

Scrum for Maximum Awesome

Hardware, Software, and Innovation

Joe Justice

President Scrum@Hardware Practice, Scrum Inc.

Joel Riddle

Transformational Advisor, Scrum Inc.

Joe Justice

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

- Owner of all-Scrum automotive Manufacturing Company
- Creator of eXtreme Manufacturing Methods
- President of Scrum@Hardware practice at Scrum Inc.



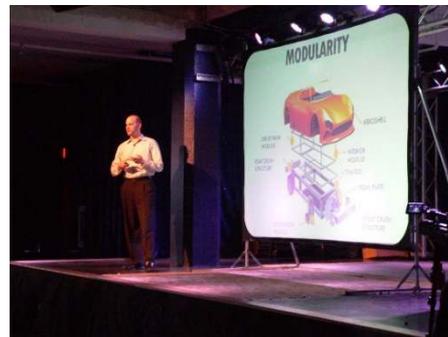
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Forbes



Harvard Business Review



TEDx

x = independently organized TED event

Discovery CHANNEL

scruminc.
the way teams work



CNNMoney.com

FORTUNE

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Joel Riddle - Scrum Master, Scrum Inc.



Joel is a Transformational Coach for Scrum Inc. and specializes in researching and codifying cutting edge Agile practices for Scrum and Scrum in Hardware.

Joel's background is in journalism. He cut his teeth at National Public Radio where he was responsible for the live, on-air production of NPR's flagship show, Morning Edition. Joel also spent three tours in Baghdad as NPR's bureau chief.



California State University
Northridge



Prudential

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Scrum In Education

Subject	Goals	Tasks	WIP	Verify	Done
Math Essential Question	Standard	Connect Activity Lecture Conclude		[Yellow] [Green] [Red]	
Reading Essential Question	Standard Challenge	Connect Activity Lecture Conclude Scrum!		[Yellow] [Green] [Red]	
Social Studies Essential Question	Standard Challenge	Connect Activity Lecture Conclude Scrum!		[Yellow] [Green] [Red]	



Class-ABLE Basic Board



<http://theagileschool.blogspot.com>

John Miller 10-15-12



Agile Classrooms

Agile Classrooms®

Reflection: Glows/Grows



What GLOWED?



Where to GROW?



What to THROW?



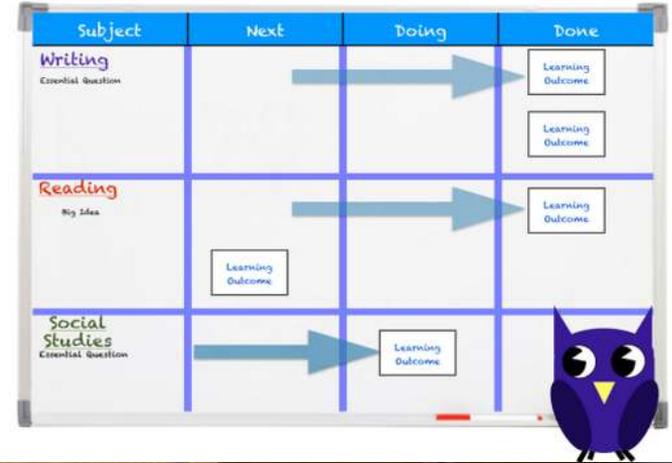
Now I KNOW?

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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



1. Candidates associate themselves with a backlog
2. Citizens vote to prioritize the backlog
3. Candidates responsible for weekly demonstrations and daily updated burn down of that backlog



Scrum in Manufacturing: A Motivational Example

F-35 "Joint Strike Fighter" – Traditional Design



- \$143 billion over budget
- Delayed until 2022 (final systems integration)
- Cost of Navy F-35C grew from \$273 million in 2014 to \$337 million by 2015

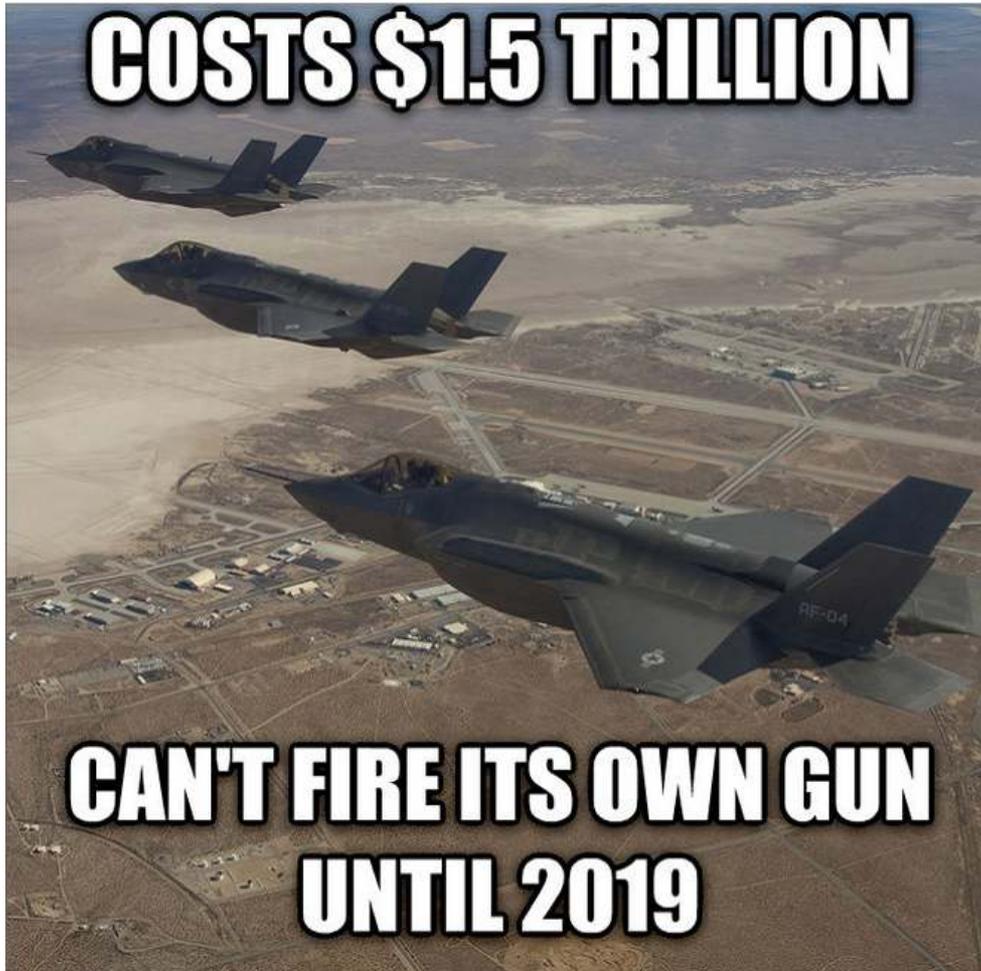
SAAB JAS 39E "Gripen" – Agile Design



- Cumulative program cost of \$15 billion
- New iteration of all systems released every 6 months
- \$43M cost¹ (20% of F-35)

1. According to Jane's Aviation Weekly, the Gripen is the world's most cost-effective military aircraft

It's so embarrassing, the F35 is now a meme.



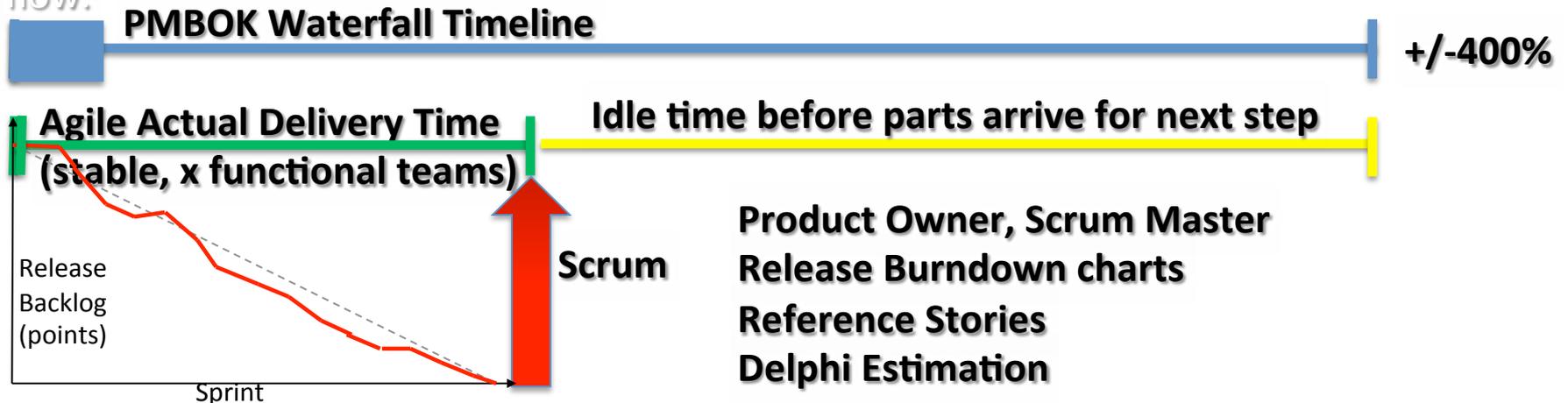
The F-35 just got crippled by a computer glitch that won't be fixed for at least 4 more years.

Meanwhile, the program's \$1.5 trillion projected cost is enough to end world hunger for 50 years (\$30 billion/year x 50 = \$1.5 trillion).

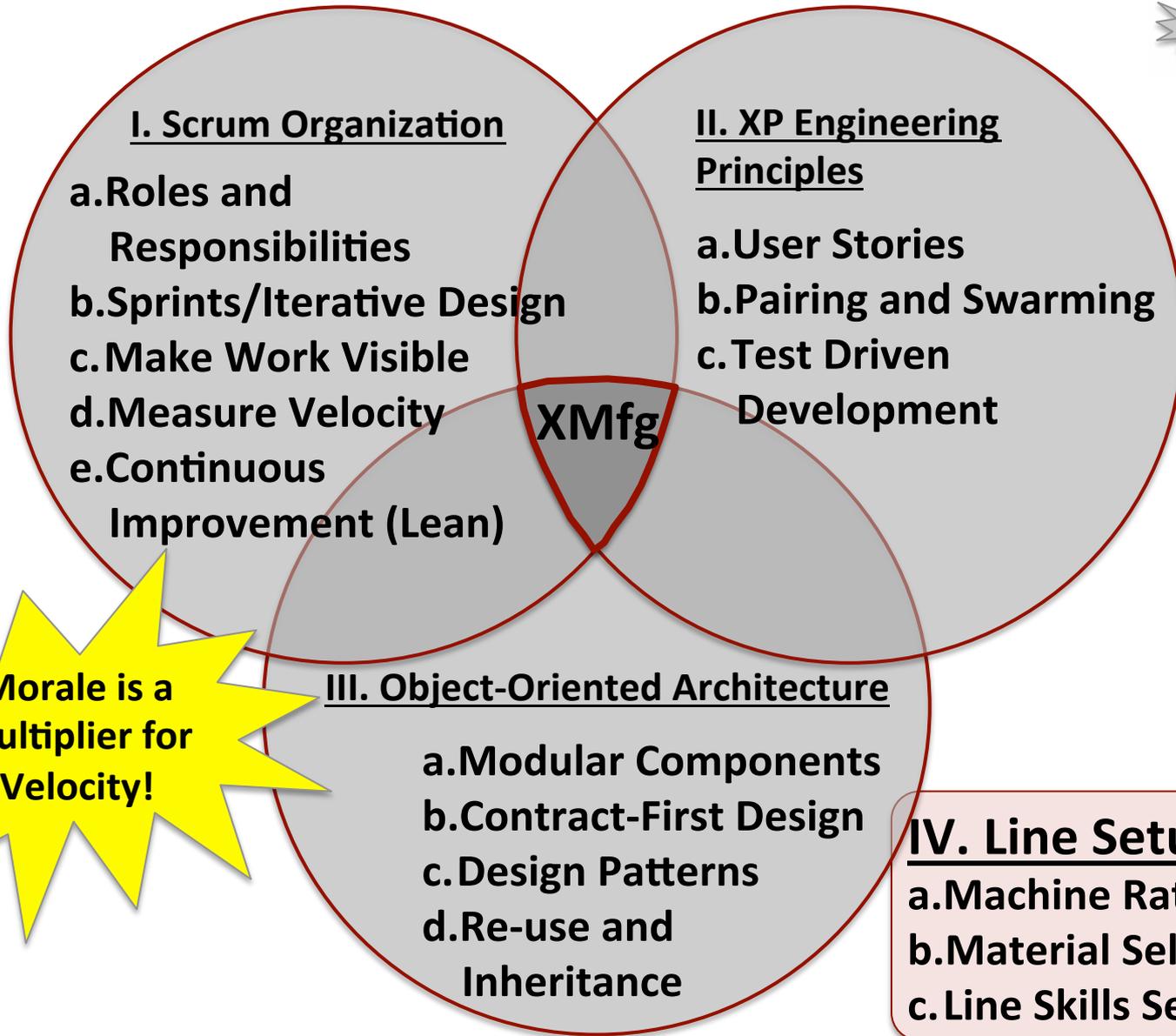
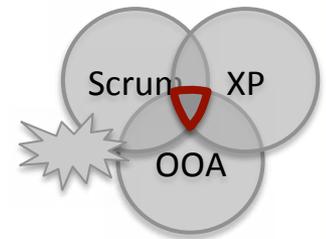
Capacity Planning



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



Scrum@Hardware



Morale is a multiplier for Velocity!

Scale as Competitive Advantage is Declining



Major Auto Company's CNC Machine:
\$100,000,000

Capacity: One dye per day



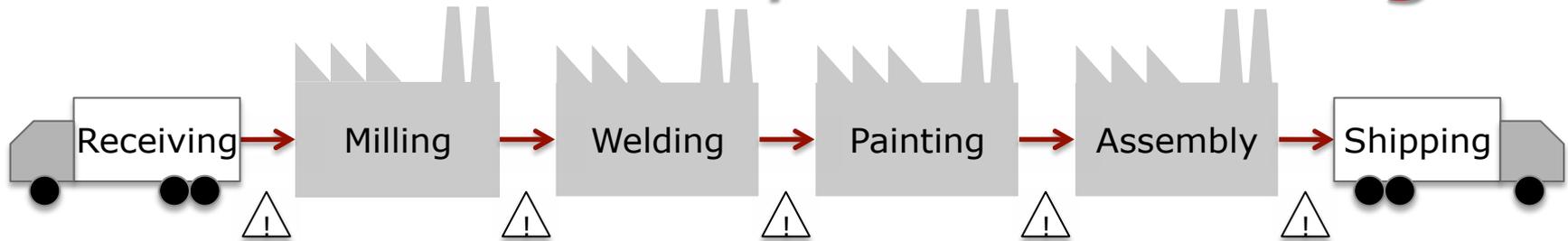
Startup Auto Company's CNC Machine:
\$2,000

Capacity: One dye per day

Source: www.wikispeed.org

That's 1/50,000th the cost

Lean is essential, but not enough!



Lean: Reduce waste, without frustrating your customer
+

Agile: Reduce the cost to make change
=

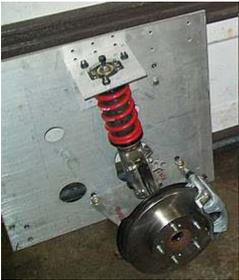
Scrum: The art of doing twice the work in half the time

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

Scrum Principles and Practices to Build into the Manufacturing Line



- A Use Scrum teams as lean cells** – Scrum for organization allows teams to improve faster and implement more lean improvements in the same timeframe



- B Object-Oriented Architecture** – be willing to over-build at key points to allow greater flexibility for the overall product and leverage design patterns

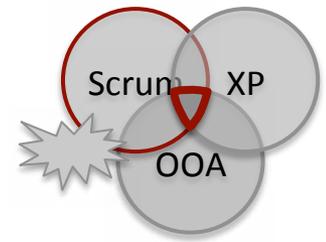


- C Shorten supply chains** – longer supply chains are more prone to disruption and slower to respond. Short ones can turn around iterations faster



- D Keep the line flexible** – make it as easy as practical to reformat the line in response to process improvement experiments

Scrum Teams as Lean Cells

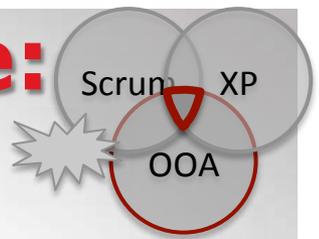


Sprint provides team improvement cadence in addition to Takt time cadence

Retrospective results in at least one Kaizen event per sprint

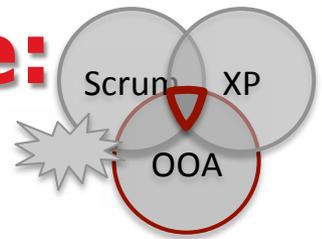
Pre-shift Daily Scrum helps align cell members and coordinate across cells to achieve day's production goals

B 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

B Object-Oriented Architecture: Known Stable Interfaces

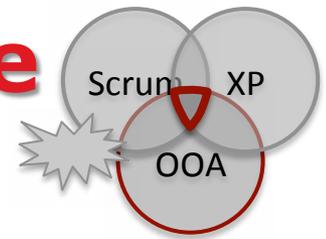


Pre-negotiated physical and data connections permit greater design versatility, and loose production coupling

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

@ScrumInc
@WTKISPEED

B Object-Oriented Architecture Design Patterns and Inheritance



- Don't re-invent the wheel
 - If a proven solution has worked well in the past, start with that and modify as needed



- Reduce complexity – Find solutions that work for multiple aspects of the problem
 - Eg. If a particular bolt works as a fastener in one location, use the same bolt in all similar situations



Scrum Supply Chains for Added Responsiveness

Long and complicated Supply Chains increase...

WIP Inventory and Working Capital



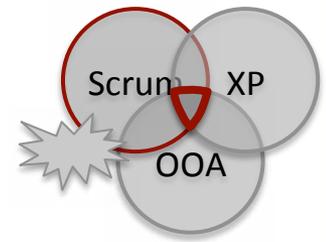
Supply Chain Risk



Feedback Cycles



Keep the Line Flexible



Long changeover time to switch the physical line limits the ability to experiment with new process improvements

Designing the line equipment to be flexible accelerates continuous improvement and supports multi-product manufacturing

Many companies mount all line equipment on casters to drive flexibility

Top Reasons Companies Say They Can't Do This

- 1 "Our product is too complicated to not plan everything meticulously in advance"
- 2 "Our quality expectations are too high to not follow a documented and unvarying plan"
- 3 "We have already made large investments in fixed machinery and tooling"
- 4 "Our product design is too tightly coupled to iterate modules without changing the entire design"
- 5 "Our vendors are not Agile enough to support this approach"
- 6 "Key steps of the manufacturing process require too long a lead time to fit in sprints"

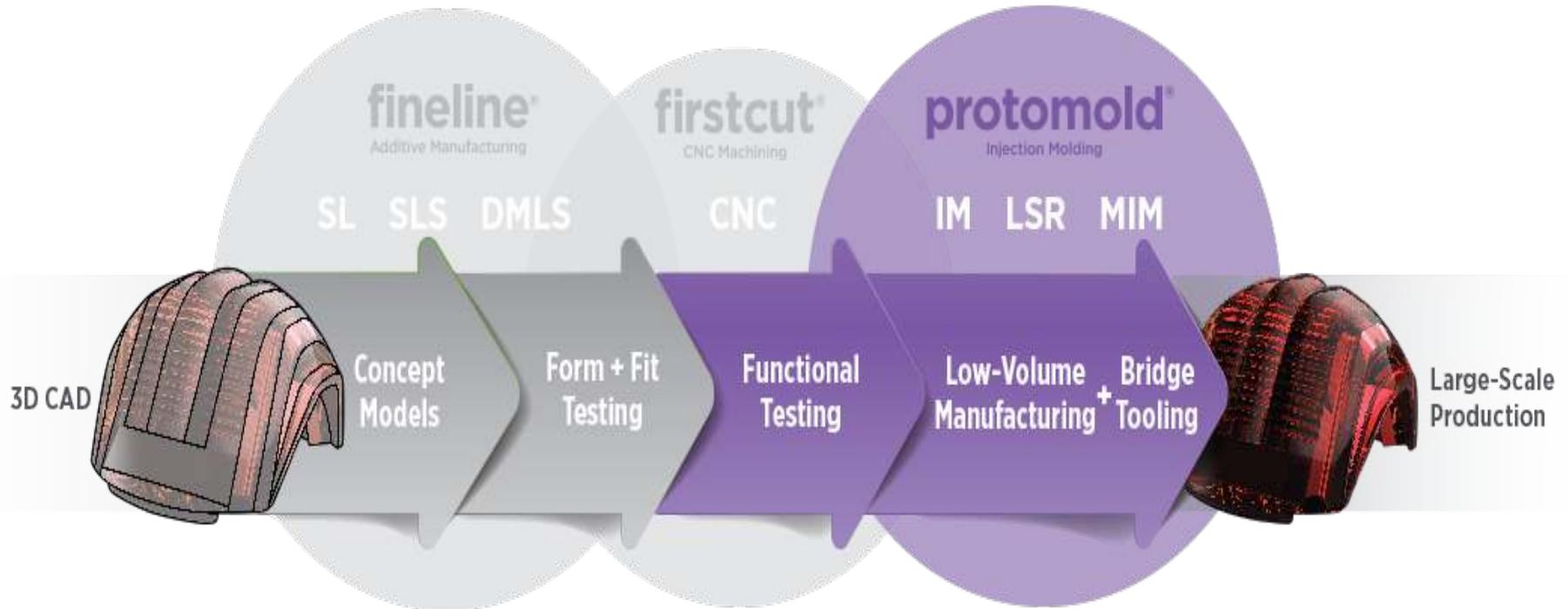
I. Fundamental misunderstanding of agile principles

II. Current impediments that can be addressed iteratively over time

III. Key issues requiring creative thinking to solve

Scrum Plastics in One Sprint:

Protomold



- Prototype parts or molds same-day
- Volume parts or molds same-week
- \$1-\$10k per mold

Scrum Electronics in One Sprint

RushPCB



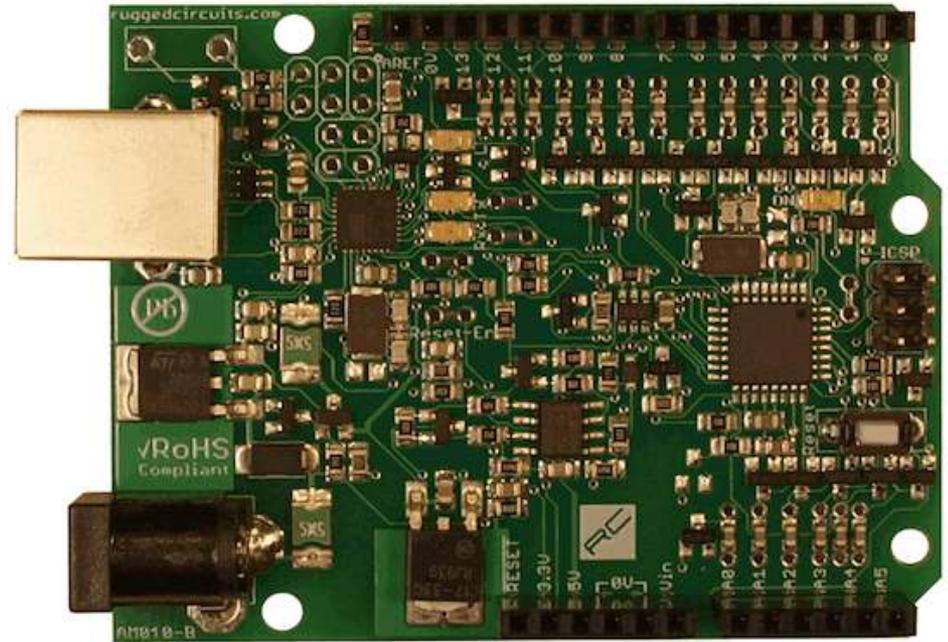
PCBs ASSEMBLED IN
24 HOURS

Prototype PCB assembly fast. Kitted and Turn-Key options available.
Quote and order online, any time.

[Click Here to Order](#)

- 2-layer circuit boards in 5 days for \$10
- Up to 8 layer circuit boards

RuggedCircuits



- Military and aviation grade hardening
- In stock same day \$40
- USB programmable, Arduino compatible

Scrum the entire partner ecosystem

Local Motors



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Scrum in mass manufacturing

Capable of one part every six seconds.
The cost to change?
New metal molds, called dies,
up to 40 tons each



Scrum your Production Molds

Molds Shipped to you Within a Sprint

3d Green Sand Casting



- Volume metal castings same-week
- Fastest, cheapest, quality metal tooling

Even Better, Make your own Molds: Make your own molds in the Scrum Room

Subtractive Rapid Prototyping (SRP)



- Roland MDX-40A
- \$8k USD, 12"x12"x4"
- Quiet for desk office use
- 28x gives similar work area

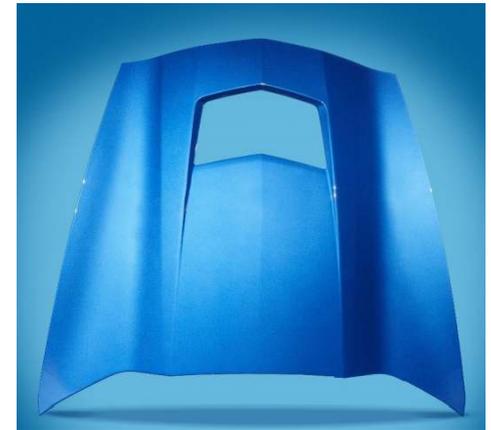


- Okuma M560-V
- \$120k USD, 41"x22"x18"
- Requires trained operator
- Durable, but costly repairs

Even Better, Scrum high performance composites

Change your Production Each Sprint with your Own Molds

Globe Industries



- Line-Speed composites: 9 minutes part-to-part.
- 1 minute tool exchange time.
- \$1M USD tool.

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Best: skip molds. Produce production structural parts in your Scrum Room

Cincinnati BAAM



- Production structural parts same day
- Carbon Filament reinforced 3d printing

Mission Bell Winery

Madera, CA

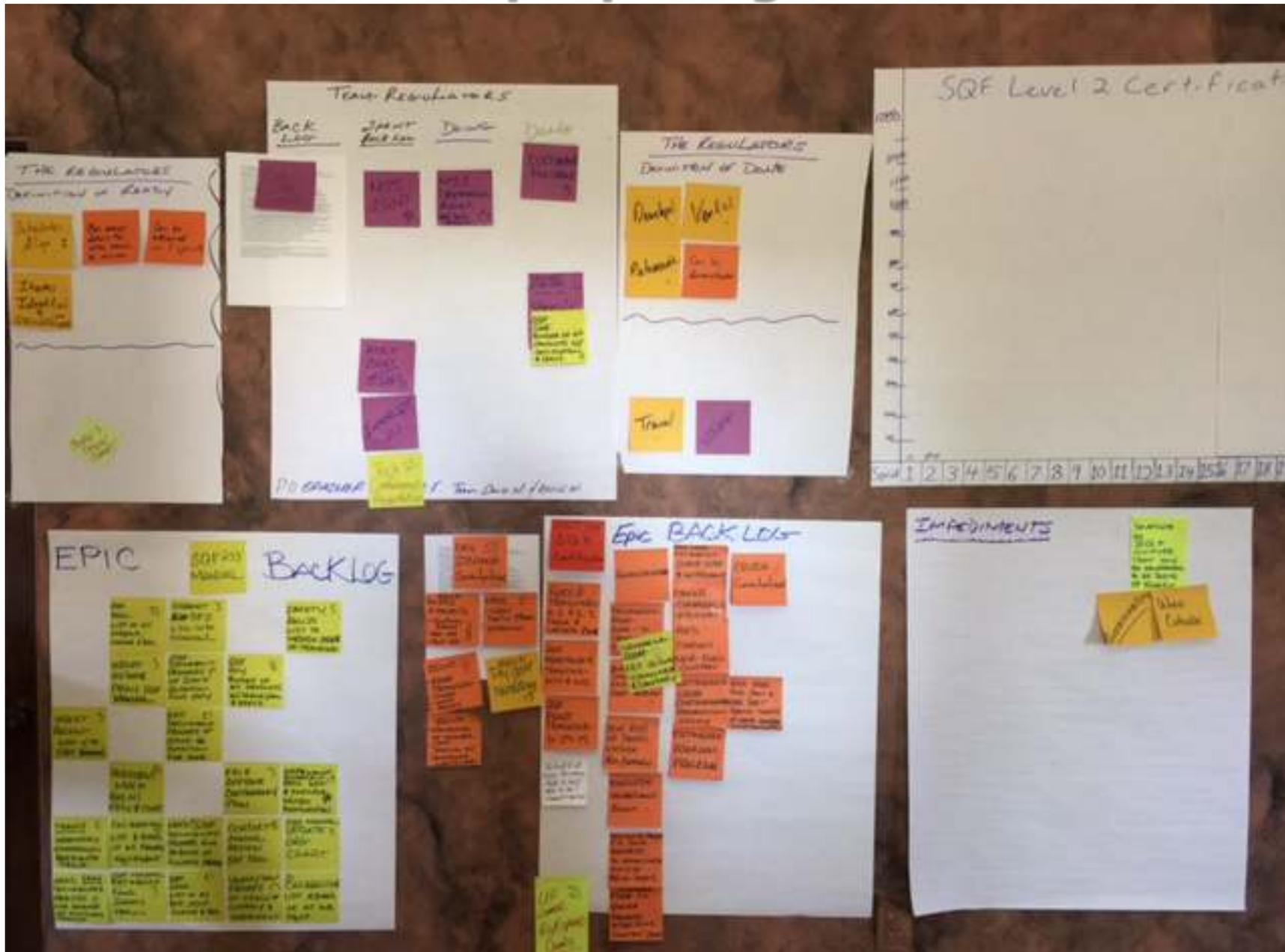
60 acres of Scrum Wine



Leadership decides it's time to Scrum



All stakeholders propose goals and missions



Single Prioritized enterprise backlog == Happy Chief Product Owner



Champagne Team Launch



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Information Radiator





UTAS Aerospace Systems

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KVH Satellite Systems Middletown, RI

Scrum Maritime Data and streaming

@ScrumInc

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Profile of a Disruptive Supplier: Rocket Bunny and Liberty Walk



From Idea to Customer in 1 Sprint

1) Scan



2) CAD, post to Facebook



3) Machine Foam Mold



4) Build and Race



5) Polish and Show



6) Sell Sell Sell



Suppliers are doing this now. If your suppliers can't do this...find different suppliers

Scrum@Hardware

- **As market responsiveness becomes more important than scale, adding agility to manufacturing is essential**
- **Scrum enhances Lean with Agile practices to the physical R&D and manufacturing world**
- **Four practices should be of interest to manufacturers:**
 - **Scrum teams as Lean cells**
 - **Contract-First Design**
 - **Shorten supply chains**
 - **Keep the line flexible**
- **All of the reasons you think you can't do this have already been solved**
- **Companies are starting to leverage Agile manufacturing to succeed in the market. Is your competitor one of them?**

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- For up coming events and new content releases.

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This May Imply Changes to Siloed Hierarchy

- Organizational Silos independently optimize towards how they are measured.
- Silos owning design, manufacture, and maintenance of a specific product and measured on speed of new product development with quality (Velocity) optimize towards faster new product development with quality.
- Celebrating and not financially penalizing retiring a silo and silo hopping reduces the cost to change the org, and in this case deploy new product types.
- Agile and Scaling Scrum make organizational change possible and comfortable, by allowing the organization to digest an increment of change each week.
- For more information of organizational change apart from the factory floor, see our Scaling Scrum online courses and our Leadership Workshop on-site service.

Line Scheduling

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.

What the solution is not

- Mfg industry is awash in data. This data is primarily supporting micro-management of production cells to stamp out variance, and does little or nothing to help us reduce the cost to make change. These same data providers can help us see our real time VSM, and line innovation time, but do not yet do this well out of the box. For now, sticky notes on a white board are the optimum visualization.
- 3d printing only helps if your end product is a 3d printable material. It is fast enough now to be viable. 3d printing molds works fantastically. SRP is viable.

MIND BLOWING NEXT STEP

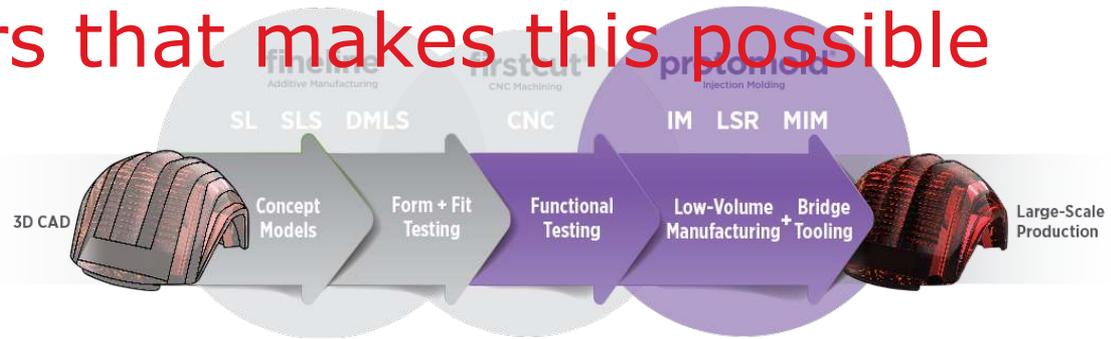
- The best hardware product flow we can think of:
- R&D at head of line. Swappable lean cells on casters inside shipping containers. Raw materials in one end, finished products out the other end. Scale out instead of Scale up. Supplies could be a container away or using any plant or process, but have TDD stubs to integrate at their site.

Why companies are re-architecting their hierarchy and silos, and blowing up their lean workflow

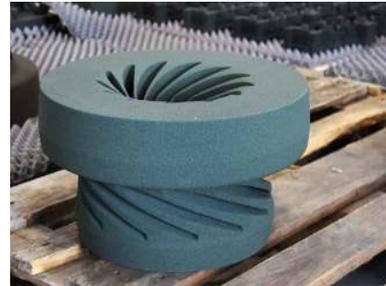
- Scrum design team across previous silos
- Mfg couldn't keep up
- Scrum in Mfg with cards to decrease time to change over the line
- Mfg could keep up with weekly iterations

Suppliers that makes this possible

- Protomold



- 3d Green Sand Casting



- Cincinnati BAAM



- Local Motors



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

Scrum@Hardware In Hardware Design



SCRUM TEAM

Tait Radio

Christchurch, NZ

Scrum@Hardware In Mass Manufacturing



SCRUM TEAM
Tait Radio
Christchurch, NZ

Scrum@Hardware Requires XP To Be Safe At High Speed

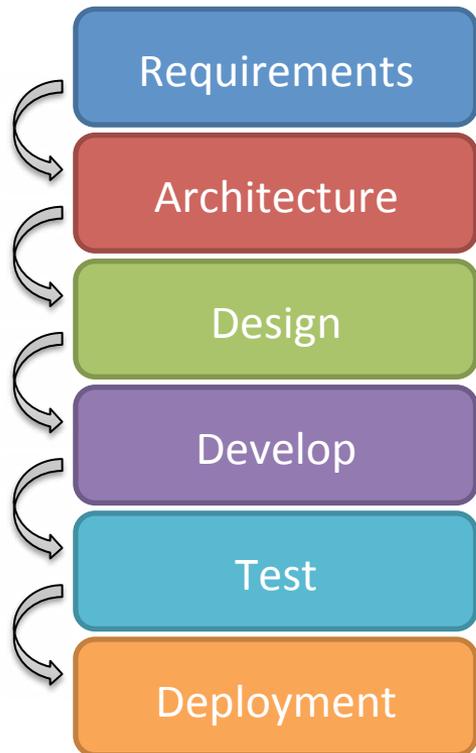


Whole Company Agility: The Retrospective

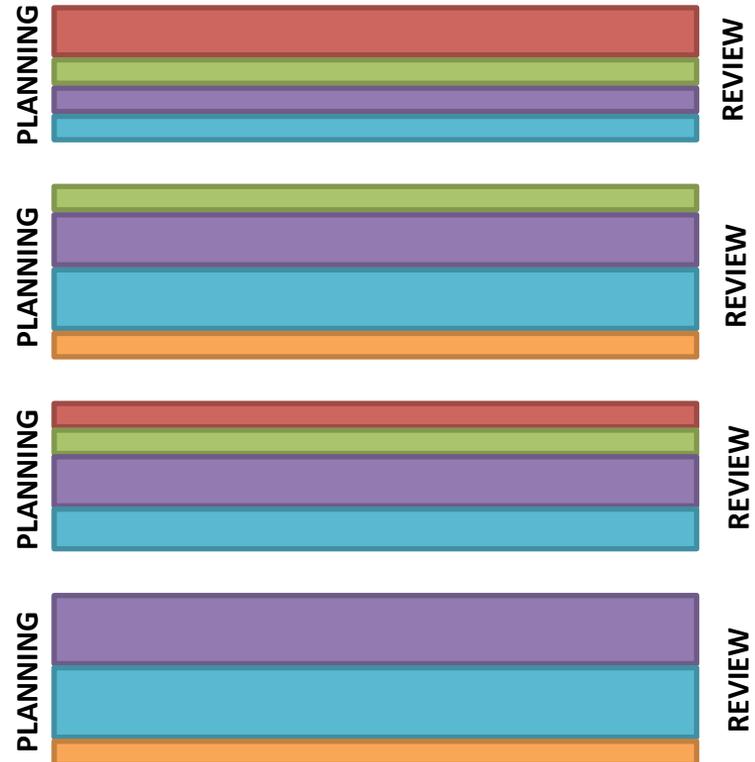


Software and Manufacturing Aren't Actually that Different

Traditional SDLC:



Agile Development:



Instead, we plan and adjust continually and build in quality