

Scrum@Hardware

Coding Hardware



ジョー・ジャスティス 「私たちはチームの士気がベロシティを何倍にもすることを発見しました」

チームWIKISPEEDの創設者でありリーダー - 100マイル/ガロン のプロトタイプカーを世界で作る。不本意なホームレスをなくすのを手助けするマイクロハウス

エクストリーム・マニファクチャリングの開発者 - 技術プラクティスがハードウェア製造とエンジニアリング組織におけるスクラムを加速

宇宙向けシステムでスクラム - ロケット、ミサイル、自動車、住居、計測学、医療器具、無線、レーダー、DevOps、組織的变化、エンターテインメント、法律、ソフトウェア・アーキテクチャ、複合材料など

講演、コンサルタント - ユネスコ世界本部、イギリス・ケンブリッジ大学、アメリカ・UCバークレー、グーグル、マイクロソフト、ジョンソン・コントロールズ、ボーイング、ロッキード・マーチン、レイセオン、HP、ウィキメディア・ファウンデーション、オープンソースエコロジー、TEDx Rainier、アスペン研究所、ピクテ銀行、その他世界中の組織で

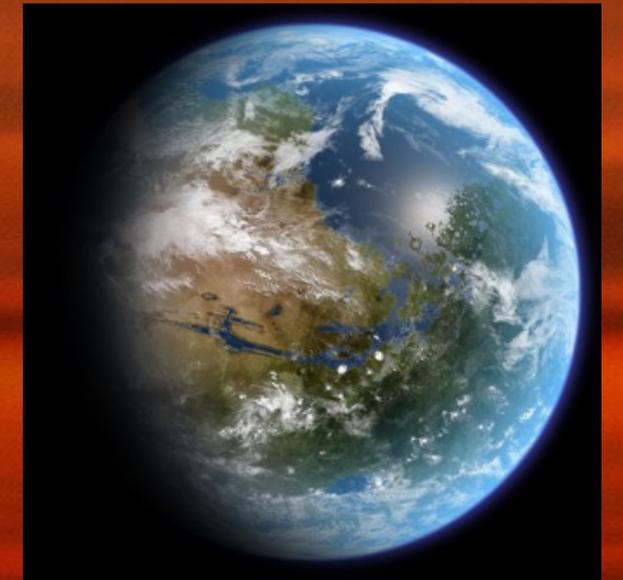


scruminc.

Joe.Justice@ScrumInc.com @WikiSpeed

Is it Hardware or Software

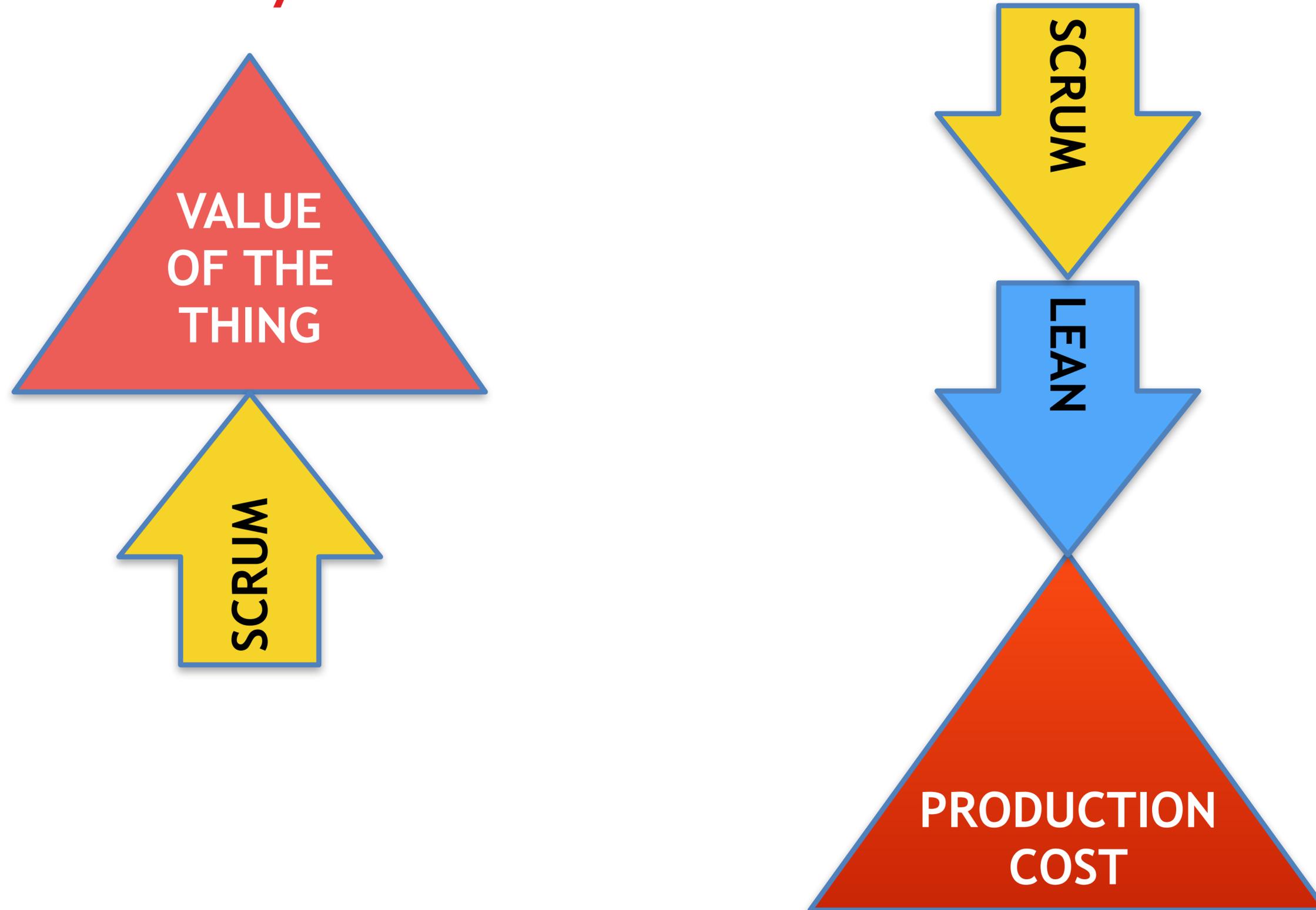
Coding Hardware



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.

Why Investors Love Scrum



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

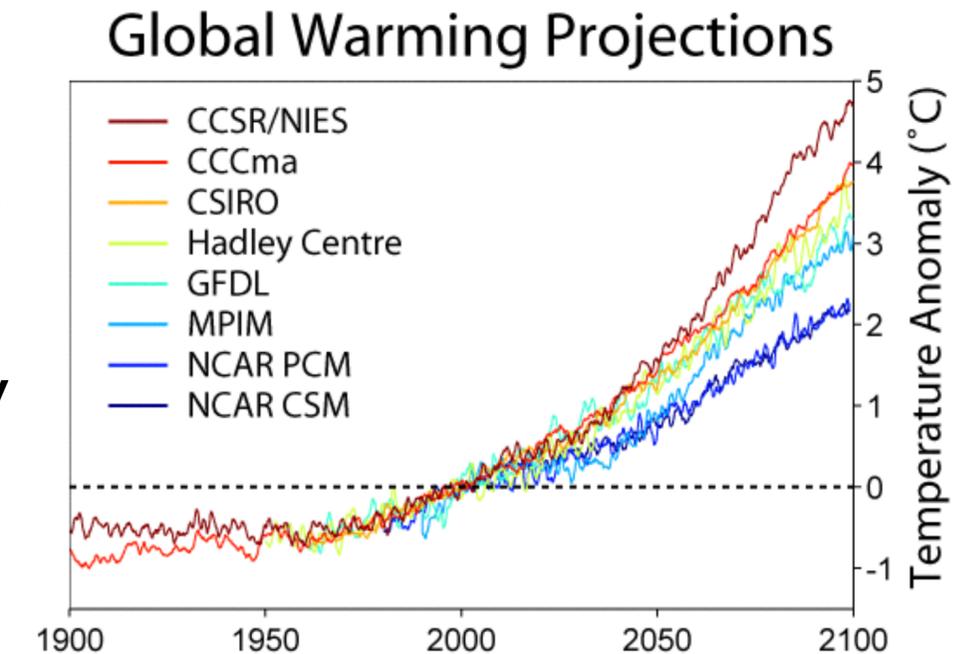
Boeing source: <http://aviationblog.dallasnews.com/2011/04/a-timeline-of-boeing-737-model.html/>

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

WHY SCRUM IN HARDWARE WILL SAVE THE LIFE OF EVERY INNOCENT CREATURE ON EARTH

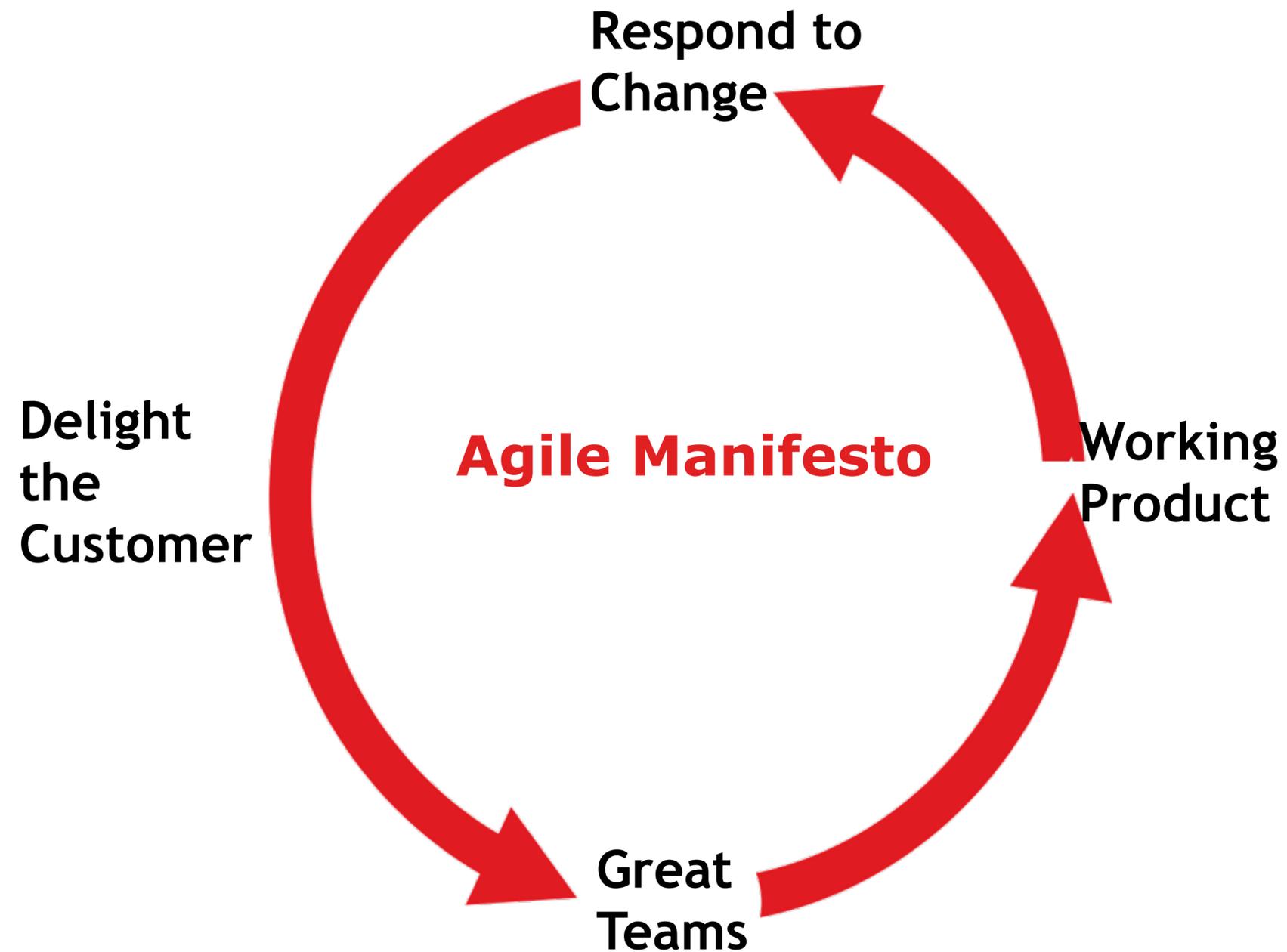
- **14 SPRINTS UNTIL WE ARE DEAD.**

- InterGovernmental Panel on Climate Change estimates planet earth will become uninhabitable by humans in 84 years.
- Primary contributors are coal (42%) and oil (33%).
 - 195 major coal plants active in 2015.
 - 19 companies producing more than 1M cars a year each, for 90M total manufactured in 2015.
 - 214 excellent, aggressive, Scrum-in-Hardware coaches needed to train and coach these plants into continuous improvement.
- Current velocity of carbon output is +10.7 GTc per year.
- To not die, we need -10.7 GTc per year accelerating 2.2% each year to keep pace with energy consumption growth.
- That means next sprint we need -62 GTc, or 11% improvement of efficiency of industrial power utilization and land vehicle power utilization in the next sprint.

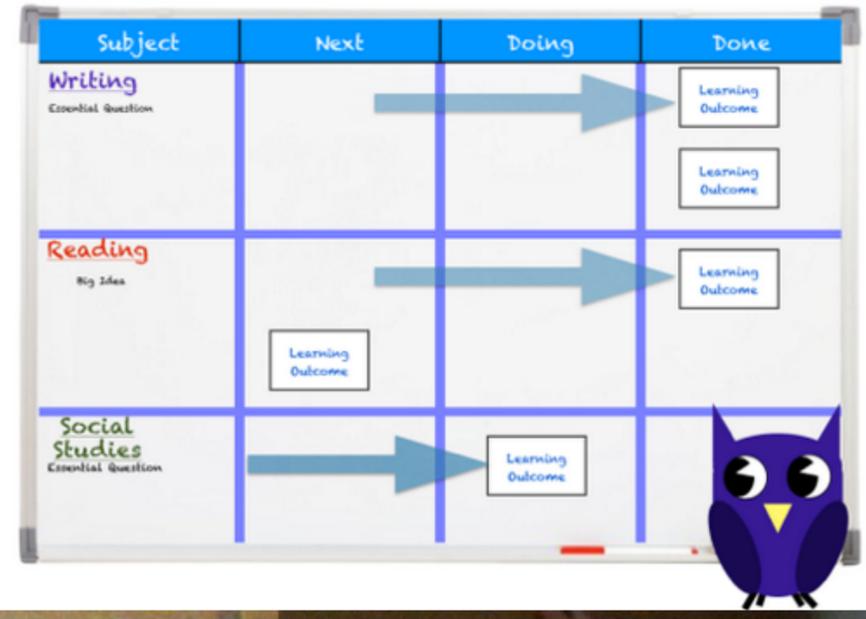


Sources: <https://www.co2.earth/global-co2-emissions>

The Market is Agile



edu Scrum



MOTIVATING

With *eduscrum* students are more motivated when they work together. They work autonomously within plain frameworks and the responsibility they get from this makes them thrive. Their teachers enjoy this as well.



The Scrum Bill

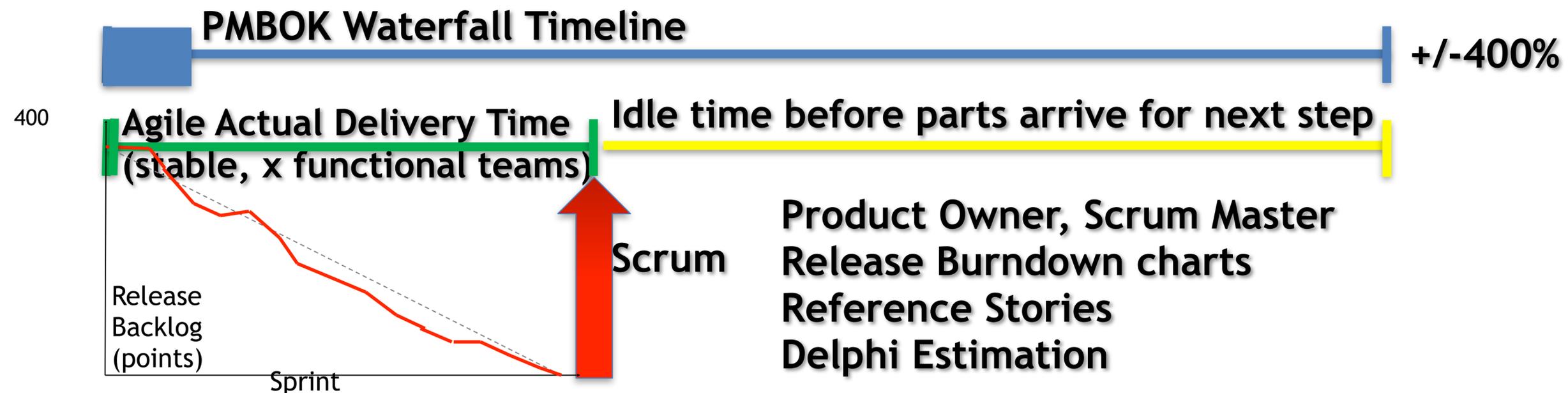
“We only fund technology projects that show citizen facing value in less than 6 months.”



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

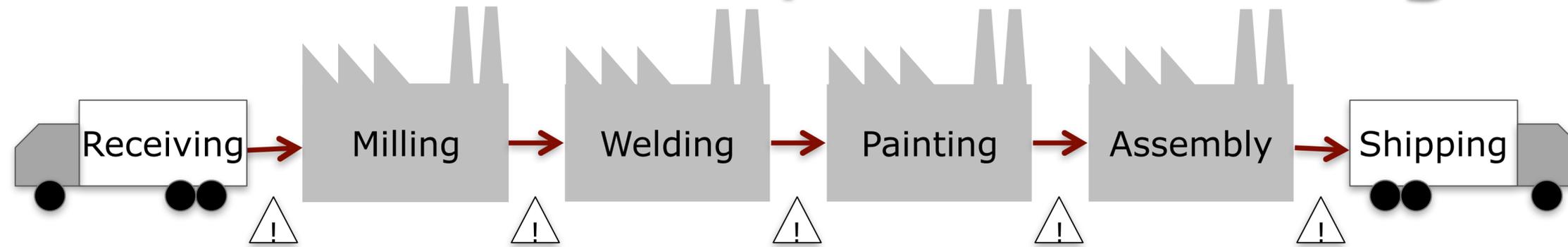


Assume team owns part of a complex value stream. Date over and under-runs disrupt flow.



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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!**

PUSHBACK



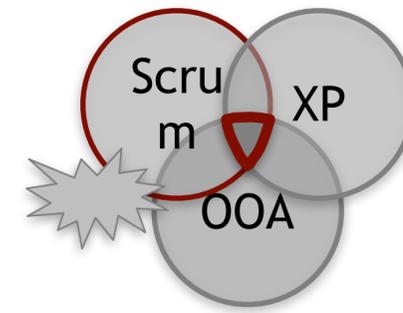
- John Deere EPDP. Over 1000 steps
- Bosch Lifecycle Management. Over 800 steps
- These phase gate steps are meant to mitigate risk

- 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 as Lean Cells

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



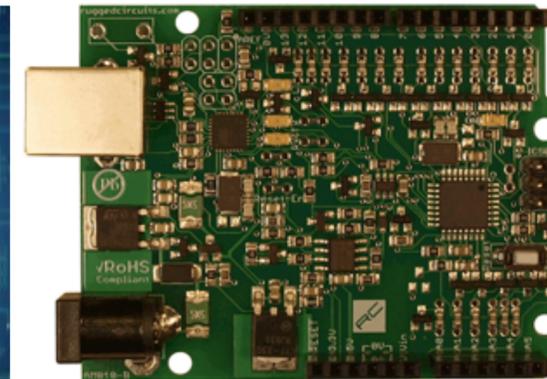
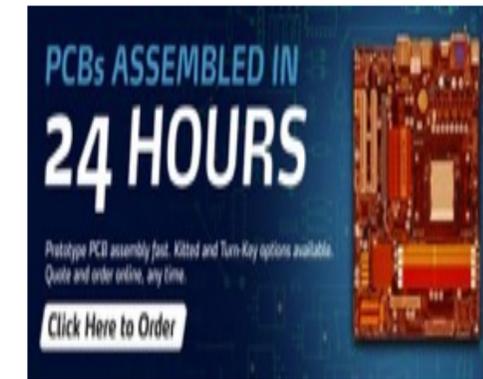
Sprint provides team improvement cadence in addition to Takt time cadence

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 make this possible

- Protomold, Rush PCB, and Ruggeduino



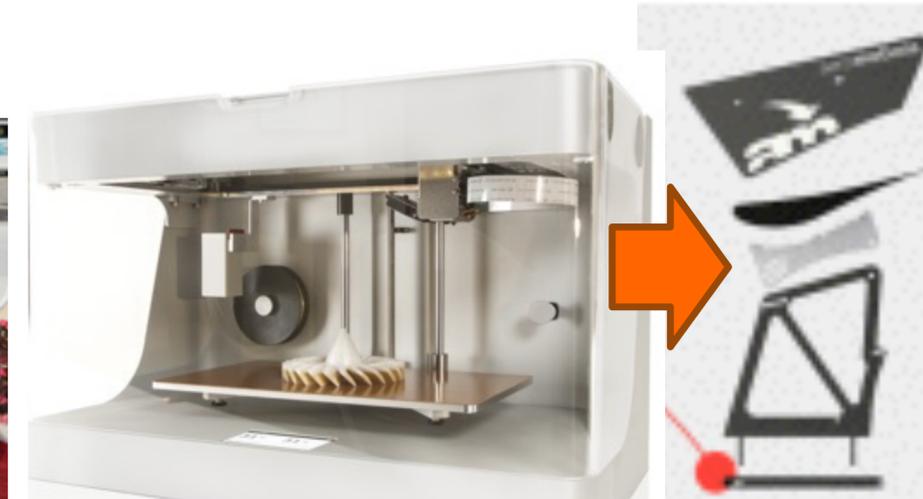
Scrum Electronics in One Sprint

- 3d Green Sand Casting



Scrum Metallics in One Sprint

- Cincinnati BAAM and MarkForged



Structural Composites in One Sprint

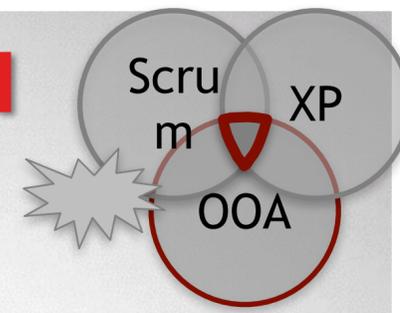
- Local Motors



- 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

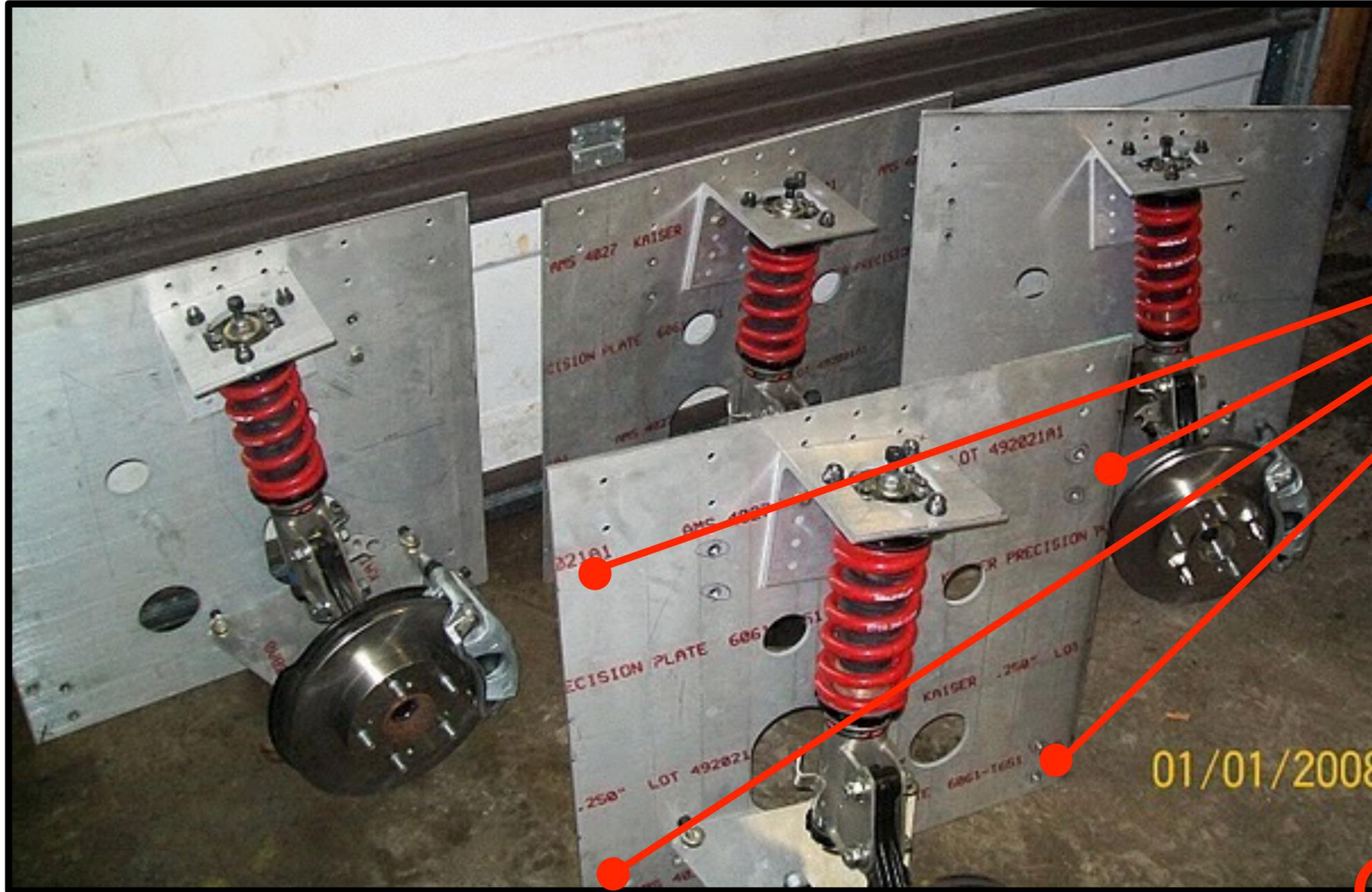
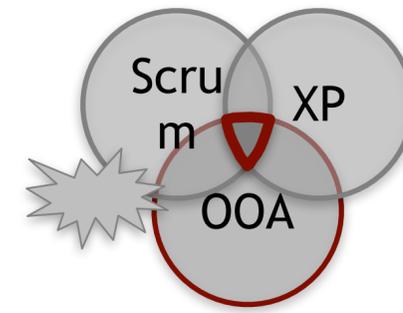


Object-Oriented Architecture: Contract-First Design



- 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

Object-Oriented Architecture: Known Stable Interfaces

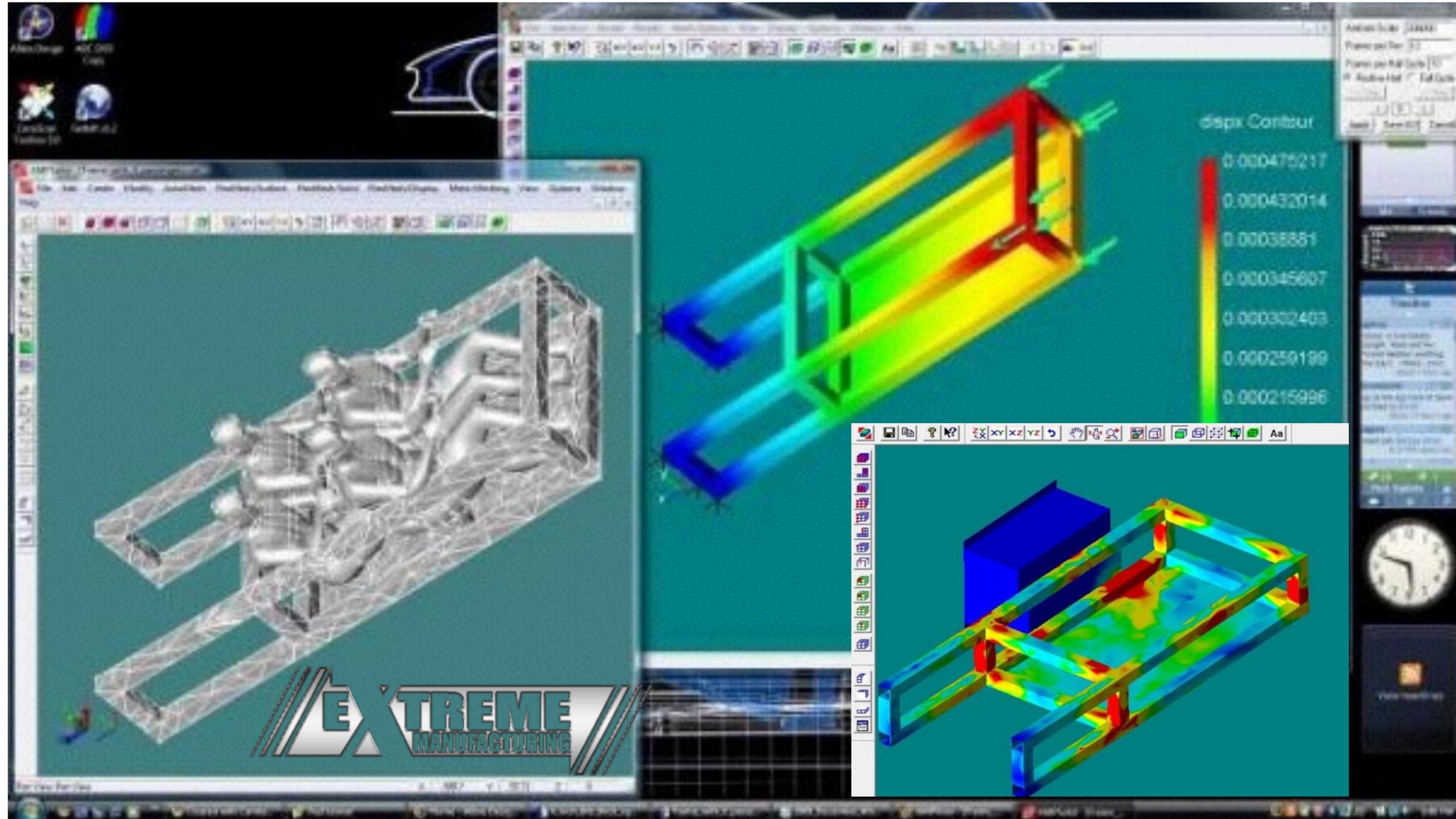


Pre-negotiated physical and data connections permit greater design versatility, and loose production coupling

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

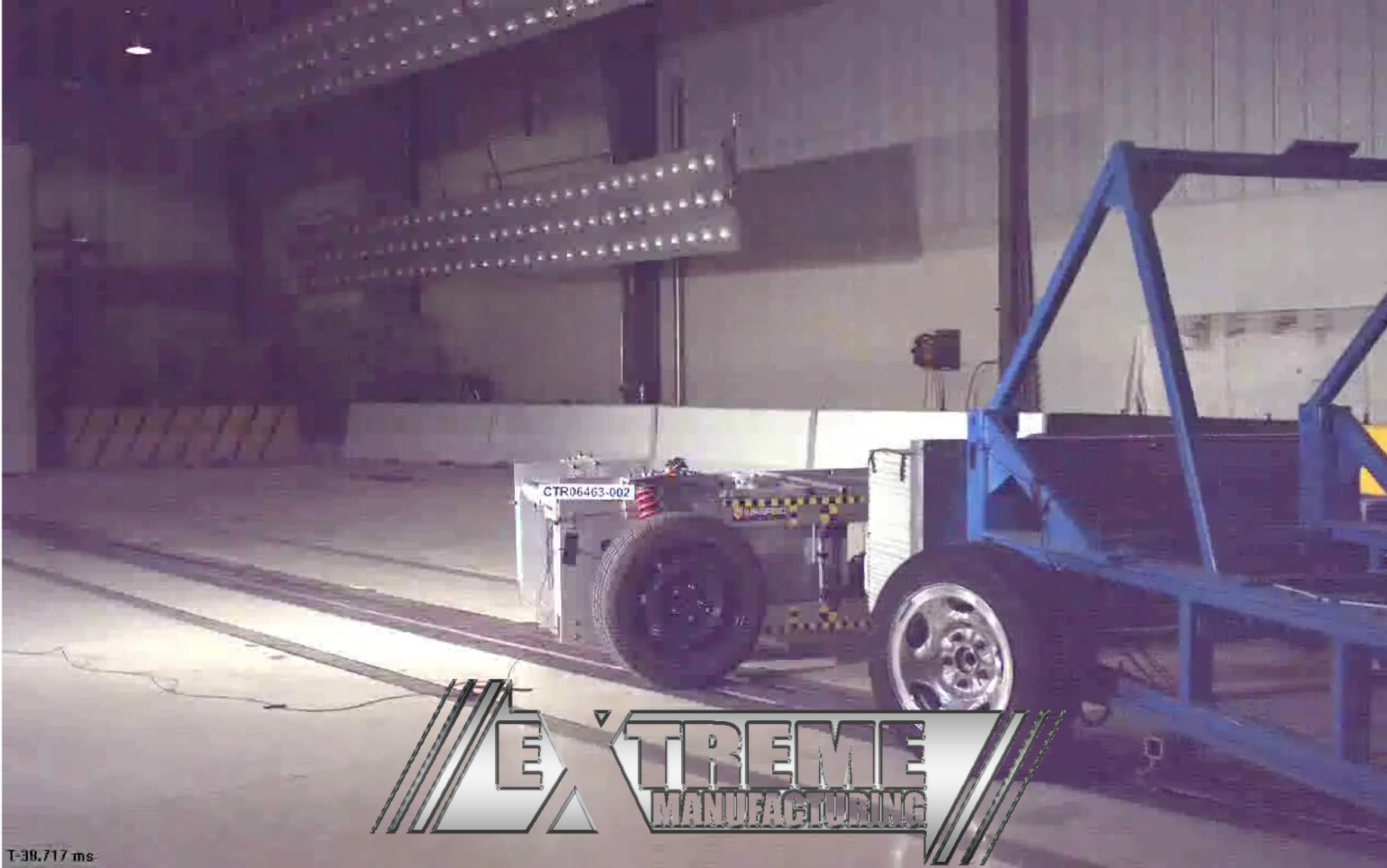
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Regulatory testing each week





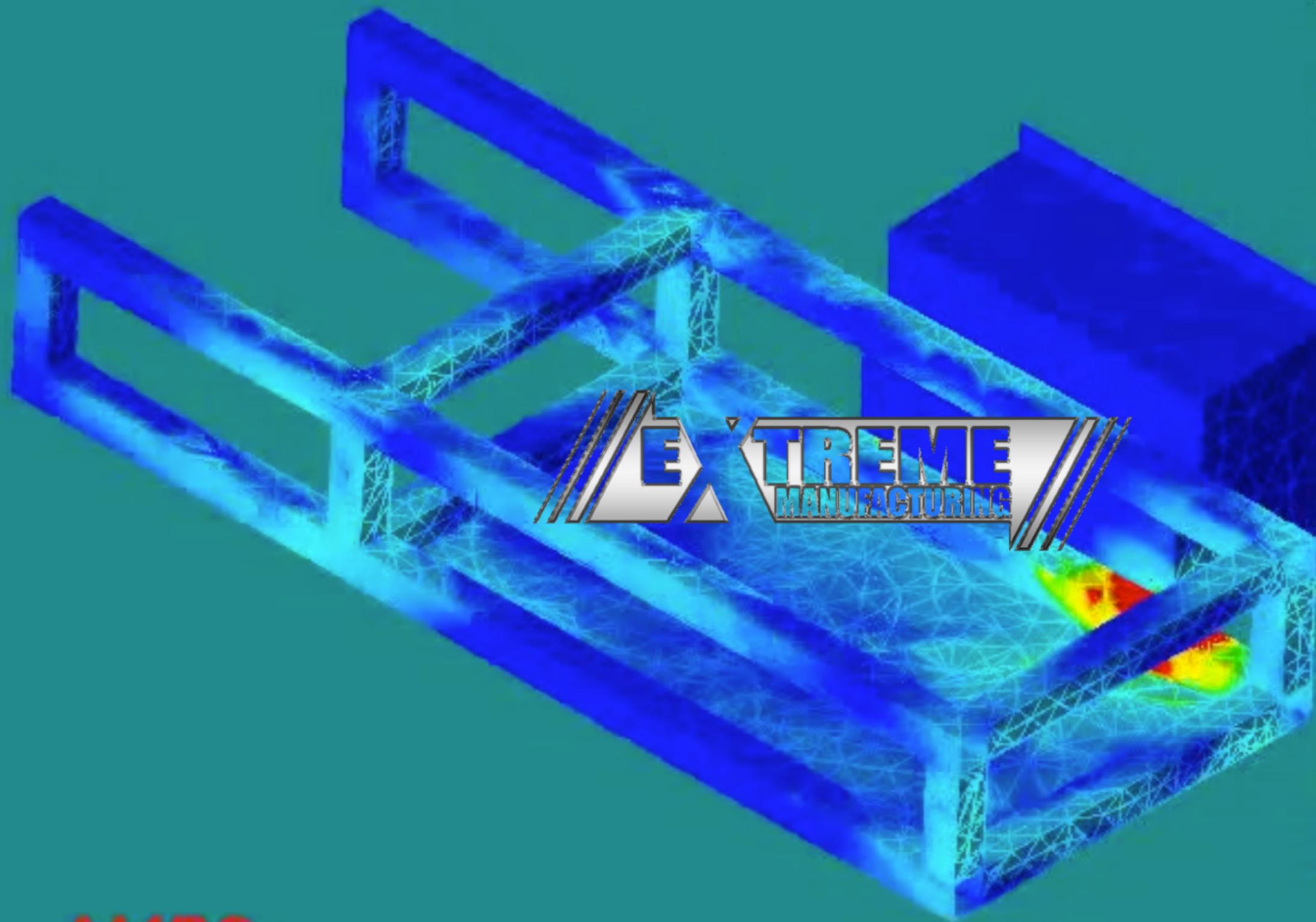
EXTREME
MANUFACTURING



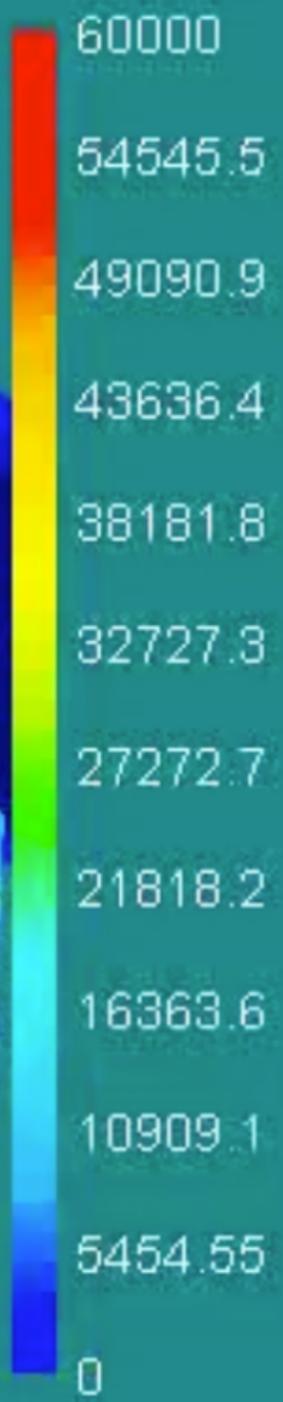
CTR06463-002

E **TREME**
MANUFACTURING

T-38.717 ms



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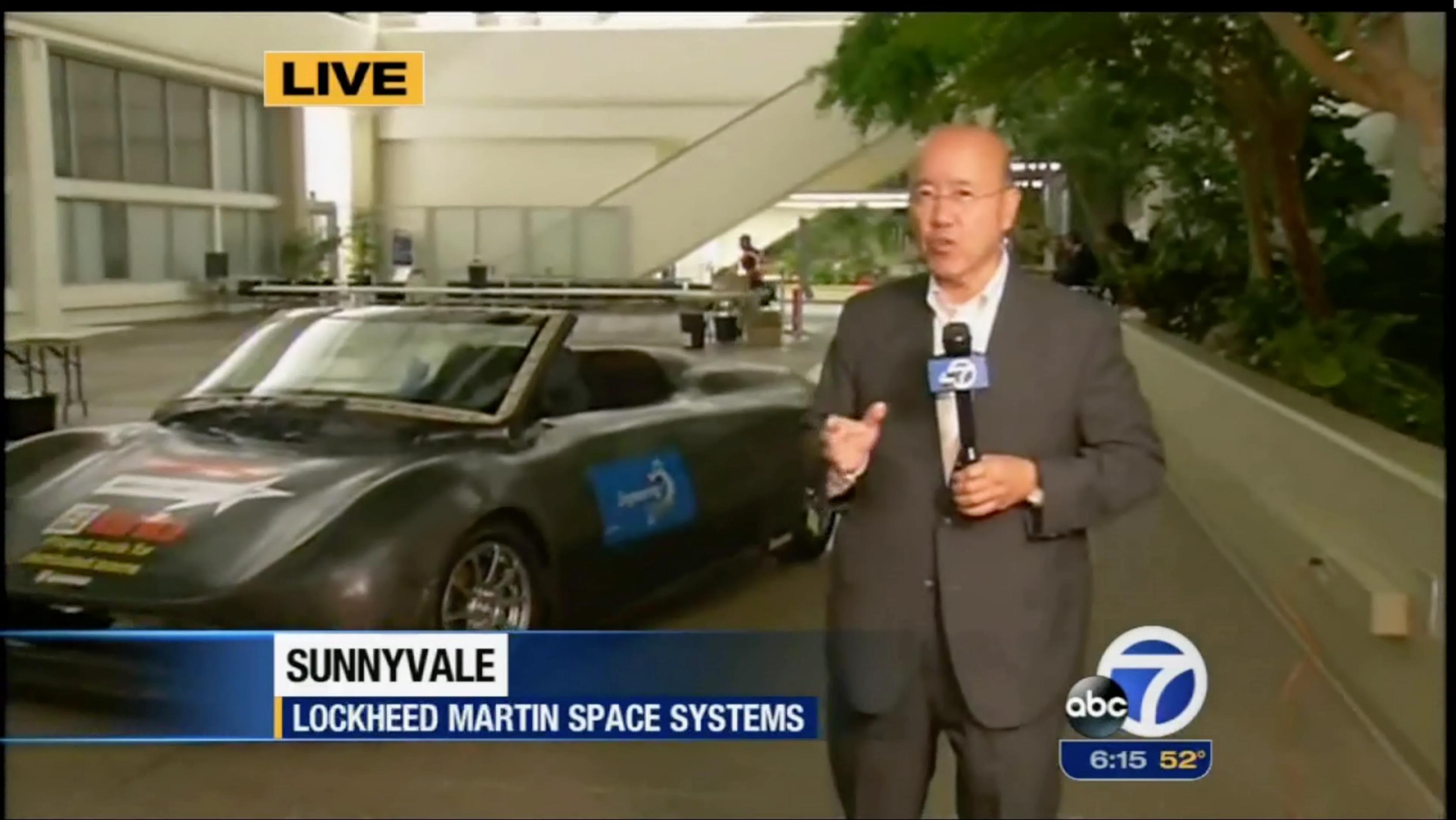


AMPS



EXTREME
MANUFACTURING

LIVE



SUNNYVALE

LOCKHEED MARTIN SPACE SYSTEMS



6:15 52°

Return on Investment for 150 Teams

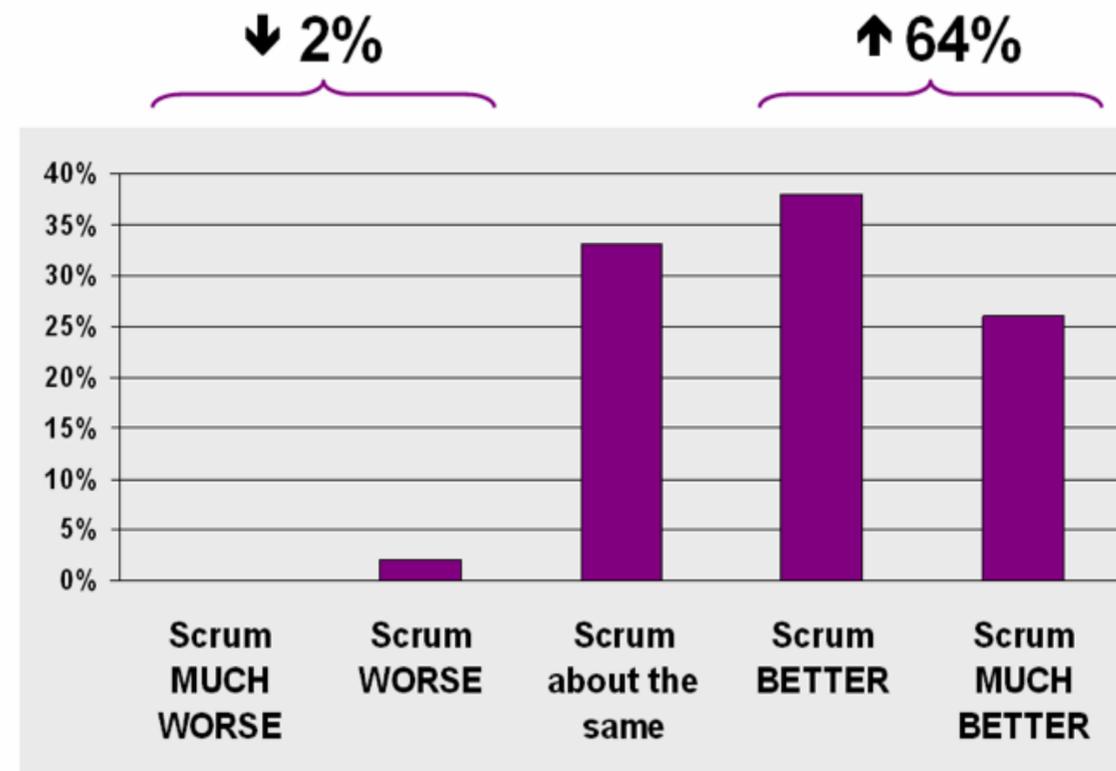
- Each Scrum trainer starts up and coaches 10 new Scrum teams a year
- Coached velocity increase is 200-400%
- Uncoached average increase is 35%
- Conservative cost reduction per coach is over \$1M/yr

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

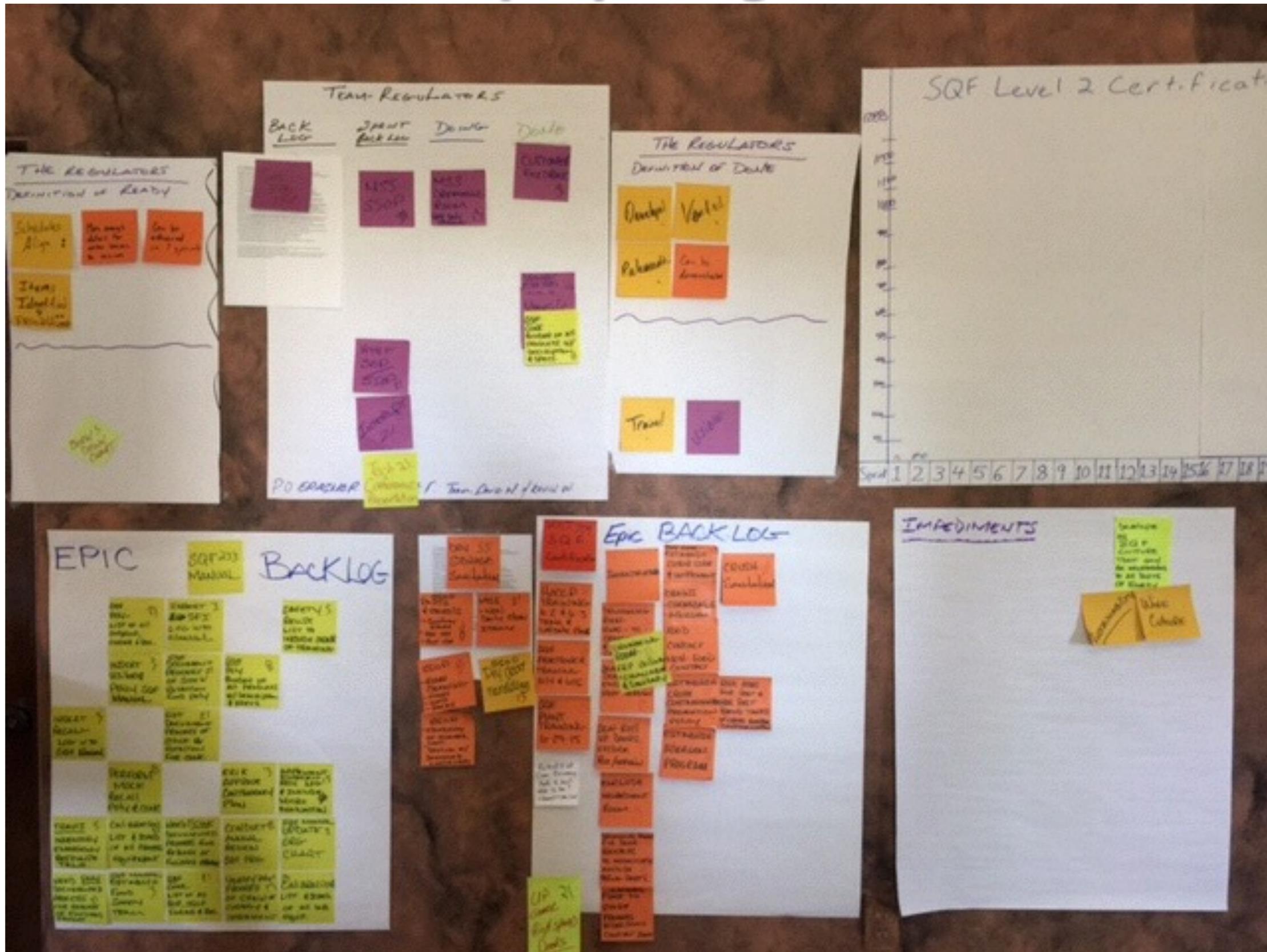


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All stakeholders propose goals and missions



Single Prioritized enterprise backlog == Happy Chief Product Owner



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Champagne Team Launch



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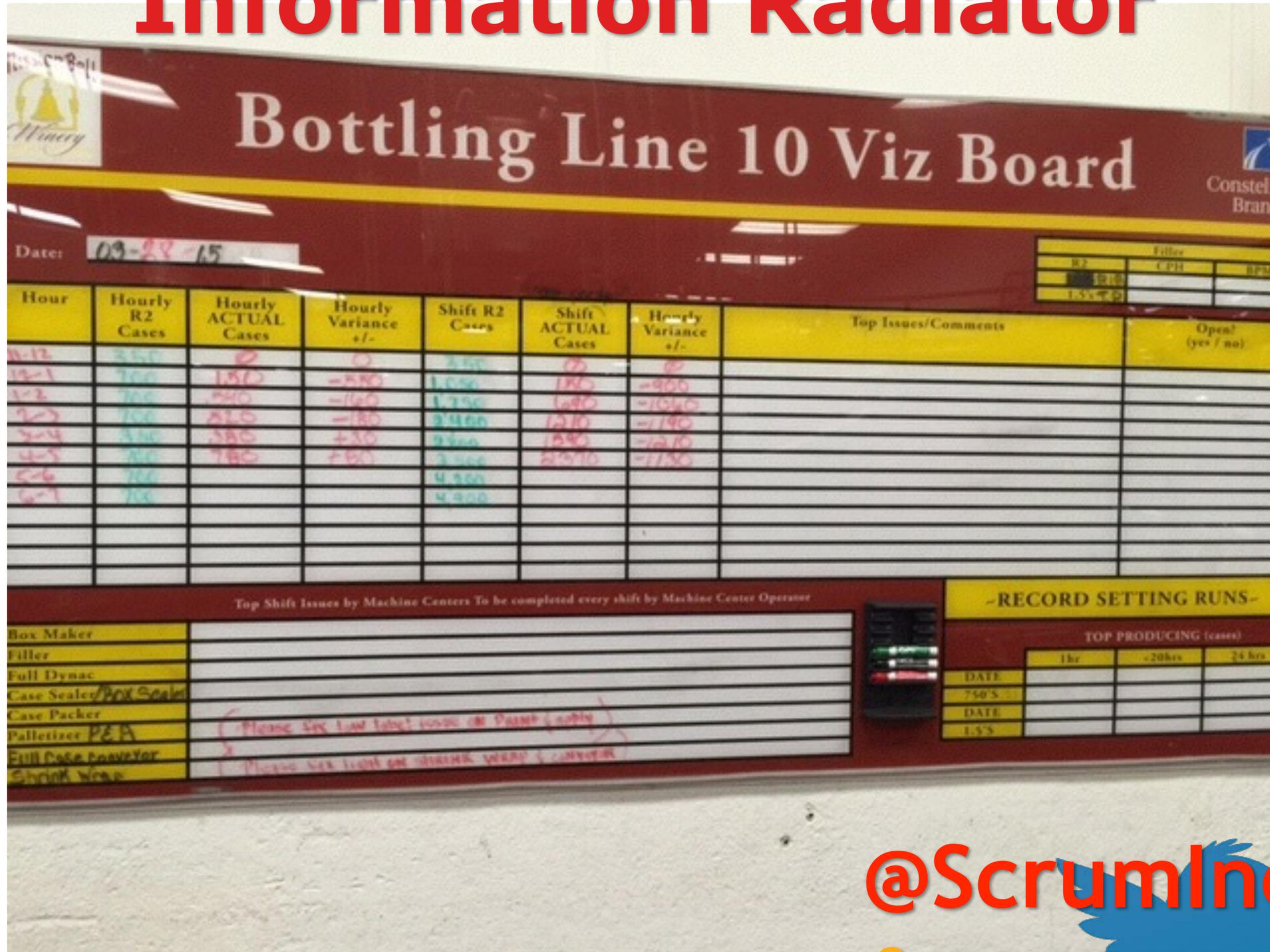
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Information Radiator



Meta Scrum

Coordinating Across Teams, Modules, Missions



Does anyone really care the Nokia mobile brand is dead?

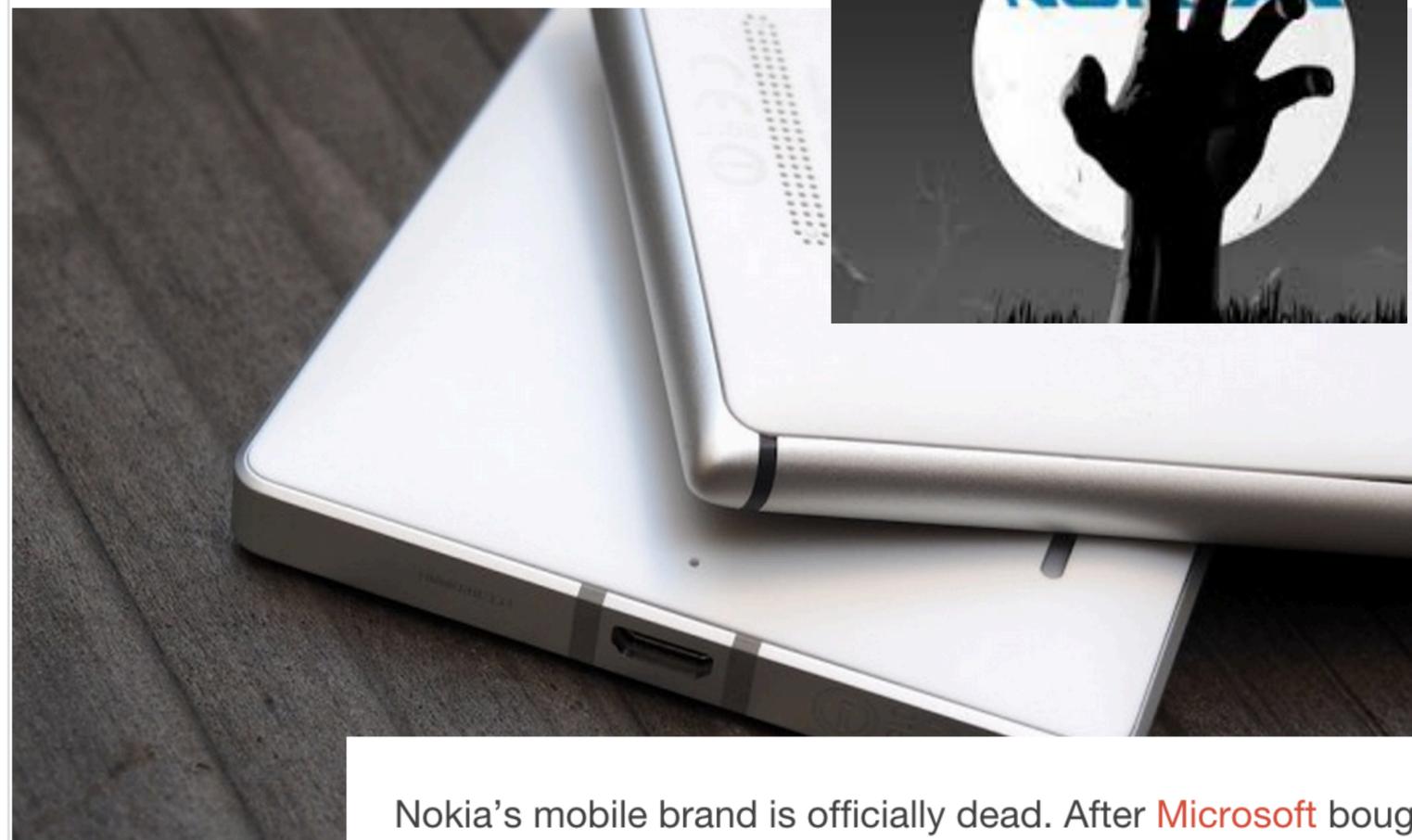
65

Nov 7, 2014

Tweet 36

Like 84

g+1 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. This 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.



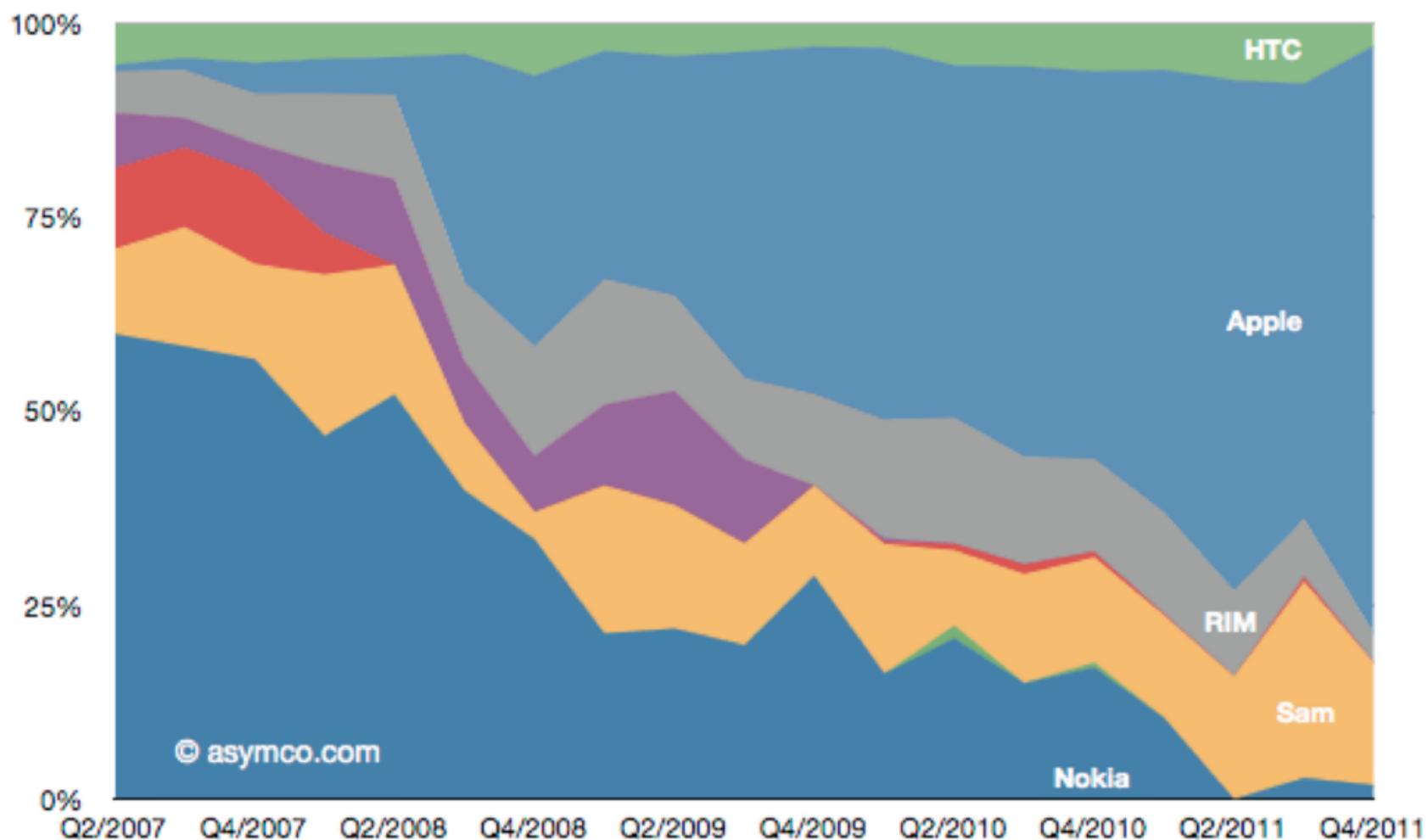
Customers loved this...



...Until they tried this...

Customers Often Don't Know What They Want Until They See It! *Humphrey's Law*

Profit shares of eight mobile phone vendors



How Scrum Scales

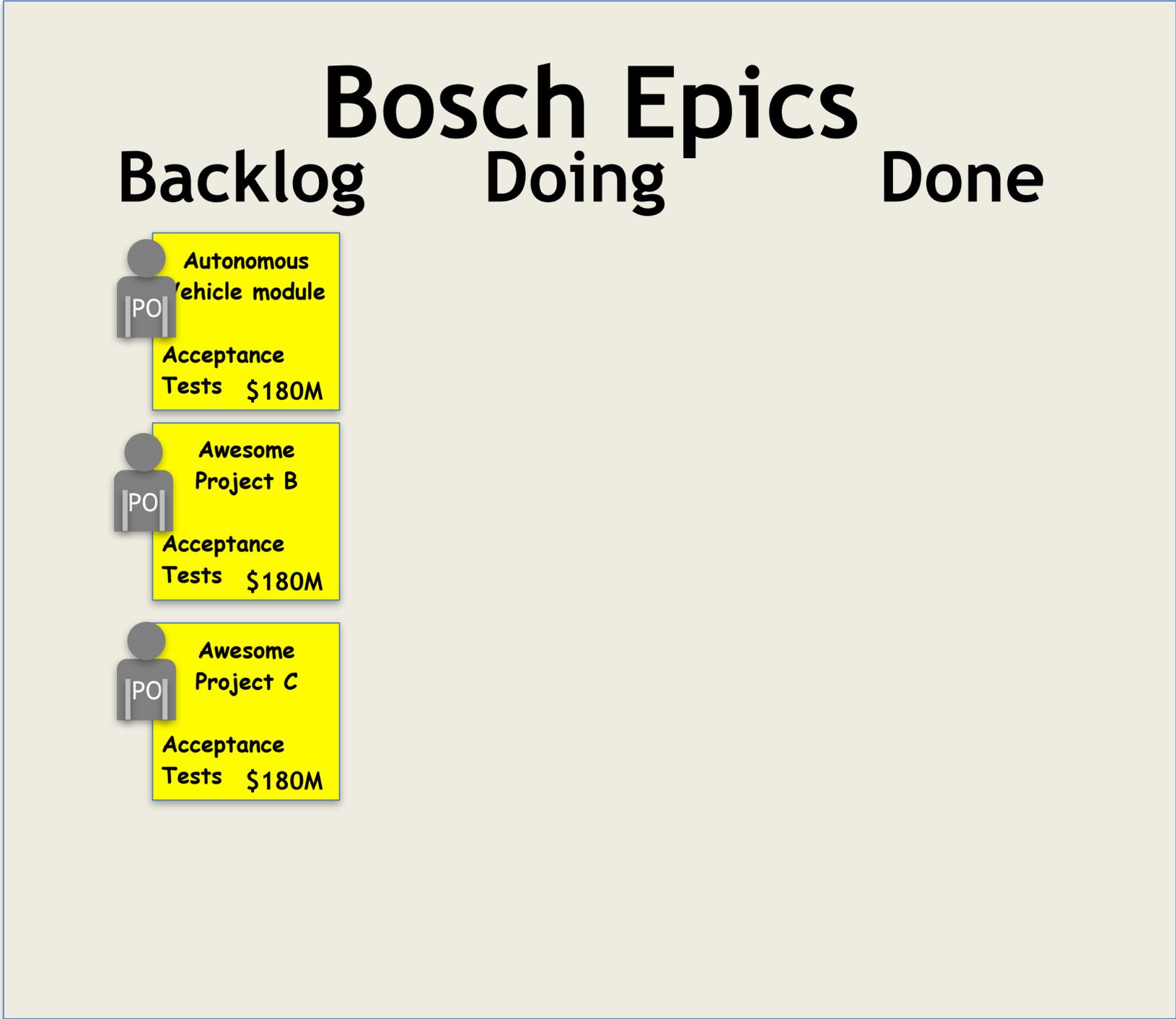
As Bosch,

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

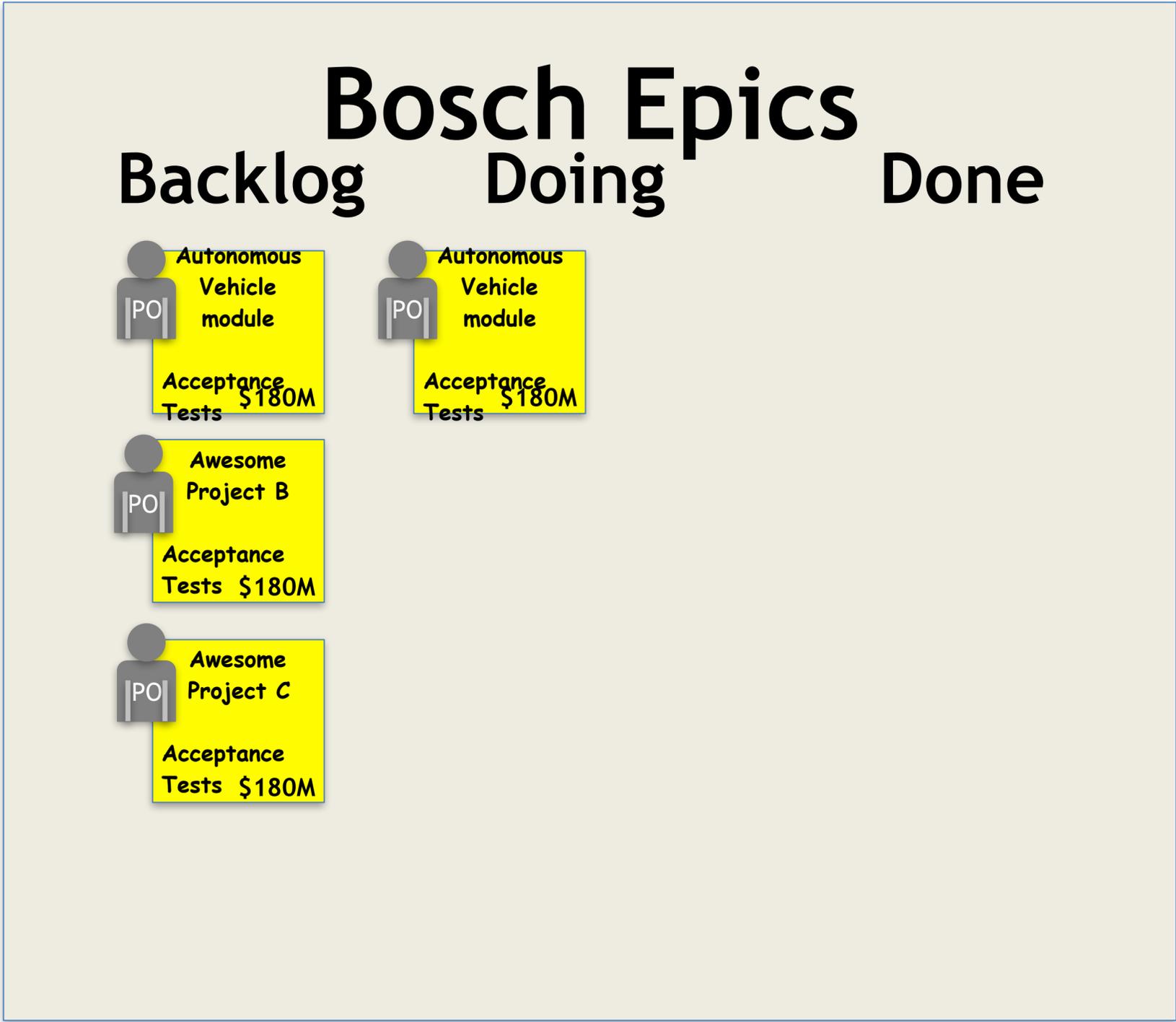
so that we can be the majority supplier of the autonomous vehicle renaissance.

- Vehicle to vehicle learning **987pts**
- Passes U.S. driver's test < Q3 2017 **\$180M**
- No changes to OEM body in white

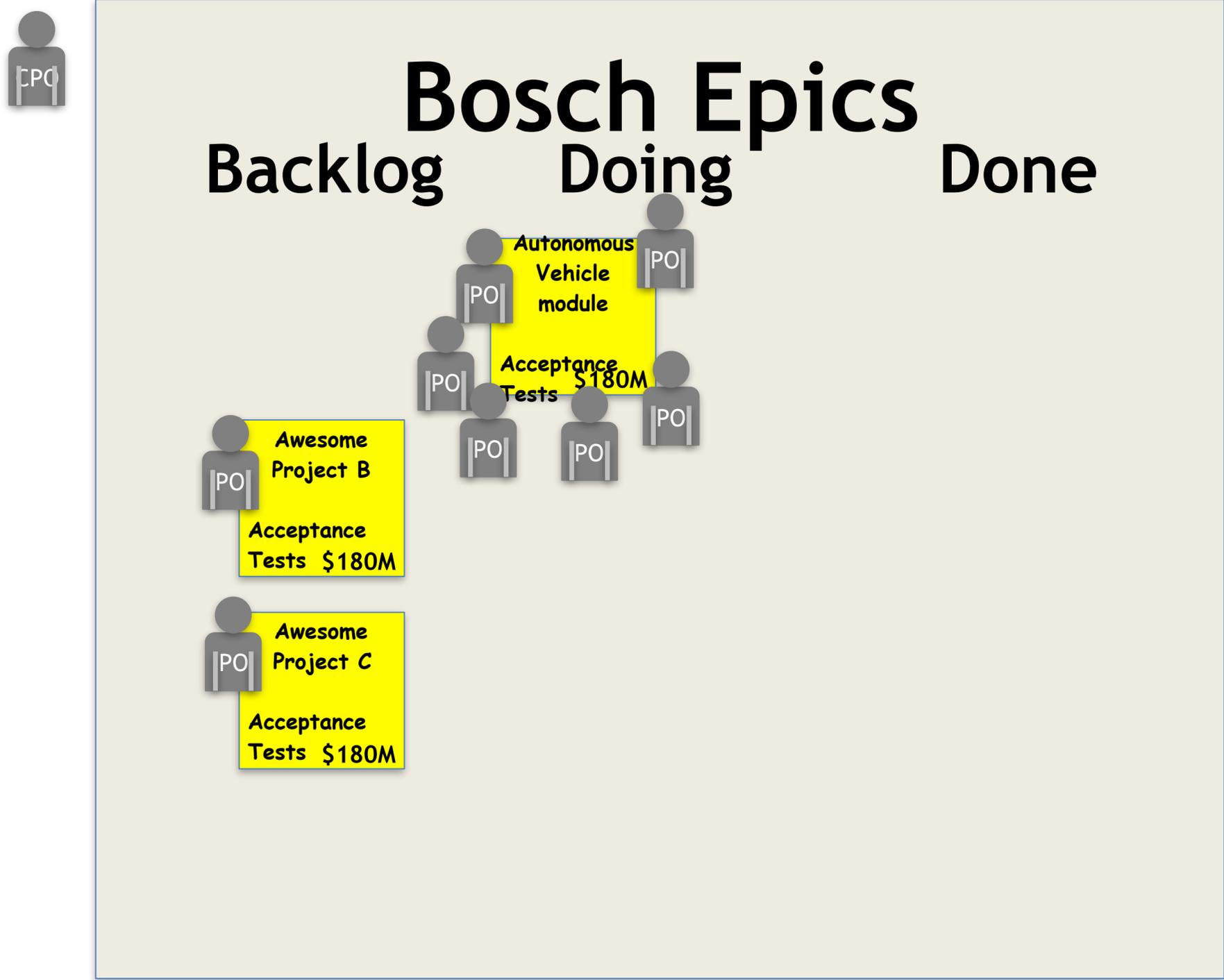
How Scrum Scales



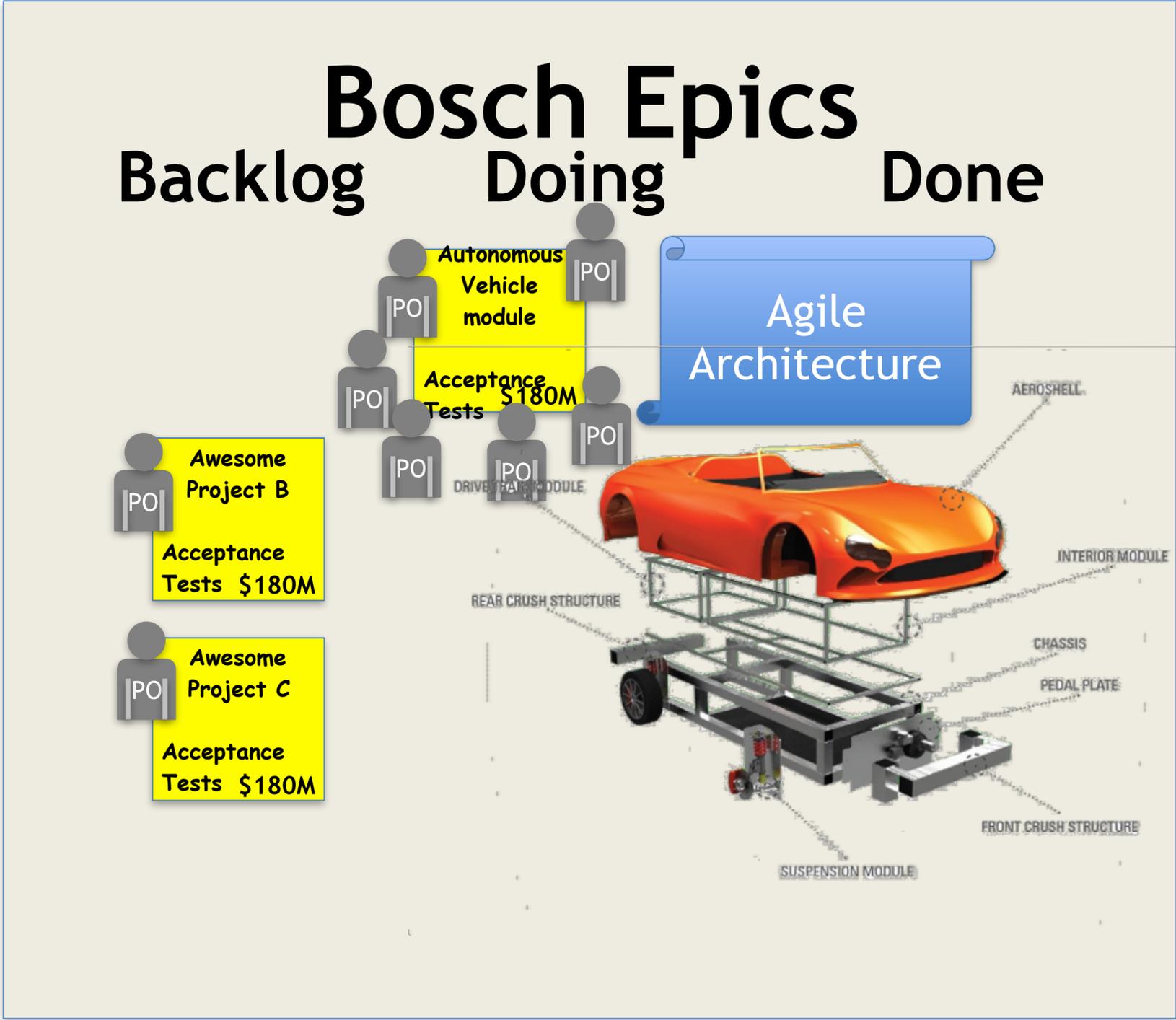
How Scrum Scales



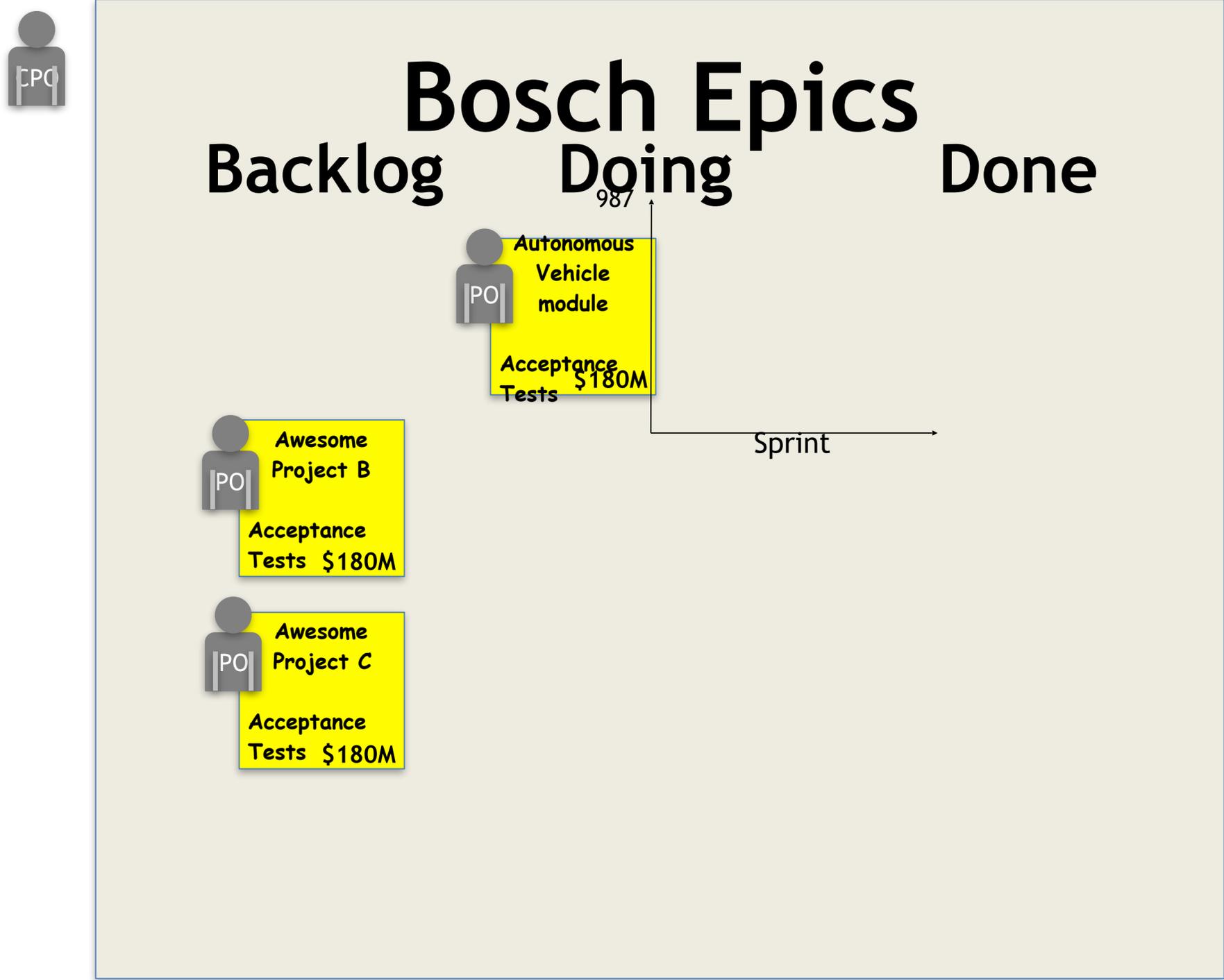
How Scrum Scales



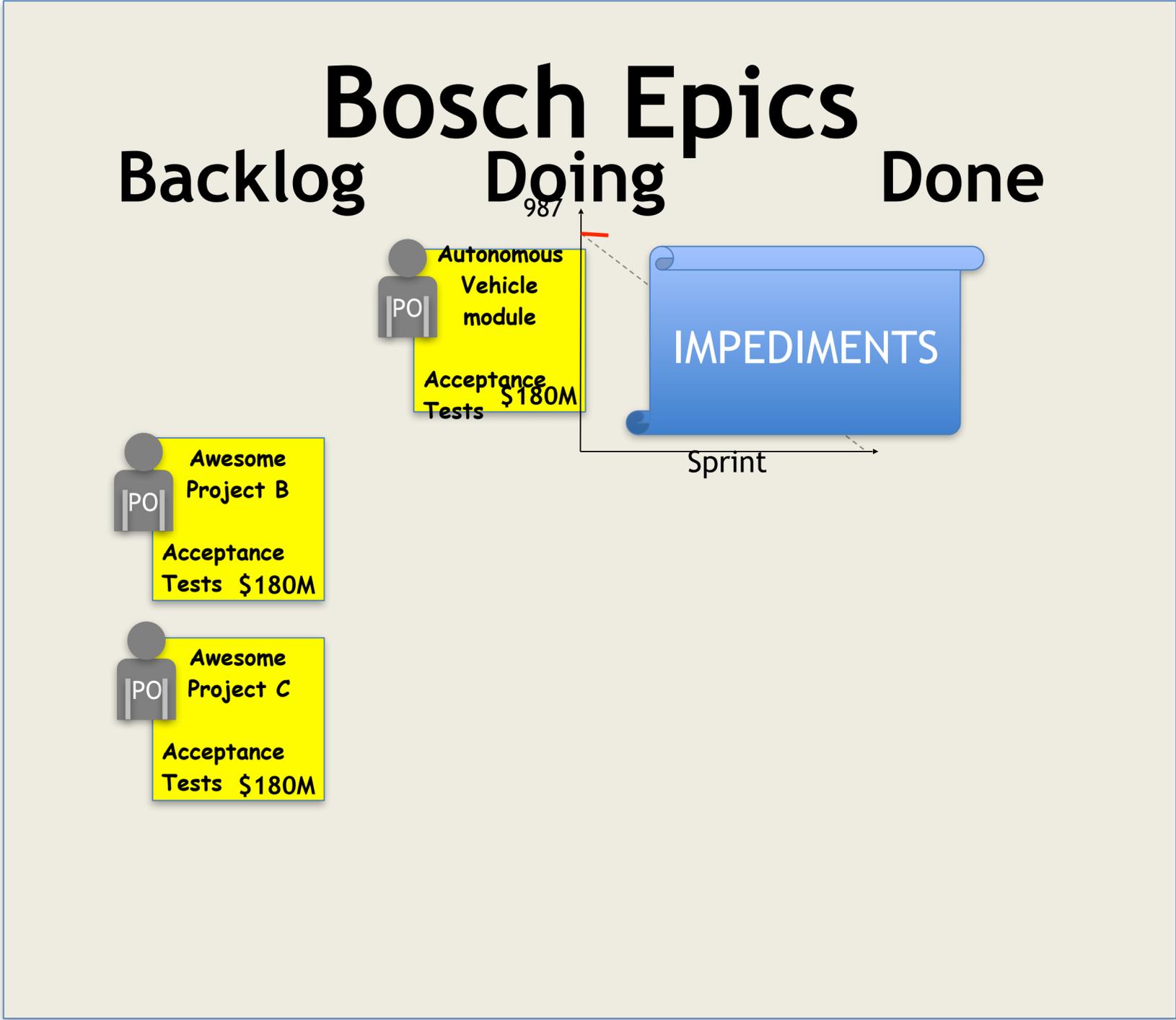
How Scrum Scales



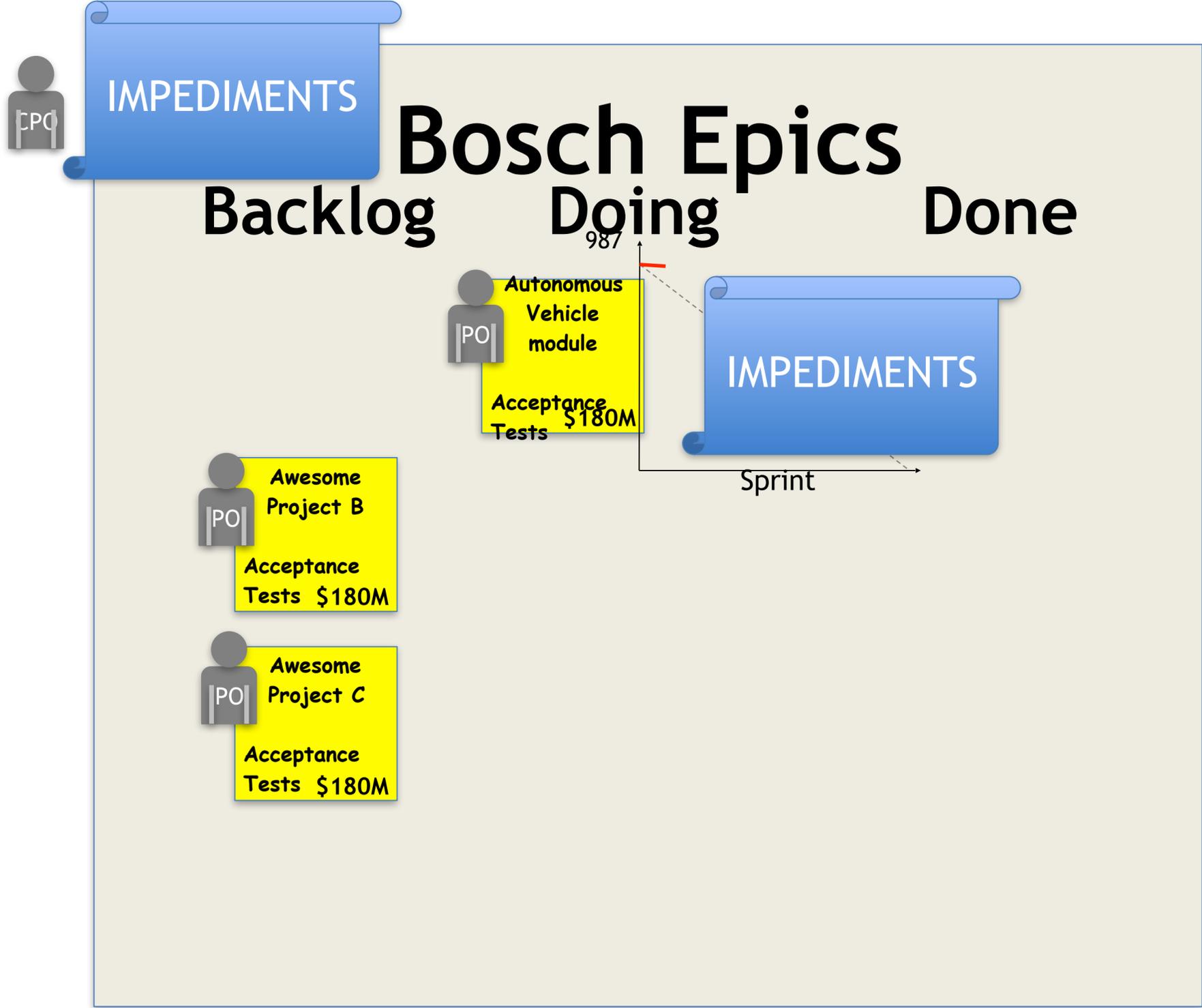
How Scrum Scales



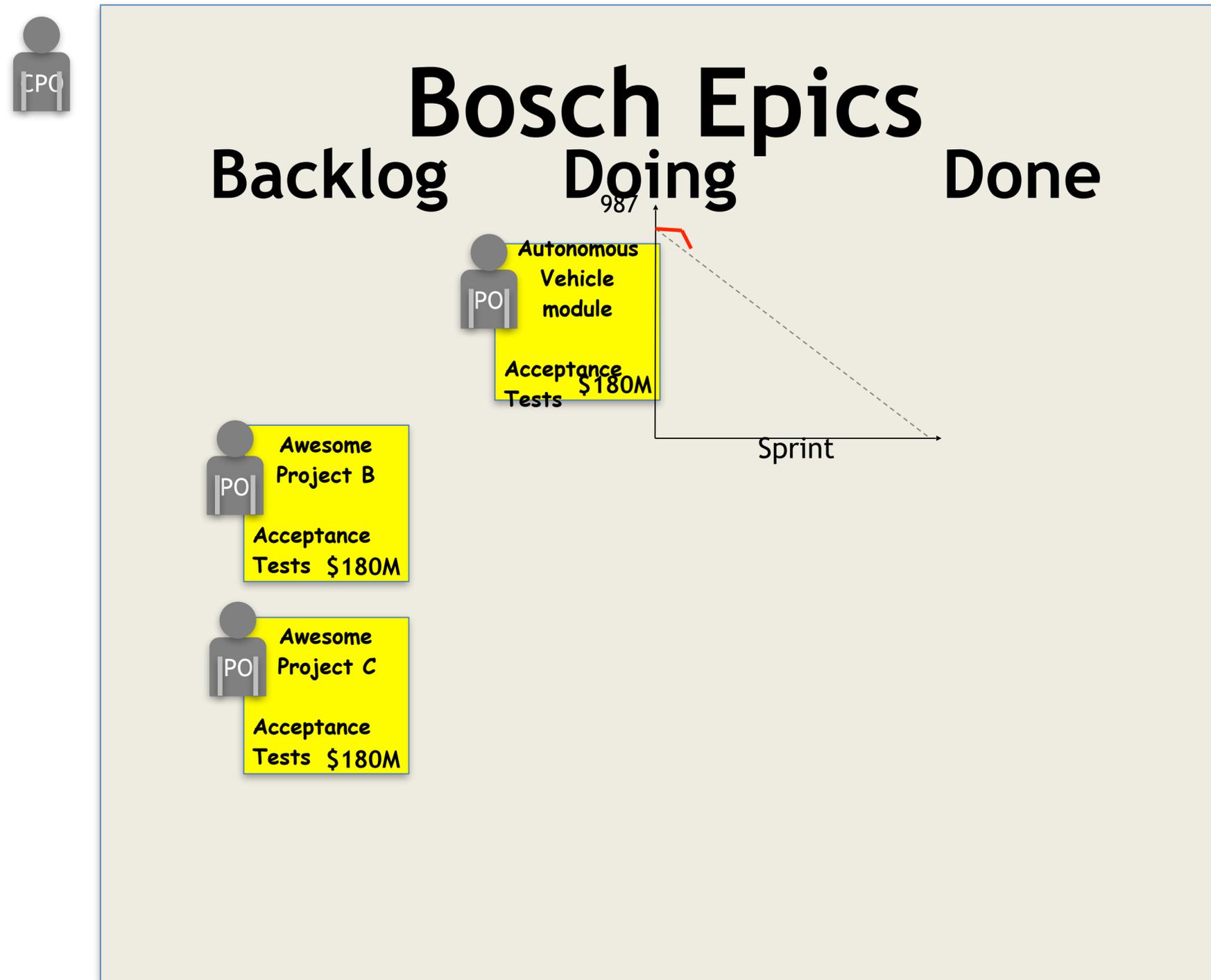
How Scrum Scales



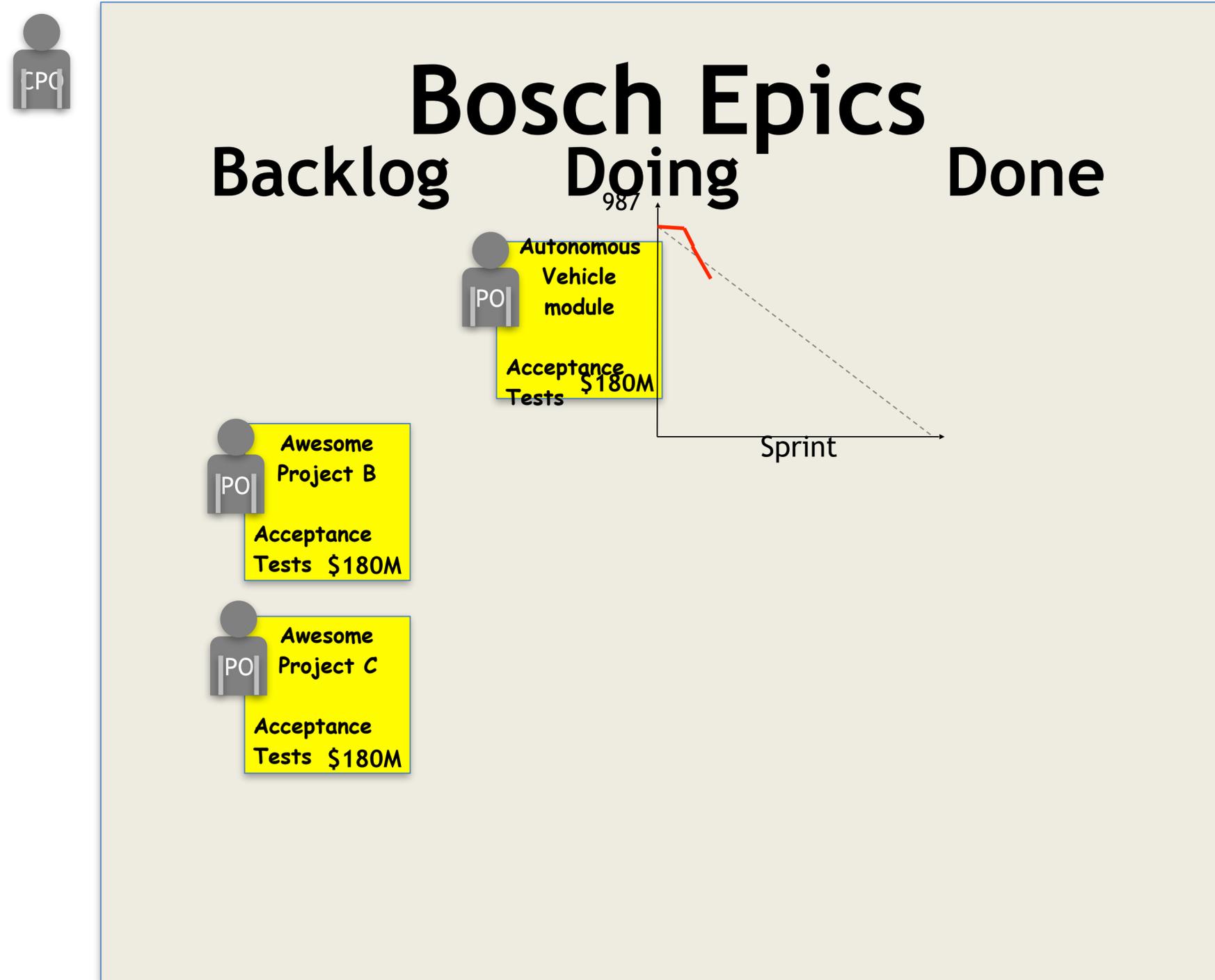
How Scrum Scales



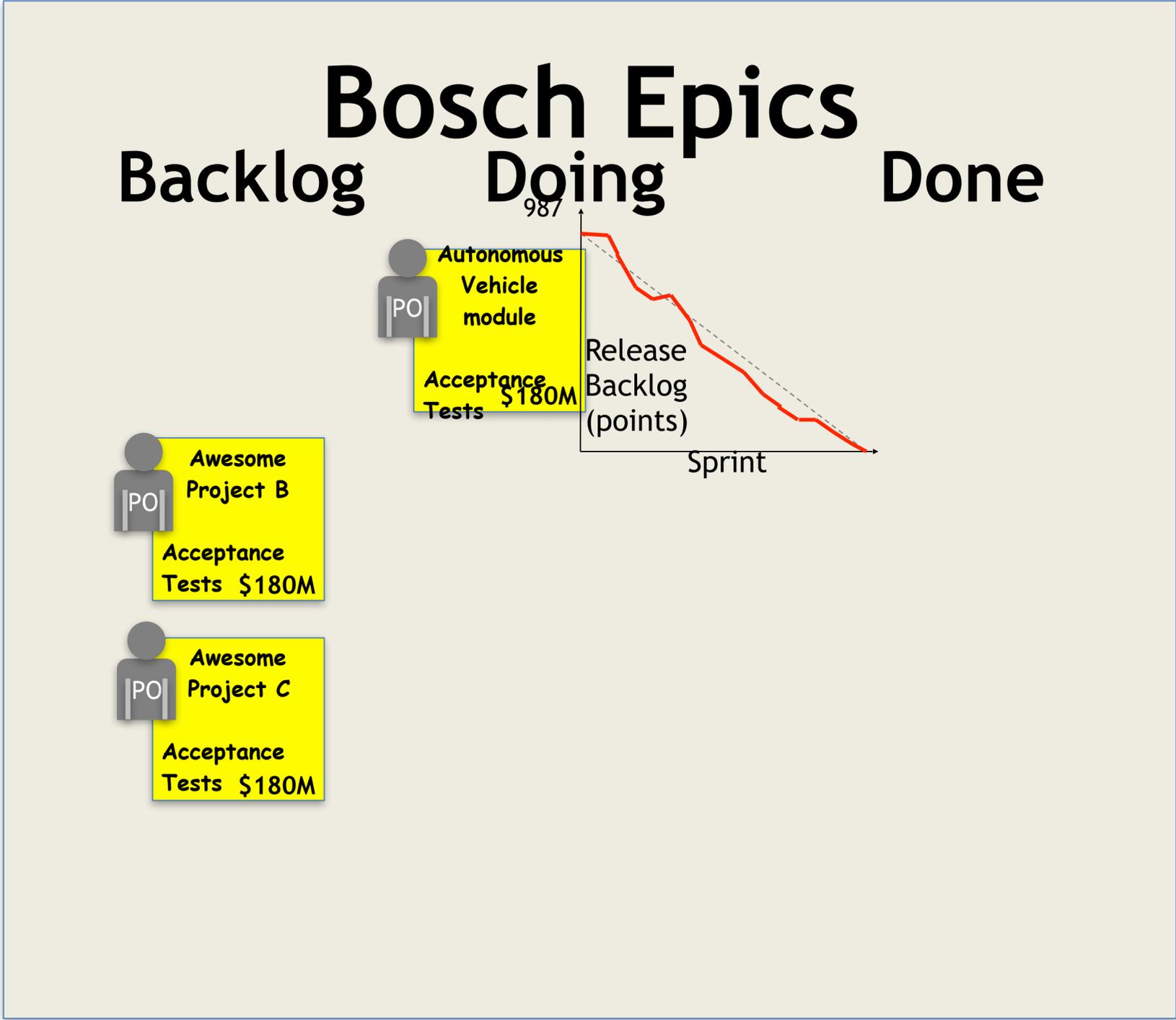
How Scrum Scales



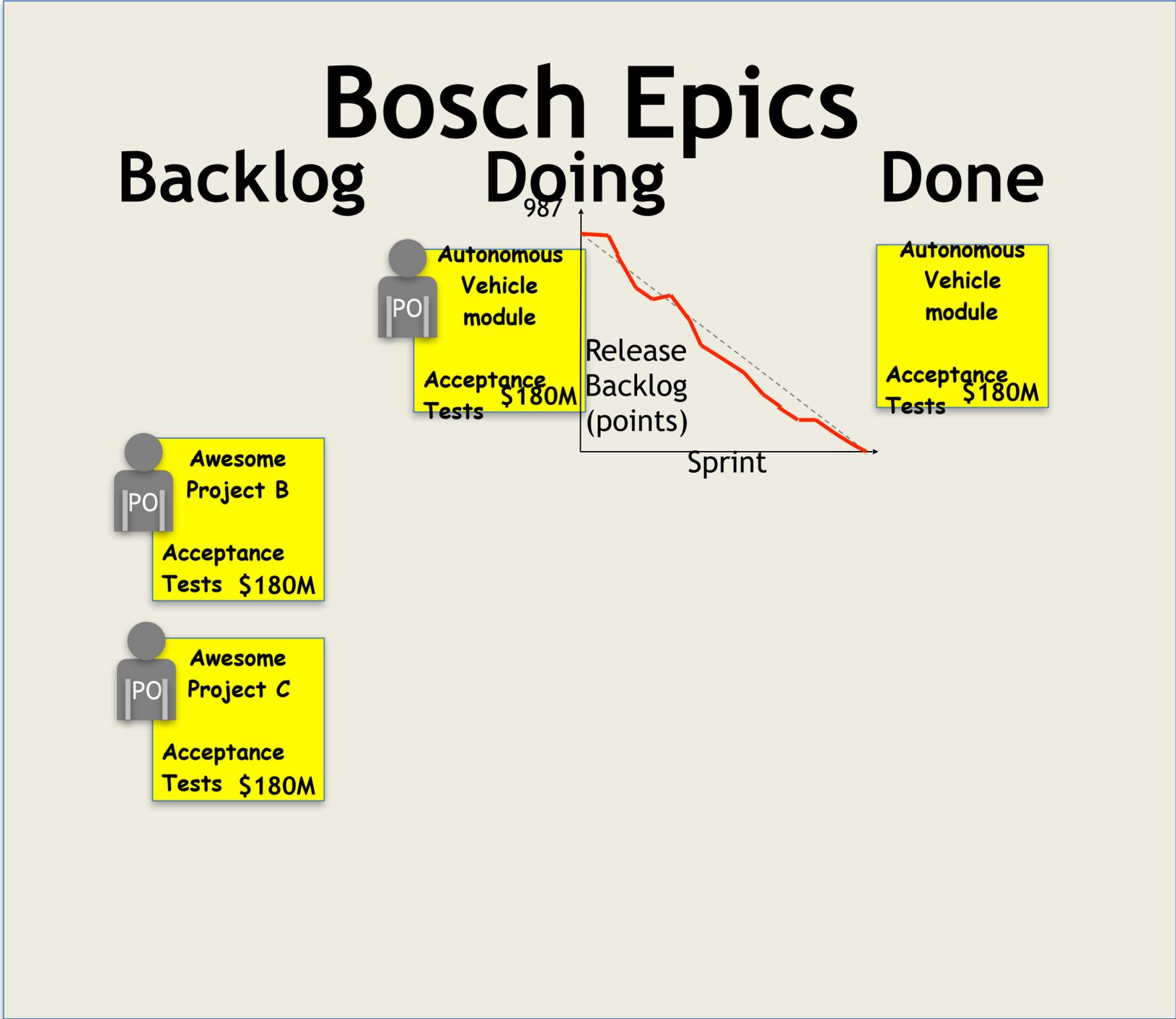
How Scrum Scales



How Scrum Scales



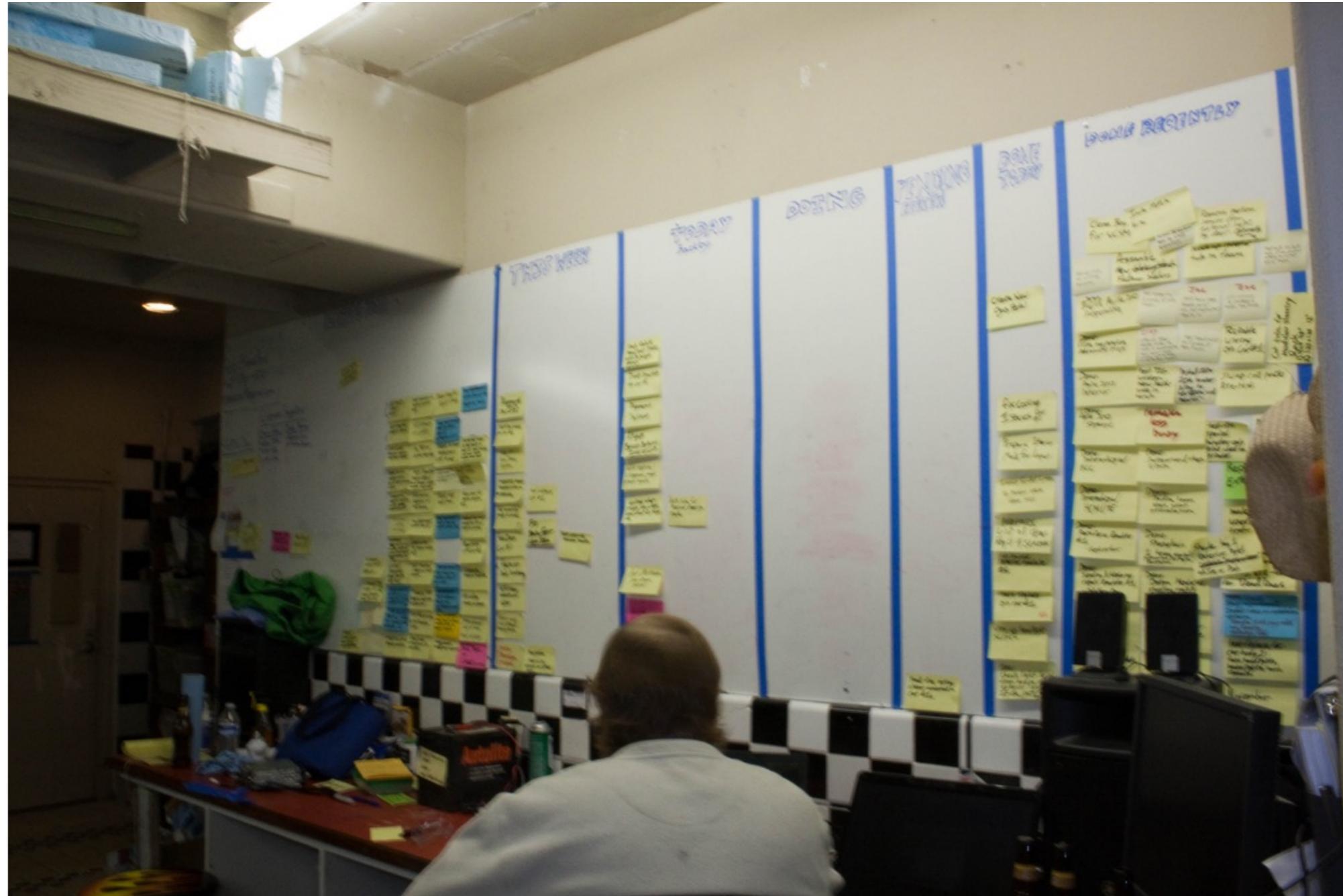
How Scrum Scales



How Scrum Scales



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



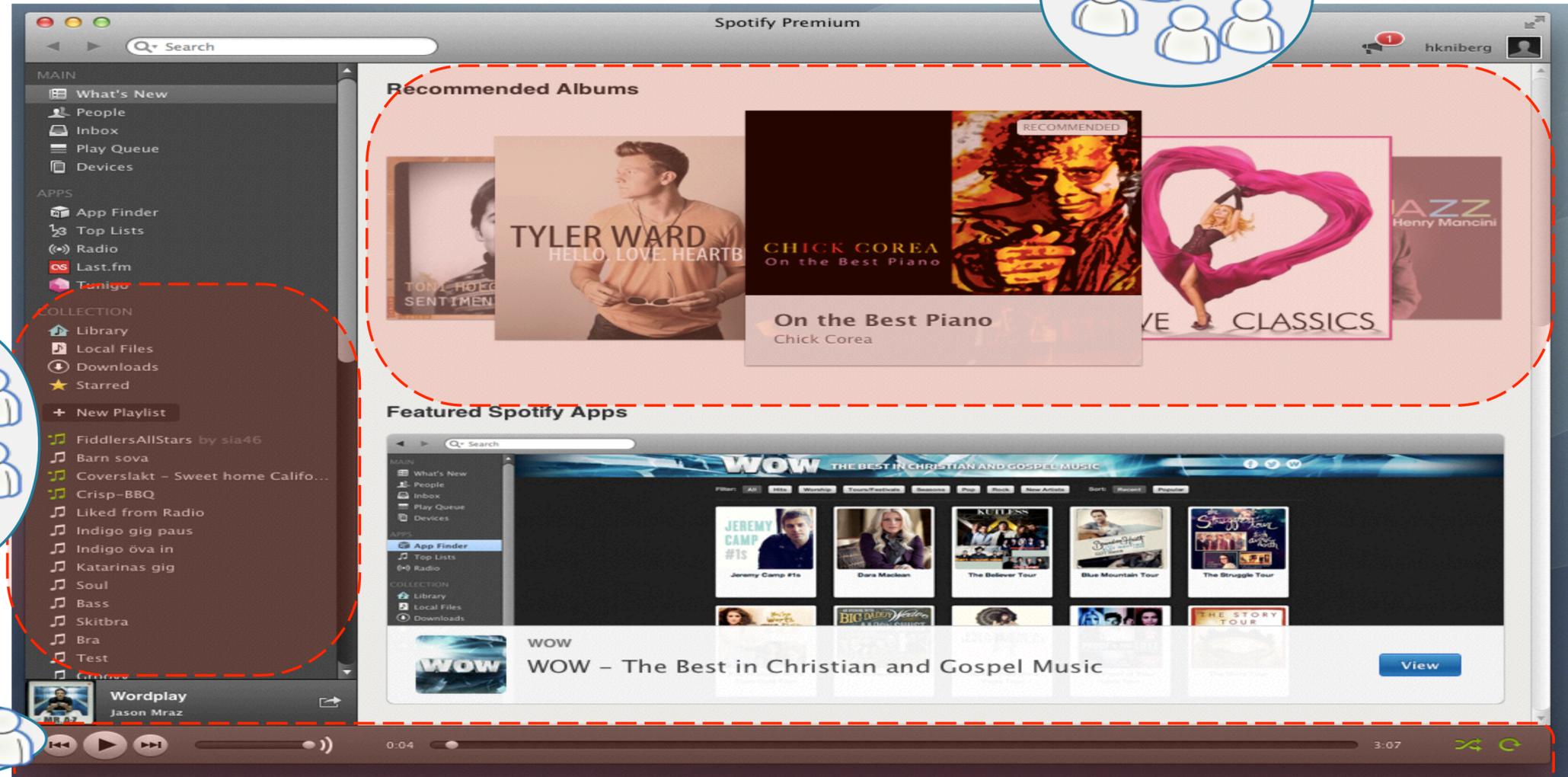
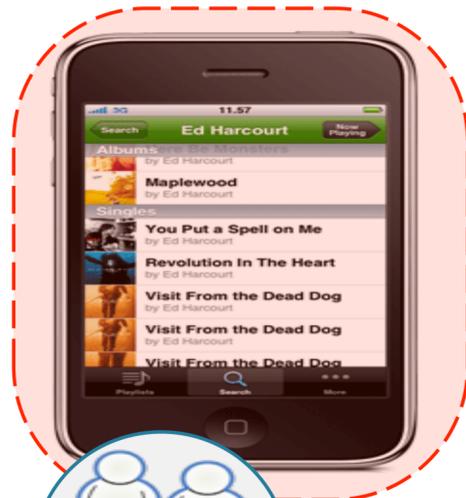
Set your Scrum Board up to mirror the steps of your current VSM!

Joe.Justice@ScrumInc.com @WikiSpeed

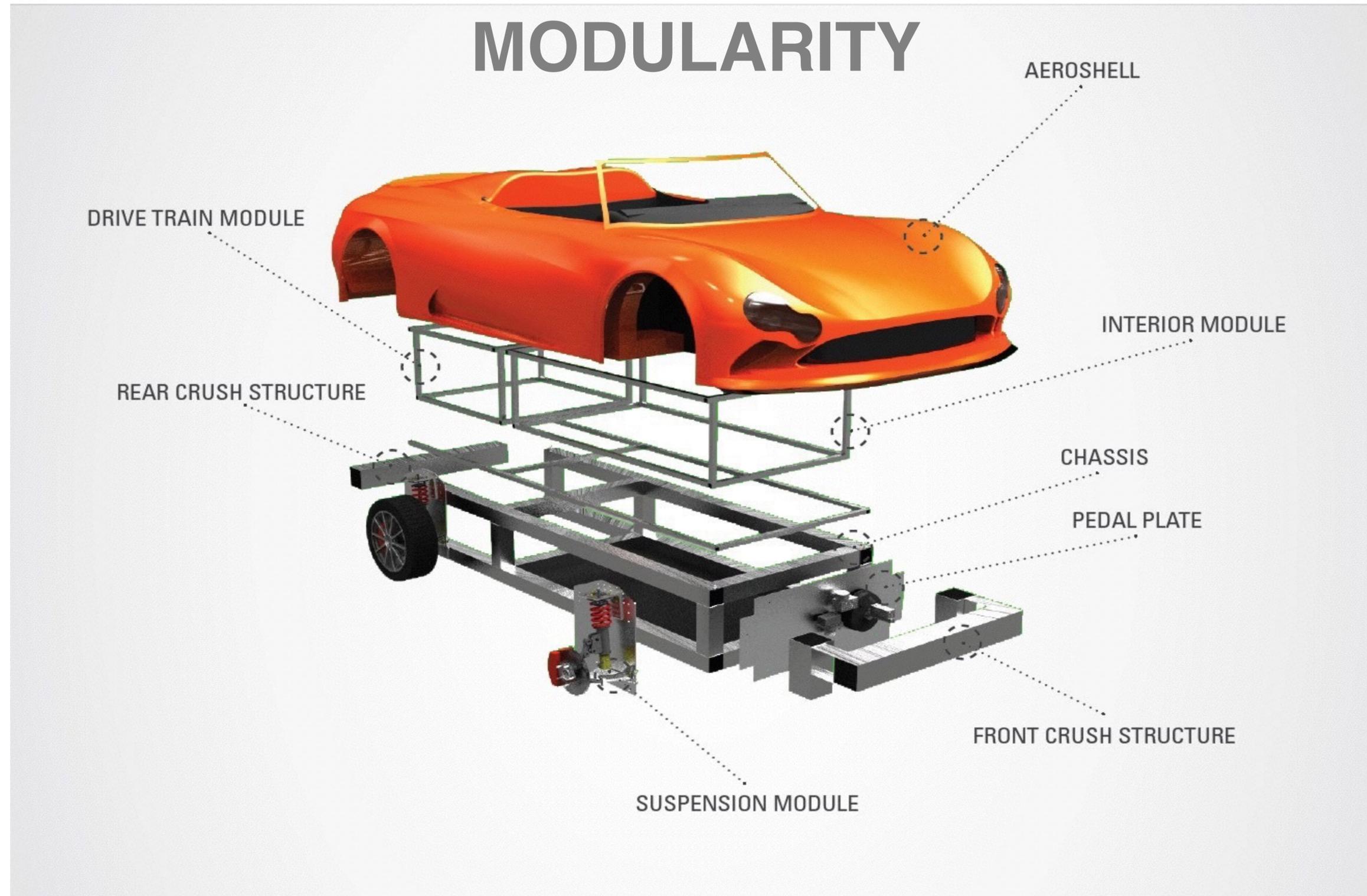
THESE EPICS DETERMINE HOW PEOPLE ORGANIZE

Squads Own Customer Visible Piece of Product

The first step to scaling is to form teams focused on features in order to maximize the user experience and speed of iterating on working software.



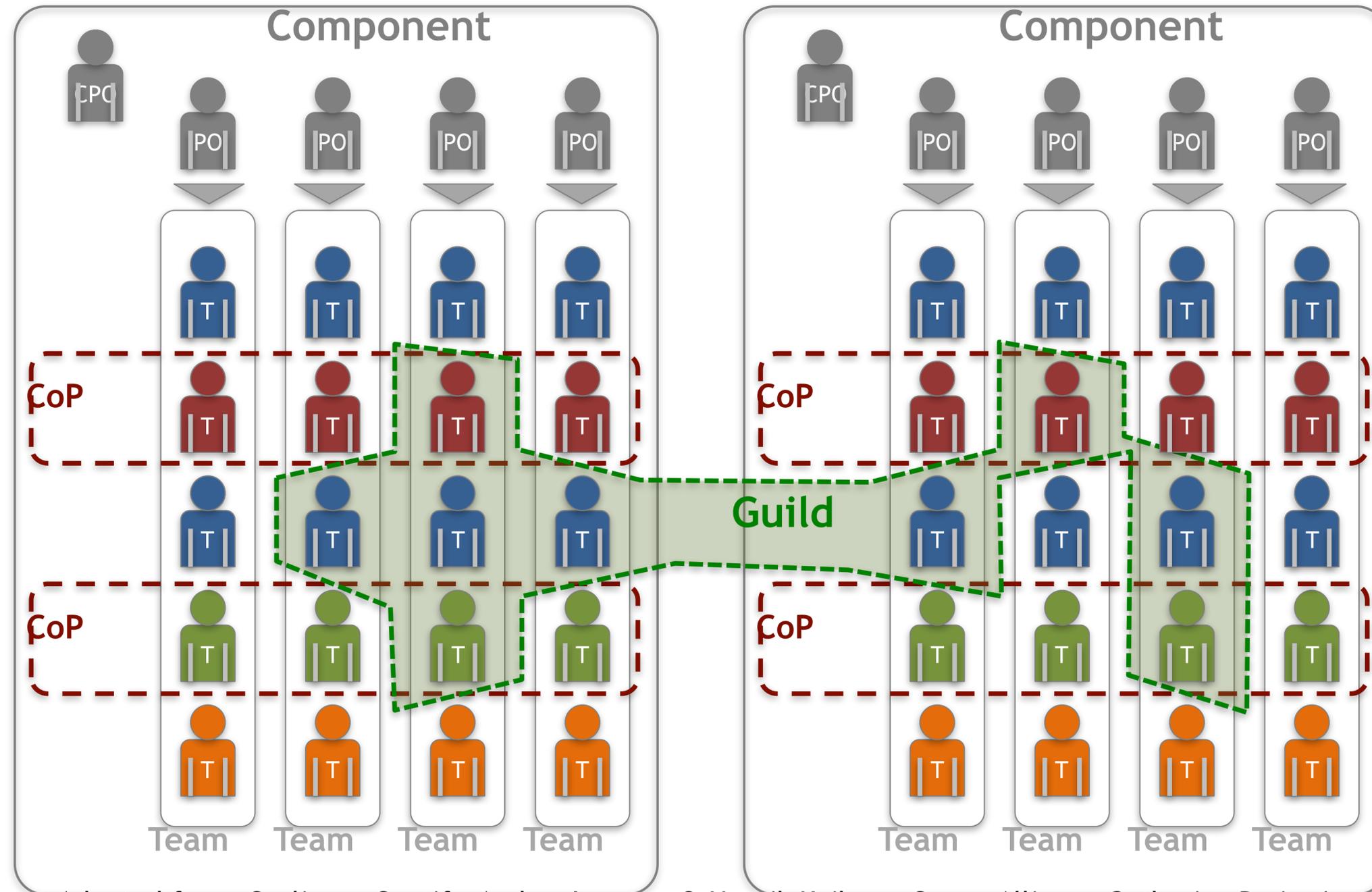
Each Team owns a component with business value



WIKISPEED SGT01 prototype road vehicle, exploded view



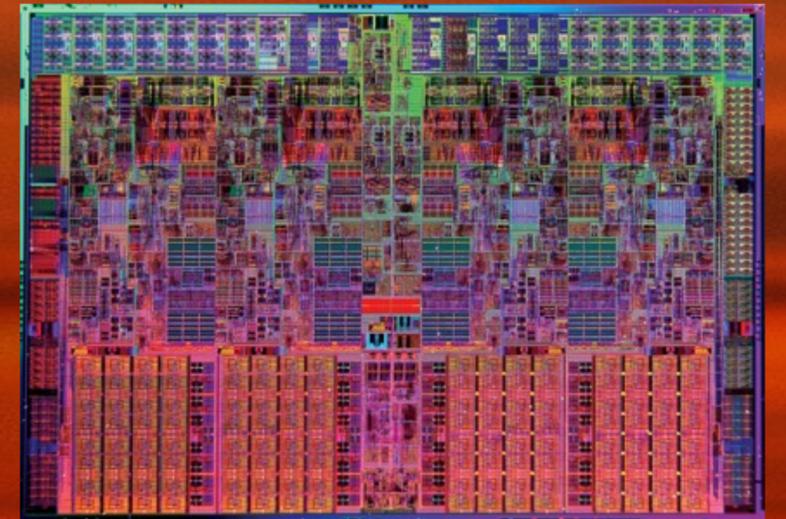
Scarce skills and Specialists



Adapted from: Scaling @ Spotify, Anders Ivarsson & Henrik Kniberg, Scrum Alliance Gathering Paris, 6 Feb 2013

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

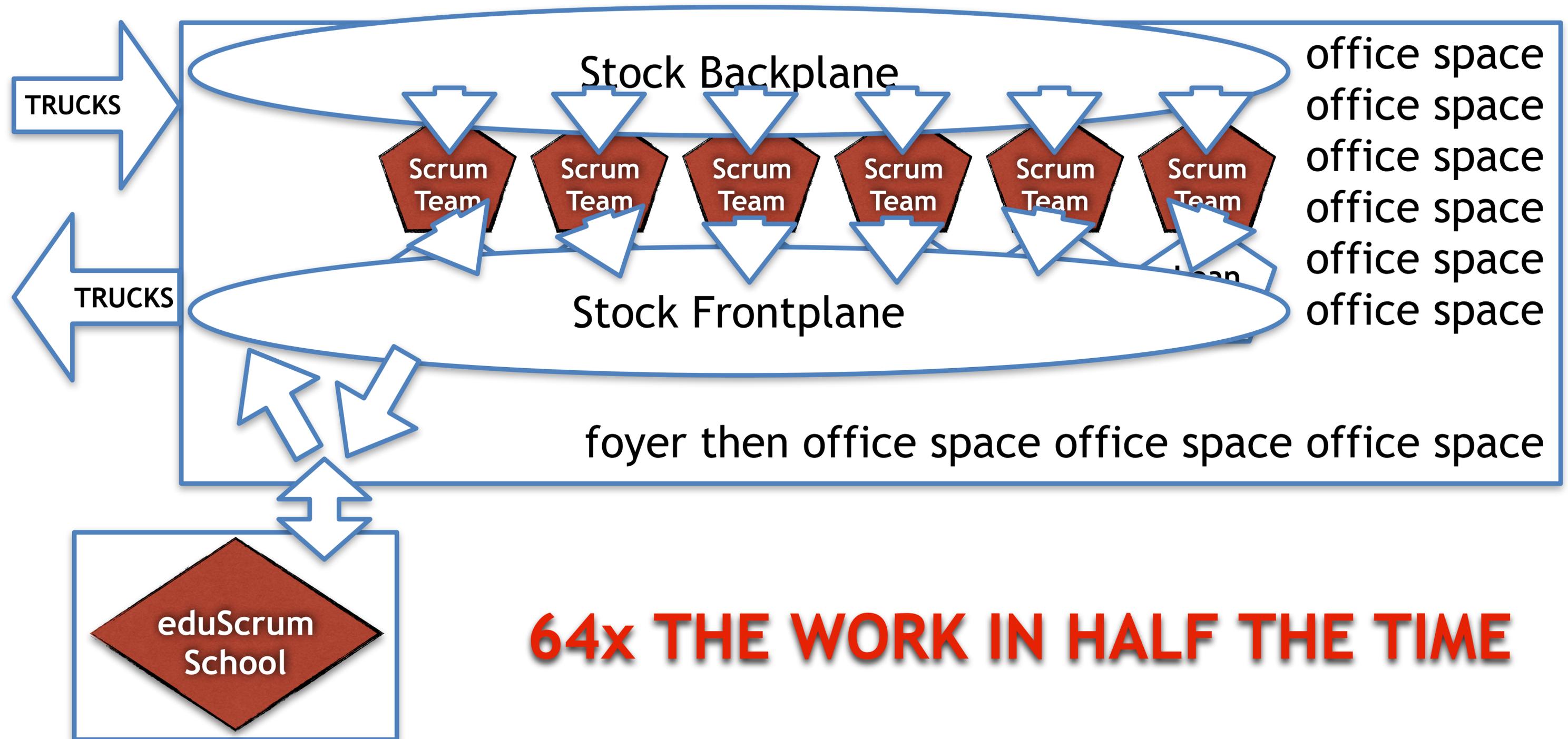


KEN DEJARLAIS PHOTO

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

Massively Parallel Concurrent Manufacturing



64x THE WORK IN HALF THE TIME

Next Steps

Software update causes \$286 million Japanese satellite to break apart in orbit

By [Lee Mathews](#)

May. 10, 2016 11:15 am

1.9K
shares



You've probably experienced a bad software update before. Maybe it slowed down your old iPhone. Maybe it reduced your laptop's battery life. It probably didn't destroy your \$286 million satellite.

That is, unfortunately, **exactly what happened** to Japan's space agency JAXA recently. In February of this year they launched a 2.4 ton, 14-meter orbital x-

Prioritize and focus

Use compliance to drive Scrum.

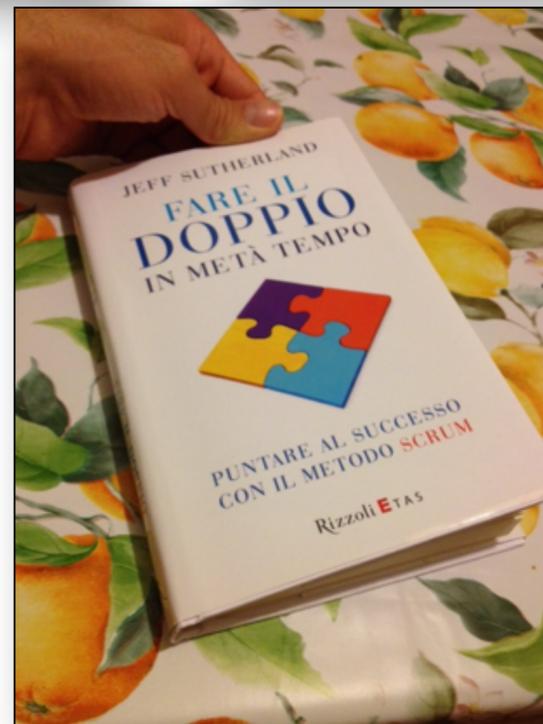
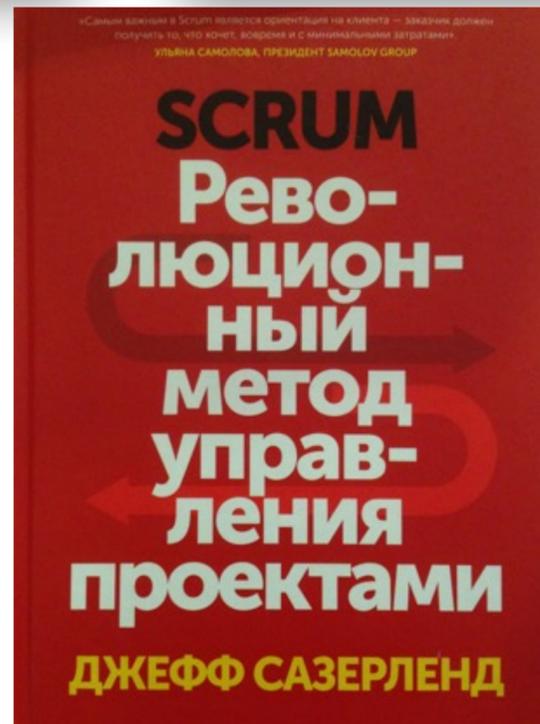
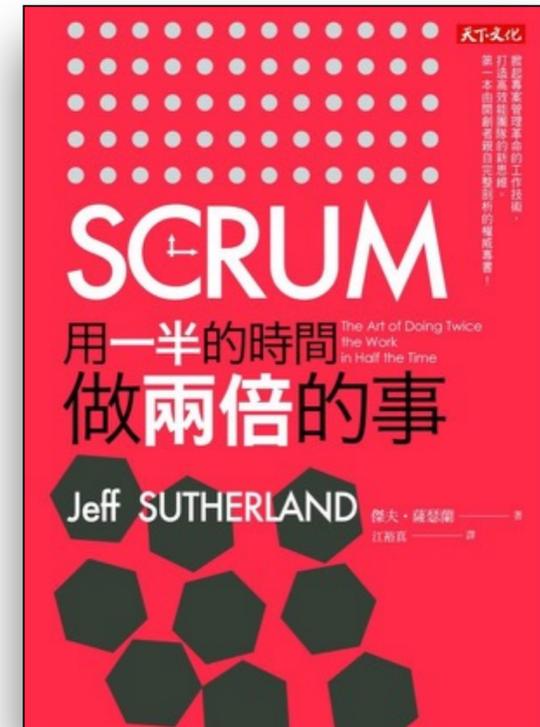
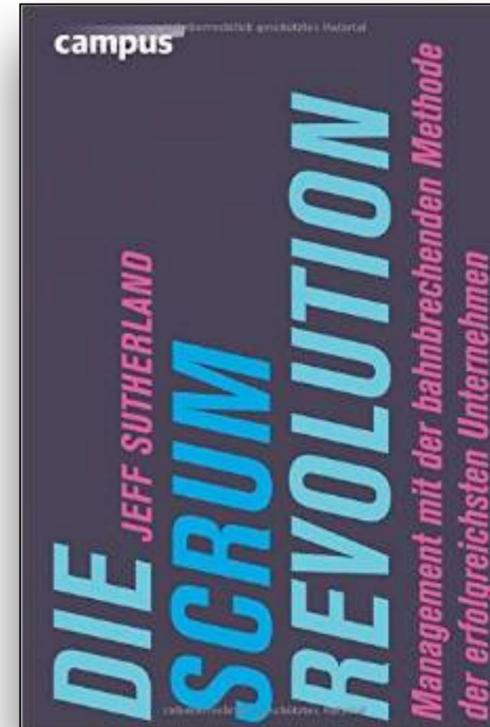
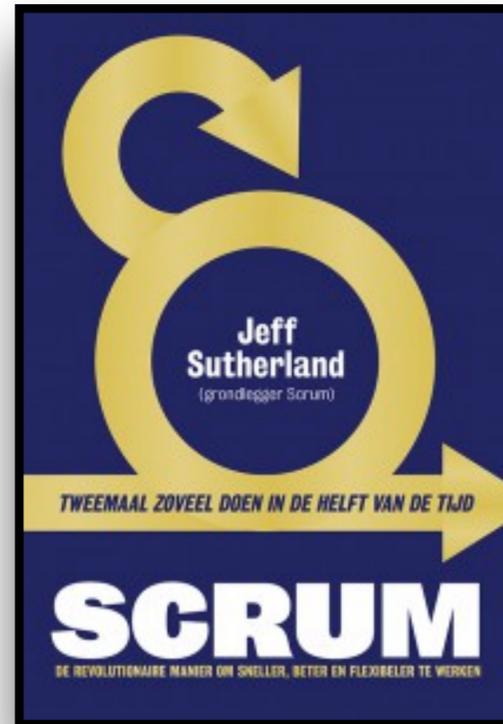
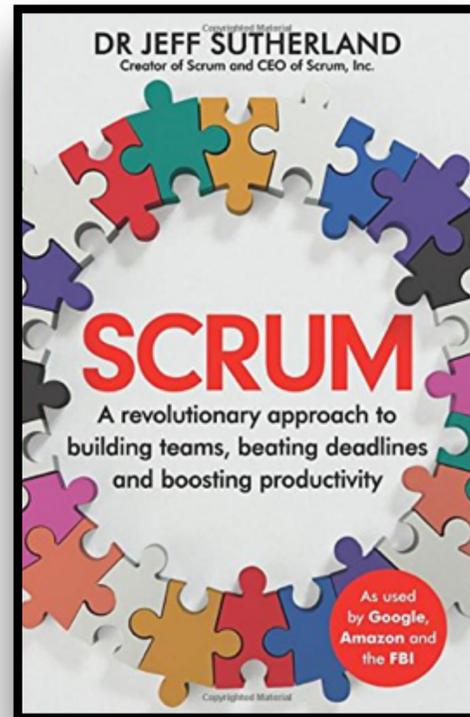
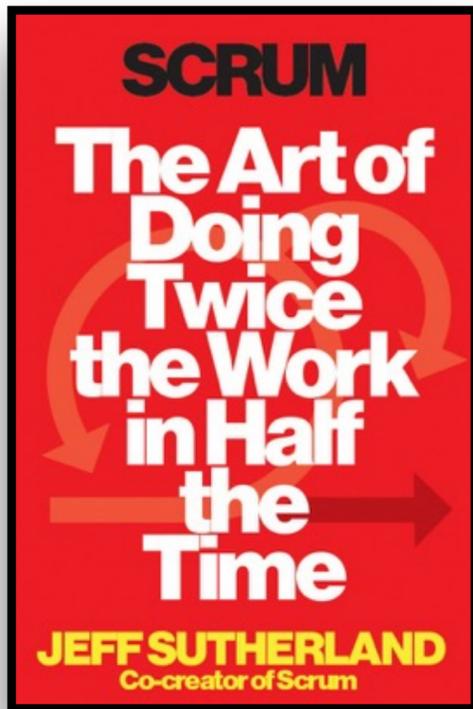
Train all staff in Scrum.

Just like pro sports teams, install a full time coach for every 5 teams.

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

スクラムは生産性の超兵器 - 驚くほど効果的

Rick Horgan, Sr. Editor, Crown Business



Certified Scrum Master Class with Joe Justice

Certief Scrum Product Owner Class with Joe Justice

www.ScrumInc.com

Next Tokyo class June 2017

scruminc. @

GROWTH SUMMIT Presented by FORTUNE