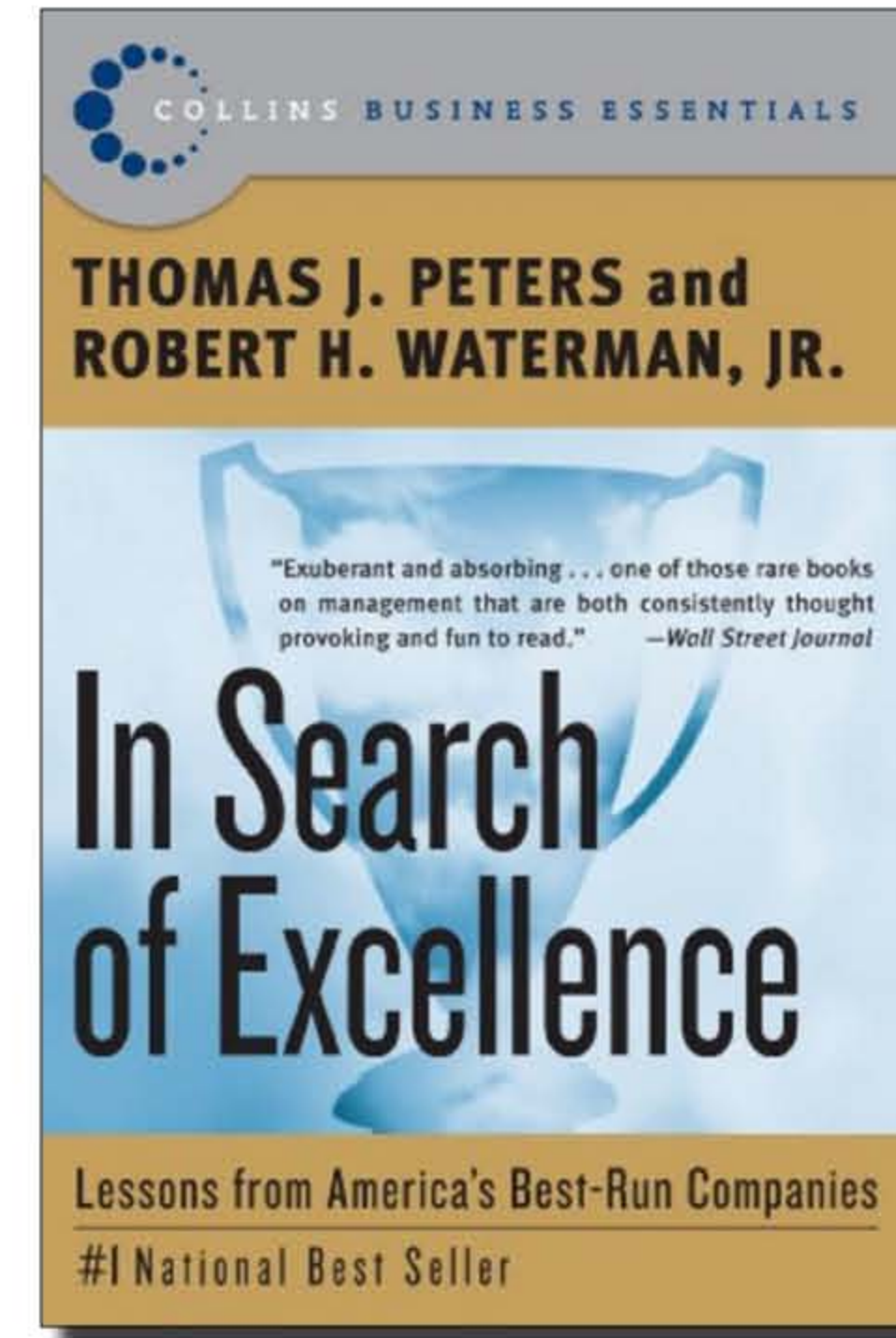
1983 MidContinent Computer Services (Denver, Seattle, San Diego, Kansas City)

- 150 Banks across United States and Canada
- Thousands of Teller Systems (all brands, Burroughs mainframes, Tandem network)
- Sutherland VP of Advanced Systems (CTO for all banks)
- Kellogg Leadership Business School Professor subgroup visited bank
- Recommendation - create a intrapreneurial company within the larger company with a radically different operating model



A Better Operating Model

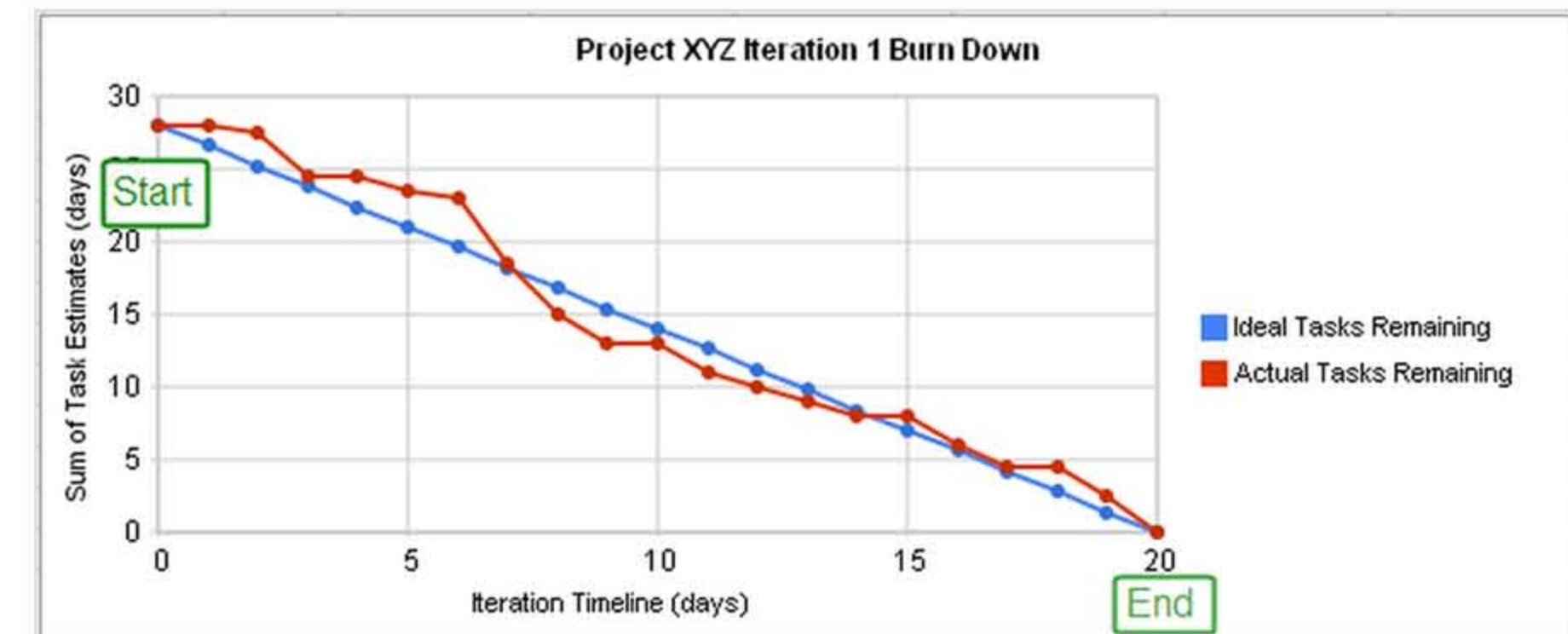
- A bias for action
- Close to the customer
- Autonomy and entrepreneurship
- Productivity through people
- Hands on, value driven
- Stick to the knitting
- Simple form, lean staff
- Simultaneous loose tight properties



Innovative companies are especially adroit at continually responding to change of any sort in their environments. Tom Peters

The Solution – First Scrum@Scale Prototype

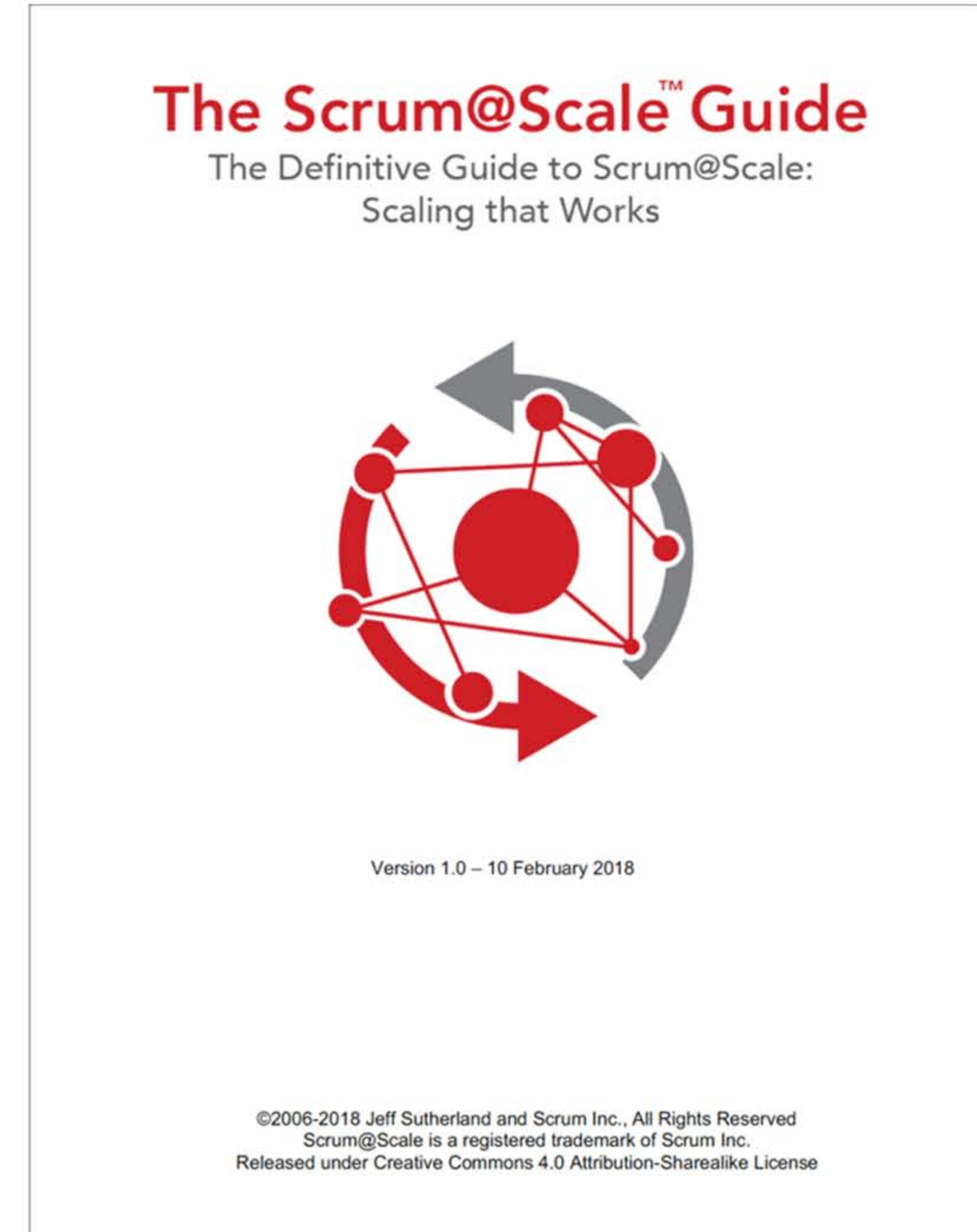
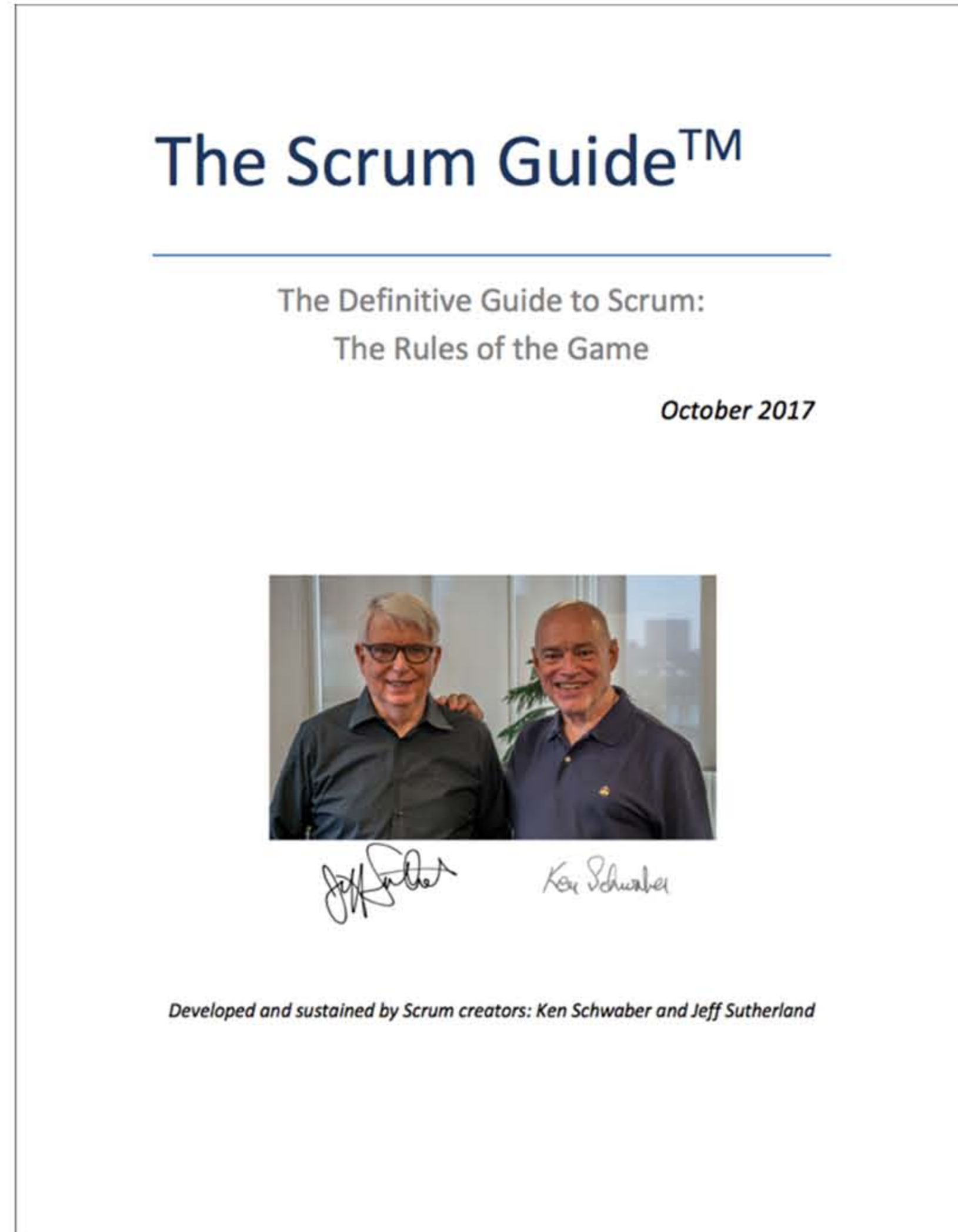
- Put every employee that touched ATM systems in one business unit and run like a startup
- Small cross-functional teams of 4-5 people
- Product manager prioritized backlog in Monday morning sprint planning meeting
- Everything Done = deployed every Friday afternoon
- Monthly business unit retrospective and big room planning



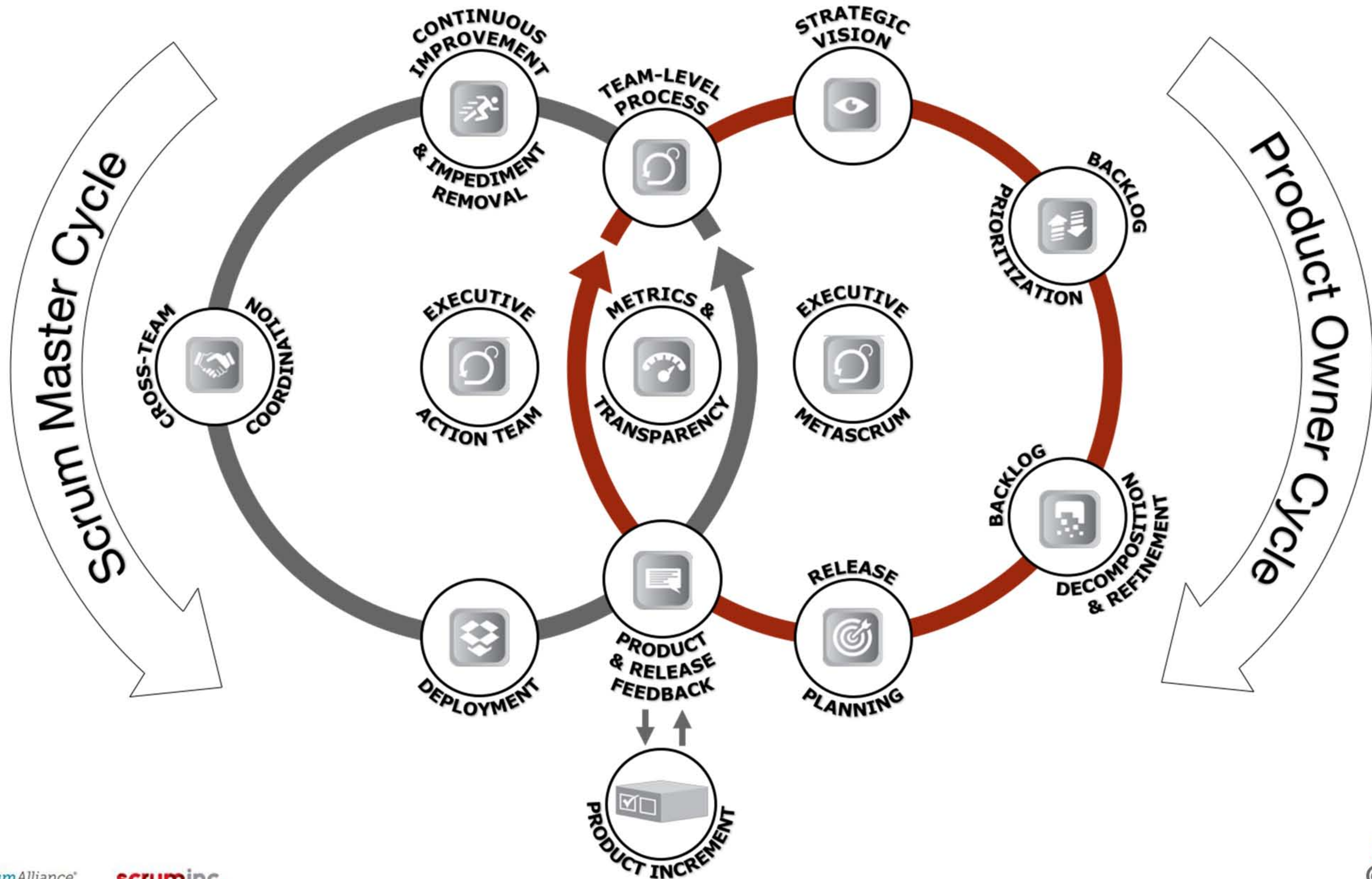
Radical Results

- Started with costs exceeding revenue by 30%
- In 6 months revenue exceeded costs by 30%
- 60% swing in margins created the most profitable business unit in the bank
- **MidContinent in 1983 enabled organizational Scrum@Scale**
 - Churches – Scrum In Church, IEEE Digital Library
 - ABN AMRO Bank -> ING
 - OpenView Venture Partners – Take No Prisoners, IEEE Digital Library
 - Management training on how to run dozens of venture companies since 2006
 - Pegasystems – Hitting the Wall, IEEE Digital Library
 - Scrum Inc training since 2006 – hundreds of companies, dozens of publications

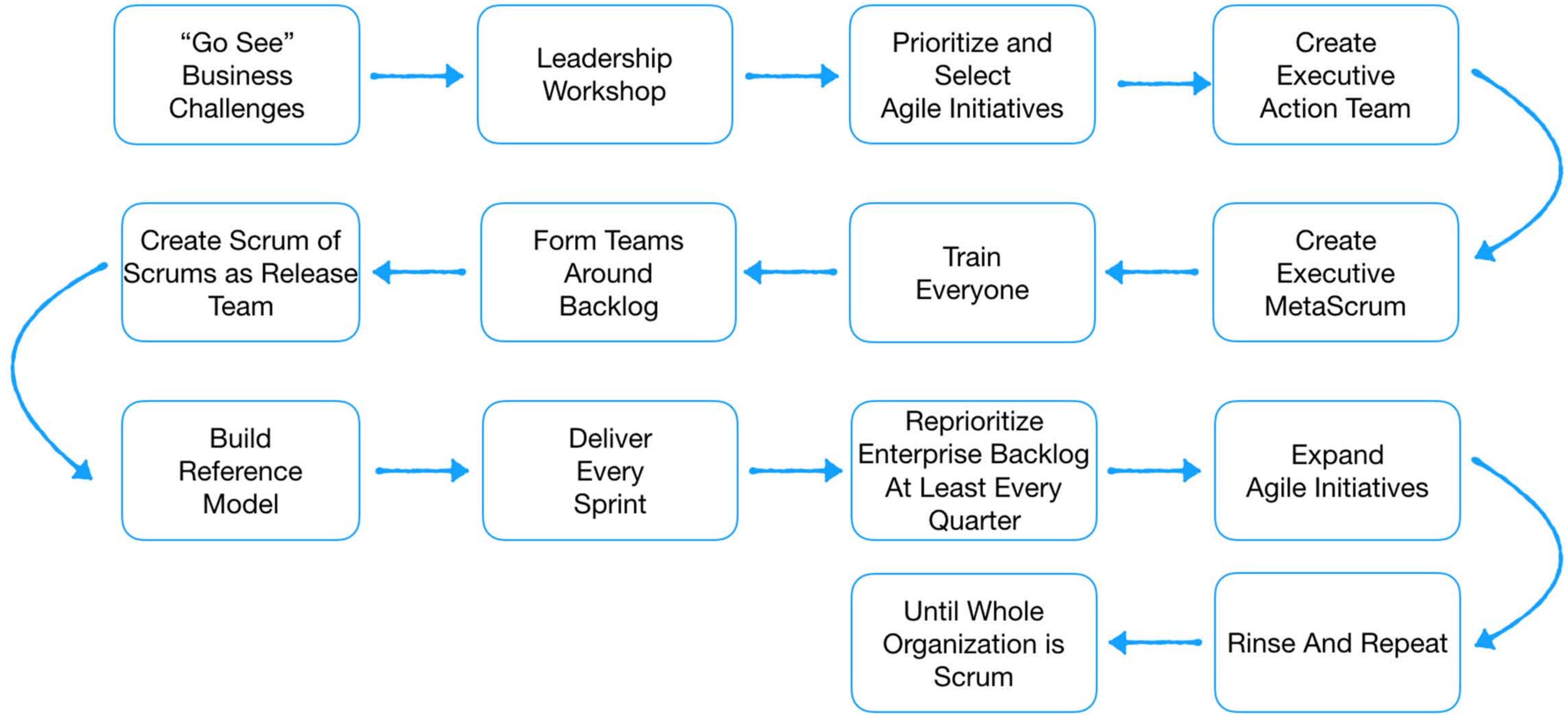
Scrum@Scale Goal: Formalize What We Did During 1983-2017 So Others Can Achieve Strategic Agility In 2019!



Scrum@Scale Framework



Scrum@Scale Implementation Roadmap



Scrum@Scale: Minimum Viable Bureaucracy

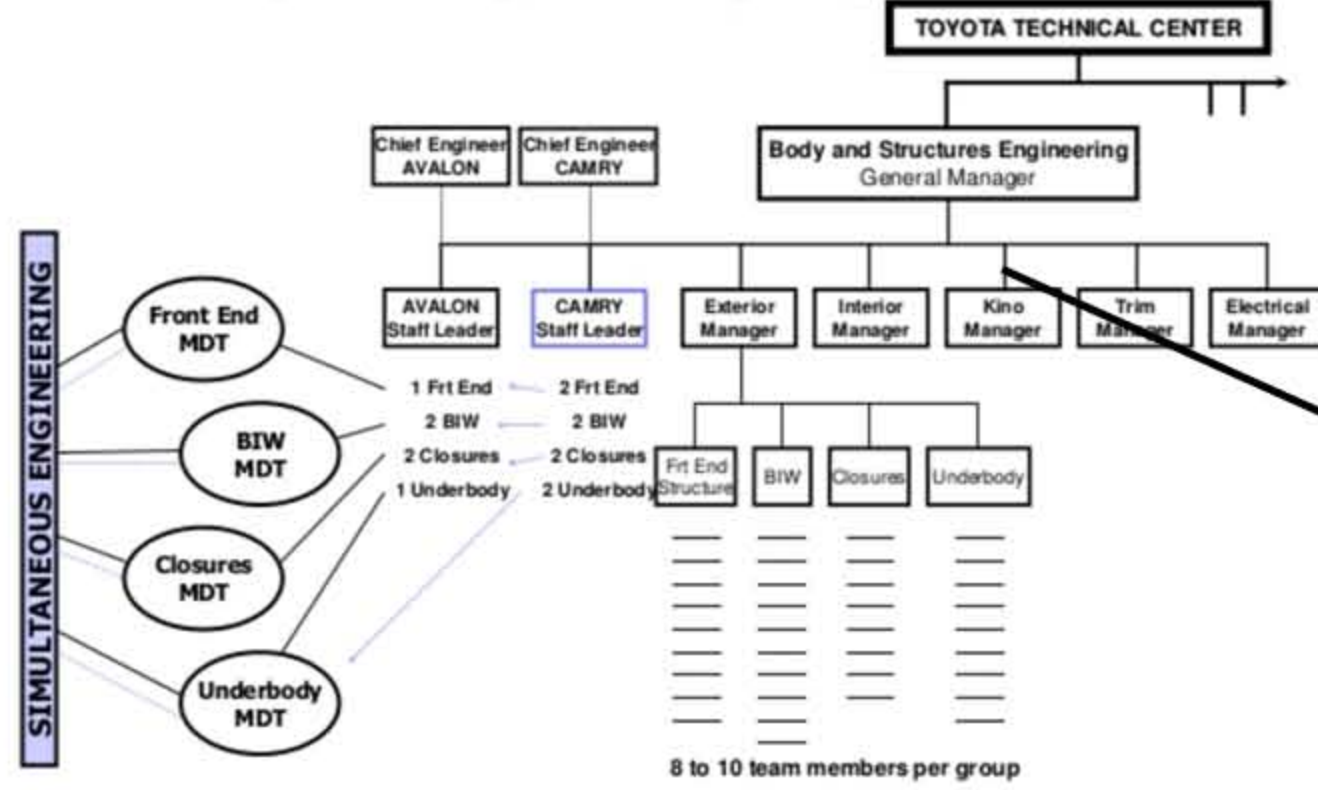
- Scrum of Scrums (Team of Teams)
 - Release Team
- Executive Action Team
 - Owns organizational structure and performance
- Executive MetaScrum
 - Owns enterprise priorities, revenue, and profitability



Waterfall Operating System

How We Do It

Toyota Engineering Organization



Organize to balance functional expertise and cross-functional integration

engineering excellence

Copyright James Morgan, 2013

Emc

Harvard Business Review

www.hbr.org

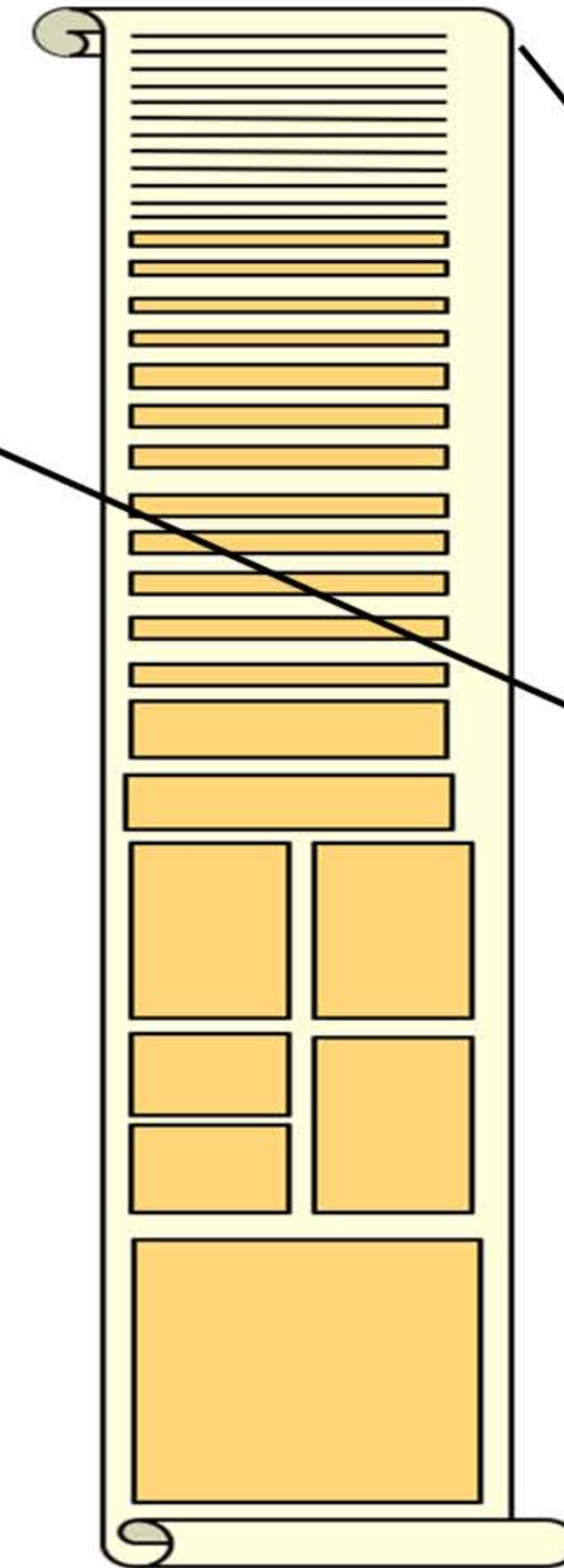
Stable and paranoid, systematic and experimental, formal and frank: The success of Toyota, a pathbreaking six-year study reveals, is due as much to its ability to embrace contradictions like these as to its manufacturing prowess.

The Contradictions That Drive Toyota's Success

by Hirotaka Takeuchi, Emi Osono, and Norihiko Shimizu

Toyota Dealer Network Commissions System
200 people, 5 years, nothing delivered

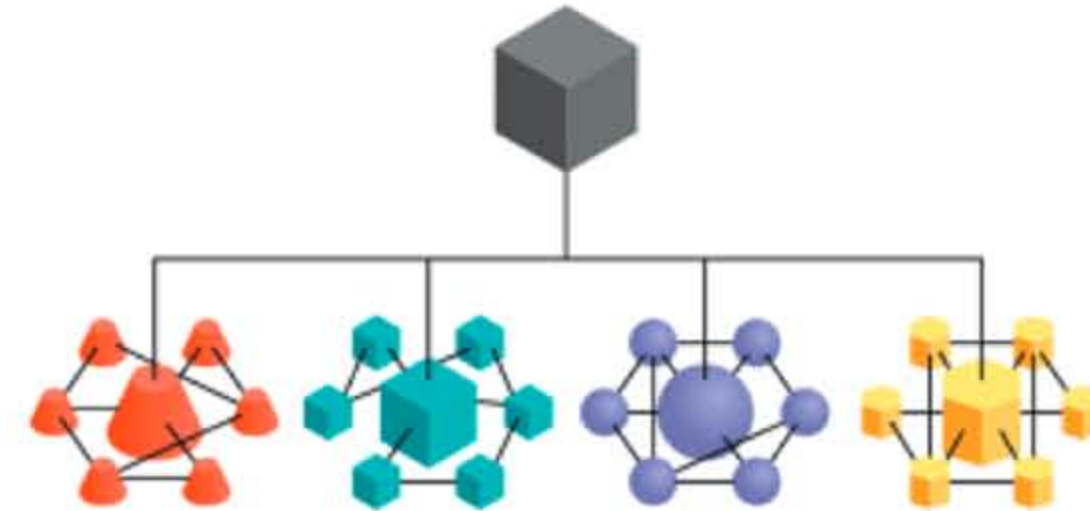
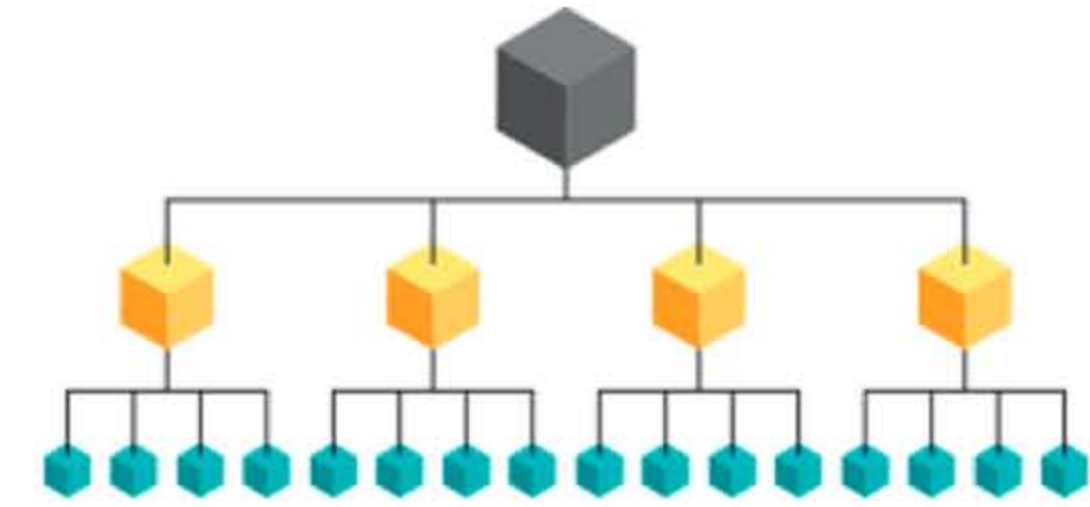
Enterprise Backlog



Volunteers

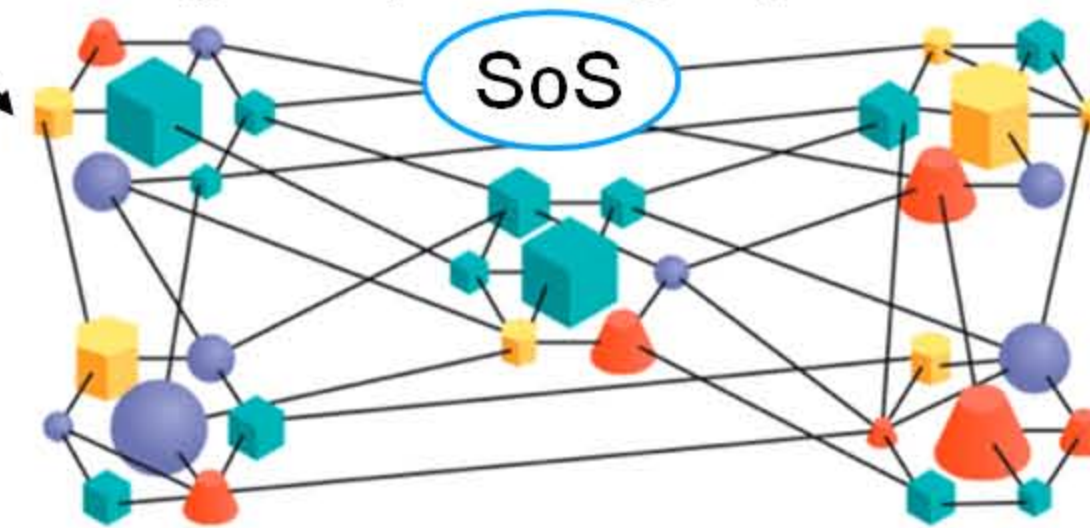
EMS

EAT



Agile Operating System

SoS



Goodbye Org Chart. Fast Company Jun 2015

Toyota Dealer Network Commissions System
20 people, 6 months, live

CEC and Certified S@S Trainer Dan LeFebvre
S@S Case Study

Definition of Scalability – Response Time Remains the Same as Organization Grows Larger

What if a company were to launch dozens, hundreds, or even thousands of agile teams throughout the organization? Could whole segments of the business learn to operate in this manner? Would scaling up agile improve corporate performance as much as agile methods improve individual team performance?

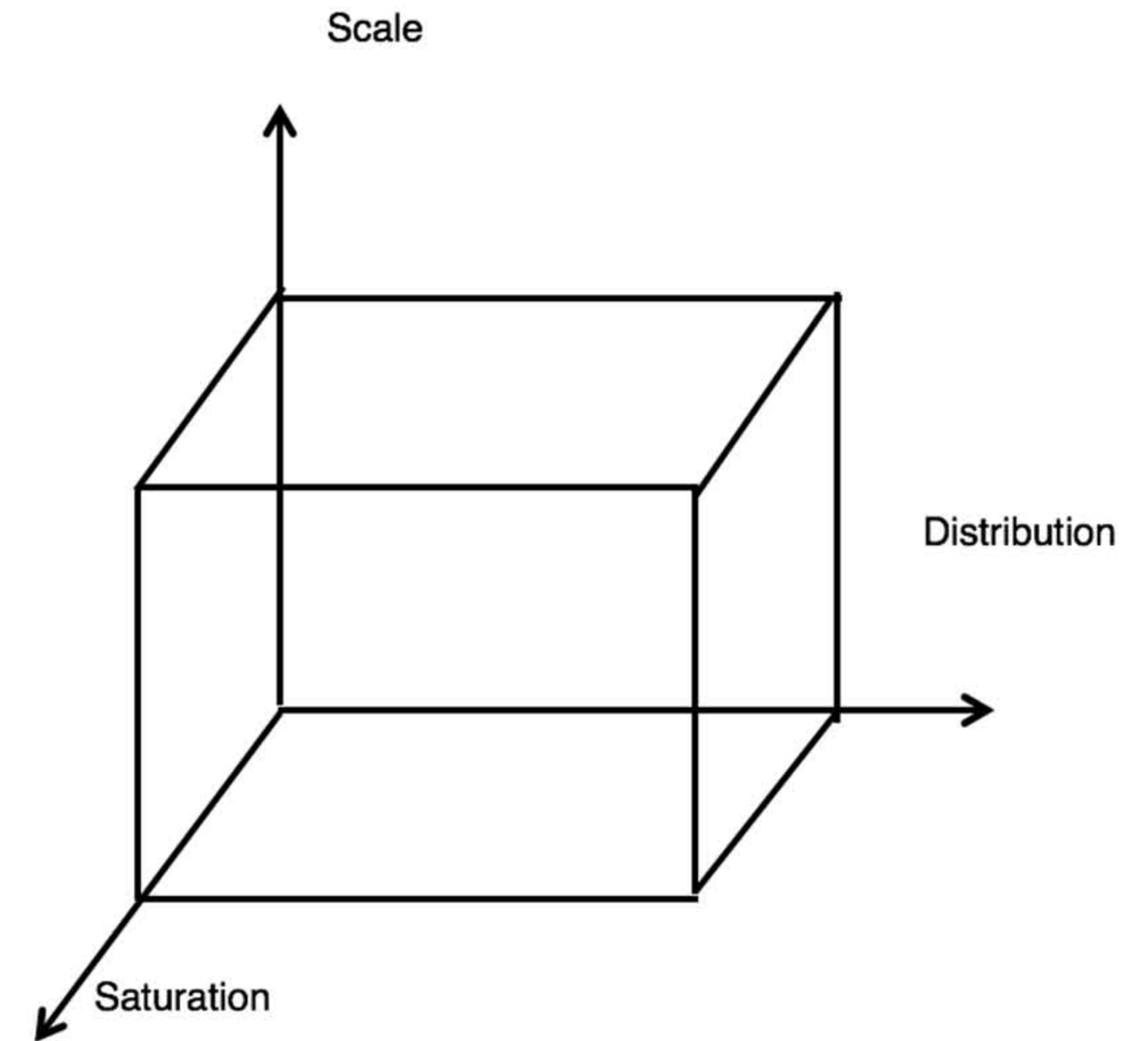
Rigby, Sutherland, Noble HBR Apr-May 2018

"The terms "performance" and "scalability" are commonly used interchangeably, but the two are distinct: performance measures the speed with which a single request can be executed, while scalability measures the ability of a request to maintain its performance under increasing load. For example, the performance of a request may be reported as generating a valid response within three seconds, but the scalability of the request measures the request's ability to maintain that three-second response time as the user load increases." - Steve Haines



Scrum@Scale Focuses on Business Agility

- Scale = number of coordinating teams; Complexity of projects
- Distribution = number of different coordinated geographic locations
- Saturation = Degree Agile principles have pervaded organization; Breaking down traditional “silos”
- Velocity = only well performing teams scale linearly



The fourth dimension is velocity

Linear Scalability: Scale-Free Architecture

- If you want to linearly scale, you need a “scale-free” architecture
- Otherwise you risk introducing waste into the system and slowing the whole organization down
- **Scale-free architectures are pervasive in biology (ex. neural networks)**
- **They are able to evolve to perform new functions more rapidly than alternative network designs**

Digital Darwinian world reveals architecture of evolution

Source: <http://chronicle.uchicago.edu/061207/darwin.shtml>

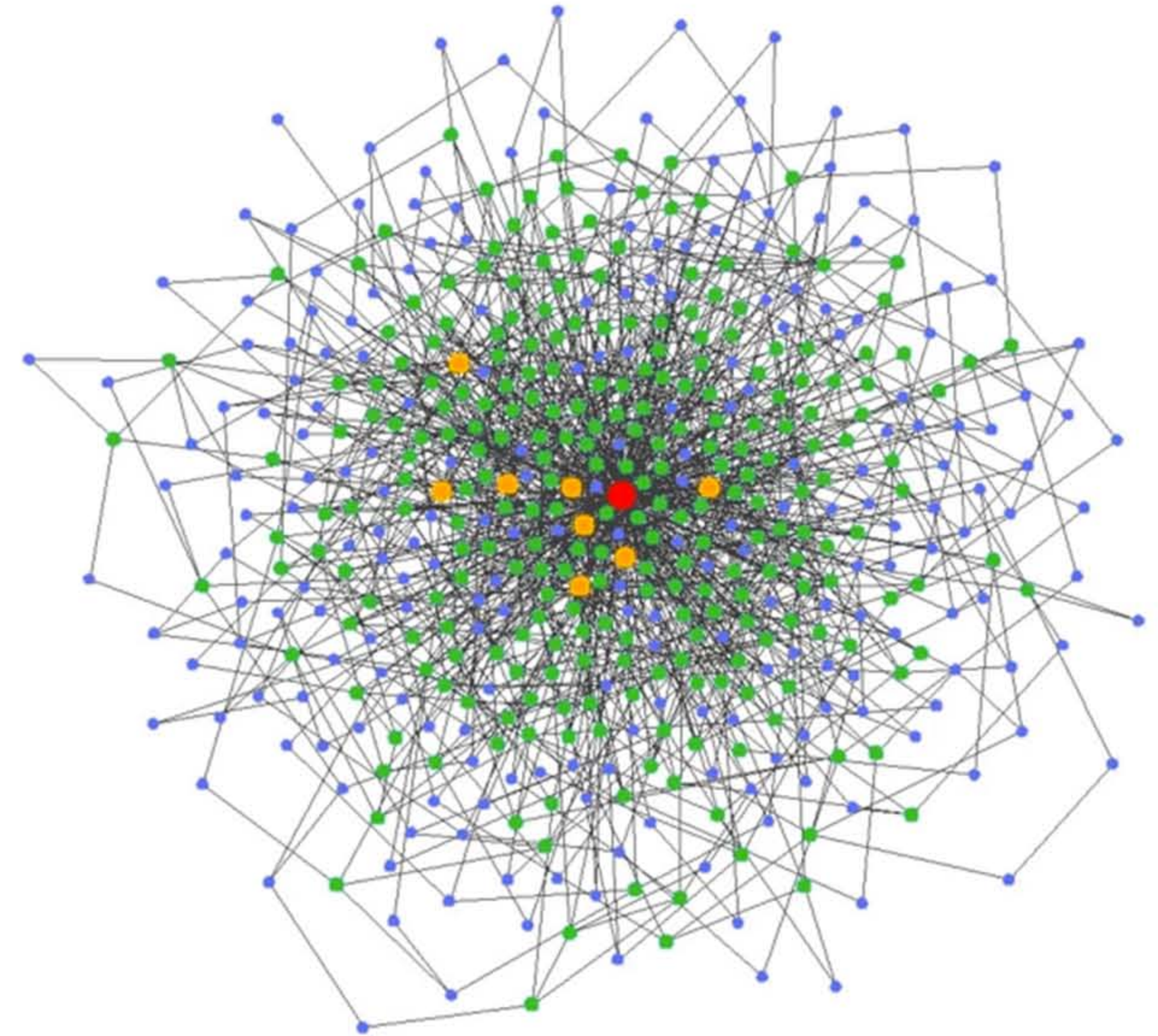
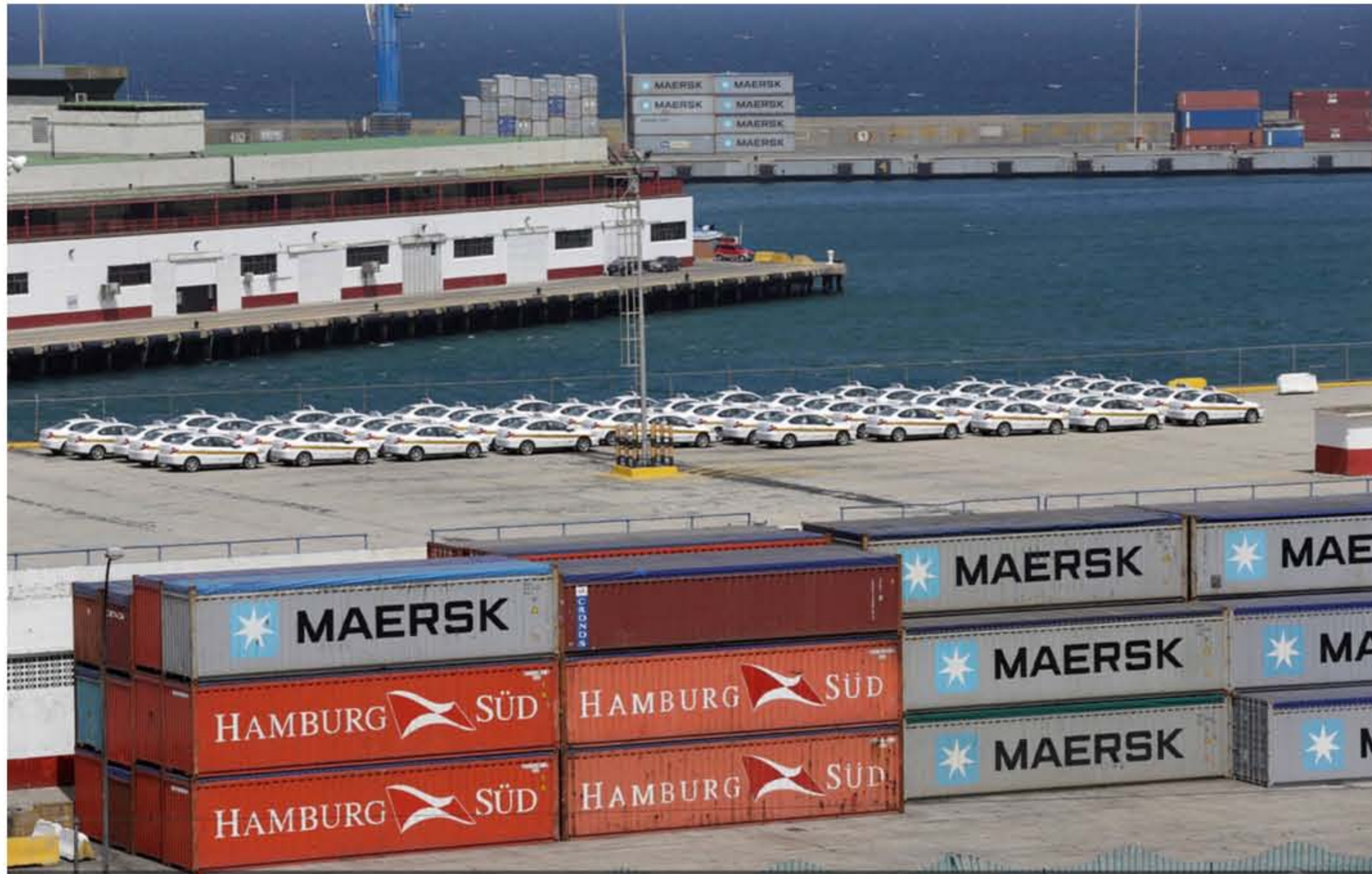


Diagram of a scale-free network that contains components with a highly diverse level of connectivity. Some components form highly interconnected hubs, while other components have few connections, and there are many levels of interconnectivity in between. Scale-free networks are pervasive in biology. Computer simulations at the University of Chicago show that scale-free networks are able to evolve to perform new functions more rapidly than an alternative network design.

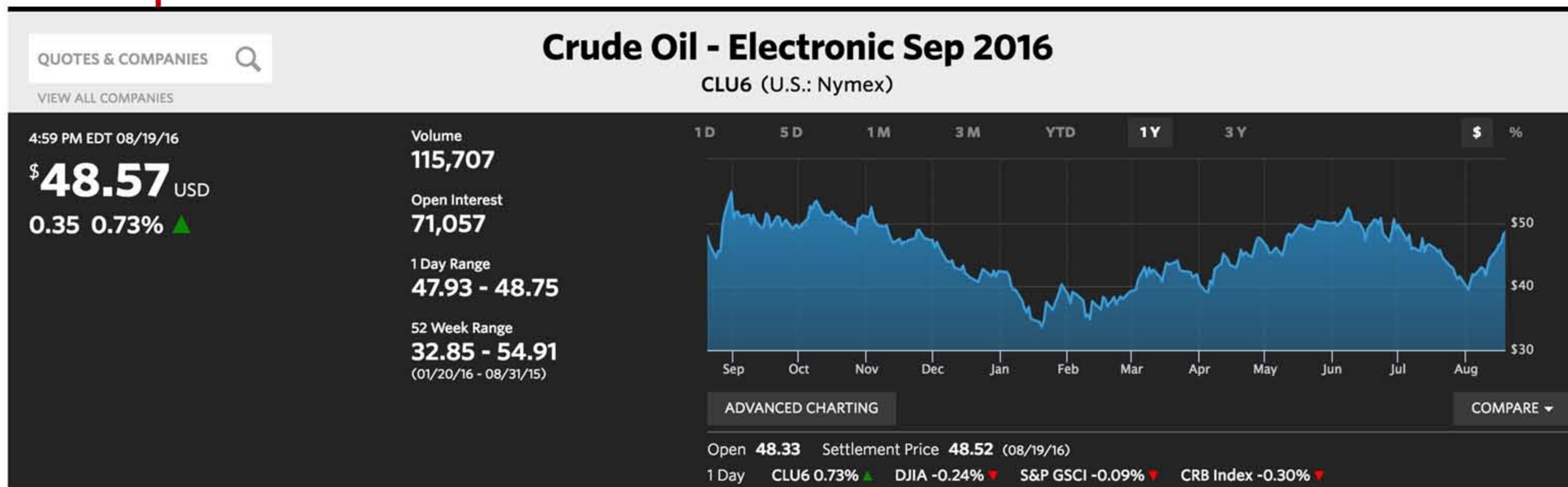
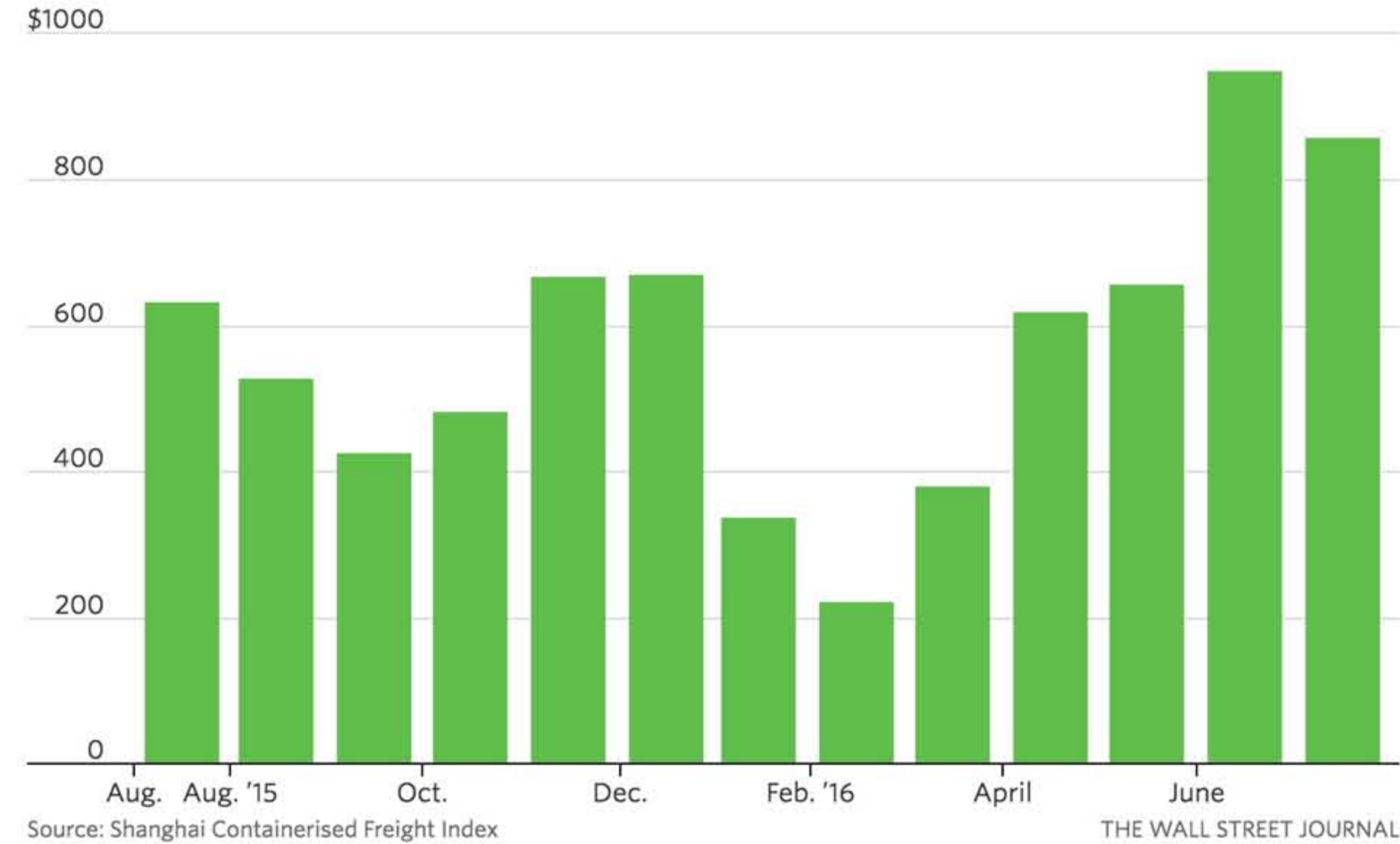
Maersk Profit Drops on Weak Freight Rates

Lower oil prices also weighed on the Danish conglomerate's second-quarter earnings - WSJ 12 Aug 2016



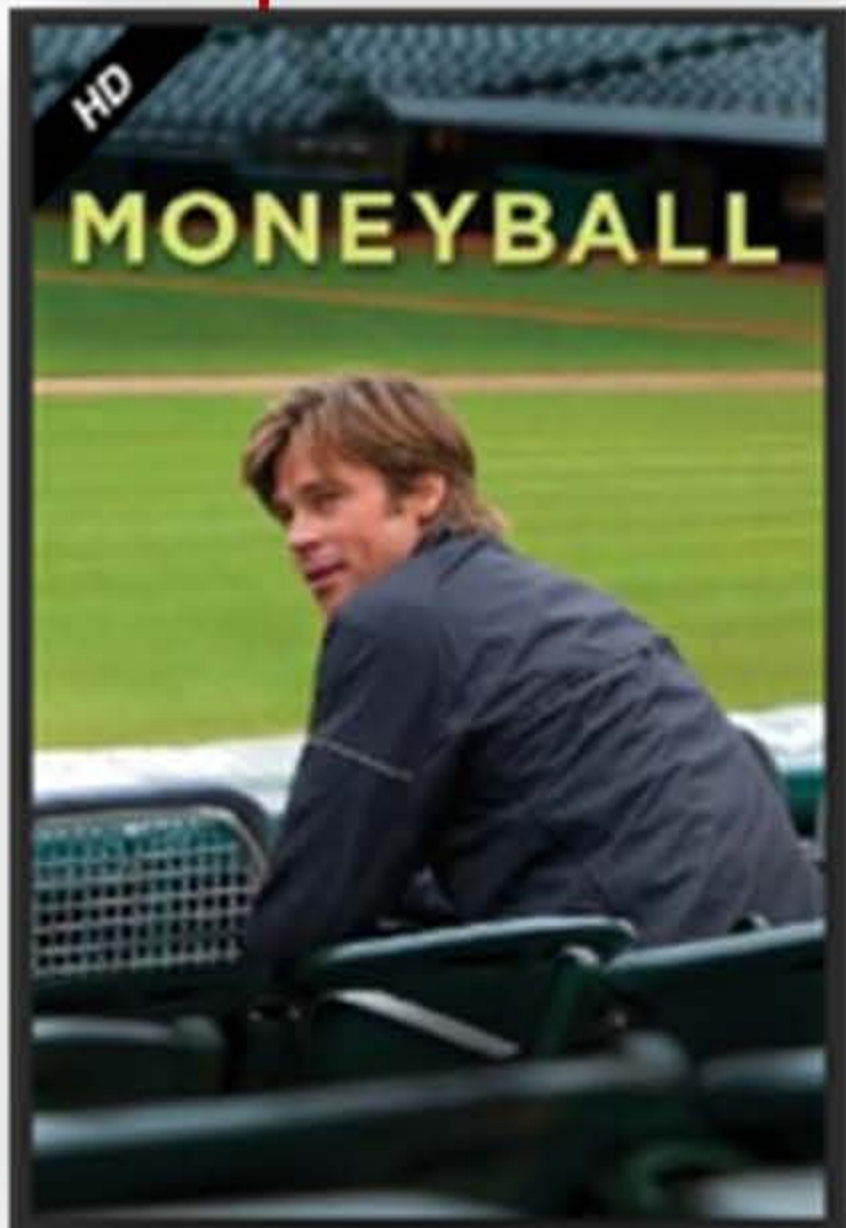
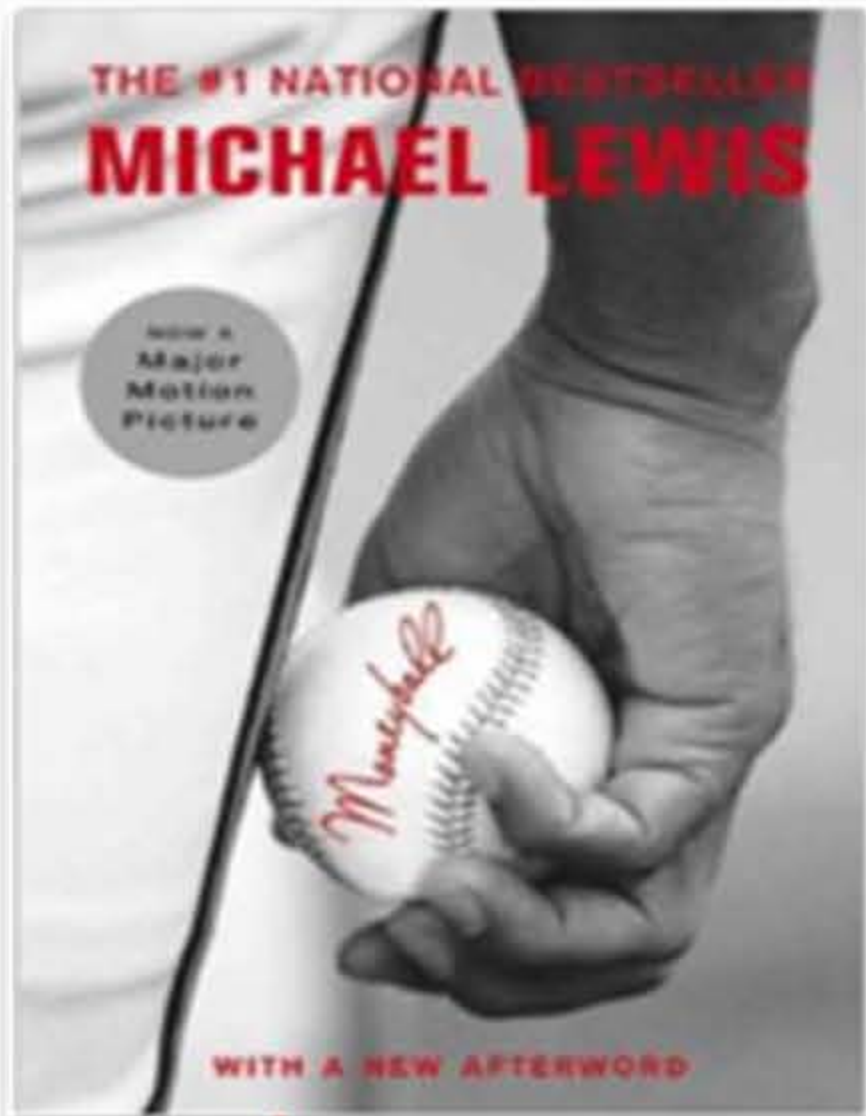
Freight Rate Misery

Average Asia-Europe monthly freight rates per container. Operators say anything below \$1,400 is unsustainable.



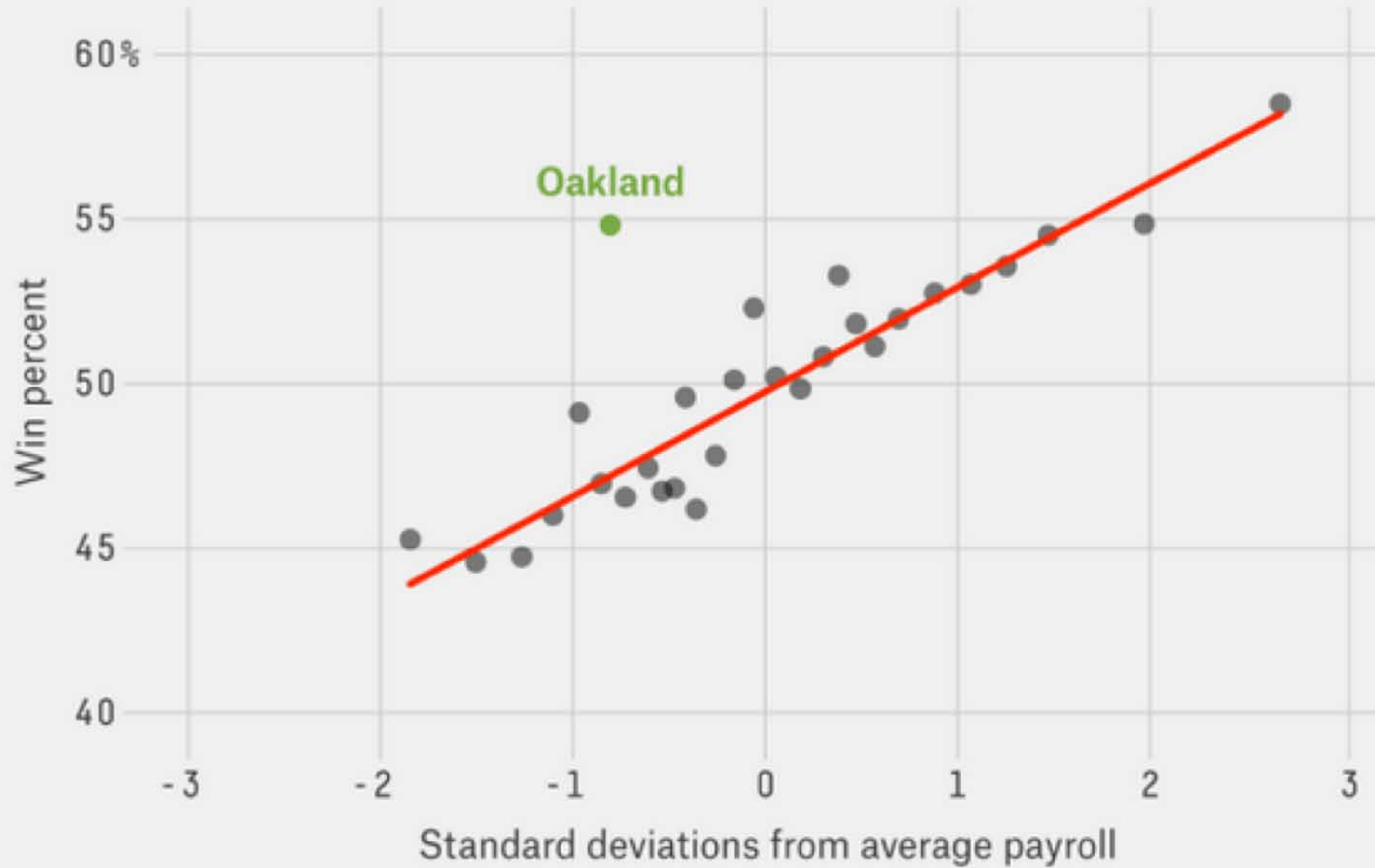
Mr. Skou said costs in Maersk Line were at an all-time low, dropping for the first time below \$2,000 per container. Maersk Oil has pushed down its break-even level to between \$40 and \$45 a barrel from around \$50 to \$55.

Money Ball



Season Win Percent vs. Relative Payroll

Standard deviations above/below league average (15 team bins)



FIVETHIRTYEIGHT

BASED ON DATA FROM ESPN, BASEBALL PROSPECTUS, BASEBALL-REFERENCE

Money Ball for Scrum Starts with Facing Reality

Seen at GE, Toyota, 3M, and many other companies



25% of staff delivering stories customers will use

64%*70% = 45% of staff delivering stories the customer will never or rarely use (Standish Group)

30% of staff working on zero value stories

- Lack of direction causes staff to make up work
- Unwillingness to prioritize proliferates useless projects

Process Efficiency = Work Time/Calendar Time

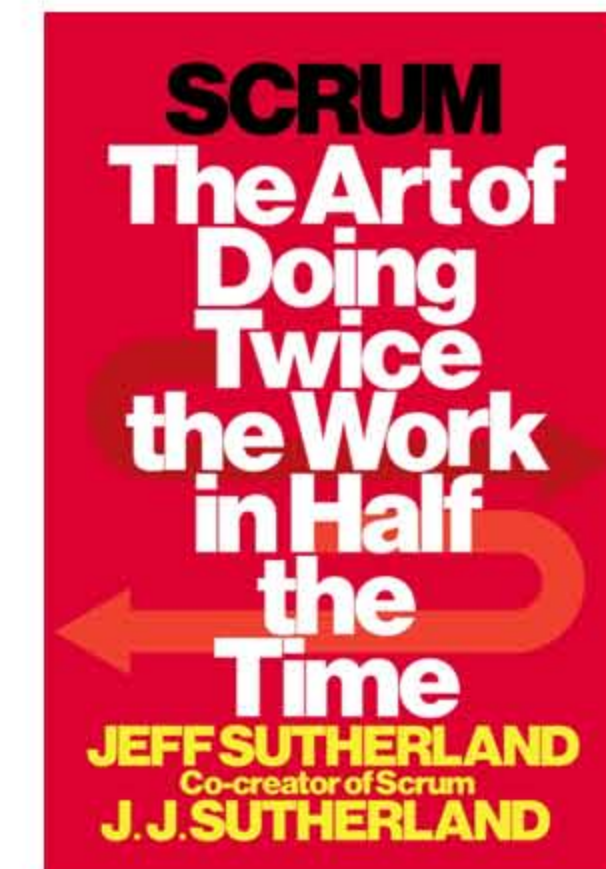
Customer
Will Use

25% of staff delivering useful stories
5% process efficiency

Organizational delivery capacity - 1.25%

Initial Goal: Improve delivery capacity to 5%

“Twice the work in half the time”



Case Study: Amazon is now “nuking” every business.

Last week it was nuking the fashion industry. This week, the armed ballistic missile is pointed at the global shipping industry.

- Robin Lewis. *Amazon's Shipping Ambitions Are Larger Than It's Letting On.* Forbes 1 Apr 2016

- [Amazon](#) has caused pain for a lot of companies with its disruptive business model.
- But now it could disrupt entire economies, especially in emerging markets, according to a research note published by a team of analysts at Morgan Stanley.
- “Amazon is a disruptive dreadnought! I don’t know how to value a company that disrupts every market it enters.” - Wall Street Insider

“Sellers will no longer book with DHL, UPS or Fedex but will book directly with Amazon.”

- Amazon 2013 Report

And Maersk will lose their Chinese-America shipping business!

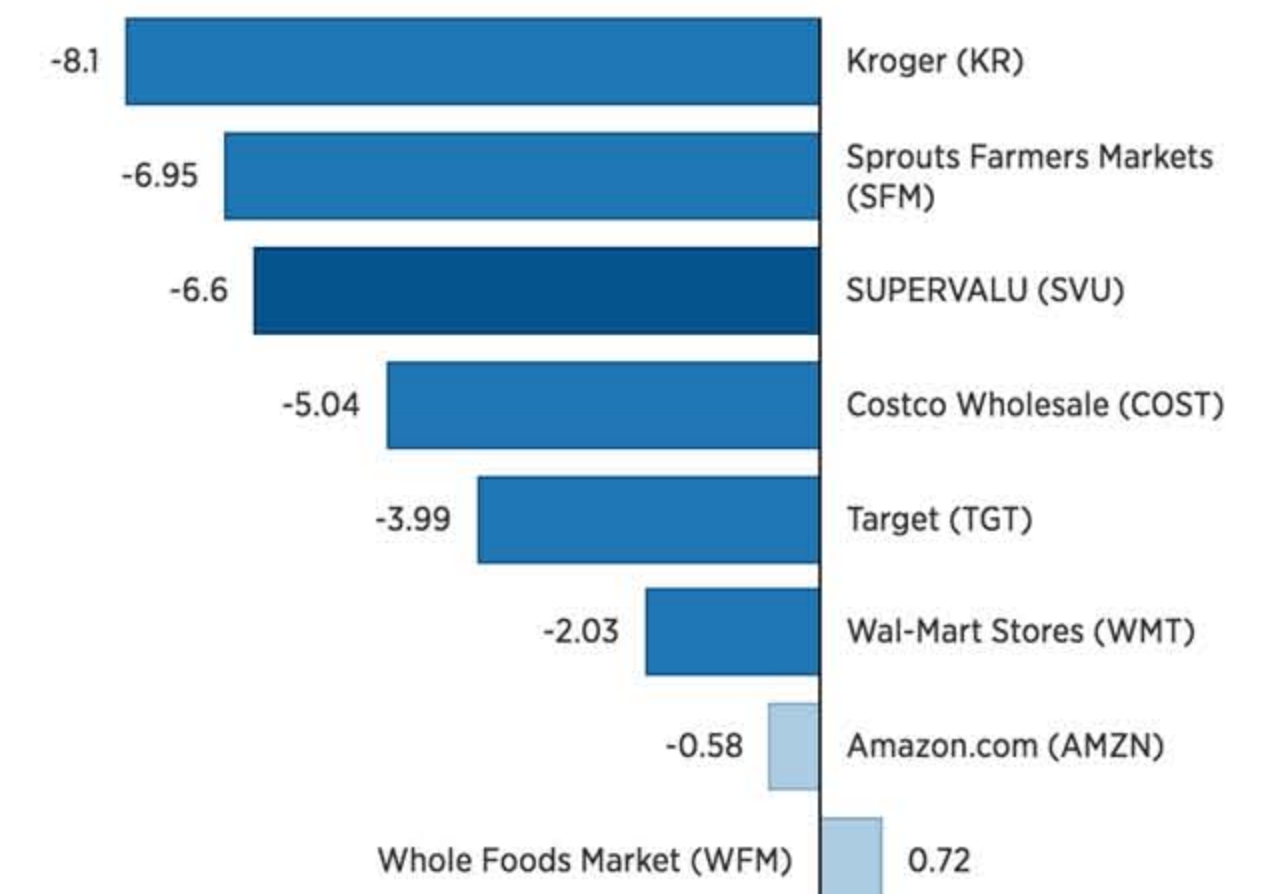
Amazon's Implementation of Scrum@Scale

- 3300 Scrum teams (2-pizza teams focused on microservices) deliver a new feature to production more than once a second.
Roy Monica, Head of Engineering Amazon Devices Demand Forecasting, 2 Mar 2018
- "People were saying that groups needed to communicate more. Jeff (Bezos) got up and said, 'No, communication is terrible!'"
Alan Deutschman, 1 Aug 2014, Fast Company
- No executive support for Scrum ever emerged, and the transition was therefore limited primarily to the team level, with many organizational impediments still in place.
Alan Atlas, theagileexecutive.com, 20 Jul 2009
- "Only 5% of teams are awesome."
Amazon ScrumInc Management Workshop, Oct 2016
- The success of Scrum at Amazon is based on a frictionless way to begin a Scrum transition: establish stable teams, make Agile and Scrum information widely and easily available, give permission to adopt Scrum.
Alan Atlas, theagileexecutive.com, 20 Jul 2009

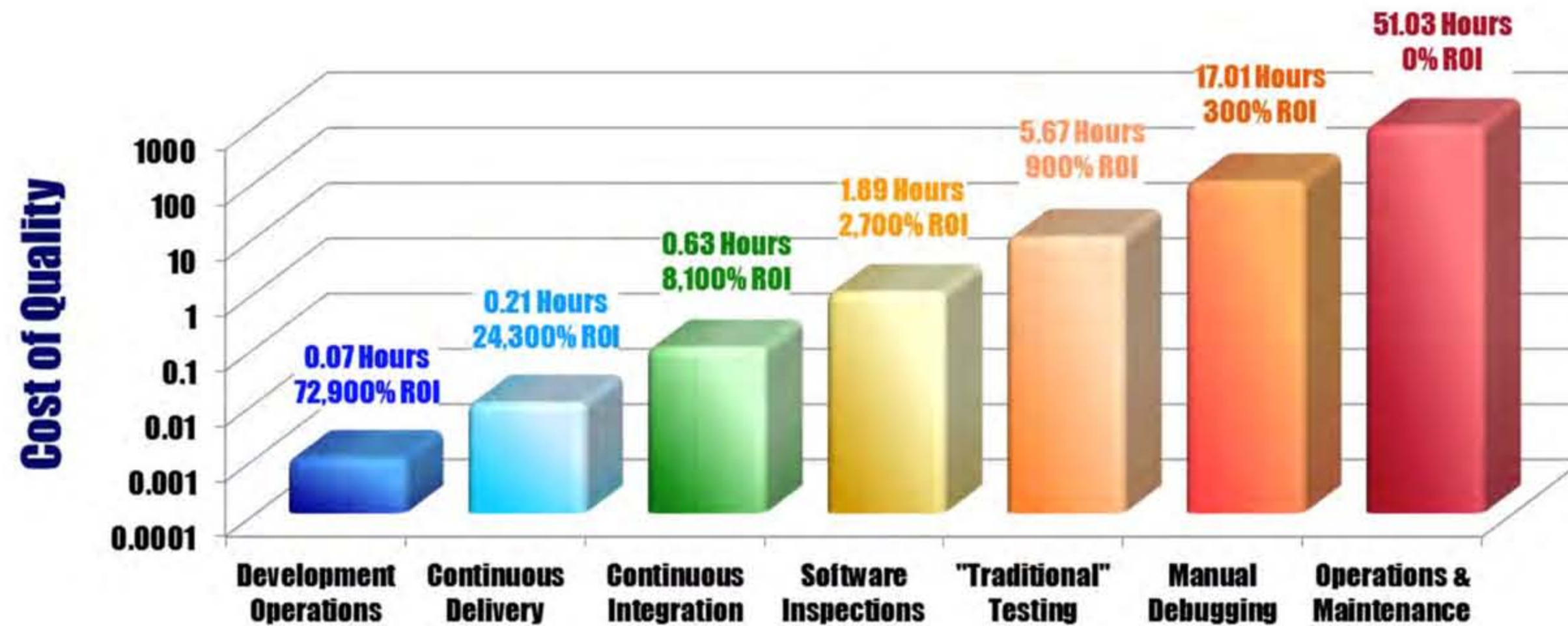
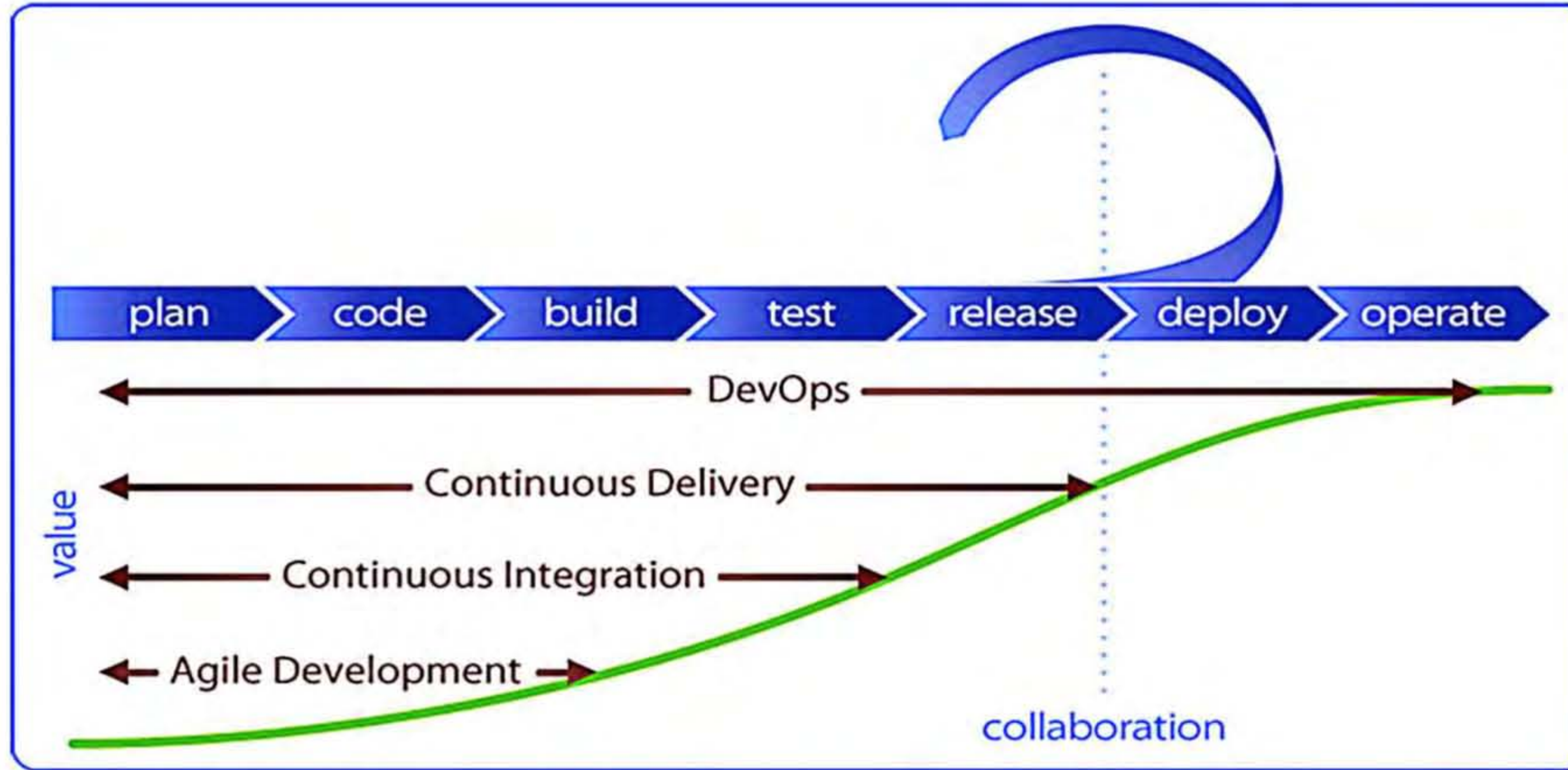
Amazon Acquires Whole Foods

Food retailers % decline

Thursday, Aug. 24, 2017.



Amazon Has a Strong Definition of Done



David Rico (2016) Business Value, ROI, and Cost of Quality (CoQ) for DevOps

Built by Scrum: Grippen JAS 39 E/F

**Over
2000
People**

Source: SAAB Group

Total Project Cost: \$14 Billion

**Unit Cost:
\$69 Million**

First Production Run: April 2017



1. "The Gripen is the world's most cost-effective military aircraft "- [Jane's Aviation Weekly](#)
2. "Saab's Gripen E fighter to take on the F-35: Jet travels at 1,522 mph with improved sensors, weaponry and range (and unlike its competitor, it works)" - <http://www.dailymail.co.uk>
3. The Planet's Best Stealth Fighter Isn't Made in America. <http://www.thedailybeast.com>
4. Gripen operational cost lowest of all <http://www.stratpost.com>

Owning the Sky with Agile

Building a Jet Fighter Faster, Cheaper, Better with Scrum

Jörgen Furuhjelm
Project Manager
R&D
Saab Aeronautics
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Johan Segertoft
Project Manager
Avionics Software
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Joe Justice and J.J. Sutherland
Scrum Inc.
Justice@scruminc.com
jj@scruminc.com

Abstract

Advanced military systems are some of the most expensive and most complex research, design, and manufacturing challenges in the world. The sheer cost of military procurement worldwide is measured in the trillions of dollars, and for decades costs risen seemingly indefinitely. As a result, many companies are seeking new ways of working that will control costs while delivering the highest quality. Saab Defense has adopted an Agile process to address the issue in both hardware and software teams to produce a new multi-role strike fighter, the JAS 39E Saab Gripen.

1. Introduction

While predecessors to Test Driven Development and related Agile practices such as dedicated, co-located, cross functional teams

with flexible priorities have been used in fighter jet design as early as 1960 [2], modern Agile practices such as Scrum roles and release burn down charts in complex systems may be pioneered by Saab Aeronautics.

3. Agile at Saab

Saab introduced Agile [3] practices approximately ten years ago during updates of the previous Gripen versions. First, small independent teams of software developers

www.scruminc.com/scrum-papers/

All Hardware is Software



Anyone in the company at any time has access to complete current 3d model and software. Everyone has the flight sim running the current CAD and code on their desktop.

Can test new part or code in simulation, fly the plane around on their desktop. Simulate high speed collision with a bird. Simulate more powerful fuel pump. Try different bolt sizes. Whatever.

The complete commitment to scaled simulation is inspiring.

Scrum Room



- Teams do the detailed planning
- Teams set the sprint targets (aligning the overall time plan)
- Teams celebrate their victories



Culture

- Complete commitment at the team level.
- Planes are cool. Only Google is rated more desirable work choice by graduating engineers.
- “May we please work even just 4 hours on Saturday?” Some teams opt for overtime.
- Swedish engineering culture: Don’t ask manager to get something for you from another department, go there yourself right now and get it.



Joe

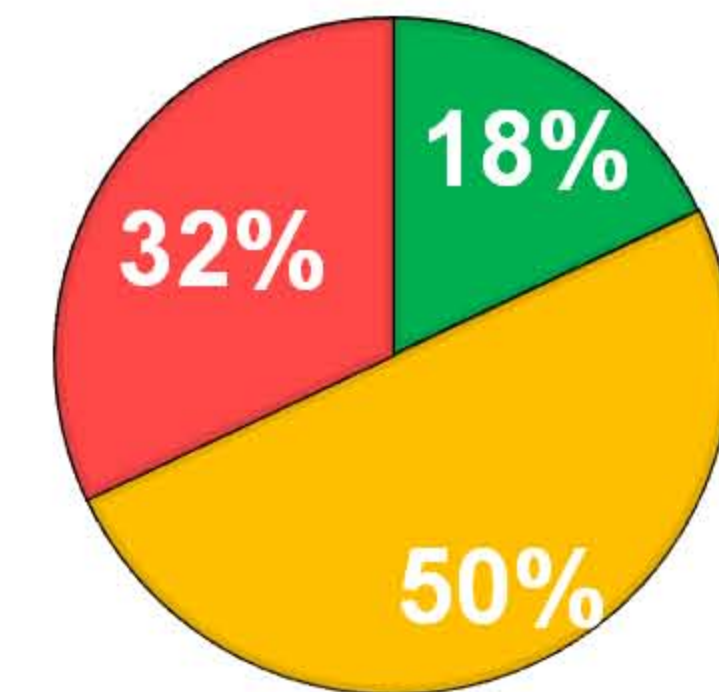
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Decision Latency: Why we need Minimum Viable Bureaucracy

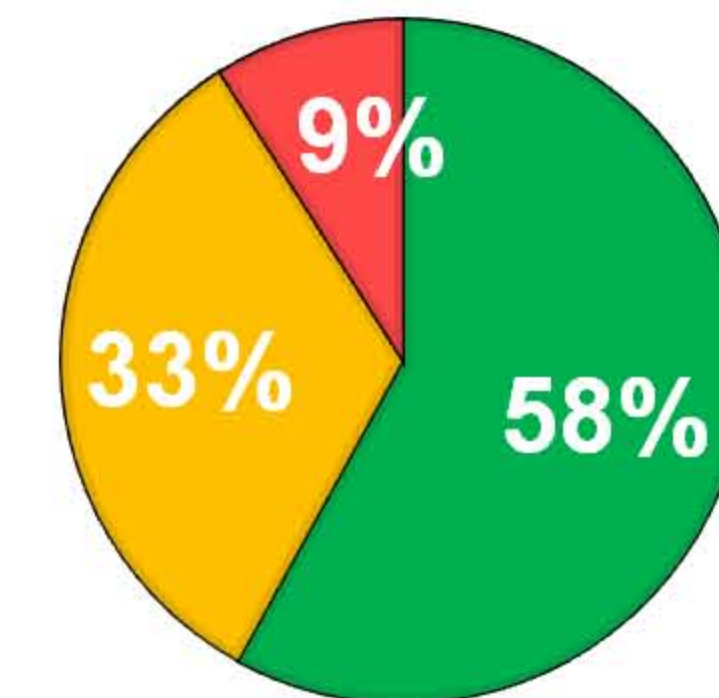
- **Time to make a decision is the primary driver of project failure and budget overrun**
- Scrum pushes decisions down to the team and small teams reduce decision latency
- Strong, decisive, available Product Owner is critical to short decision latency
- Scrum of Scrums, Executive Action Team, and MetaScrum shorten decision latency

Decision Latency > 5hrs

■ Success ■ Challenged ■ Failed



Decision Latency < 1hr



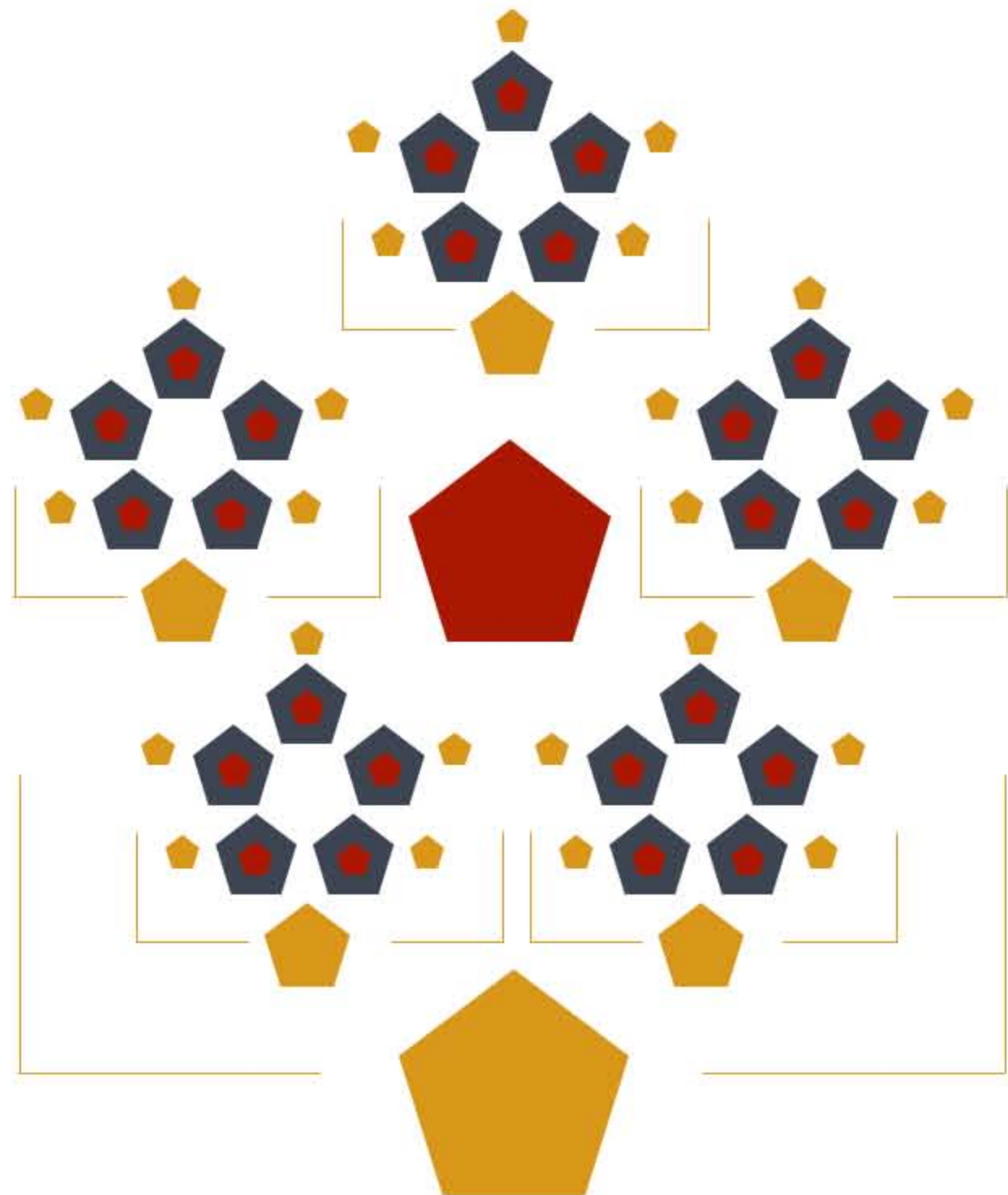
Standish Group Data 2013-2017

The adversary that can move through these cycles faster gains an inestimable advantage by disrupting his enemy's ability to respond effectively! John Boyd

SAAB Aeronautics – First Test Flight Grippen E

Synchronize 2500 people in 1.25 Hrs

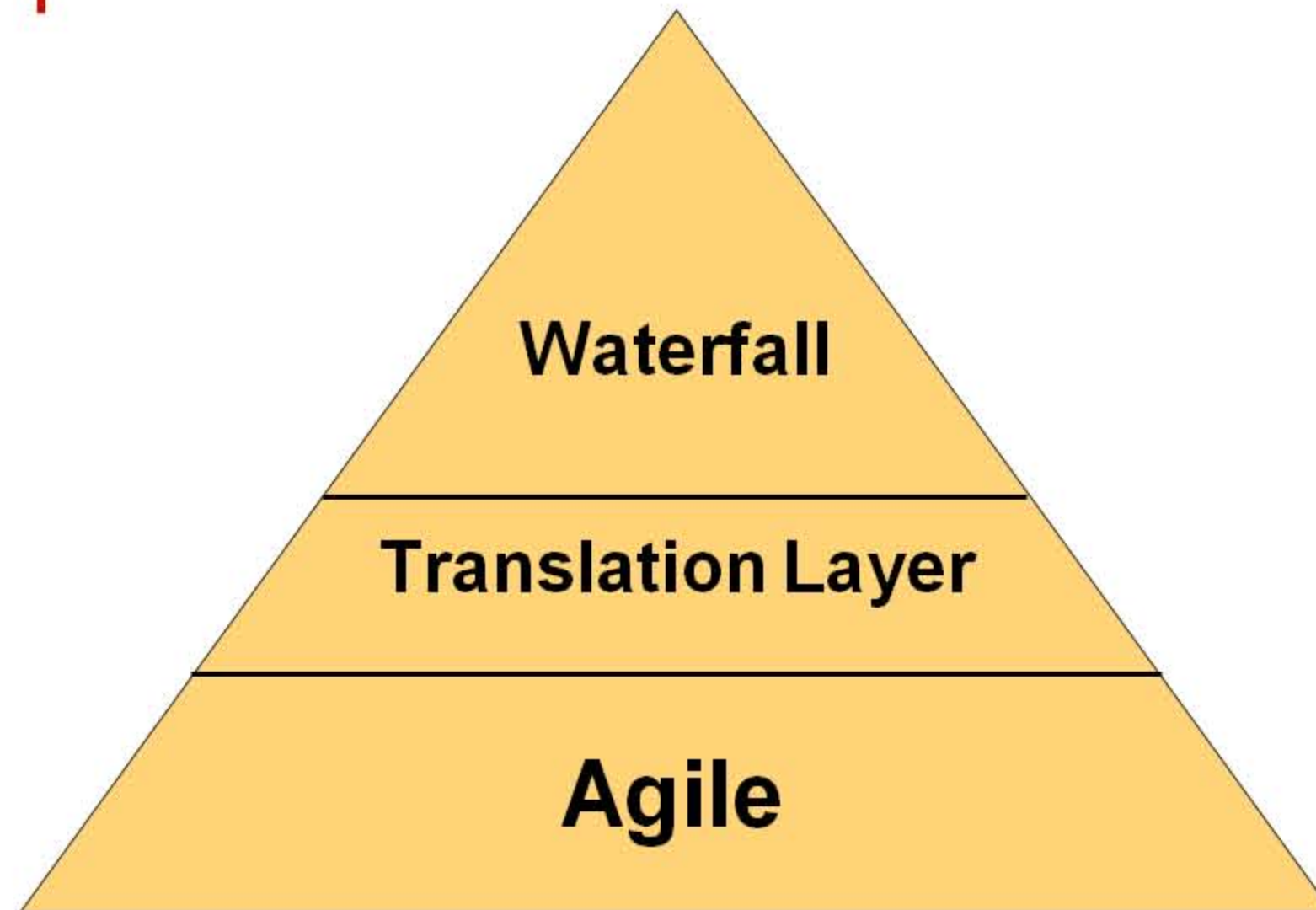
- 8:30 Executive Action Team
- 8:15 Scrum of Scrum of Scrum of Scrums
- 8:00 Scrum of Scrum of Scrums
- 7:45 Scrum of Scrums
- 7:30 Daily Scrum
- Scaled Retrospectives



FrAgile (WaterScrumFall) - poor decision latency

#1 problem in "scaled Scrum"

- Traditional management hierarchy creates project teams
- "Scaling frameworks" are often used to provide scaffolding for the legacy organization until it can evolve
- **This is a translation layer that provides insulation and must ultimately be removed to get high performance**
- Bureaucracy or changes in management often cripple and/or destroy agile implementation yielding a virtually 100% failure rate.



They don't even look at the goddamn bottom up.

How can you decide what's going to be top down until you understand what's bottom up?

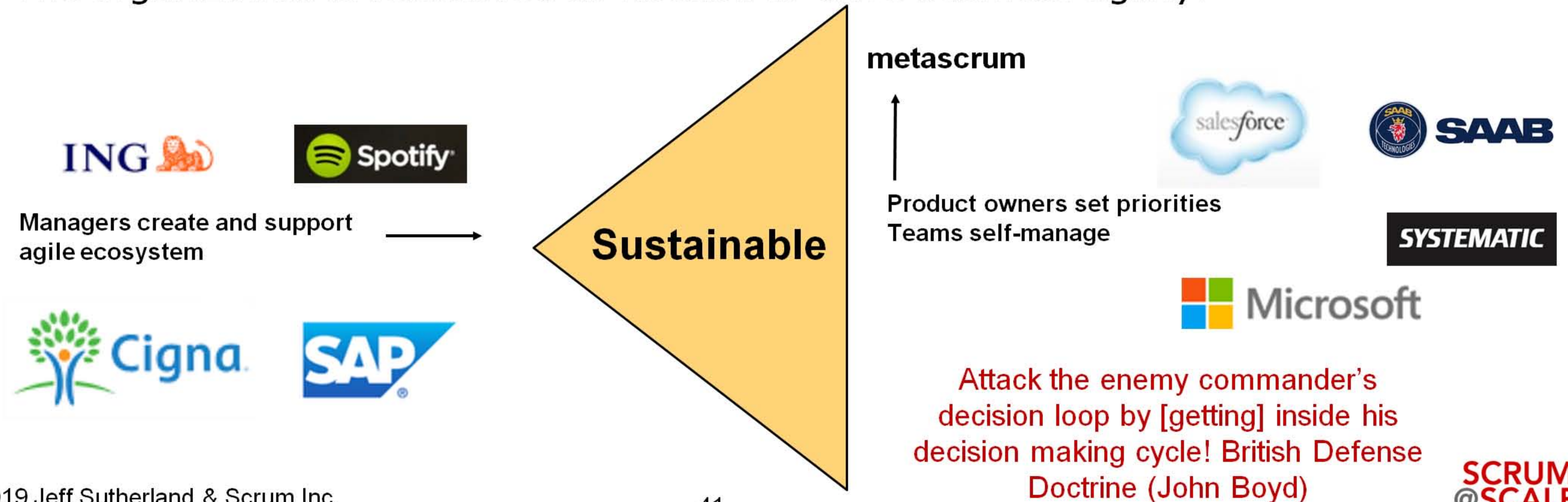
John Boyd



Sustainable Agile Implementation

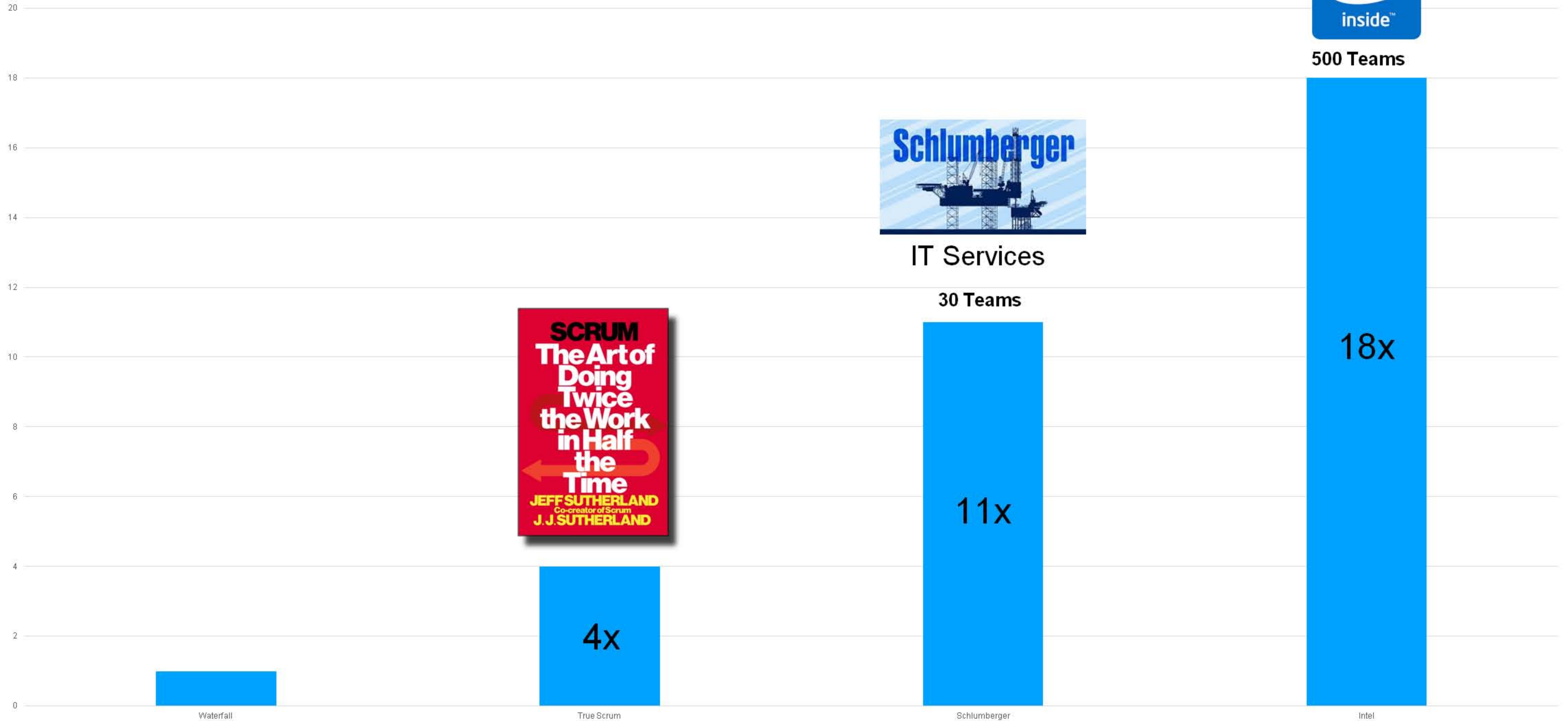
Install Agile OS - reduce decision latency

- Product Owners drive priorities, leadership supports their priorities.
- Teams self-organize in alignment with a prioritized backlog to maximize production.
- Leaders create virtual teams that drive communities of practice across the company.
- The organization is refactored as needed to drive business agility.



Where are you on your Agile journey?

Scrum@Scale Productivity Improvement



S@S - Building a Scaling Map for Your Organization

- Rows are scaling components
- Columns are your company
- Sticky notes evaluate your company (or part of company where you have influence)
- Prioritize initiatives to form a scaling backlog



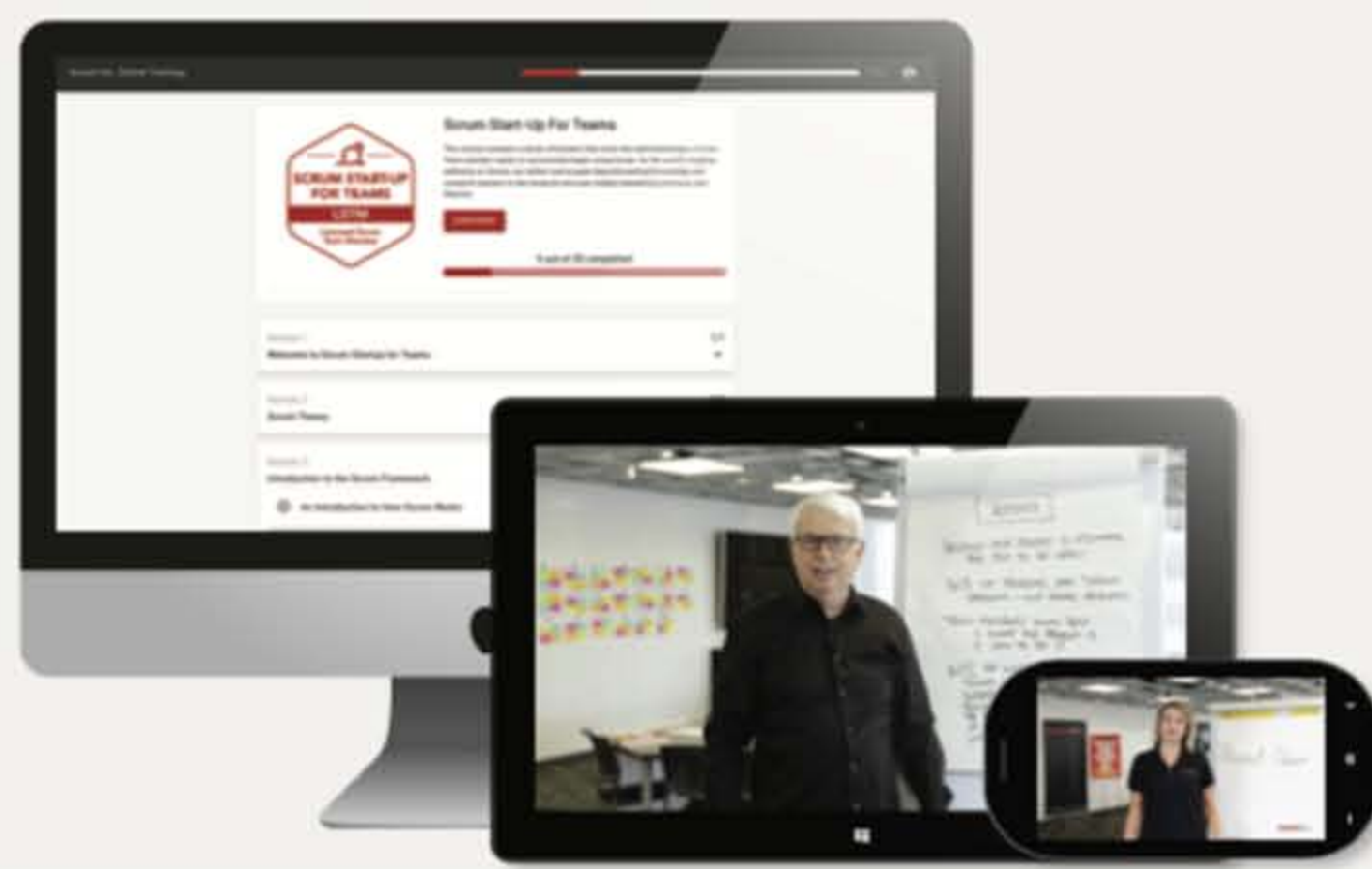
To learn more:

- **Courses Worldwide**
- **ScrumatScale.com**
- **S@S Certification**
- **Become a Certified Trainer**
- **Contact**
 - info@scruminc.com



Scrum Start-Up for Teams

Laying the foundation for an
agile transformation



www.scruminc.com/ss4t

online-learning@scruminc.com

OVERVIEW

Whether you need training for 10 people or 10,000, the Scrum Startup for Teams online course offers a scalable online Scrum education experience that teaches everything needed for a Scrum team member to hit the ground sprinting.

The curriculum and content has been developed in collaboration with the co-creator of Scrum, Dr. Jeff Sutherland, so your students are getting training informed by the latest research and thinking based on real-world experience.



Experience it on desktops,
tablets, or mobile devices.



Accurate progress reports and
self-service reporting for admins.

8/8

Earn 8 Professional Development
Units from PMI & 8 Scrum Education
Units from Scrum Alliance



Those completing the final exam will
earn their Licensed Scrum Team
Member credential.

“Jeff, you need to explain where the magic come from!” Ken Schwaber

- Scrum Values anchor our culture
- Empiricism is how we make changes
 - Transparency
 - Inspect
 - Adapt

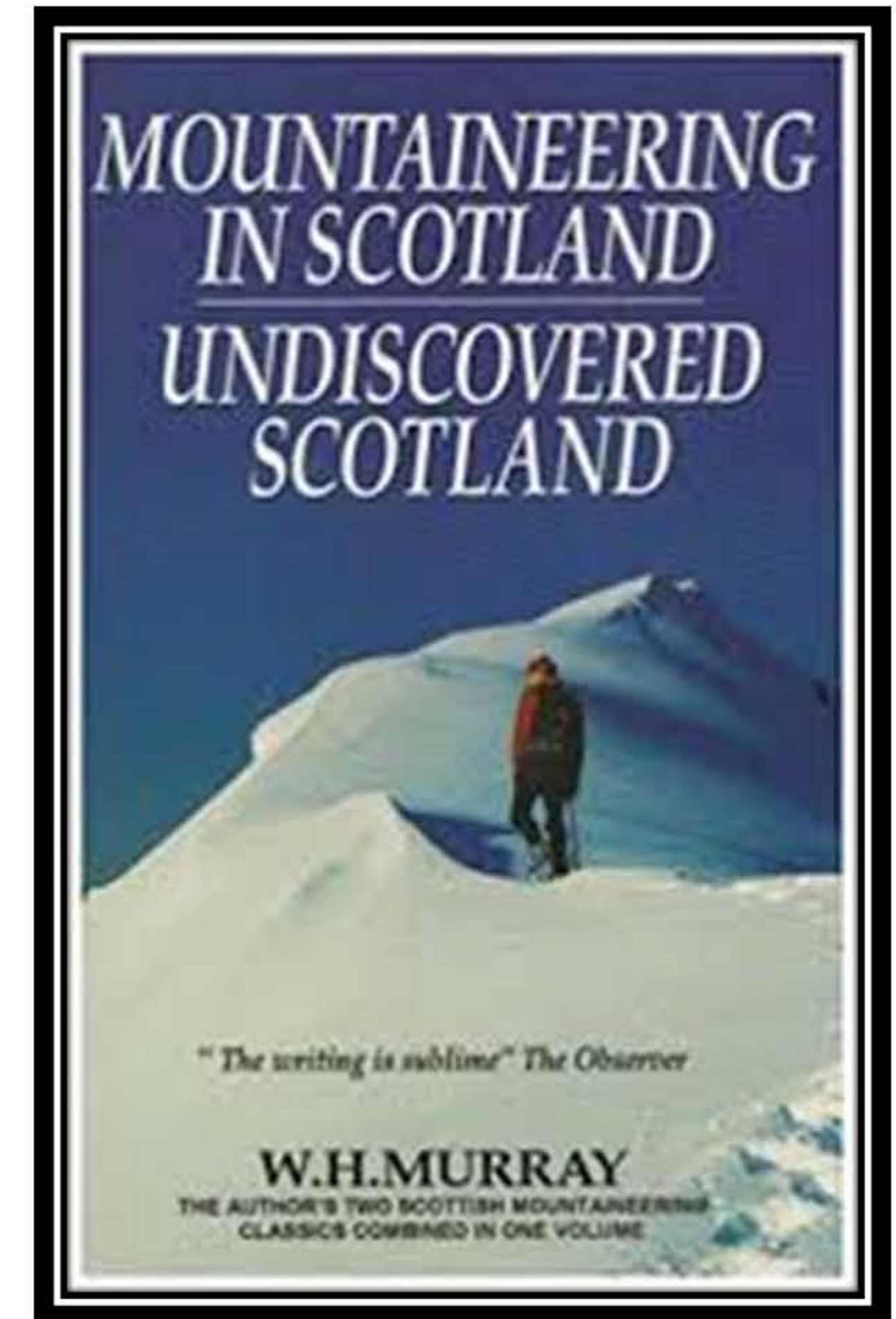
OPENNESS
RESPECT
COURAGE
FOCUS
COMMITMENT

Until there is commitment
***There is hesitancy, drawing
back, ineffectiveness***

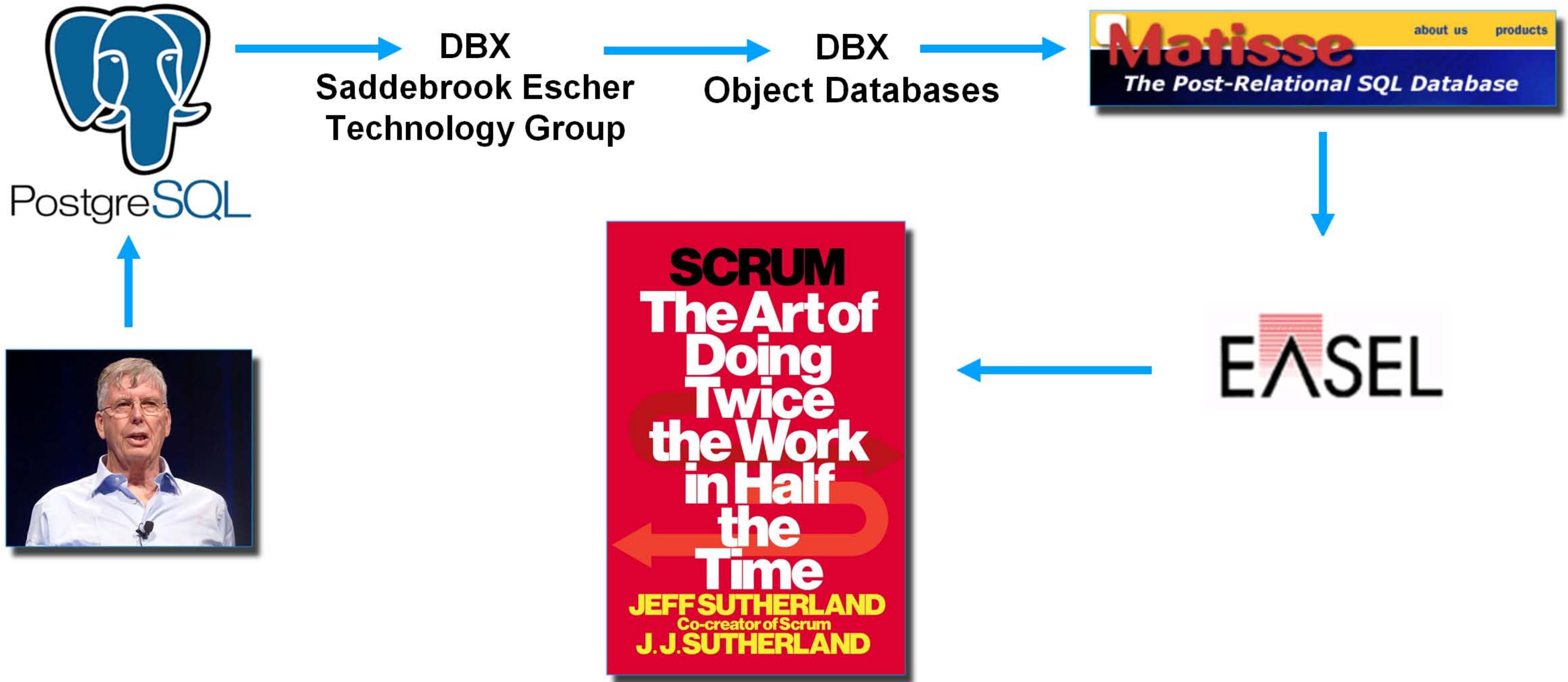
There is one elementary truth -
***at the moment one definitely
commits providence moves.***

All sorts of things happen to help.
***A whole stream of events flows
from the point of commitment.***

Raising in one's favor all manner of
incidents and meeting and material
***assistance which noone could
believe could come their way.***



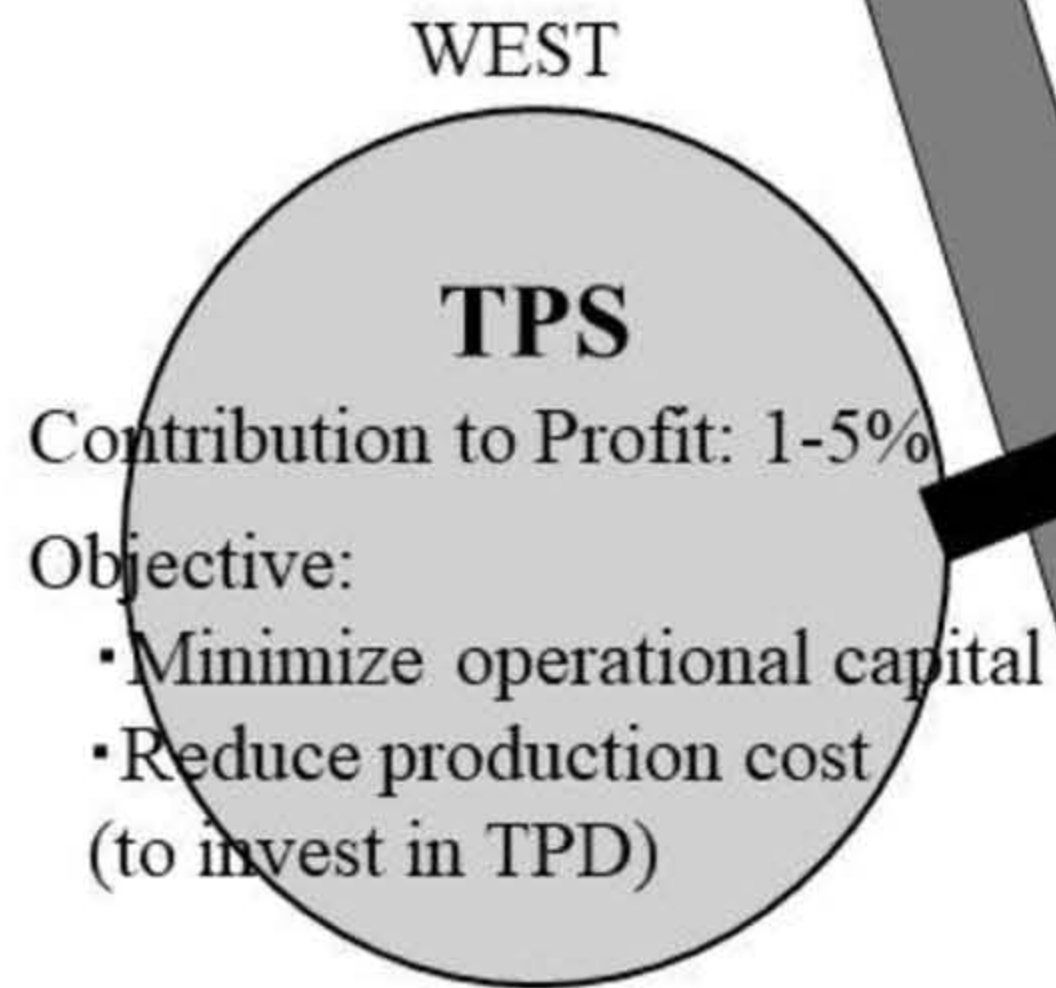
Where Did Scrum Come From?



**PDCA
Lean
Kanban**

5%

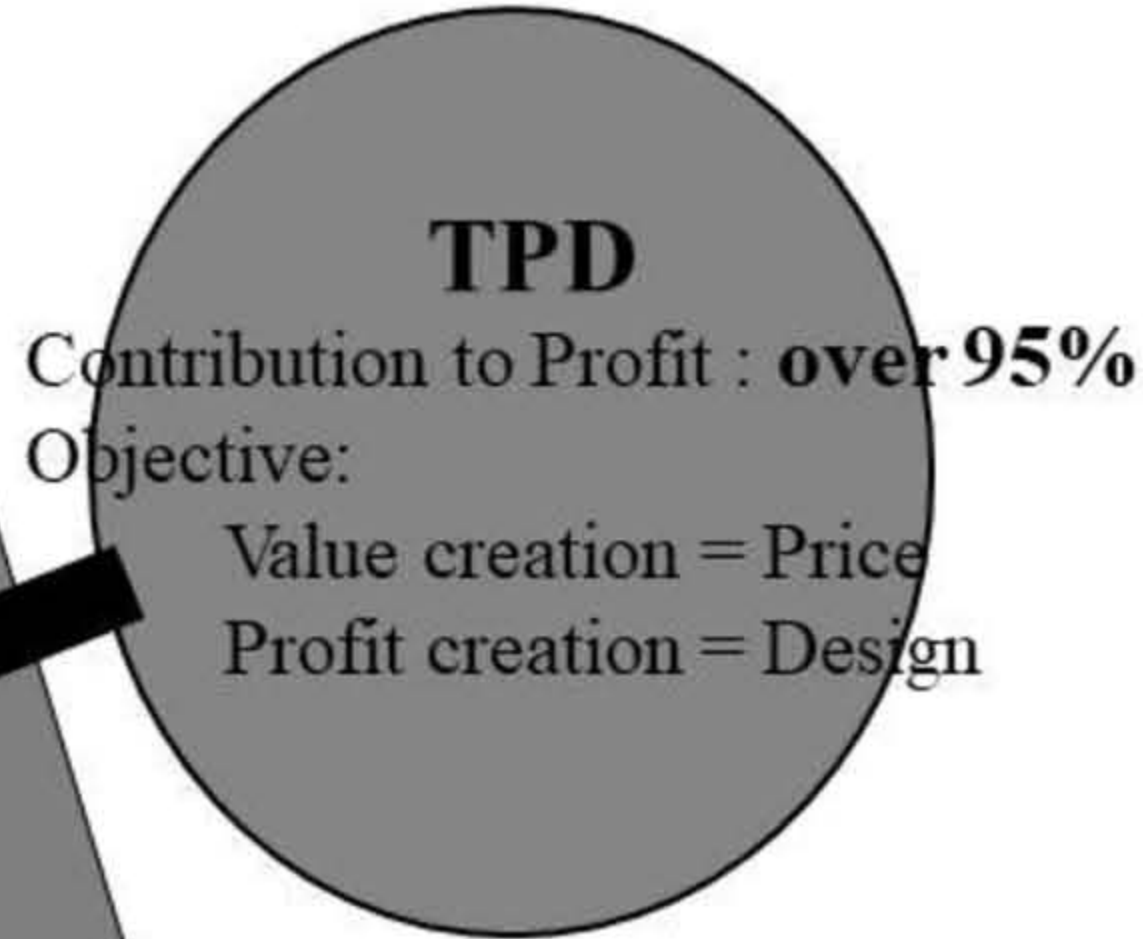
NR248



*Kanban/Andon
Tano-kou/5S/QC circle
VA..*

**OODA
Loop 95%**

EAST



*CE System
Toyota way target costing
(GENKA-KIKAKU)
Toyota way VE*

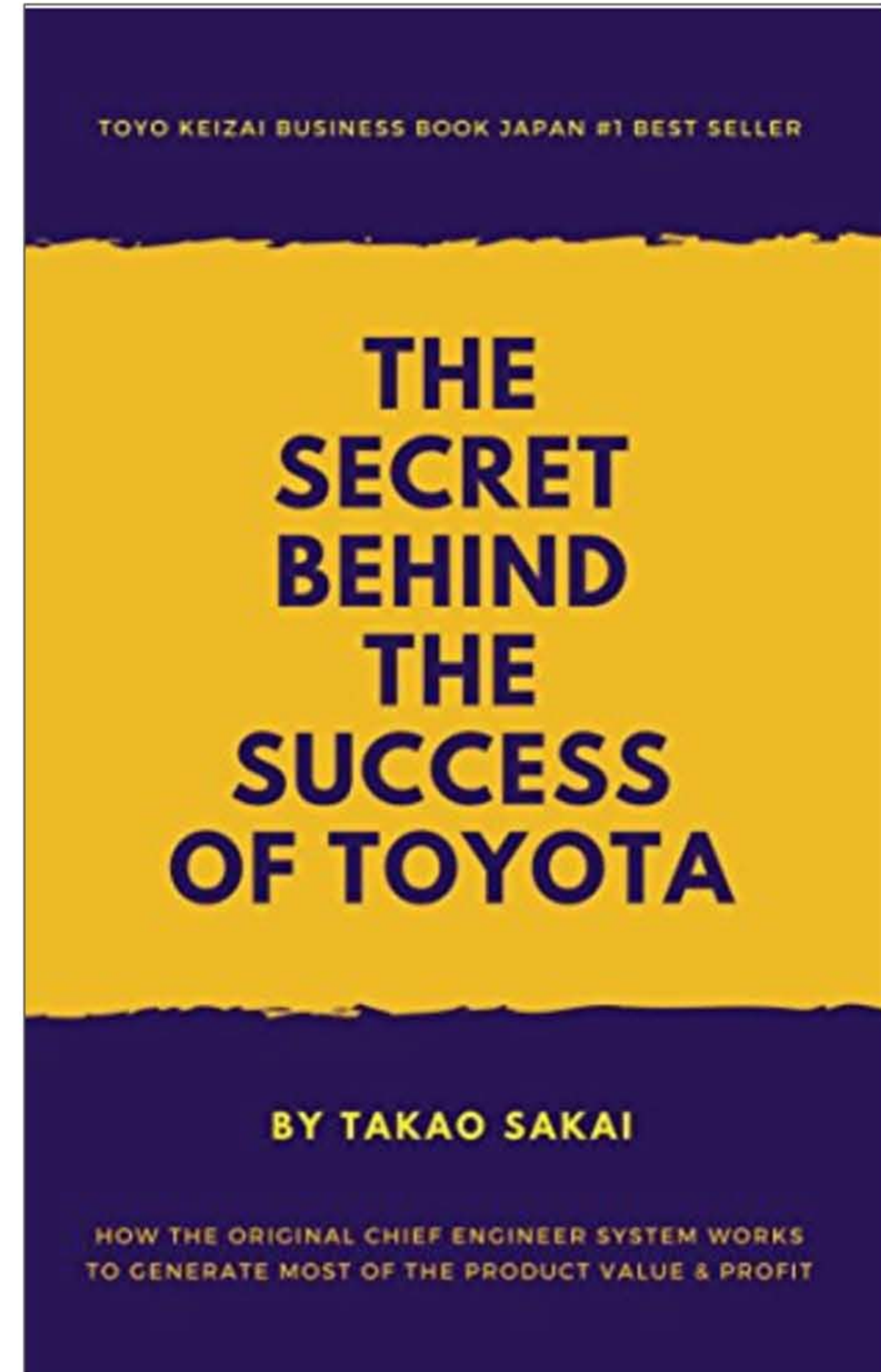
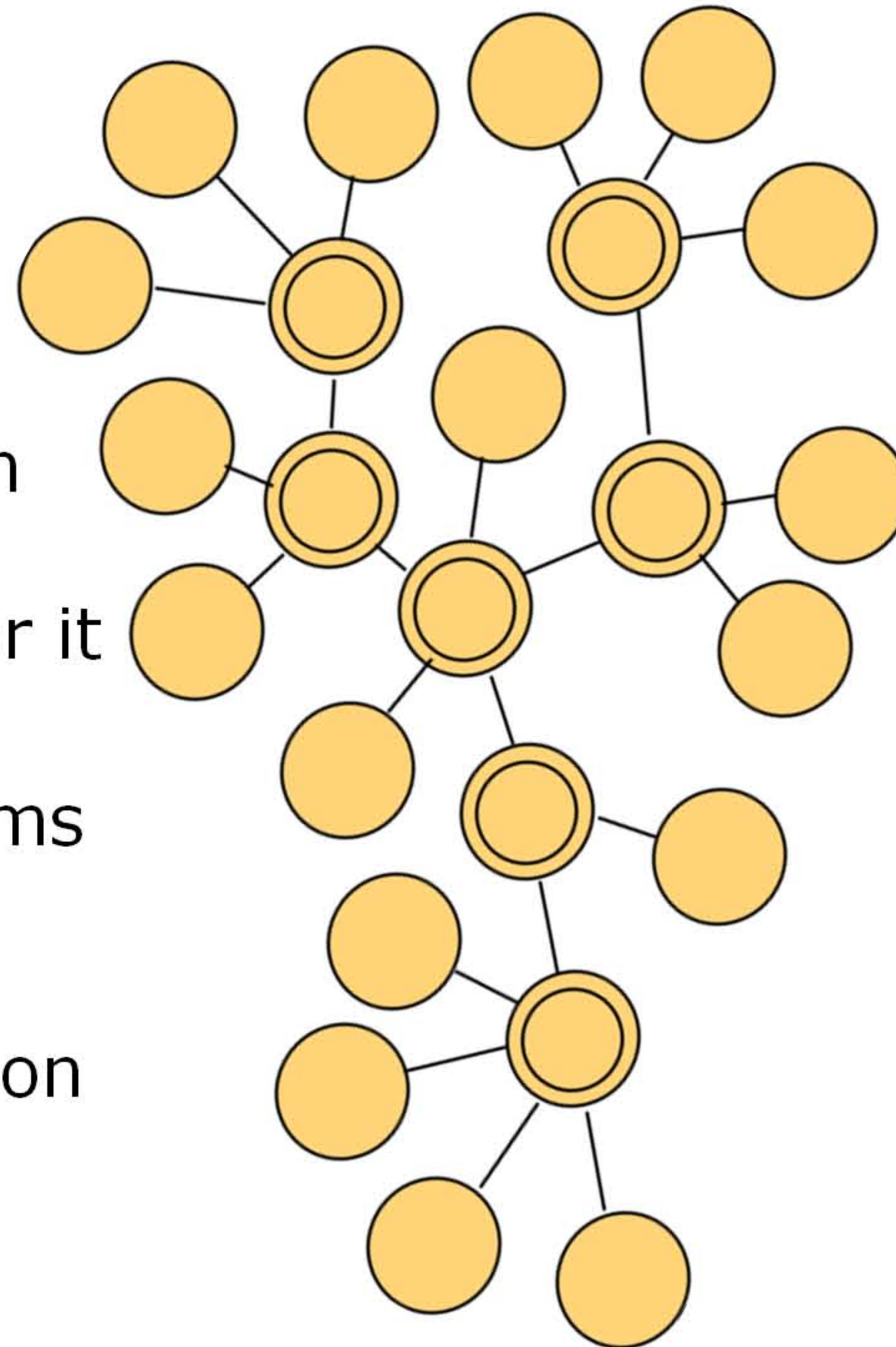


Fig. 1-4 East & West sides of NR248

Scale Free Architecture: The SM Role Scaled

- Scrum must scale in an organic way consistent with the Scrum Guide or it will be slow
- Using a Scrum of Scrums reduces communication paths but increases communication saturation

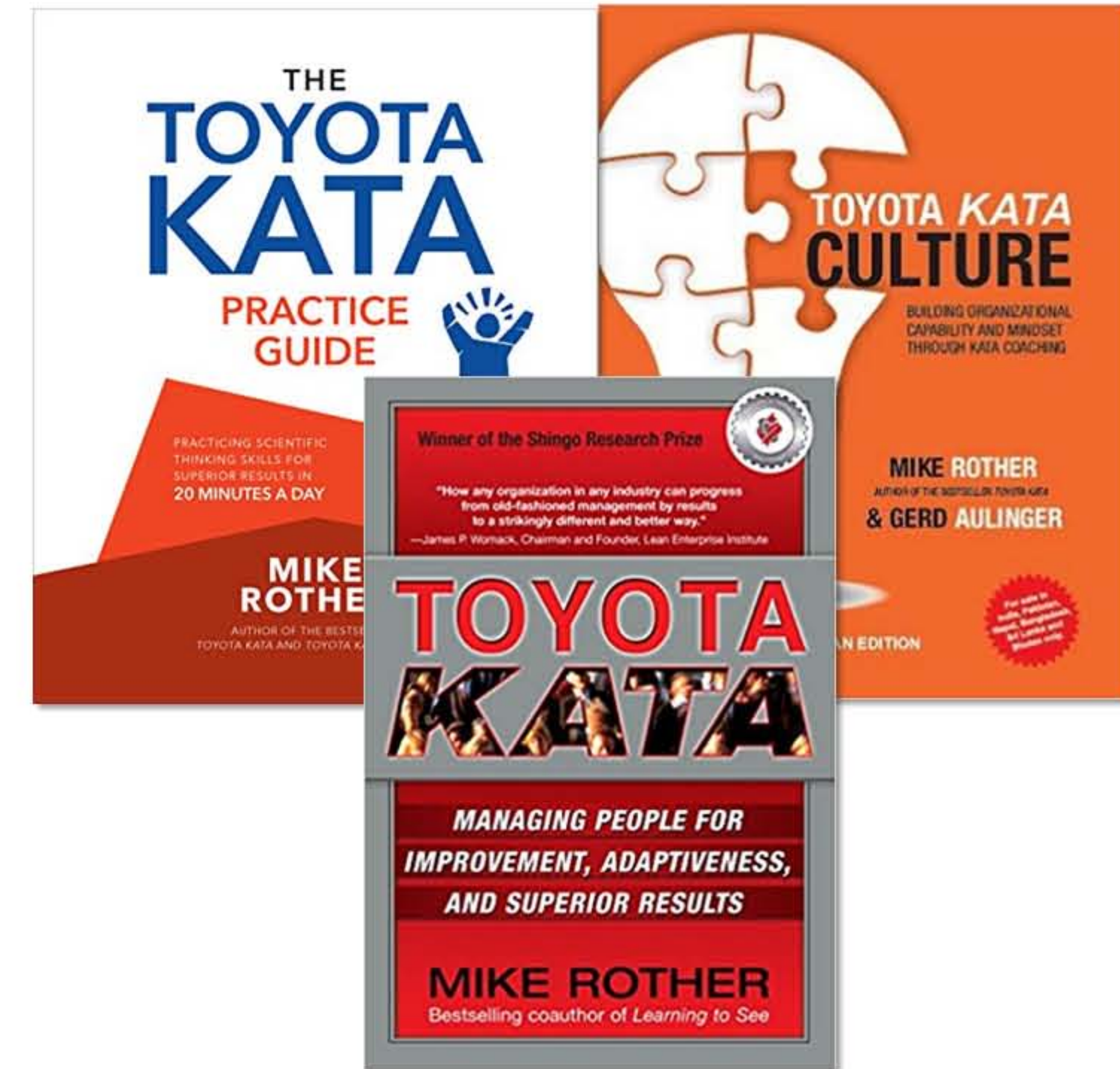


NEW ROLE

- In order for the SoS to be most effective, we need a **Scrum of Scrums Master** (SoSM) to ensure that:
- Impediments are shared and removed
- Knowledge is spread and standardized
- Dependencies are discussed and resolved
- The SoS functions as a Release Team

Decide on the next smallest experiment

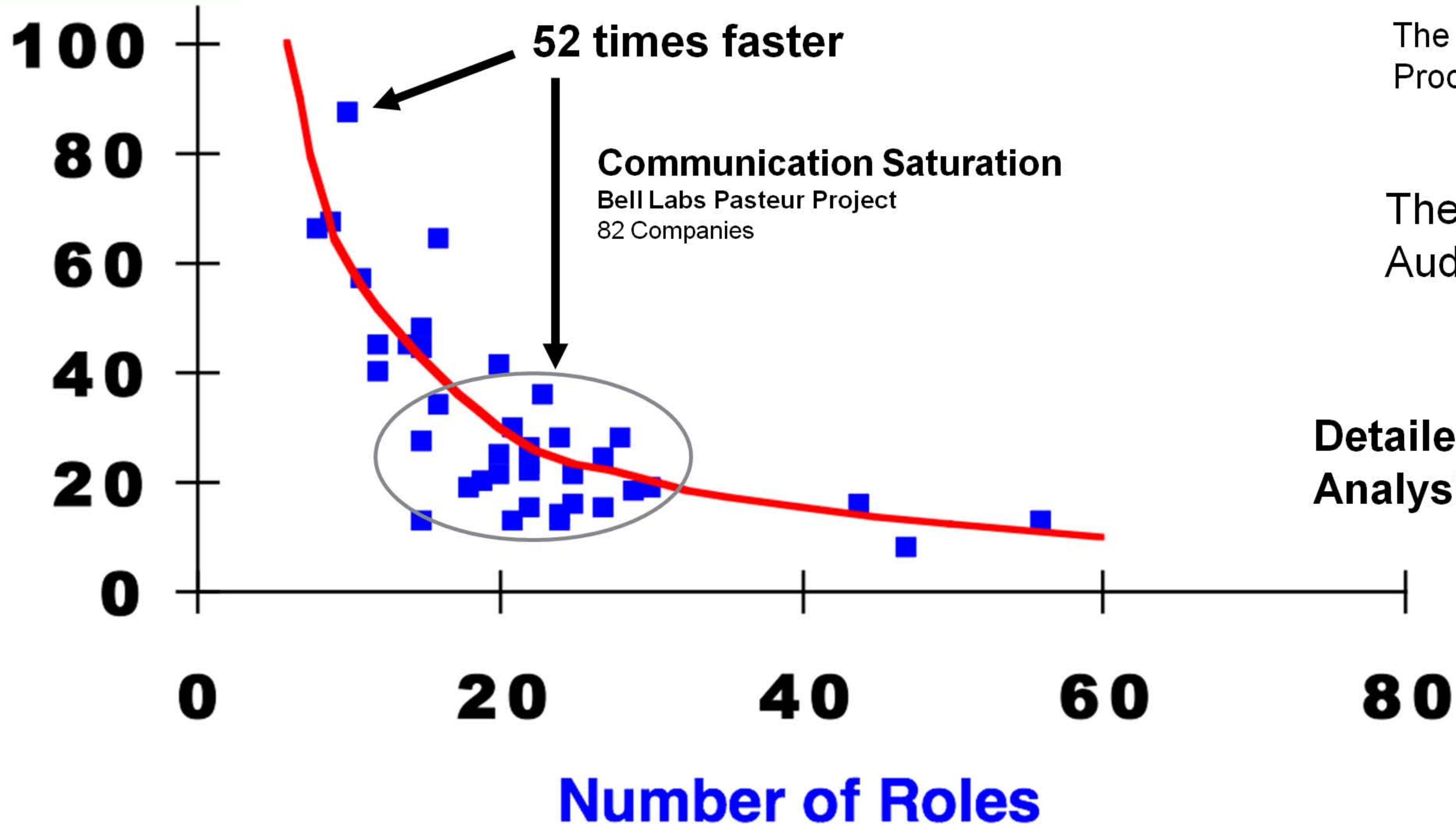
1. What is the **target condition**?
2. What is the **actual condition** now?
3. What **obstacles** do you think are preventing you from reaching the target condition? Which **one** are you addressing now?
4. What is your **next step** (next experiment)? What do you expect?
5. How **quickly** can we **go and see** what we have learned from taking that step?



Case Study: HyperProductive Team

Daily Meeting and Short Sprint

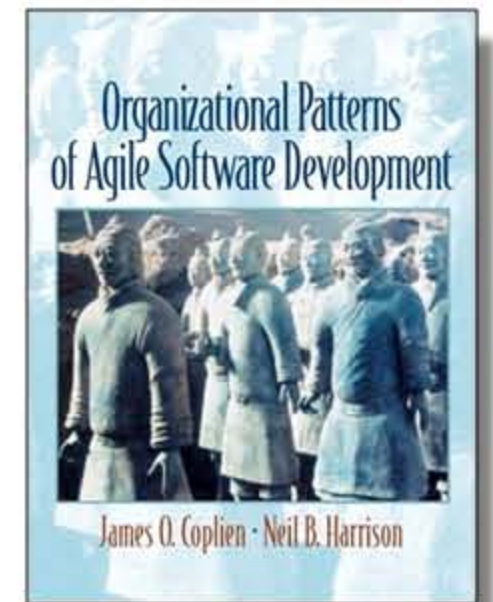
% Saturation



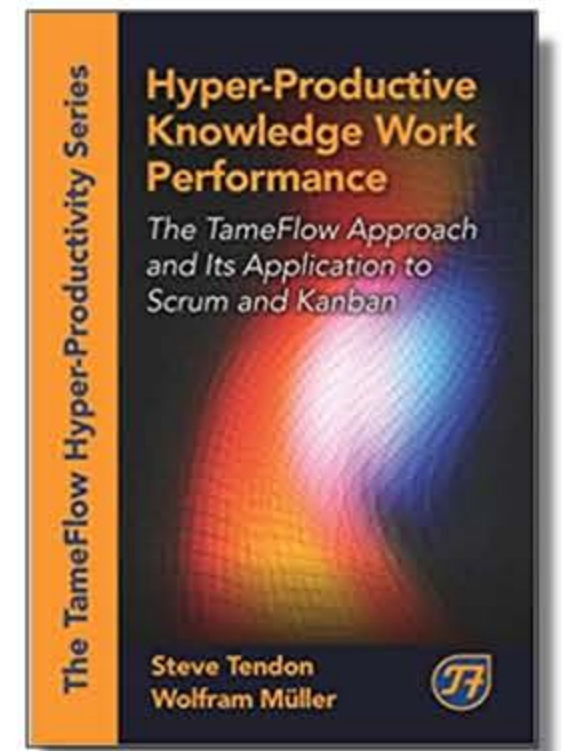
The Product



The Audit



Detailed Analysis



Agility - In Memory of Mike Beedle

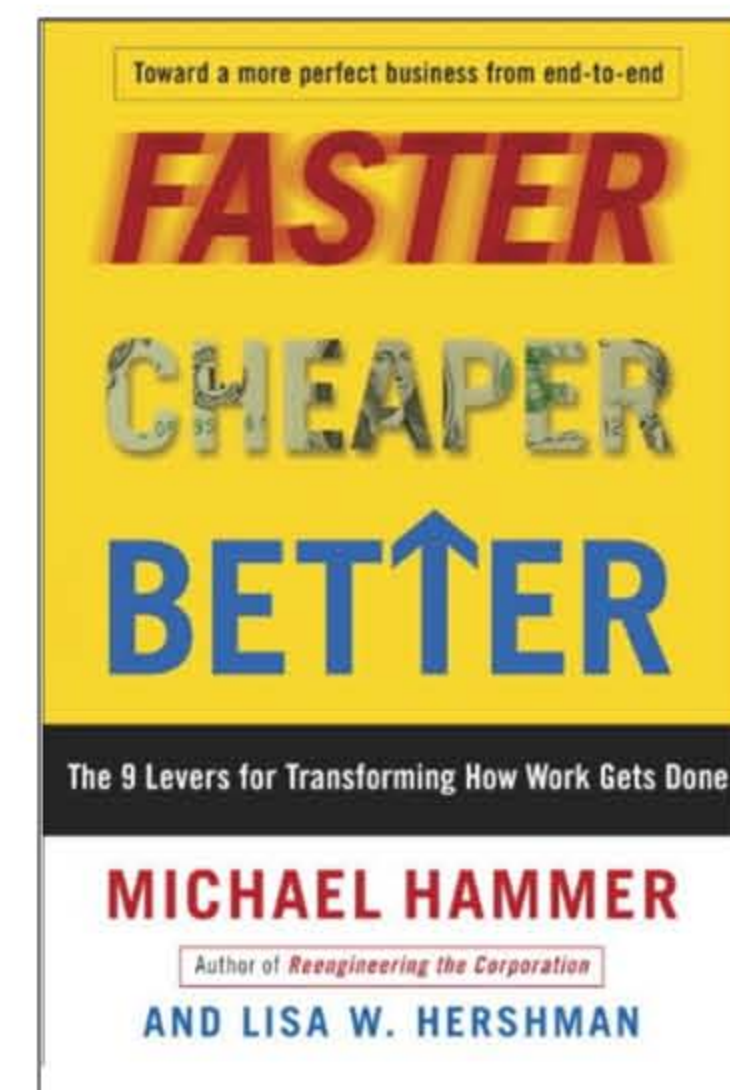
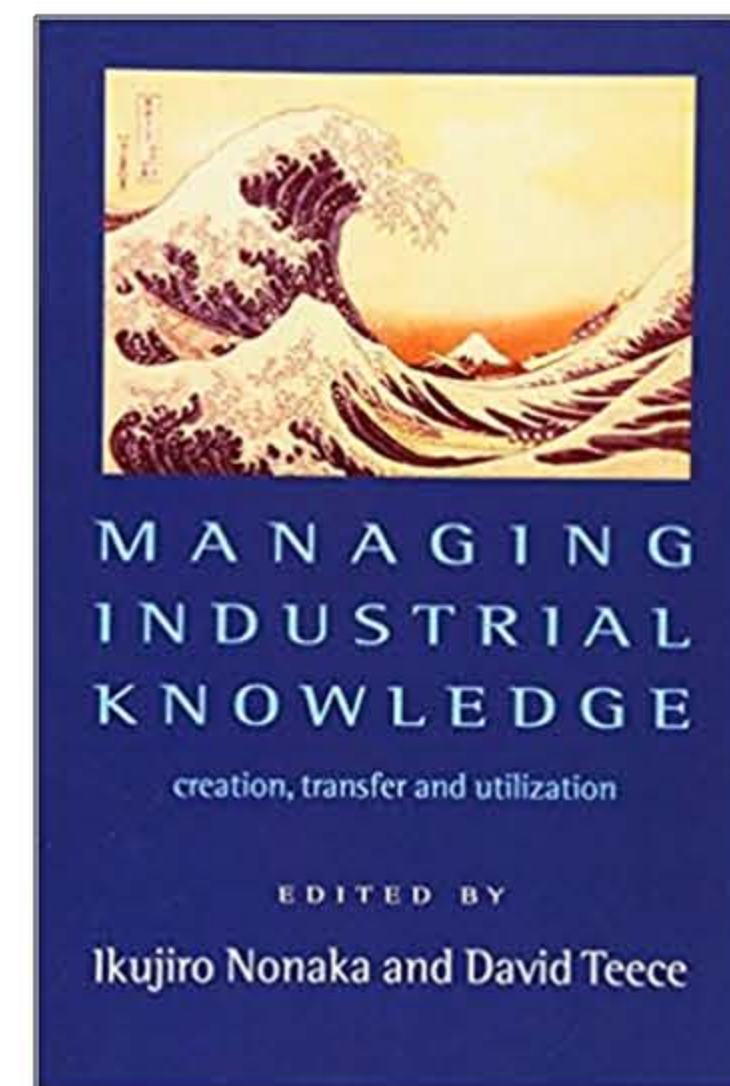


- **Signatory of Agile Manifesto**
- **Co-author of first Scrum book**
- **Second person to generate hyper productive teams**
- **First CEO to implement Scrum company-wide**
- **First person to demonstrate business agility-hyperproductive revenue**
- **Got 10 people to do the work of 200**

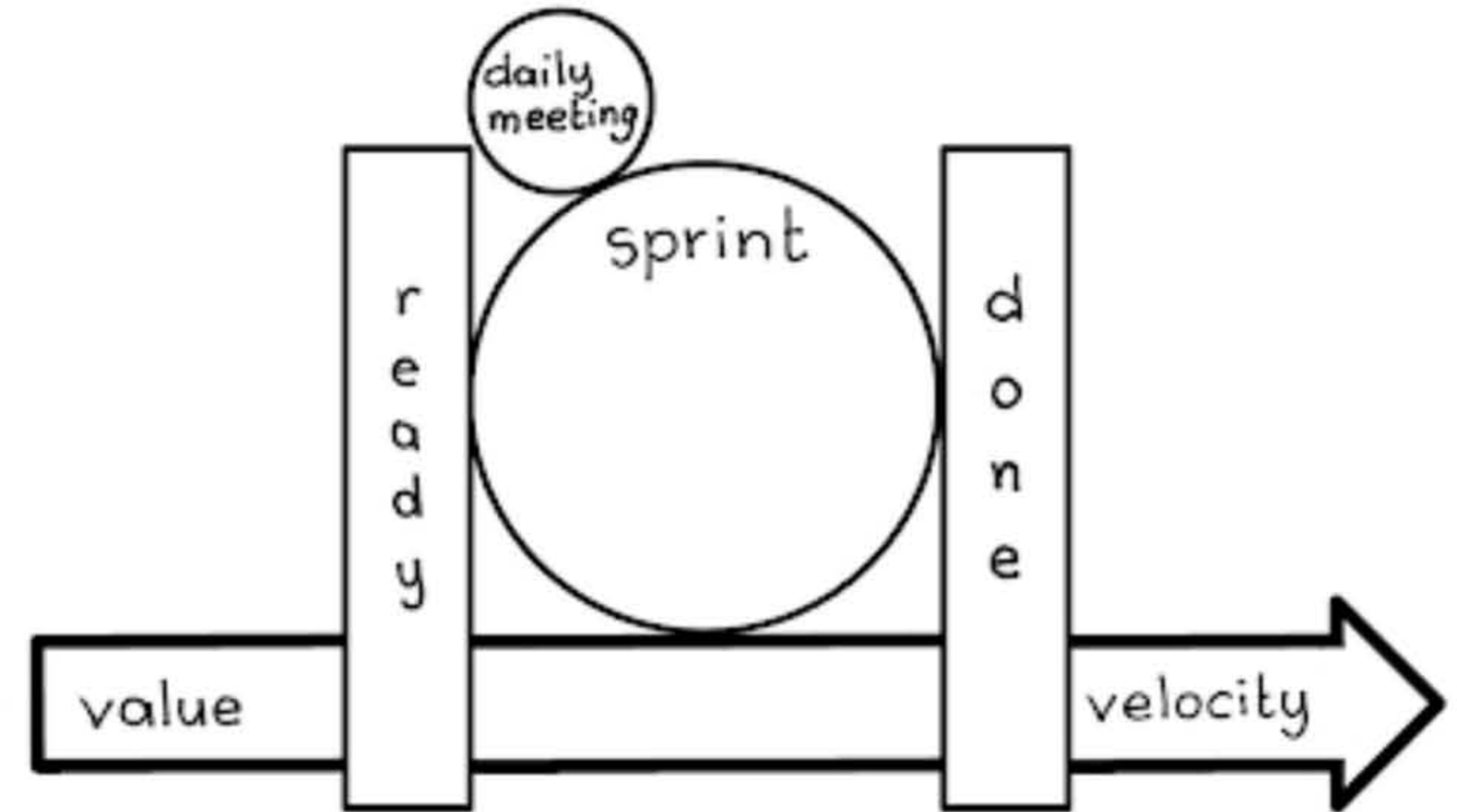
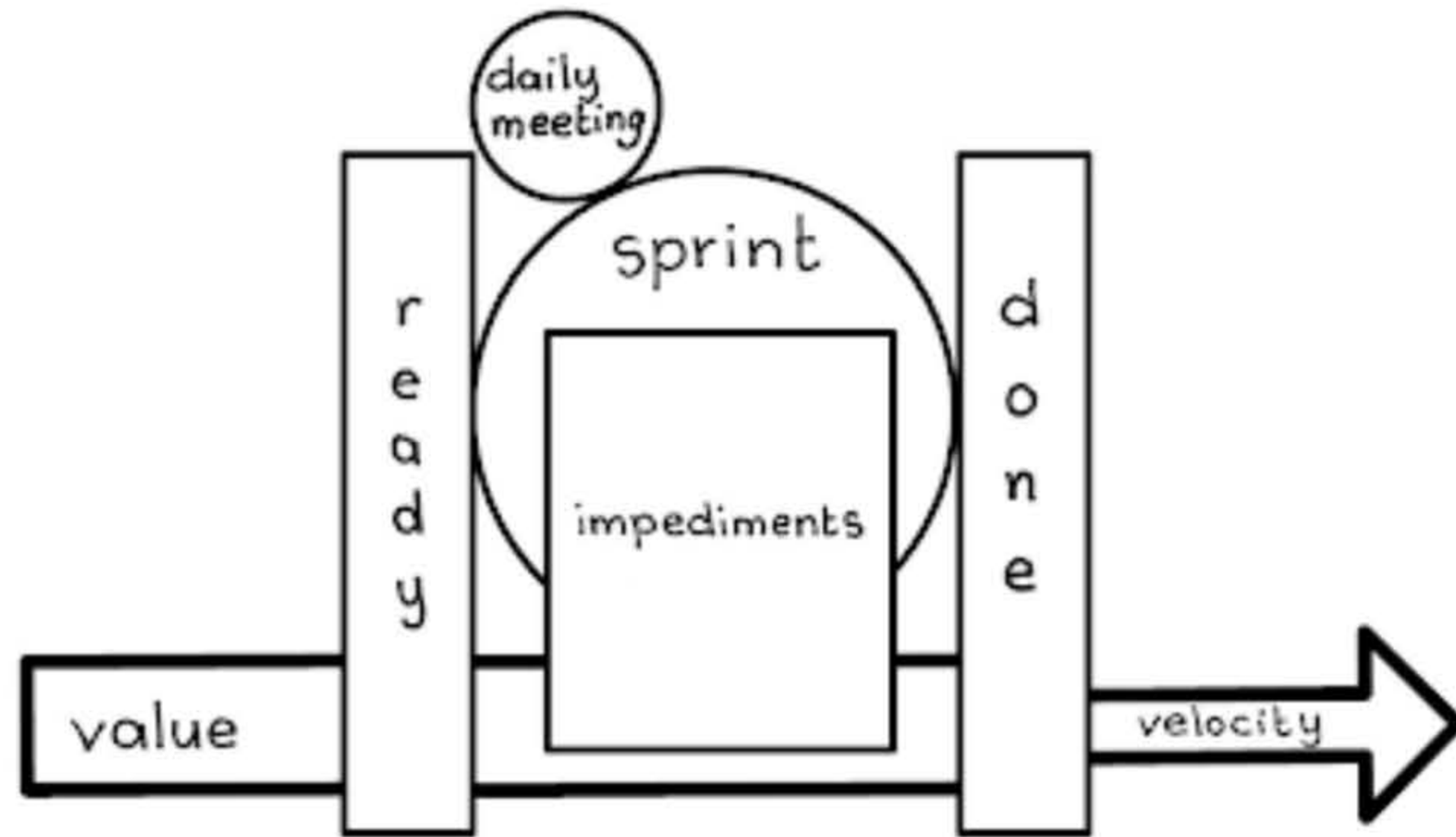
Mike Implemented the First Scrum Transformation

Leadership, Culture, Governance, and Expertise enable organizational change

- Leadership
 - Create a vision and communicate it throughout the organization
 - Facilitate an environment for product creation
 - Implement the Scrum values
- Culture
 - Kaizen Thinking - Constant incremental structural change
 - Eliminate organizational debt
 - Create a business plan/organization that works
 - Provide all resources the teams need
 - Remove waste identified by the teams
 - Assure organization is set up to maximize production
 - Value Stream Mapping and Process Efficiency are the best tools
- Governance - Coach the organization
 - Hold Product Owners accountable for value delivered per point
 - Hold Scrum Masters accountable for process improvement and team happiness
- Expertise
 - Get the right people in the right place



Value Cannot Come Through the Scrum Cycle Without Velocity



ScrumPlop.org - Scrumming the Scrum

Scrum@Scale LLC

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- Train the Trainer sessions take place every quarter in the U.S. and Europe
<https://www.scrumatscale.com/scrum-at-scale-trainer-program/>

