

Scrum For Product Engineering and Production

Hardware, Software, and Innovation

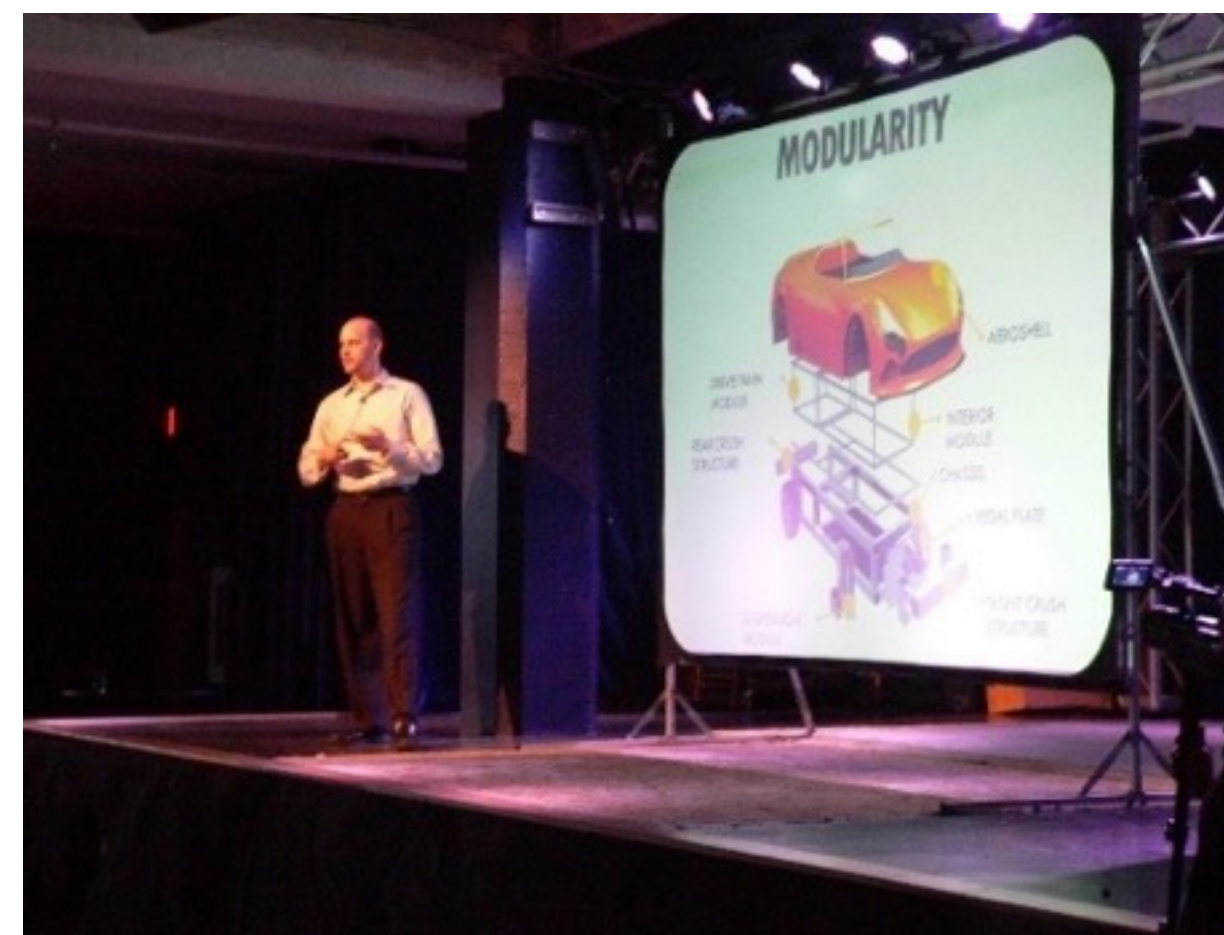
Joe Justice

“WE HAVE FOUND TEAM MORALE
TO BE A MULTIPLIER FOR VELOCITY.”

- **President Scrum@Hardware at Scrum Inc.**
- **Creator of eXtreme Manufacturing Methods**
- **Owner of all-Scrum automotive Manufacturing Company: Twice the MPG in half the time.**
- **Collaborated with Toyota, Ford, GM, Bosch, Johnson Controls, Microsoft, HP Labs, Aspen Group, Lockheed Martin, Local Motors, Honda Racing. Winner Autonomous Vehicle Challenge, X Prize Finalist.**



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Forbes



TEDx
x = independently organized TED event

Discovery
CHANNEL

CNN Money.com
FORTUNE

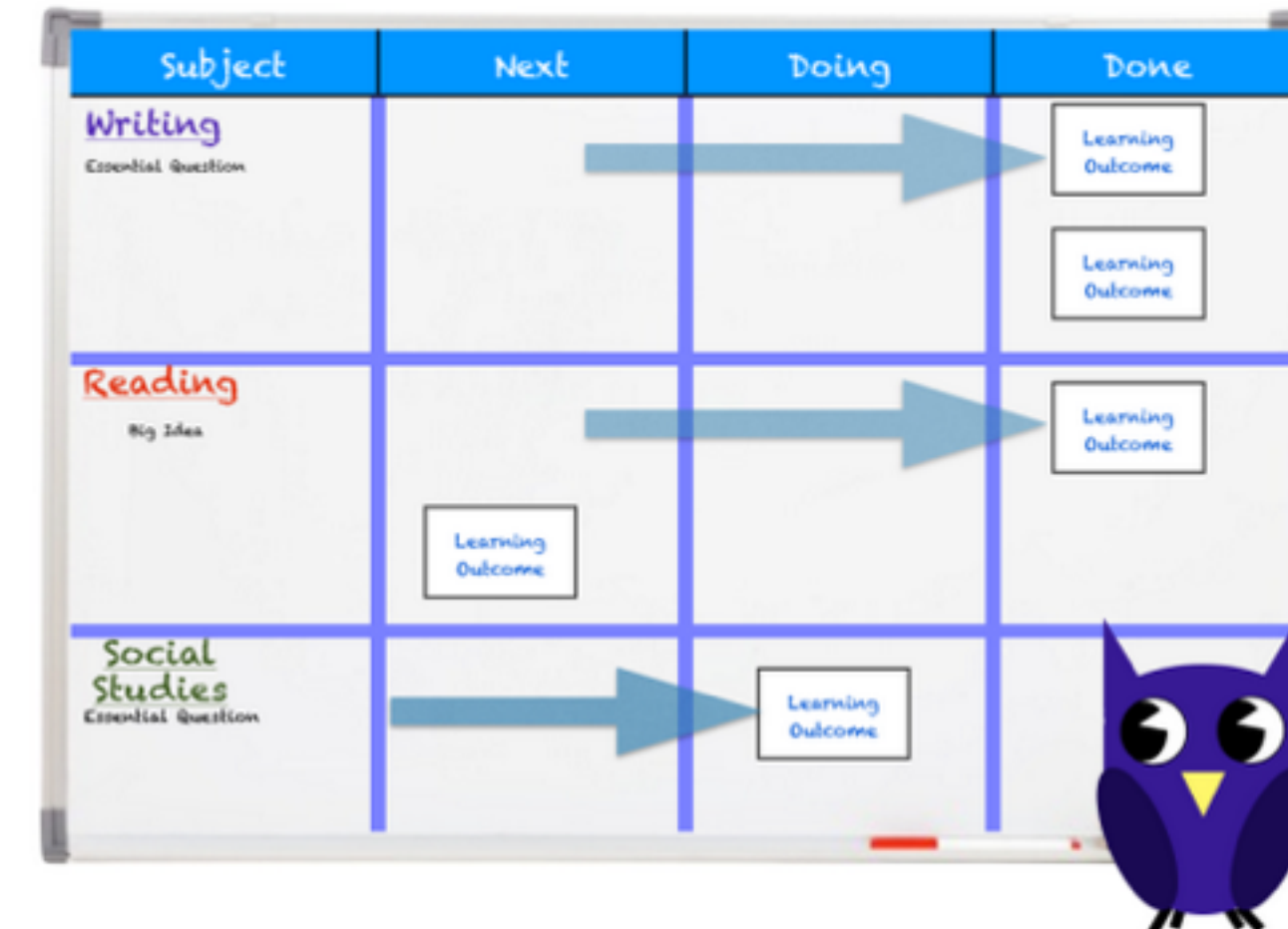


scruminc.

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 *Visualize Learning in Motion*



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#eduScrum



The Scrum Bill

“We only fund technology projects that show citizen facing value in less than 6 months.”



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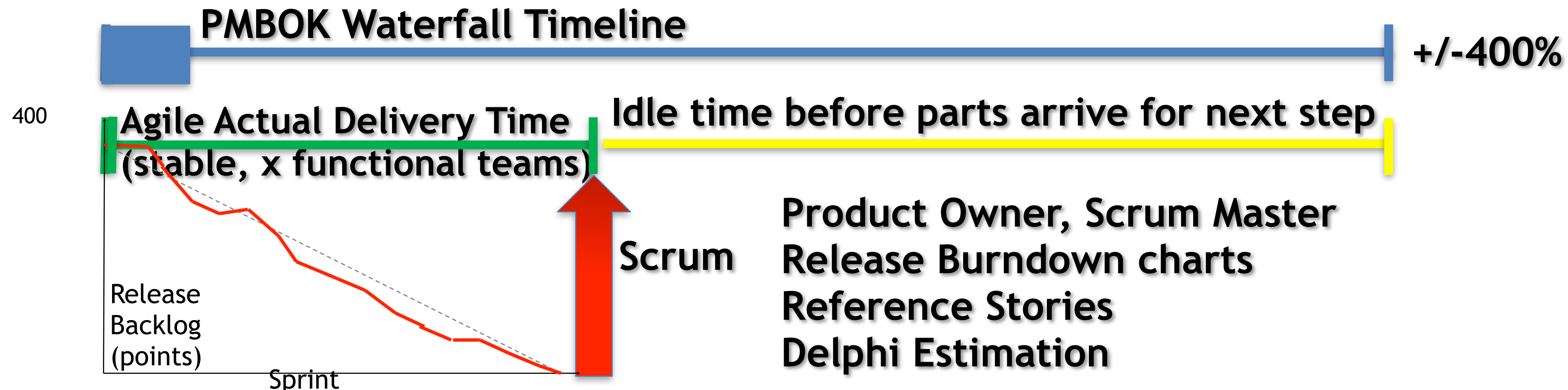
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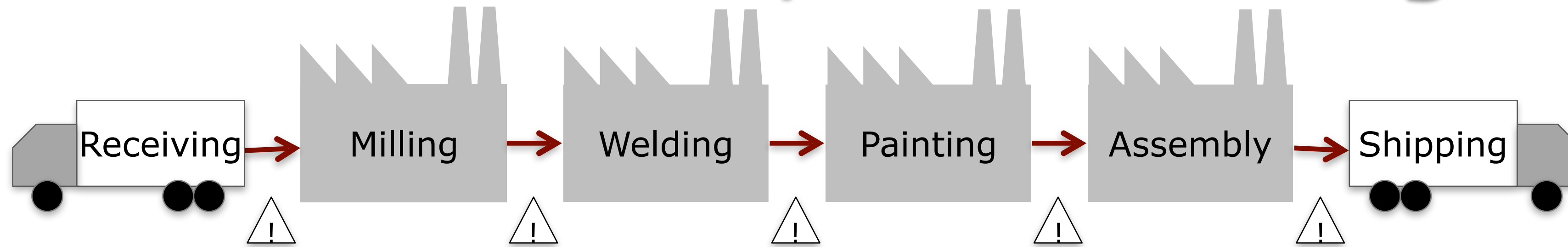
Manufacturing is building the machine that makes the machine – Elon Musk



Teams own manufacturing 1/7th of each 737. Date over and under-runs disrupt flow.



Lean is essential, but not enough!



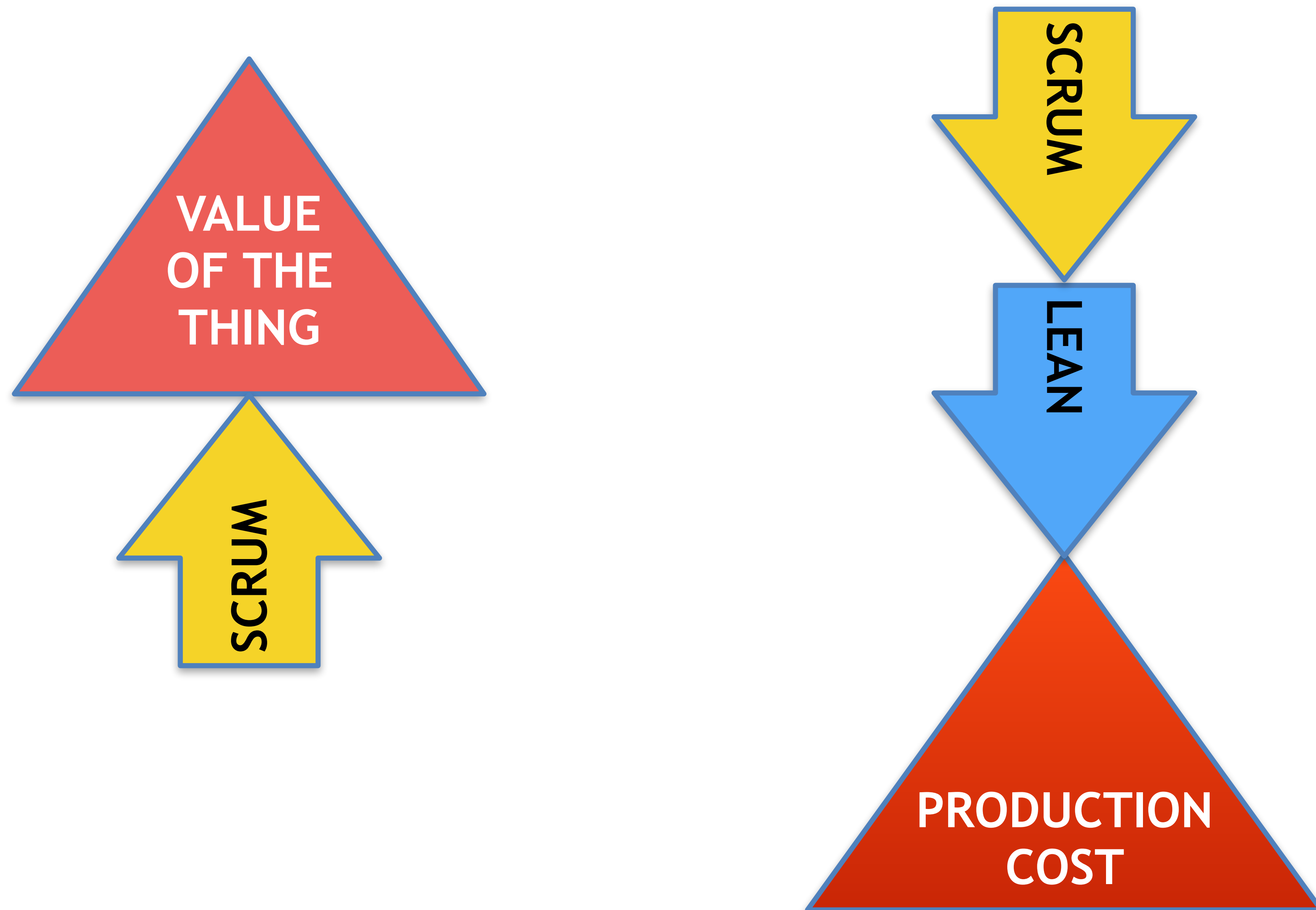
Lean: Reduce waste, without
frustrating your customer
+

Agile: Reduce the cost to make change
=

Scrum: The art of doing twice the
work in half the time

**Lean alone makes an efficient company with no
innovation. Innovation is a variance!**

Why Investors Love Scrum



SCRUM ALL THE THINGS

- Investors demand 5% or greater improvement per year.
- Scrum is the leanest and most systematic framework of improvement we know.
- If people do the work- they can be a Scrum team.
- If machines do the work- people update the machines to do it better and make better stuff.
- The faster the machines are updated, the faster we have improvement.
- This means great Scrum in the teams that update the machines, and machines that can be updated regularly with minimal disruption to production.

THE CURRENT MARKETPLACE

- Hardware companies iterate already to increase customer visible value:
 - Porsche: new 911 every 7 years. (overlapping dev, 14 years)
 - Boeing: new 737 variant every 6 years.
 - Microsoft: new gaming console every 8 years.
 - Honda: New Civic every 4 years (overlapping dev, 8 years)
 - Bosch: New autonomous car steering rack every 3 years.
-
- **HARDWARE COMPANIES ARE SPRINTING ALREADY, BUT NEED HELP ACHIEVING SHORT SPRINTS.**

Porsche source: https://en.wikipedia.org/wiki/Porsche_911

Boeing source: <http://aviationblog.dallasnews.com/2011/04/a-timeline-of-boeing-737-model.html/>

Microsoft source: <https://en.wikipedia.org/wiki/Xbox>

PUSHBACK

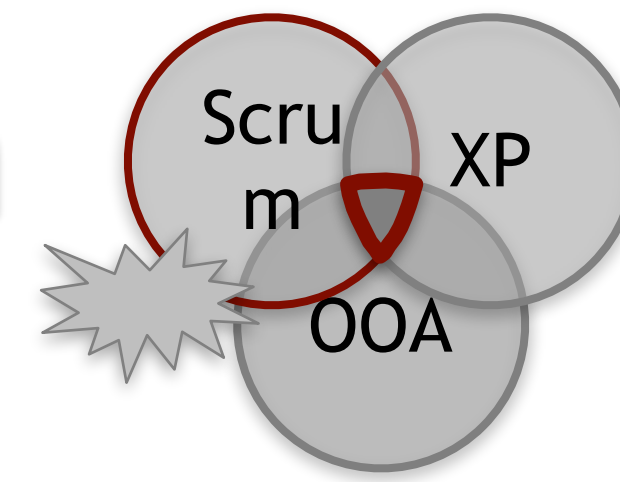


- John Deere EPDP. Over 1000 steps
- Bosch Lifecycle Management. Over 800 steps
- These phase gate steps are meant to mitigate risk
- Scrum mitigates as much or more risk with superior process efficiency
- Pure-Play agile teams that choose their own process have difficulty here
- Scrum teams with DoR, DoD, and Release Burn Down win over middle management.
- Scrum team with release burn downs win over senior management and investors.
- TDD is typically one-to-one compatible with regulatory bodies.

A

Scrum Teams in Production

4-5 people with all tools to design, manufacture, and test.



Sprint provides team improvement cadence in addition to Takt time cadence

Backlog shows tests to pass and trend-line to all tests passing.

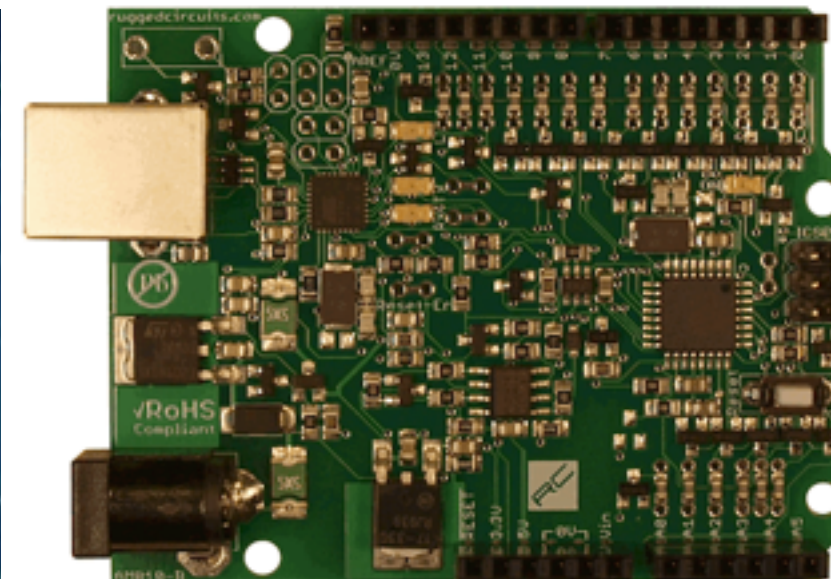
Scrum Master removes impediments to team velocity and morale. Trains Product owner and team in Scrum.

Suppliers with same week custom delivery

- Protomold, Rush PCB, and Ruggeduino



Scrum Plastics in One Sprint



Scrum Electronics in One Sprint

- 3d Green Sand Casting



Scrum Metallics in One Sprint

- Cincinnati BAAM and MarkForged



Structural Composites in One Sprint

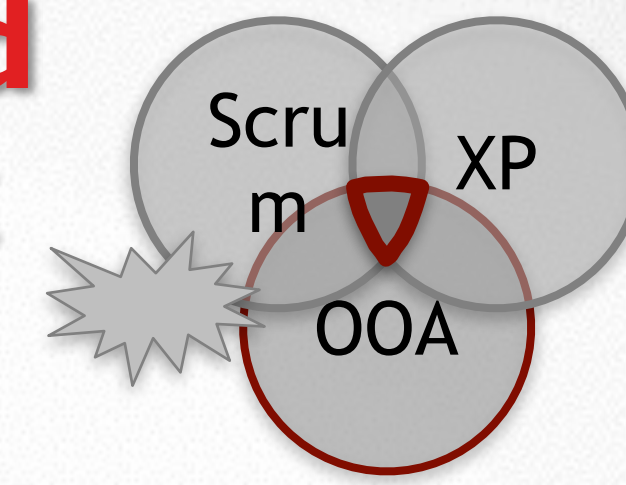
- Local Motors



- WORKING WITH THESE PARTNERS THRIVES ON STABLE INTERFACES, TEST DRIVEN DEVELOPMENT WITH STUBS.

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Each Team owns updating, testing, and manufacturing one module each week



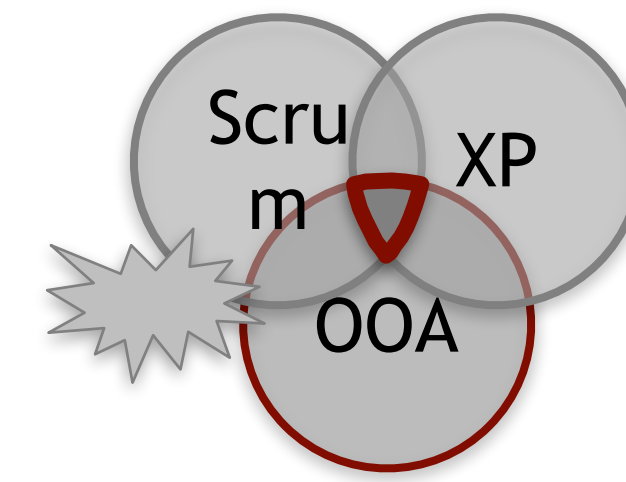
Object-Oriented Architecture: Contract-First Design



- Volvo's SPA, or Scalable Product Architecture, announced August 13th, 2014
- This Contract-First Design reduces cost to produce many descendent designs
- The next step? Reduce the cost to change the manufacturing process
- For that, we need to add Known Stable Interfaces

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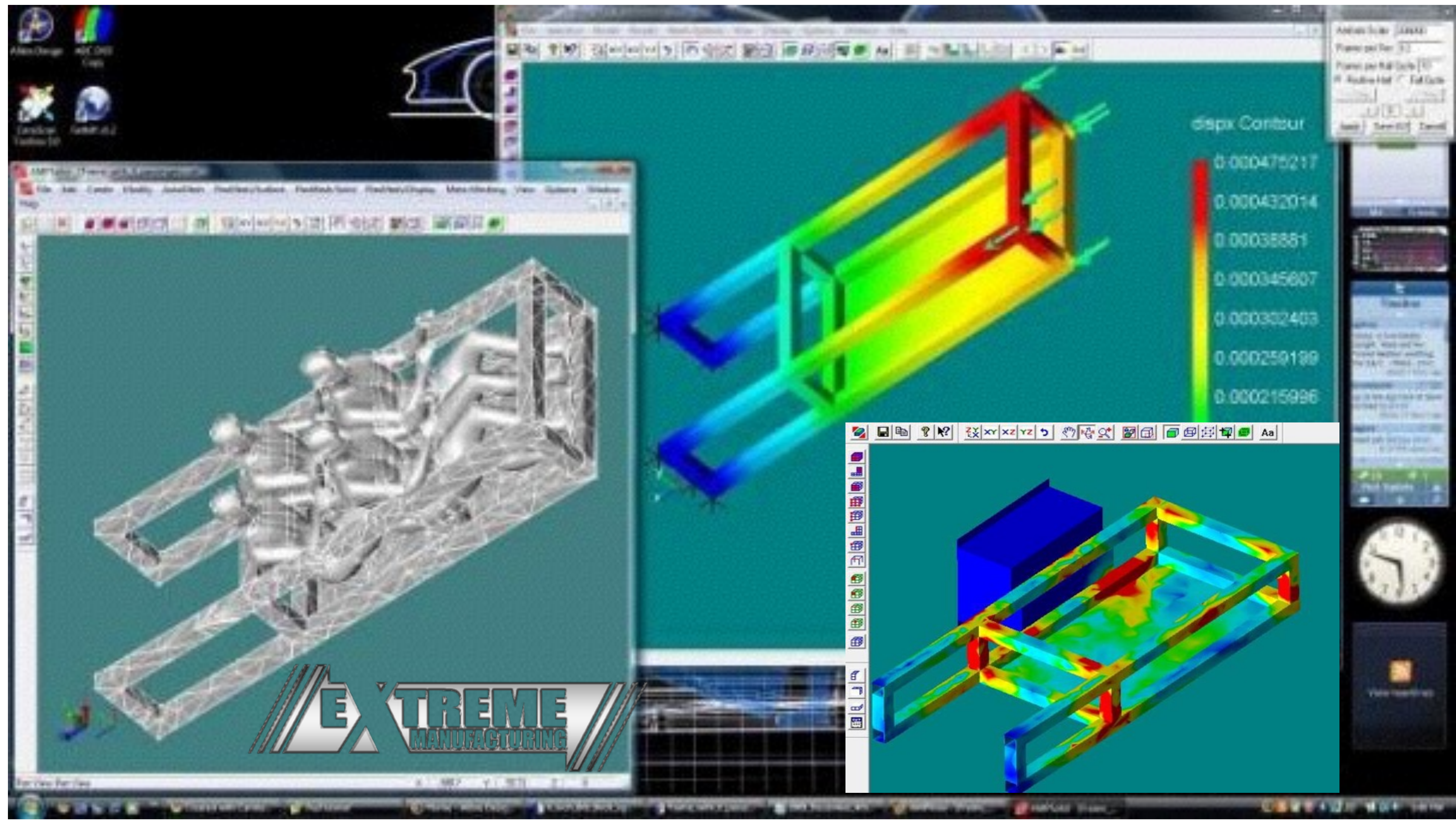
Object-Oriented Architecture: Known Stable Interfaces



Pre-negotiated physical and data connections permit greater design versatility, and loose production coupling

Interfaces
deliberately over-designed to reduce need for disruptive re-negotiation

Regulatory testing each week

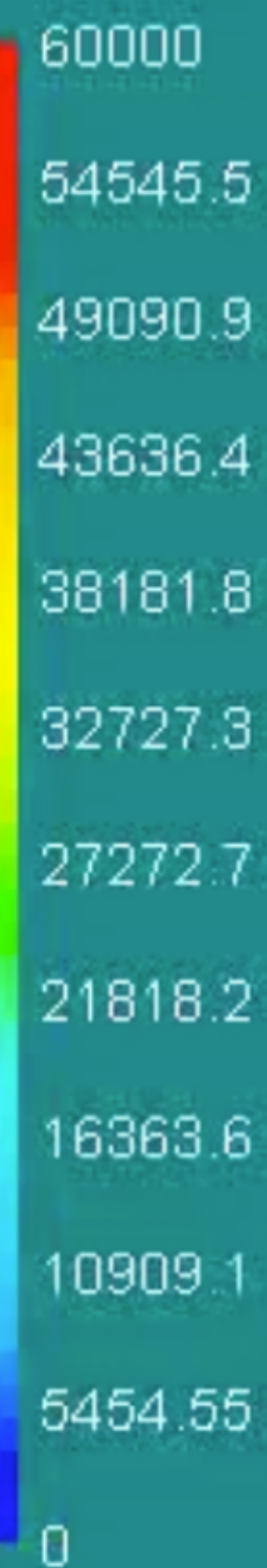




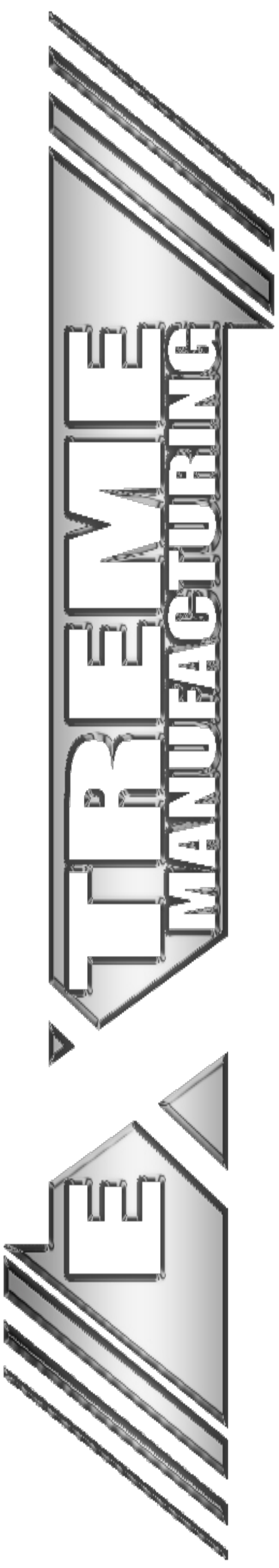


T-39.717 ms

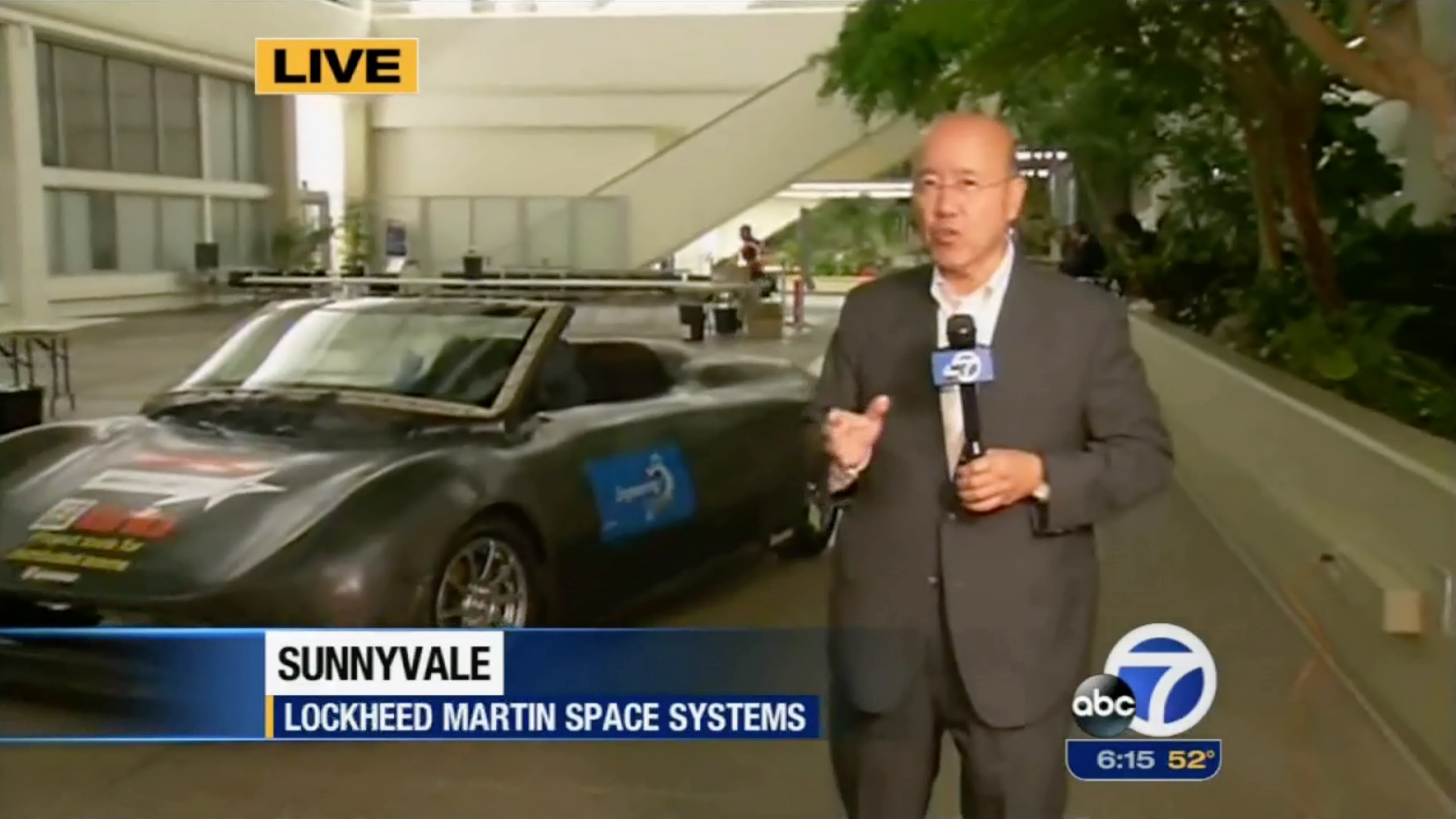
sig_equiv Contour



AMPS



LIVE



SUNNYVALE

LOCKHEED MARTIN SPACE SYSTEMS



6:15 52°



Return on Investment for 150 Teams

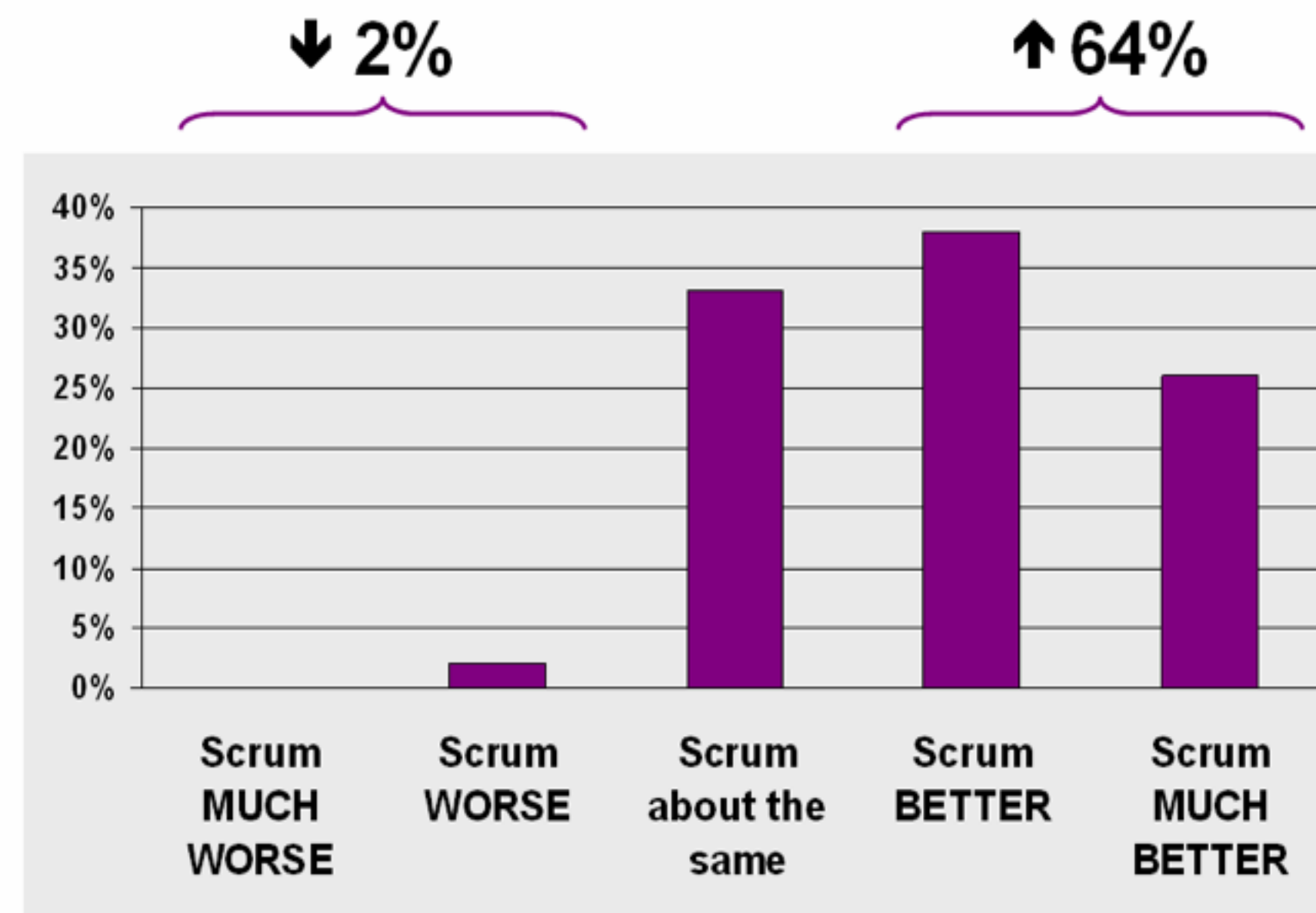
- Each Scrum trainer starts up and coaches 10 new Scrum teams a year
- Coached velocity increase is 200-400%
 - Uncoached average increase is 35%
- Conservative cost reduction per coach is over \$1M/yr

G. Benefield, "Rolling Out Agile at a Large Enterprise Systems, Big Island, Hawaii, 2008.



Rate Scrum relative to how the team was building products previously:

Business value of what the team produced in 30 days?



Faster, Better, Cooler

Happier People Function Better

- Doctors in a positive mode show three times the intelligence and creativity and diagnose 19% faster.
- Optimistic sales people outsell their pessimistic counterparts by 56%.
- Happy CEO's are 15% more productive.
- Happier managers improve customer satisfaction by 42%.
- Research shows that **happiness causes better performance.**



**Morale is a
multiplier for
Velocity!**

Mission Bell Winery, Madera, CA 60 acres of Scrum Wine



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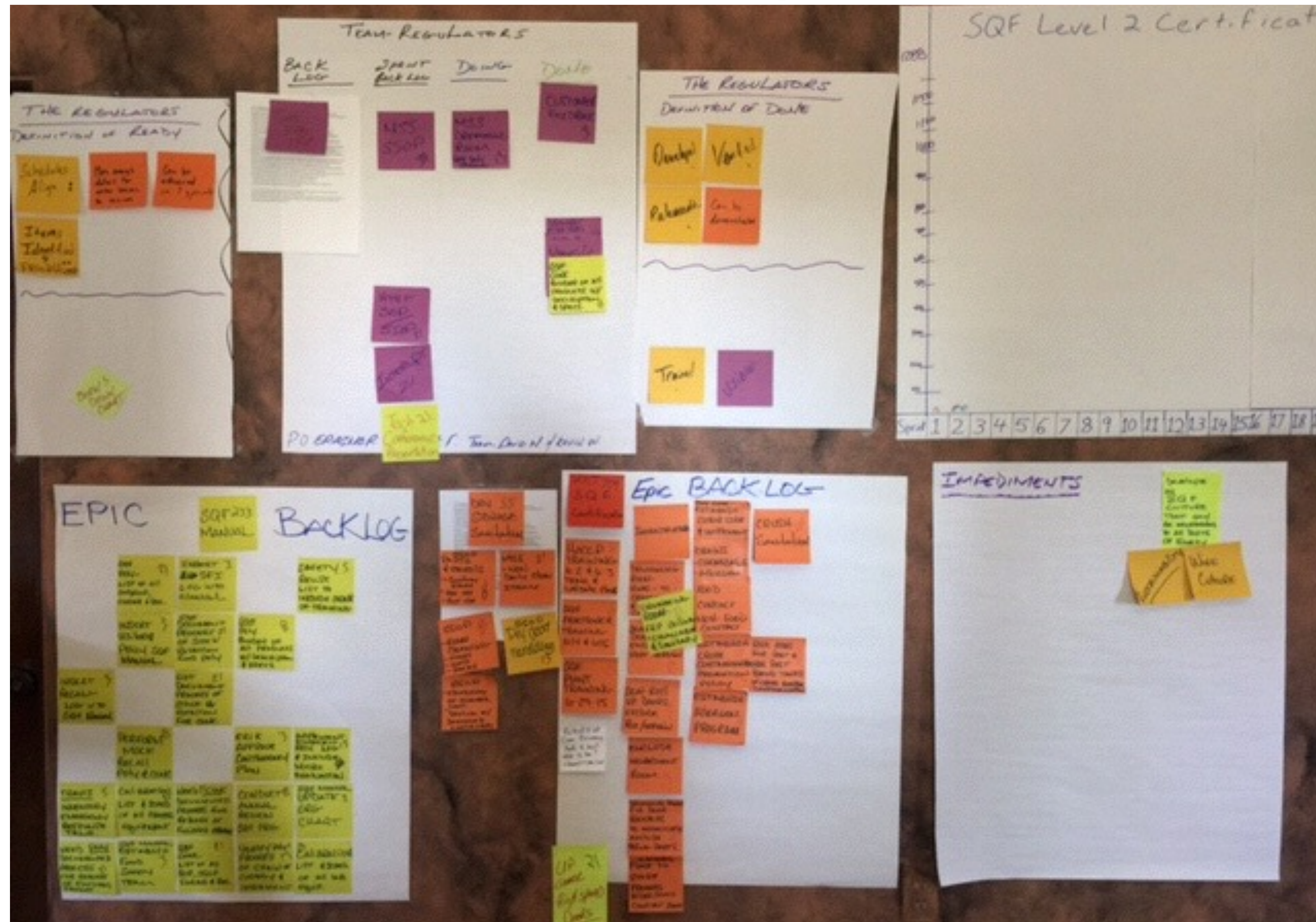
Leadership decides it's time to Scrum



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All stakeholders propose goals and missions



Single Prioritized enterprise backlog == Happy Chief Product Owner



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Champagne Team Launch



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 Constellation Bank

Date: 03-28-15

Filter		
R2	CPH	RPM
1.5% 乙醇		
1.5% 乙醇		

-RECORD SETTING RUNS-



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Meta Scrum

Coordinating Across Teams, Modules, Missions



Does anyone really care the Nokia mobile brand is dead?

Nov 7, 2014

Tweet36

Like84

g+11



Nokia's mobile brand is officially dead. After Microsoft bought the company, it took only months for it to decide that using the Nokia brand meant little and it could walk away from it without offending too many customers or worrying about losing market share. It was an historic moment, but it was a necessary one in Microsoft's mind, and it was perhaps an end of era in the industry.



65

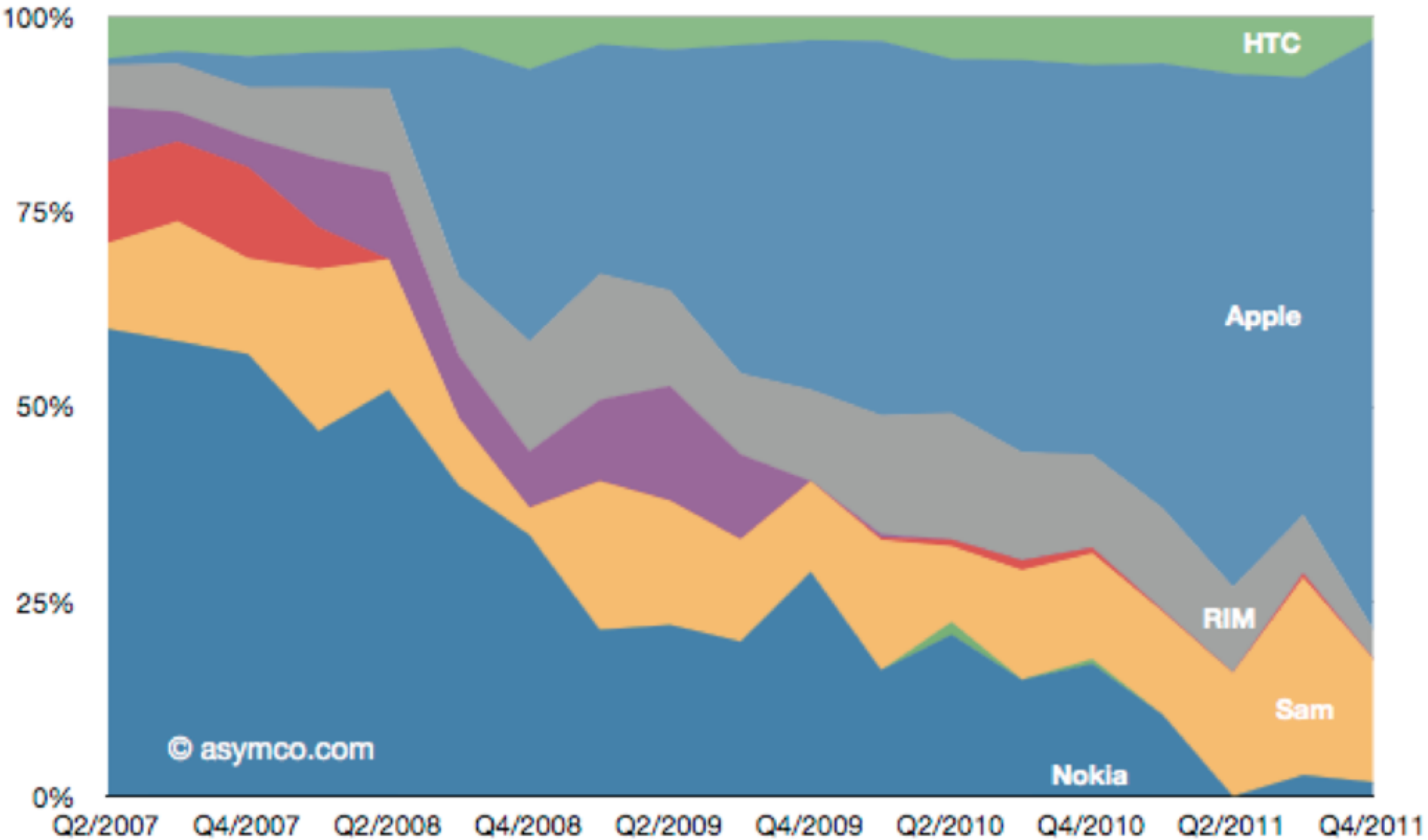
Customers loved this...



...Until they tried this...

Customers Often Don't Know What They Want Until They See It!

Profit shares of eight mobile phone vendors



How Scrum Scales

As Bosch,

I'd like to market a complete autonomous vehicle solution for existing OEM's to integrate into their established vehicle models,

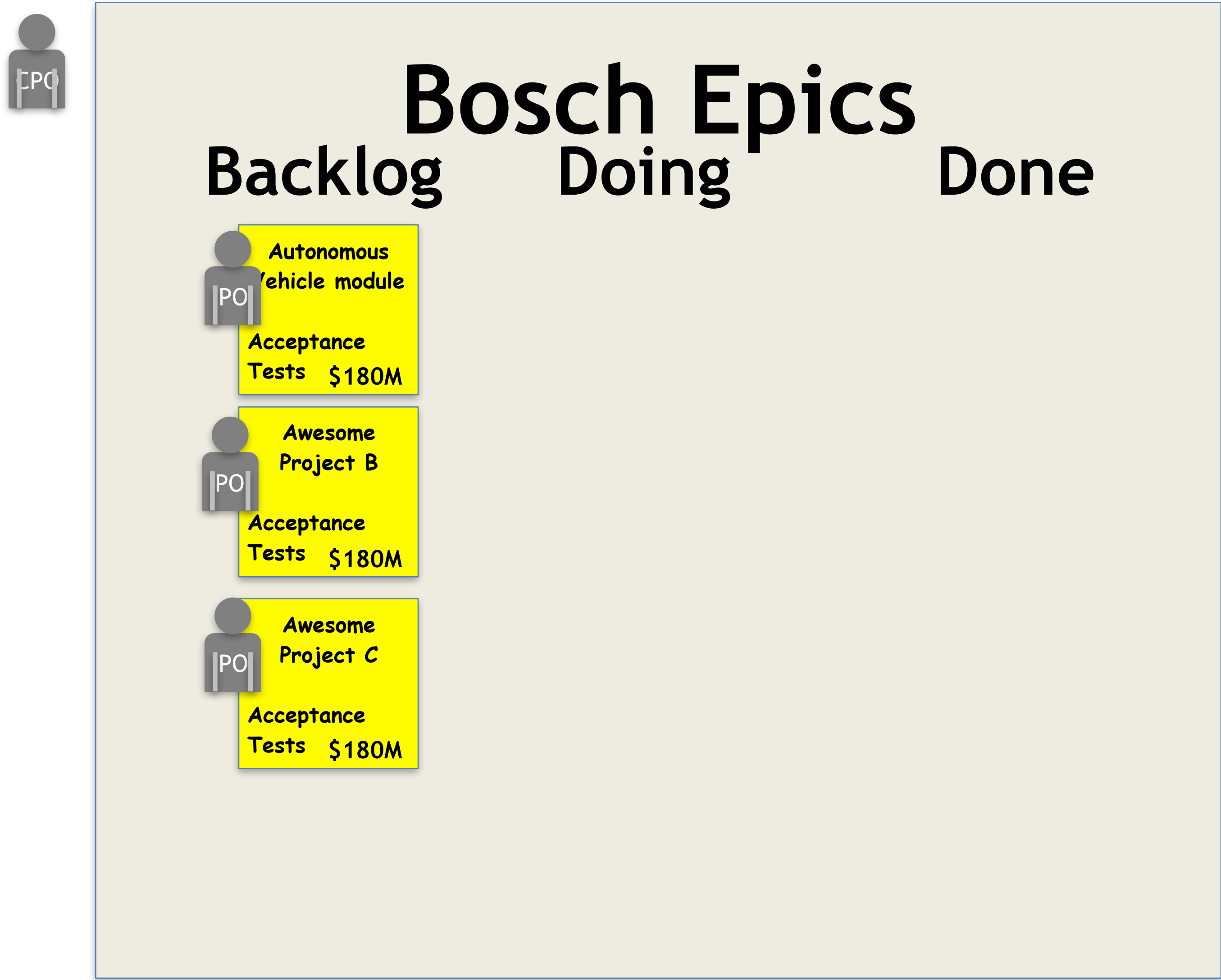
so that we can be the majority supplier of the autonomous vehicle renaissance.

- Vehicle to vehicle learning
- Passes U.S. driver's test < Q3 2017
- No changes to OEM body in white

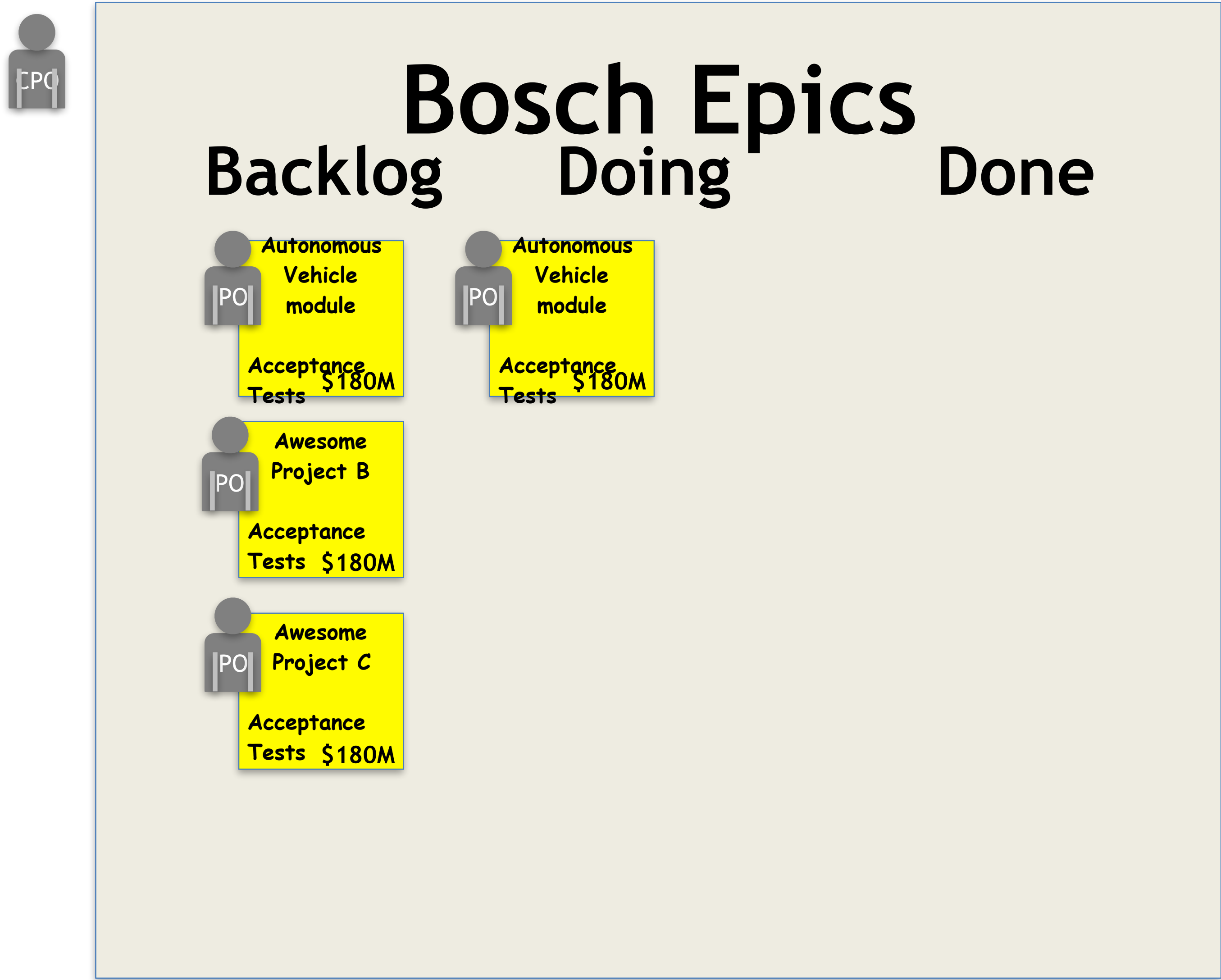
987pts

\$180M

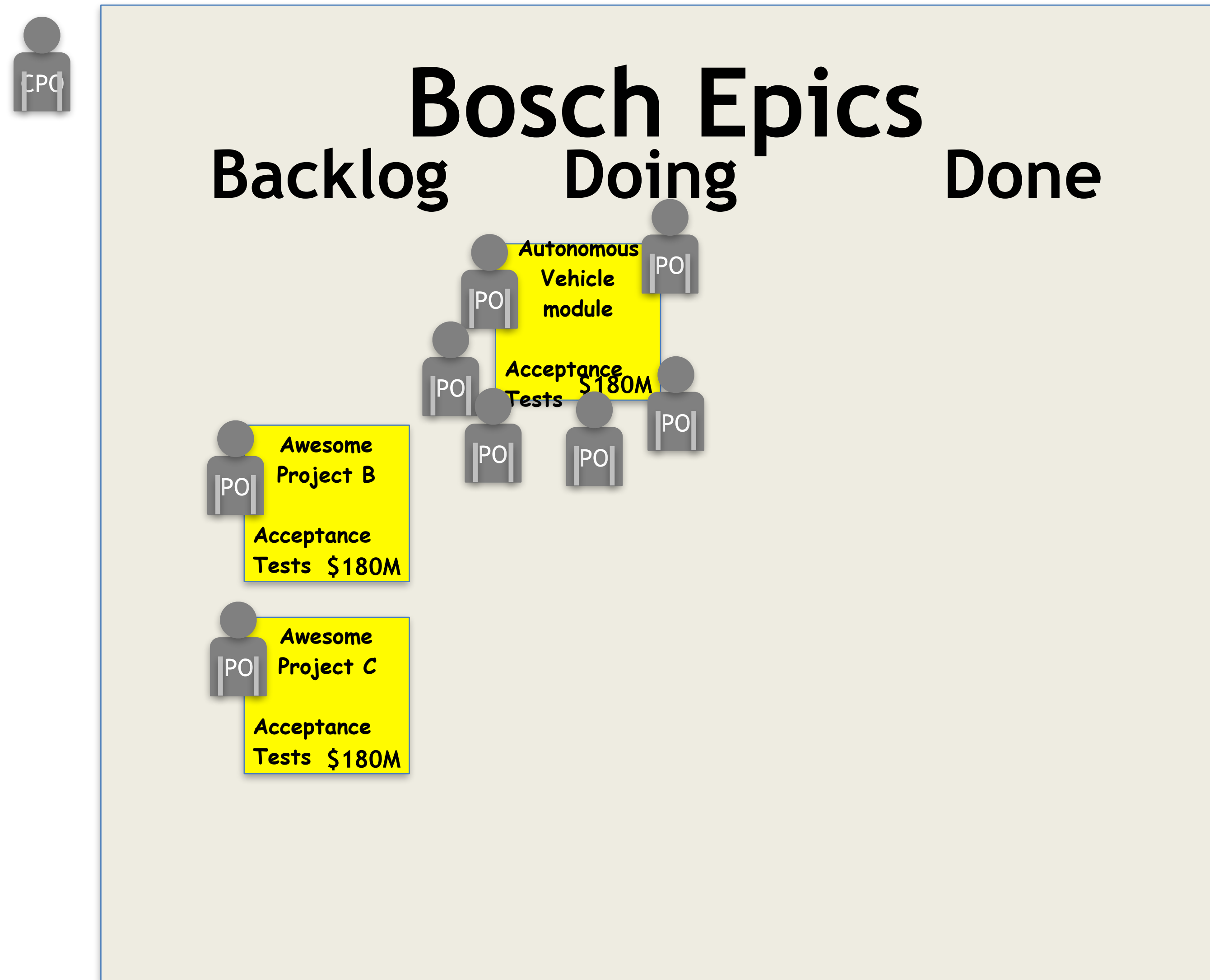
How Scrum Scales



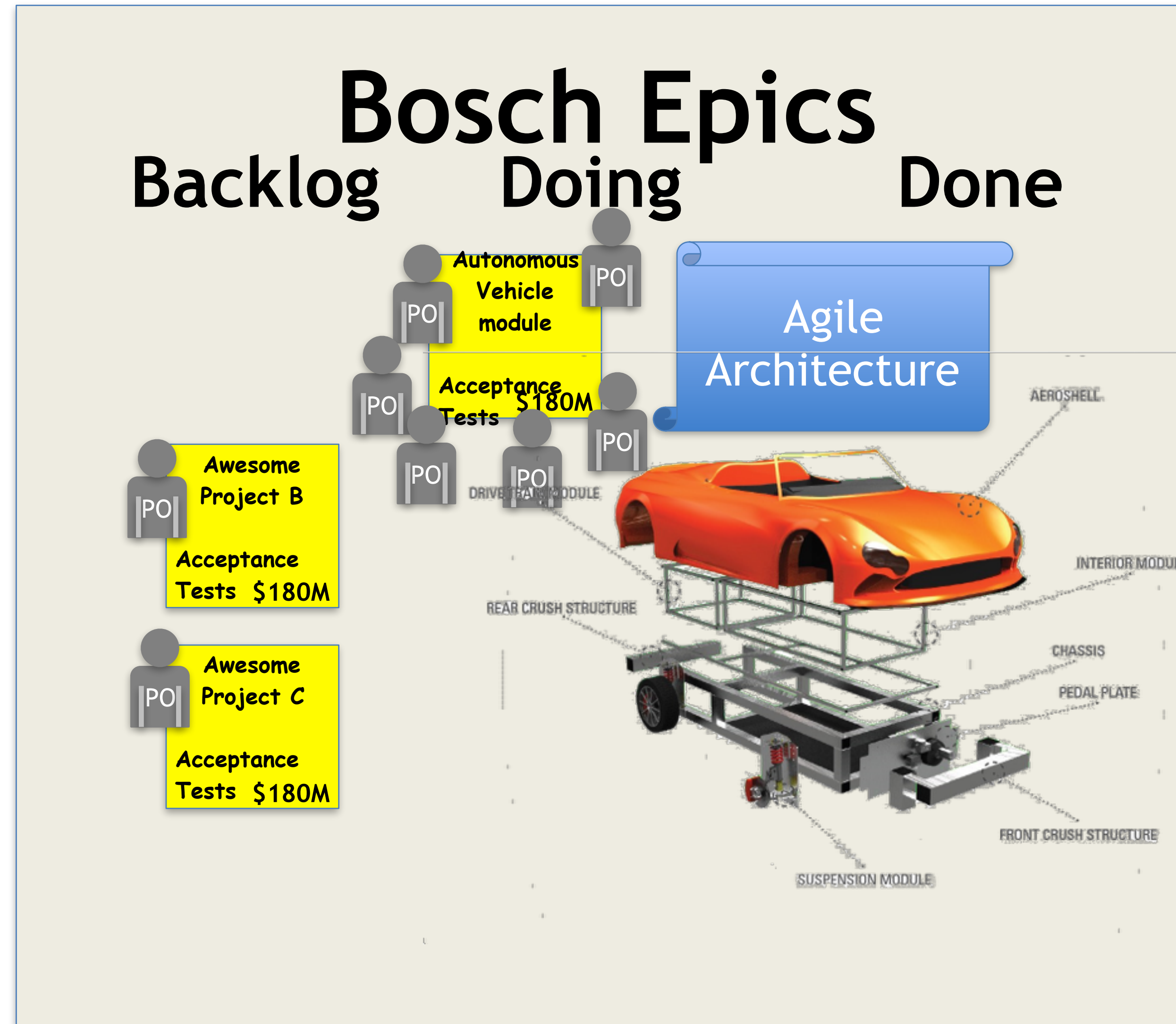
How Scrum Scales



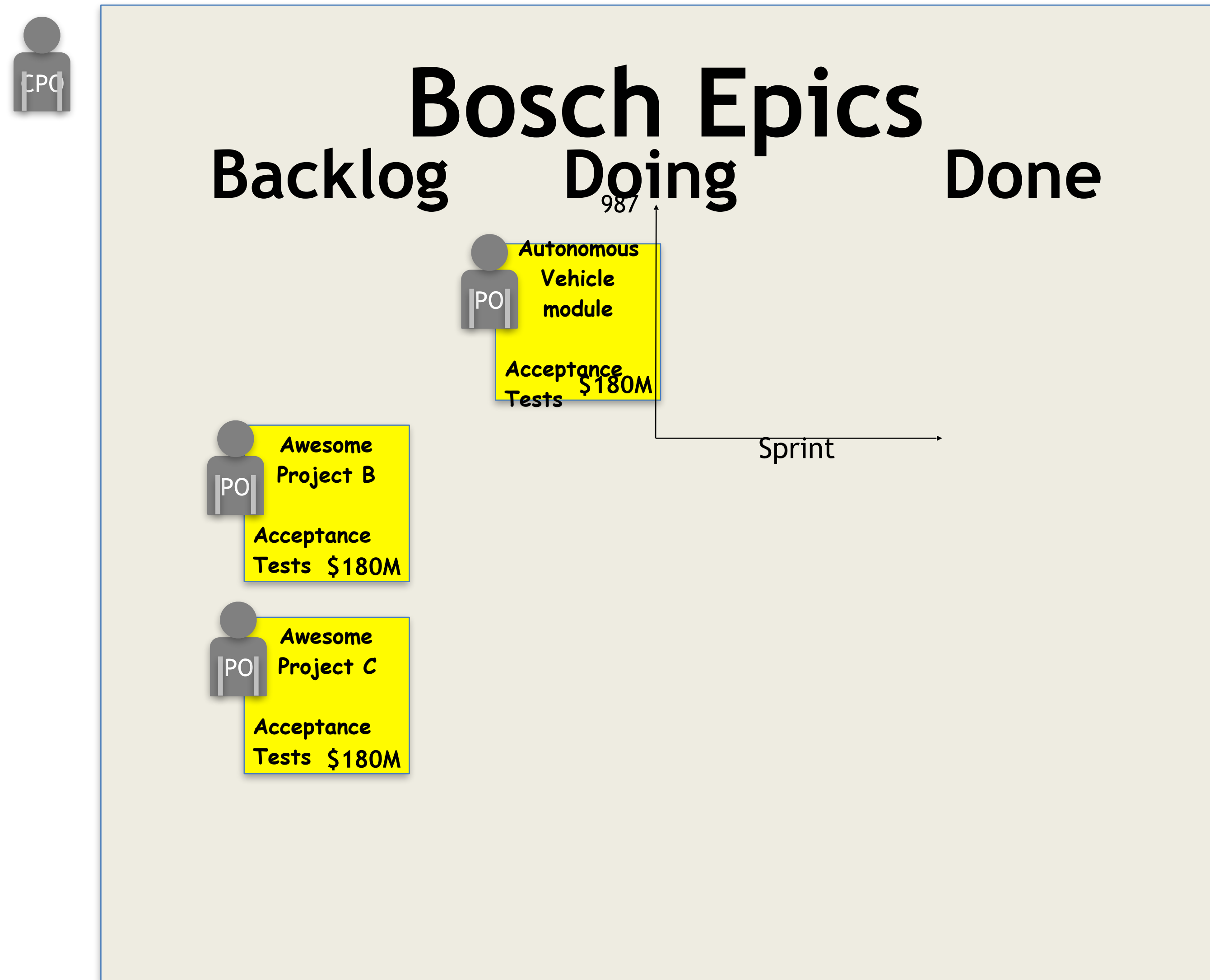
How Scrum Scales



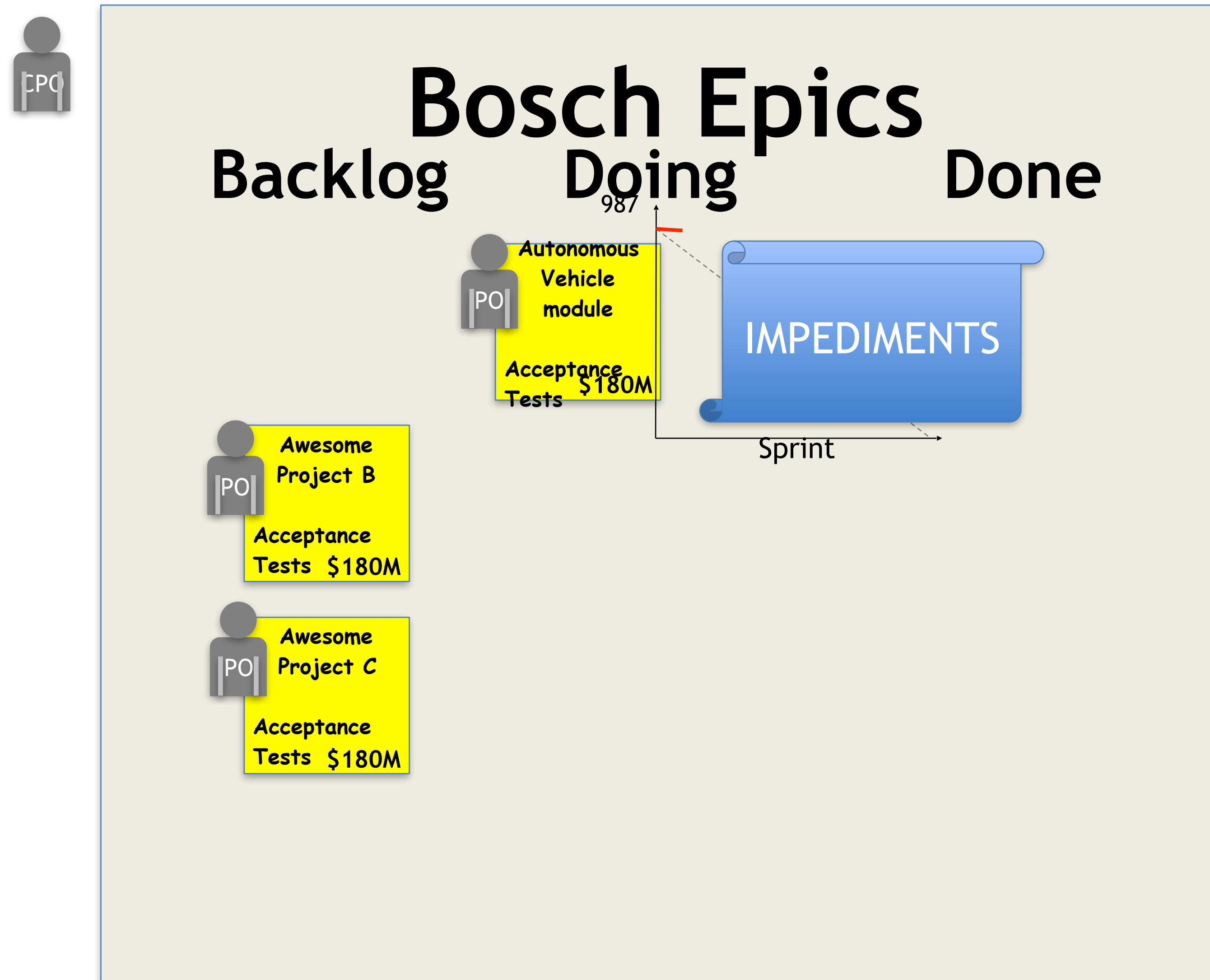
How Scrum Scales



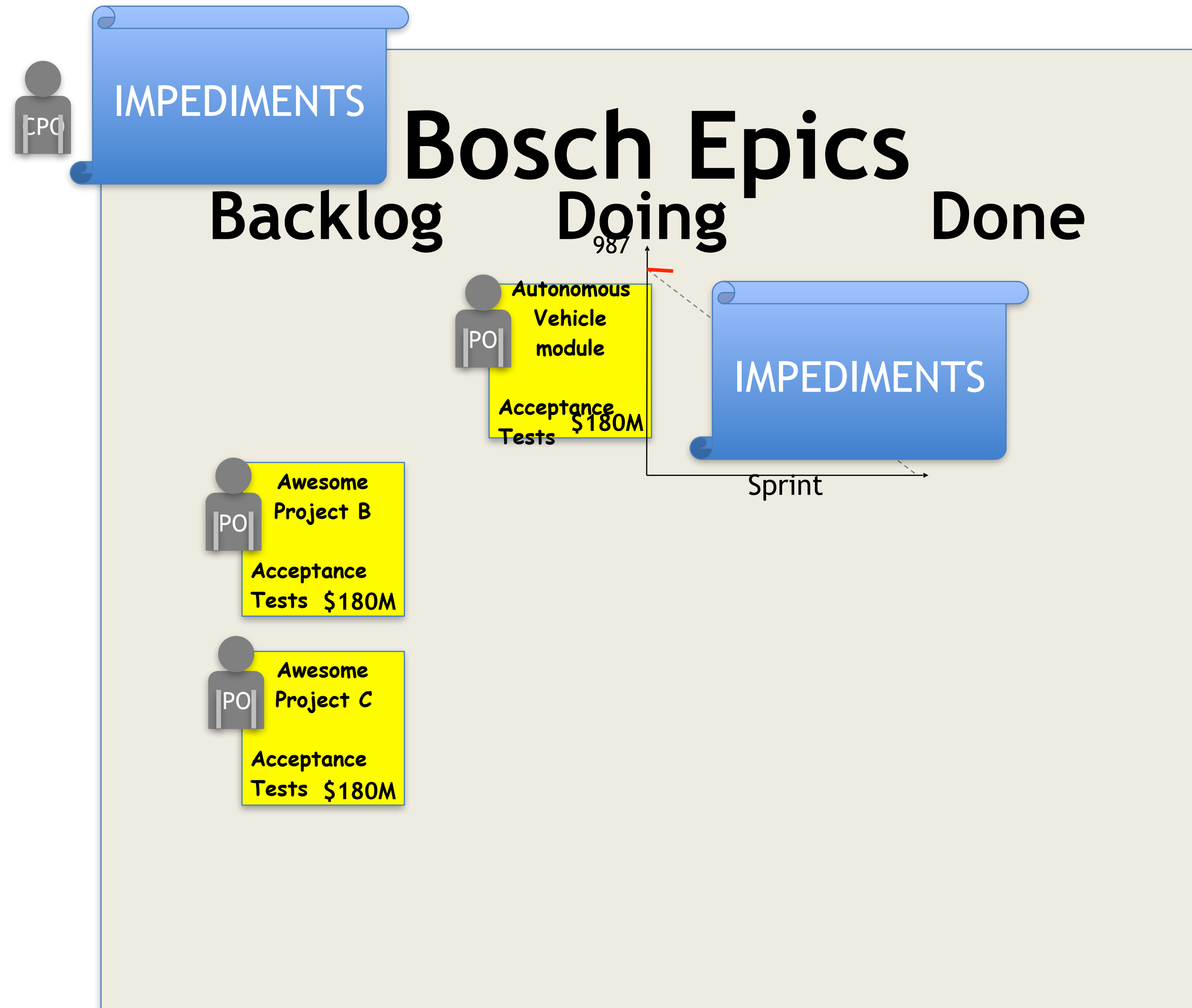
How Scrum Scales



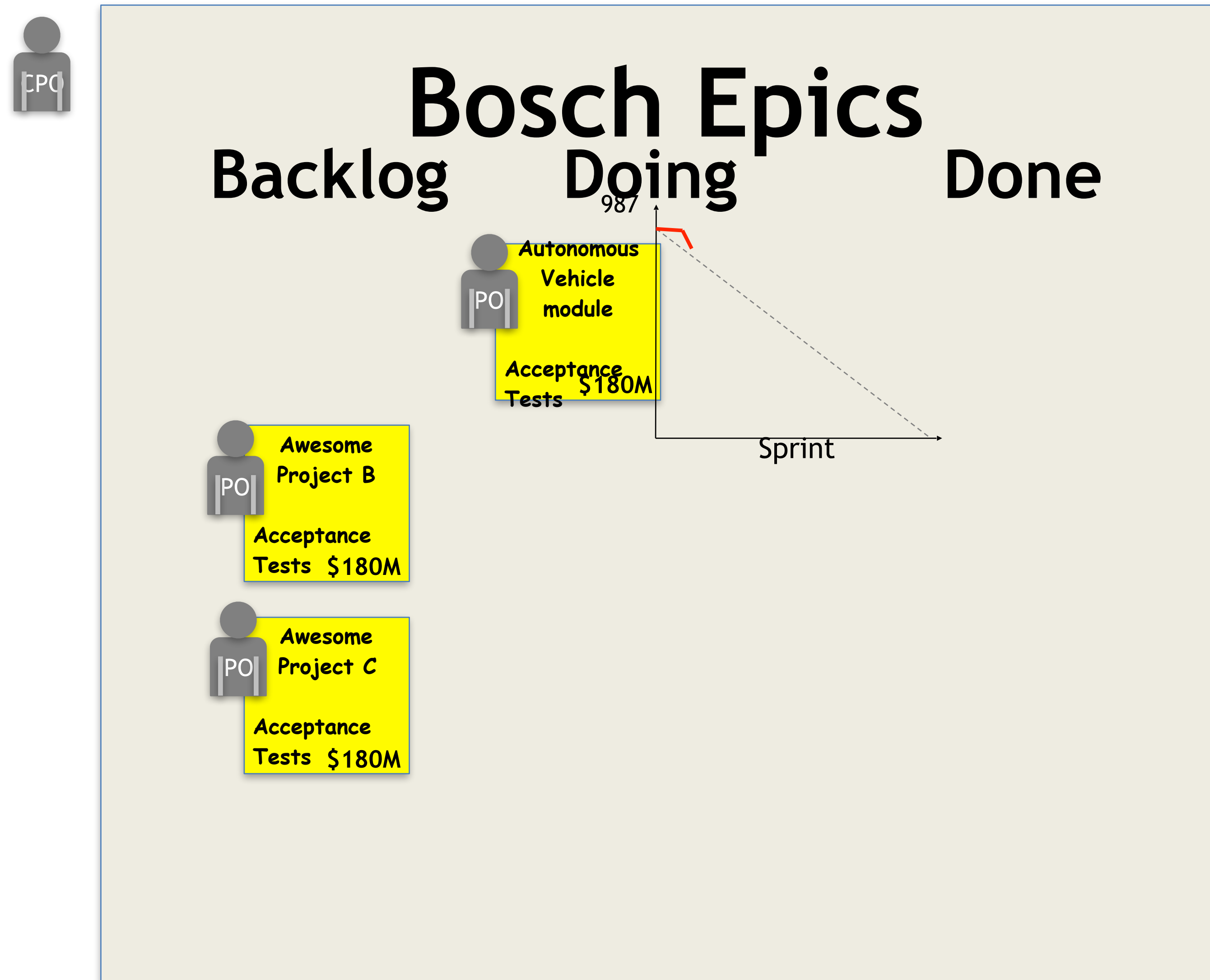
How Scrum Scales



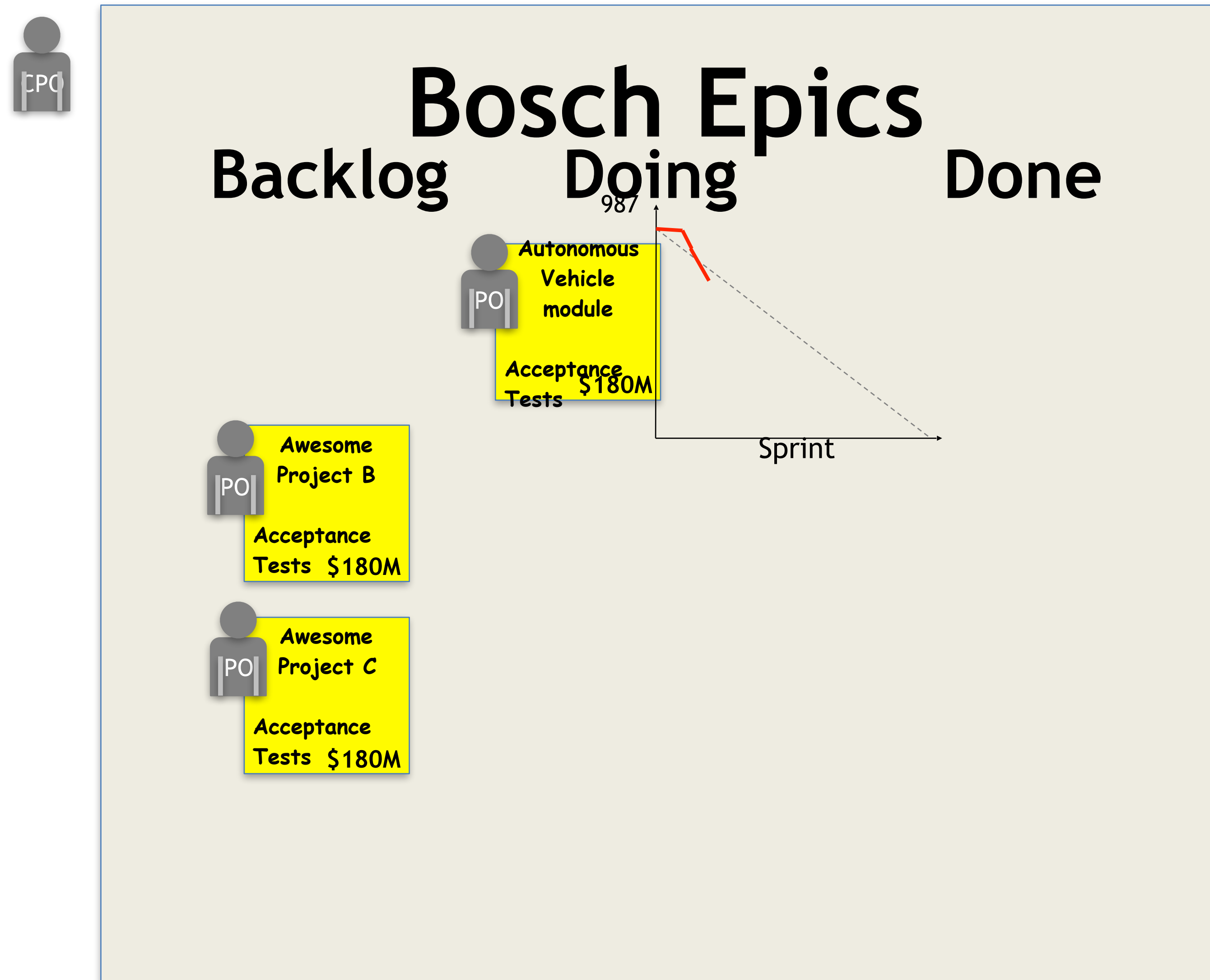
How Scrum Scales



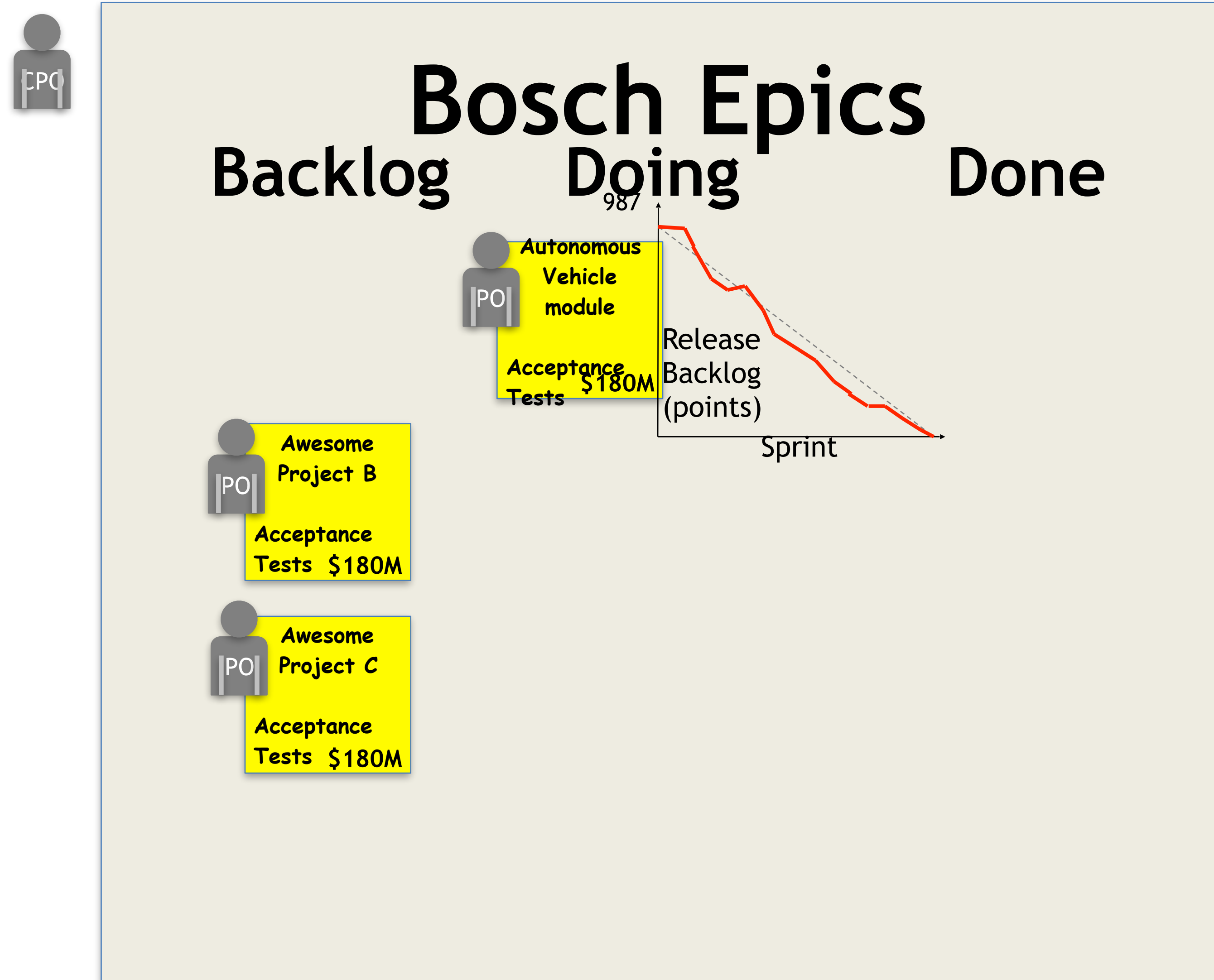
How Scrum Scales



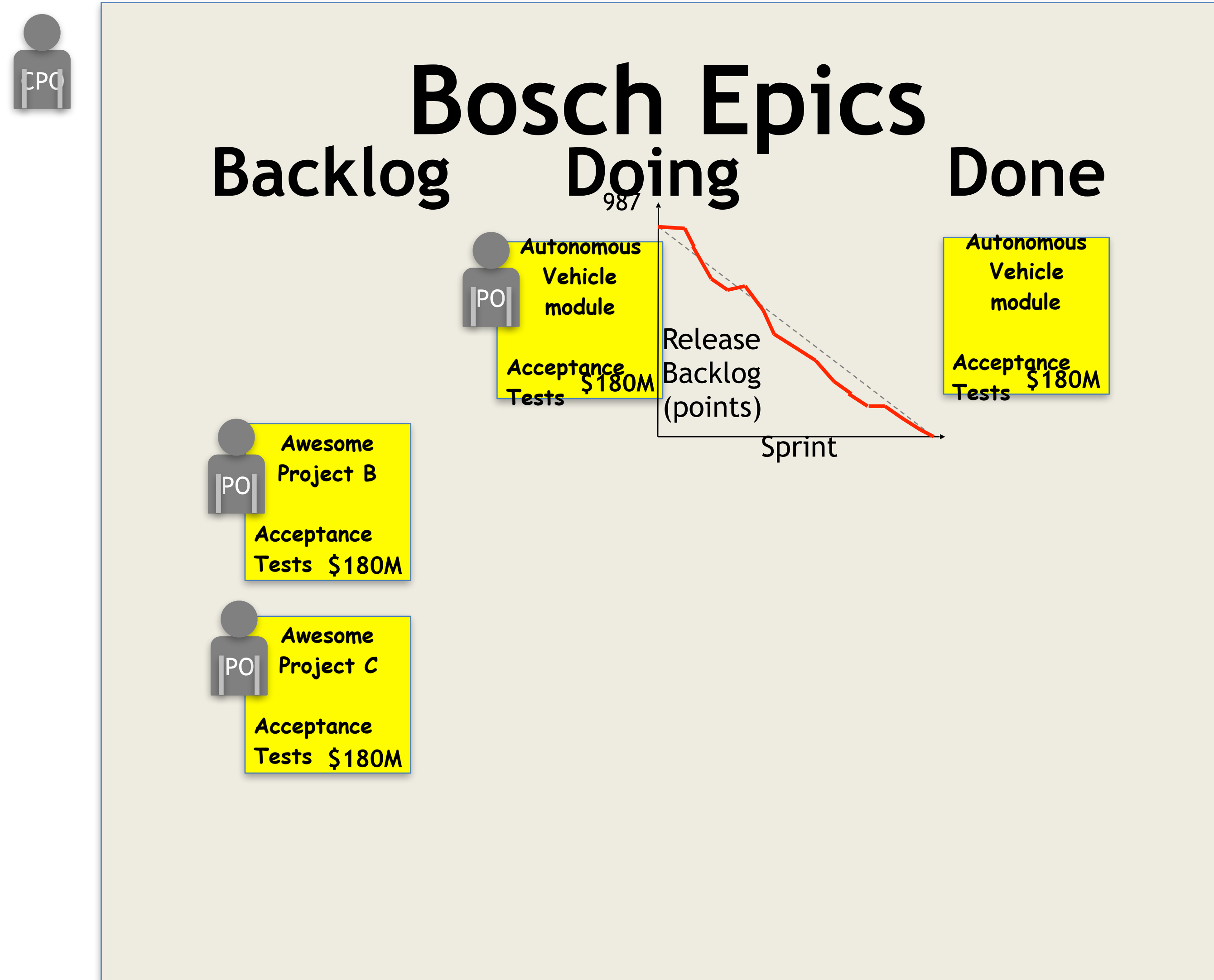
How Scrum Scales



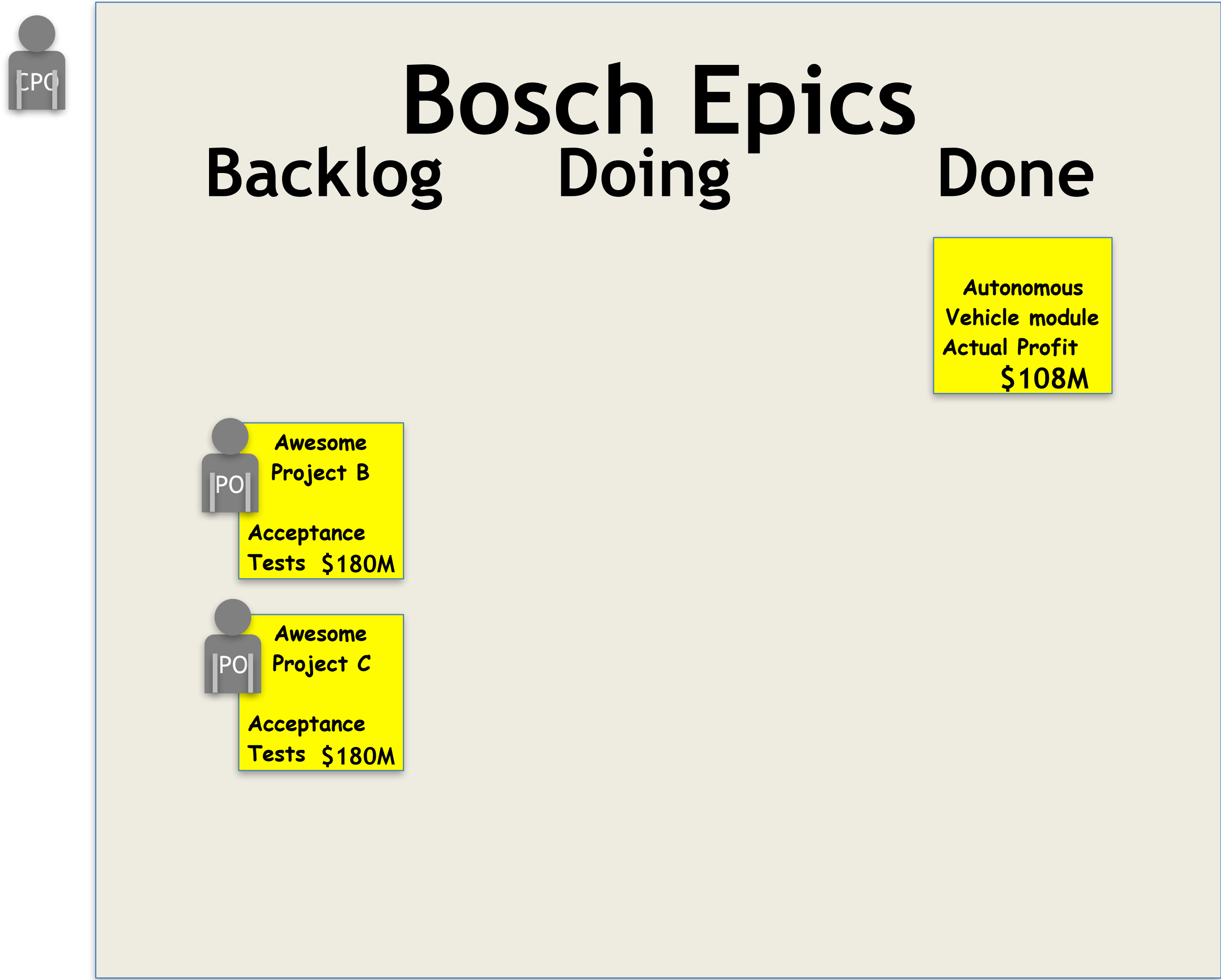
How Scrum Scales



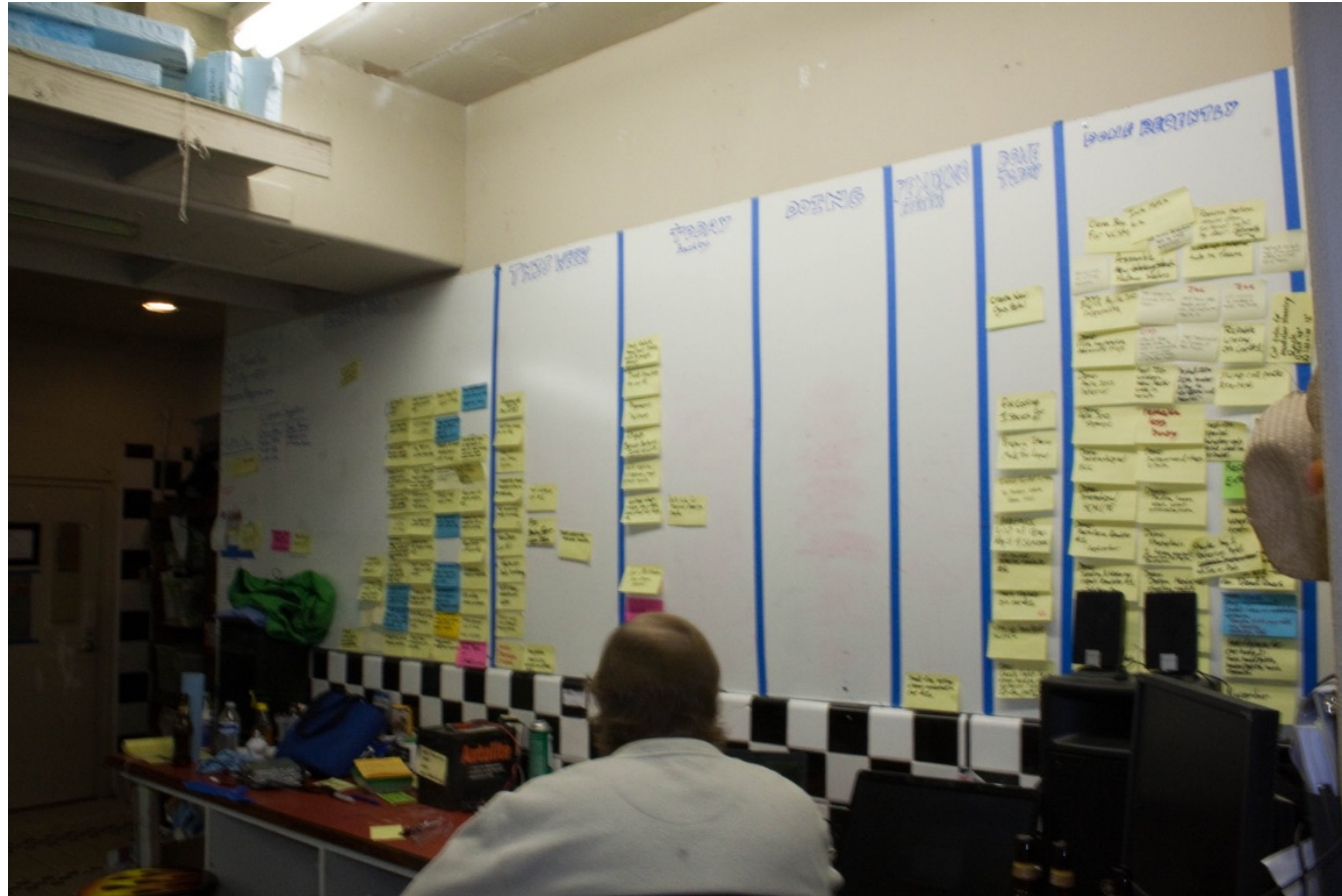
How Scrum Scales



How Scrum Scales



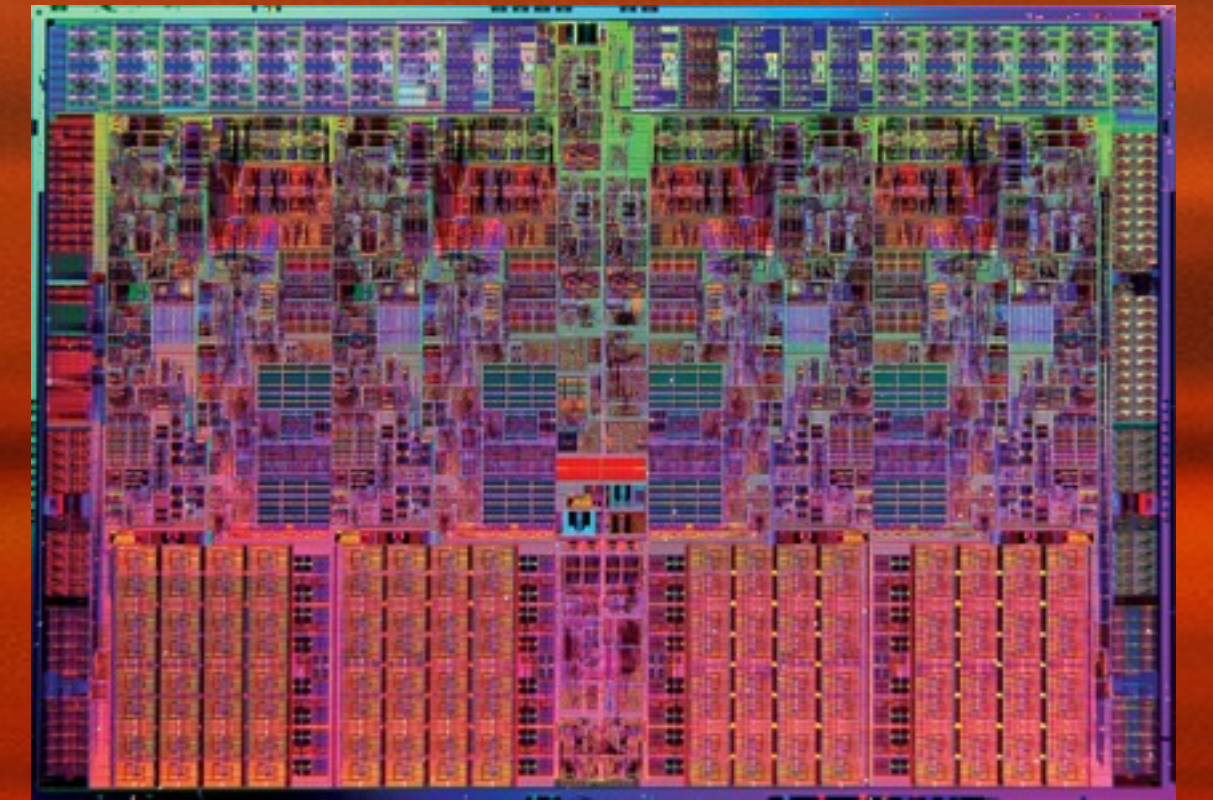
Taking it to the Next Level: A Living, Visible VSM



Set your Scrum Board up to mirror the steps of your current VSM!

Sequential vs. Concurrent Manufacturing

Massively Parallel Concurrent Manufacturing



Massively Parallel Concurrent Manufacturing

With contract first design and a flexible line, line scheduling is processed daily and programmatically as a multi-threaded operation and not like a dependency matrix, as dependencies (bottlenecks) have been removed above the module level.

Allows symmetric processing and super-threading¹ for a further line energy consumption reduction of 10% .

1: Simultaneous Multithreading on x86_64 Systems:
An Energy Efficiency Evaluation, Robert Schöne Daniel Hackenberg Daniel Molka.



Sequential Line



KEN DEJARLAIS PHOTO

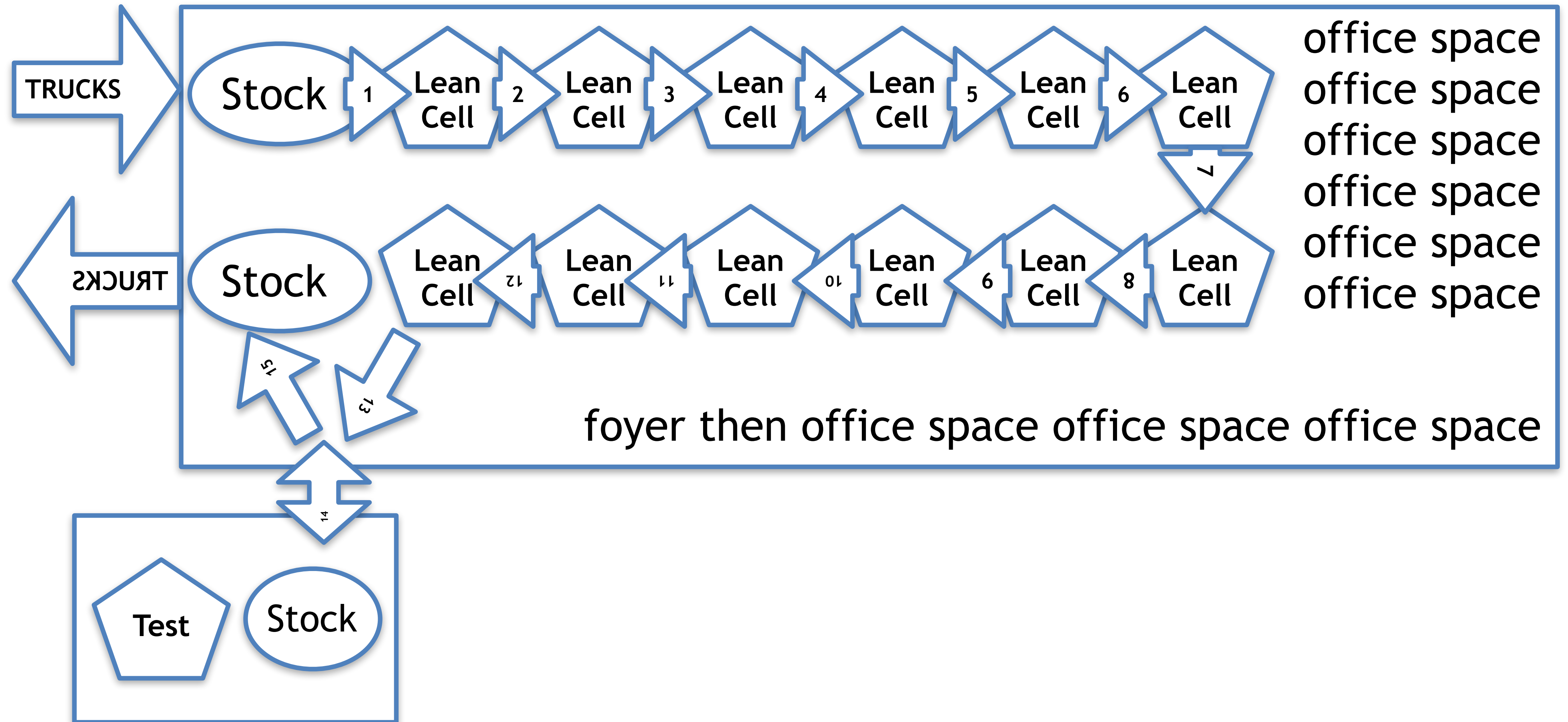
Feeder lines provide subassemblies for installation on 777 twinjets in Everett, Wash. This process frees mechanics from installing many small parts on the airplane, resulting in decreased production time.

Feeder Lines Coming to Sequential Line

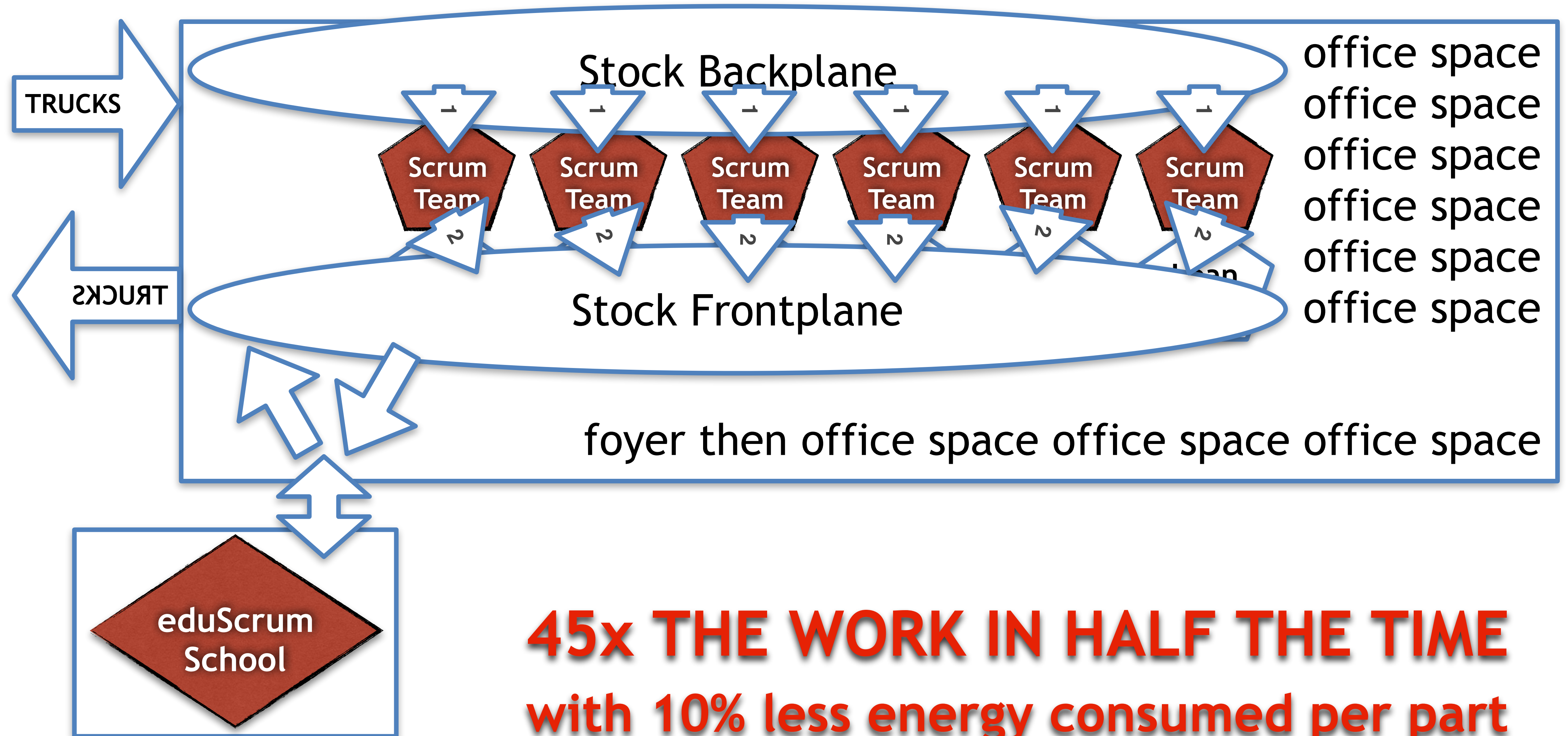
IT'S HARD TO CHANGE AN ENTIRE FACTORY AT ONCE

- Refactoring in place:
- encapsulate part of the factory.
- stabilize I/O contract to and from your little factory piece.
- Execute Scrum in that piece, increasing velocity and value until I/O outside is overwhelmed.
- encapsulate the overwhelmed piece.
- repeat.
- Once critical mass is achieved, update the floorpan.

Traditional Lean One Piece Flow



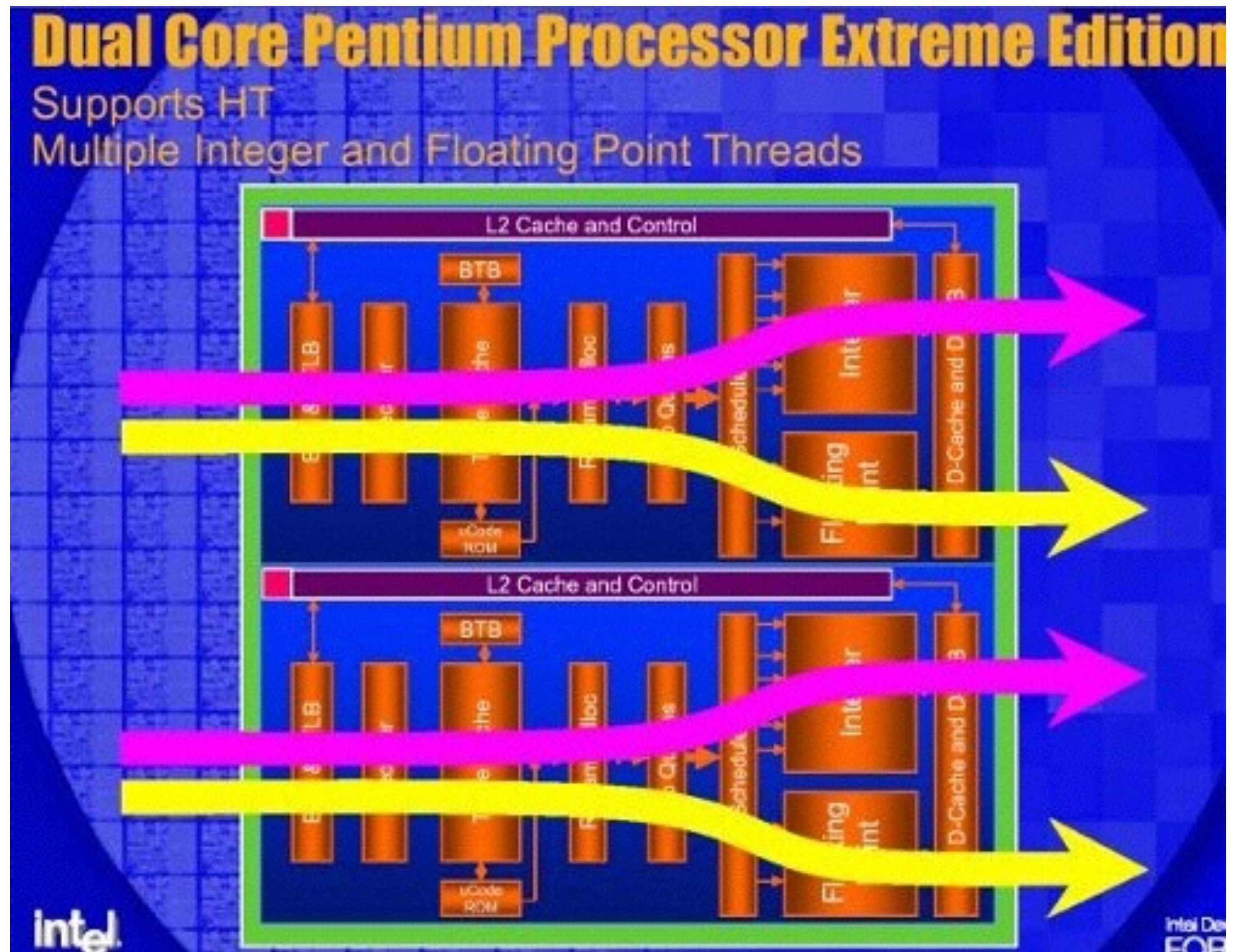
Massively Parallel Concurrent Manufacturing



45x THE WORK IN HALF THE TIME
with 10% less energy consumed per part

15 steps reduced to 2 steps. Each step produces 1 part per scrum team instead of 1 sub-assembly requiring 15 steps to become one part.

To achieve
Moore's Law
benefits of
processing into
manufacturing
structure the
factory floor
into a data bus

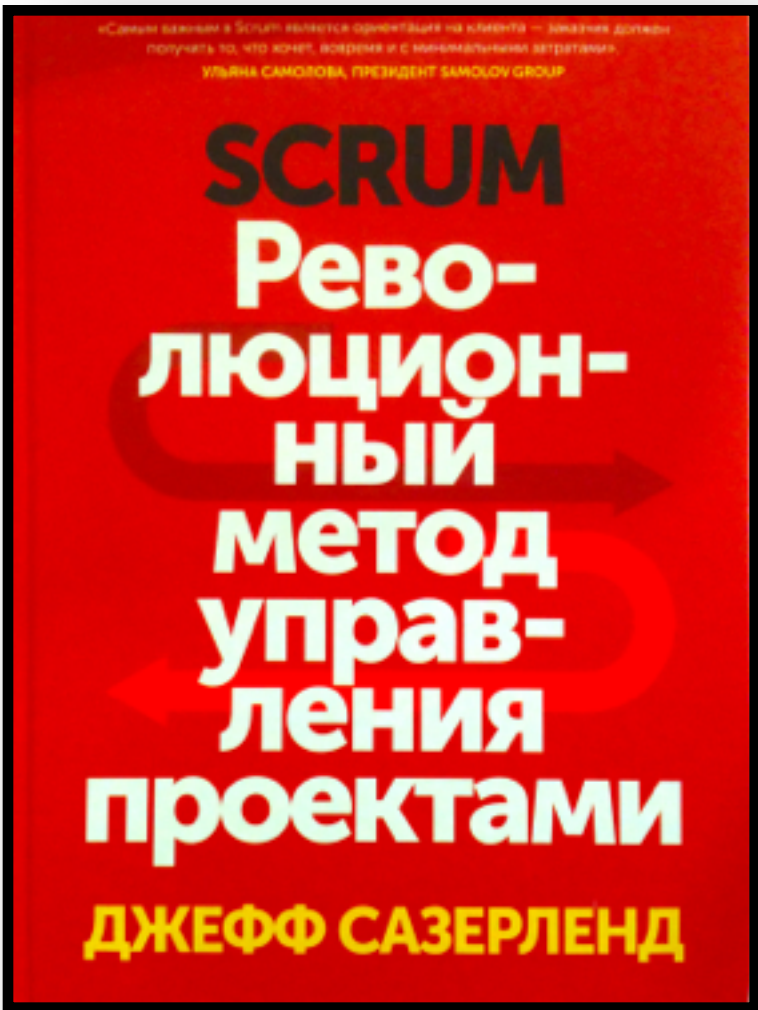
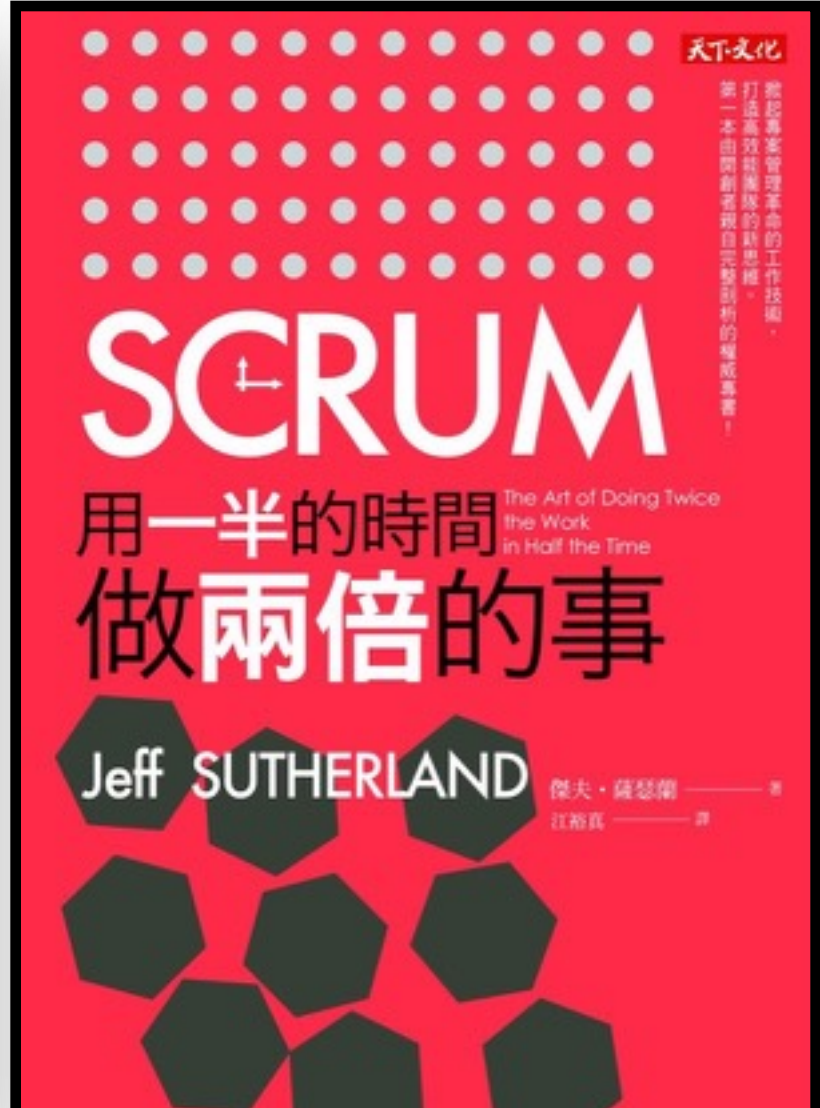
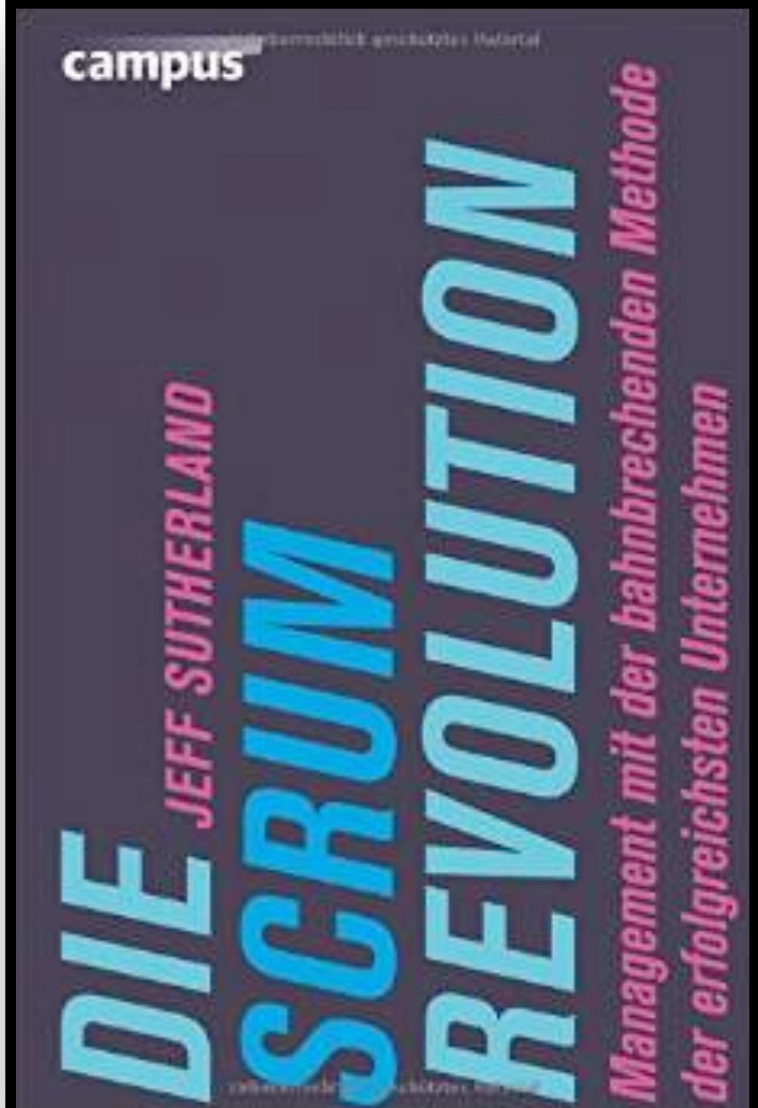
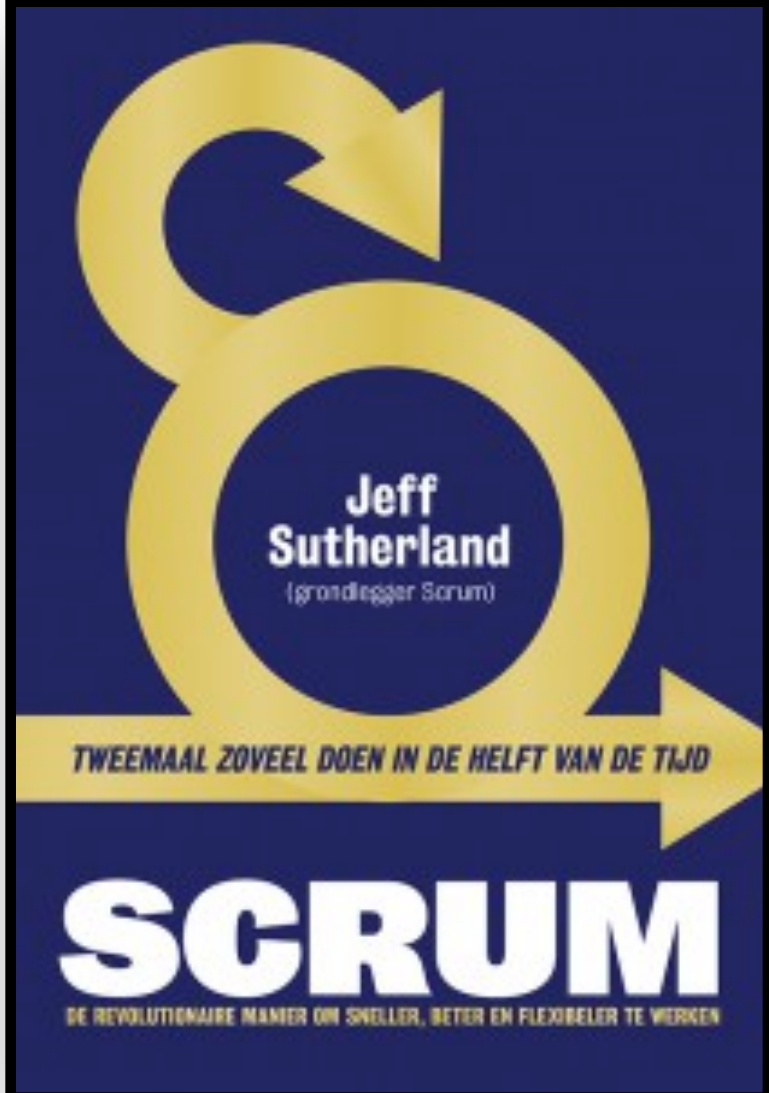
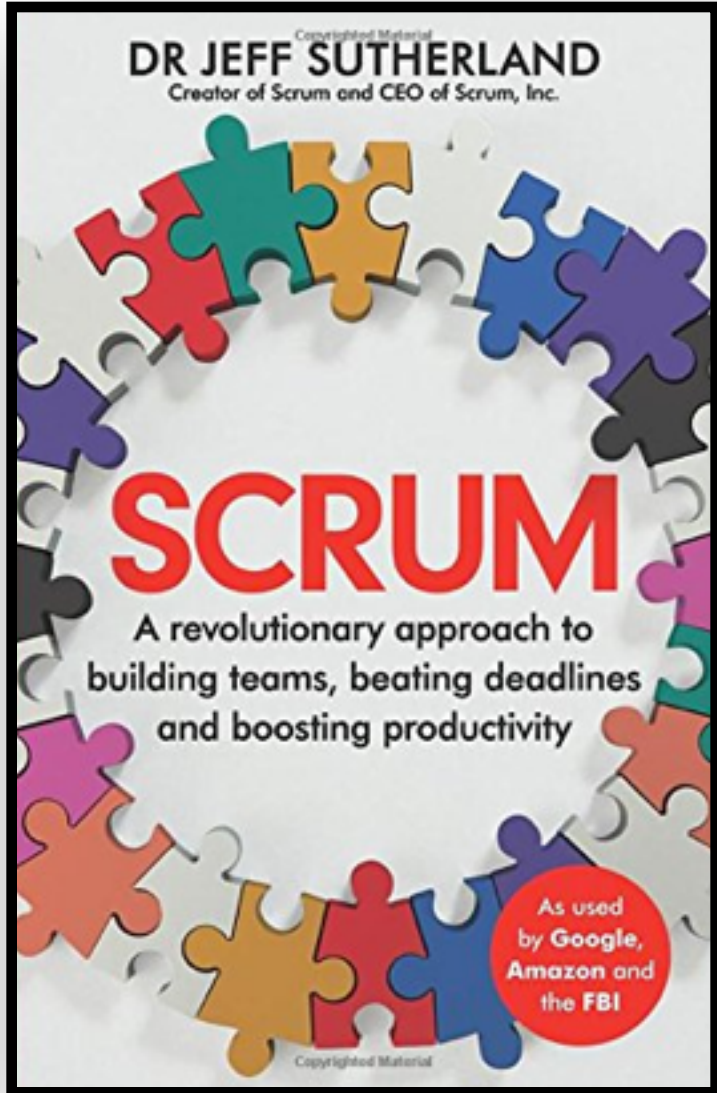
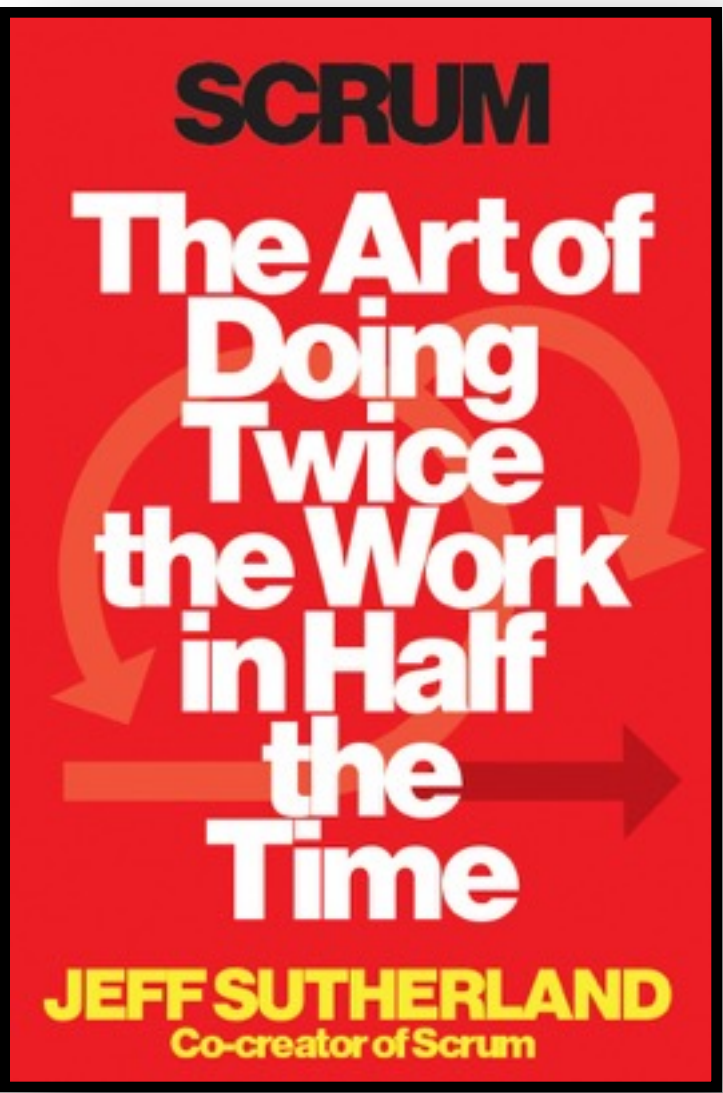


BUILD PARTY, TRAIN, COACH



Scrum is a productivity super-weapon. It is shockingly efficient.

Rick Horgan, Sr. Editor, Crown Business



Scrum@Hardware
Train the Trainer
Feb 4 2017, Seattle, WA

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Next Steps

What would our bottlenecks look like when Scrum is applied?

Prioritize and focus

Use compliance to drive Scrum.

Require Product Owners provide Burn Down Charts to each project with a dedicated team to that project, instead of mythical Gantt charts or “80% complete” statuses.

Train Product Owners in Scrum.

Just like pro sports teams, allocate 1 out of every 25 employees interested in accelerating to train up as a Scrum Coach.

Train teams during facilitated Team Launch events. Measure them against their velocity and quality before launch.