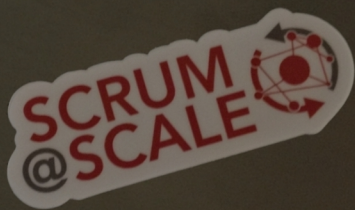


Paolo Sammicheli

Scrum for Hardware



SECOND EDITION
Foreword by Joe Justice

Scrum for Hardware

Paolo Sammiceli

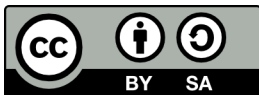
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Huge thanks go to [Avanscoperta](http://www.avanscoperta.it/)¹. Again Alberto Brandolini and the great Alessandra Granaudo. When this book was just a bunch of notes and post-its, they believed in me and started organizing the [first workshop](http://www.avanscoperta.it/it/training/scrum-for-hardware-course/)² of Scrum for Hardware.

I also would like to thank my family, which always supports and encourages me even without understanding my job.

And, of course, my infinite gratitude goes to Joe Justice. He is the myth that inspired me to write this book; at the same time, he is the humblest, most modest, and kindest person I know. A modern hero who – I am sure – will be in schoolbooks one day.

¹<http://www.avanscoperta.it/>

²<http://www.avanscoperta.it/it/training/scrum-for-hardware-course/>

Dedication

I would like to dedicate this book to the people who contributed to make me who I am and who are no longer with us.

Germano, Patrizia, Renato, Maurizio.

You are always with me.

Foreword

What would happen if we all could deploy a superior product or service every one week or even faster? That changes long lead procurement, separate test organizations with queues, project status meetings, and risk sources from “can we do it?” to “will they use it?” The idea of a “Development Phase” and a “Production Engineering Phase” lose meaning or utility for project planning and funding in a system that moves this quickly.

This book takes the stance that markets are rewarding faster development and time to market.

Shorter development times mean less risk and less cash outlay. This book comes during the turning point of all product development. Software development embraced agility at scale, and now no customer will even entertain a ten-year software development life cycle. Like financial services groups and governments, Hardware companies are driving Agile Manufacturing, and specifically Scrum for Hardware are in every time zone globally. We see this acceleration around the world from luxury niche to mass production to military-grade. The quest for half-price, half-time projects has forced the question, investigation, and adoption of daily standup meetings, empowered Product Owners, and highly trained Scrum Masters sprinting across teams of teams doing new product development on the factory floor.

Paolo Sammiceli’s work results from collaboration with my work, my clients, his clients, and the rich professional peer group of expert practitioners and the earliest adopters such as Peter Stevens, Hubert Smits, Peter Borsella, and many more. We are learning that all of the technical patterns that revolutionized software for twice the work in half the time, such as the XP practices, the Scrum PLoP, UATDD,

and software design patterns for performance and reusability, have direct translations across domains with similar speed increases. In the words of Jeff Sutherland, co-creator of Scrum, “Scrum did not start in software, and it will not stay there.”

So what does Scrum for Hardware look like? Imagine a manufacturing shop floor with concrete floors and suspended heating ducts. Then imagine groups of 4 to 5 people, each group clustered around a piece of flexible manufacturing equipment, test fixtures, and computers. Tens of teams, hundreds of teams, in some cases tens of thousands of teams. Each team has a big board to organize the flow of work inside their small group and a labeled “input” and “output” for parts or sub-assemblies, with quality indicators, called the Definition of Ready and Definition of Done. Components and sub-assemblies are shuttled non-linearly between teams by autonomous carts or excited interns. Integration happens inside each team, with no part being allowed to be called “done” unless integration tests successfully pass. Each team is responsible for producing their piece of the parallel puzzle and improving it, testing it, and validating it in production every sprint. And the shorter the sprint, the faster the product is reinvented.

This book is the first significant publication on the topic, the most complete and authoritative. If the Agile transformation of the Software industry has any parallels outside software, and if the current client adoption rate is any indication, this book will be the reference for executives, shop floor managers, and team members globally. And it is clear this book and books like it will grow with case-studies from readers just like yourself. Every aspect of Scrum for Hardware is observed from teams delivering and retrospectively improving, to Kaizen. That would mean the source of ammunition for this book is the readers’ clear production and process notes. So let’s keep up the awesome.

Joe Justice

Creator of Scrum for Hardware and eXtreme Manufacturing.

Introduction

This book is being published through the [Agile Publishing](#)³ method. This means that it has been published several times, well before being completed, to allow me to receive rapid and frequent feedback from my most passionate readers. It also means that the content and form of the final draft will be affected by my readers' feedback. From yours as well.

THANKS IN ADVANCE!

Your tips will allow me to adjust the text and create the best possible book on **Scrum for Hardware**.

Did you like what you read? Do you have any questions I did not answer? Do you feel that something is missing? Is there any vague phrase?

Please write me at feedback@scrum-hardware.it

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Sharing my work with a permissive license so others can freely use it is the best way I know to create a better world and to thank the giants who came before us.

Future editions

I am going to publish various paper editions, adding every time new stories and practices I discover with clients. The electronic version will always be updated on [Leanpub](#)⁵. You will not need to pay for future electronic editions and you will receive all updates forever. It is a promise!

Changelog

If this is the first copy you downloaded from the [Leanpub.org](#) website, you can jump at the [next](#) paragraph. If otherwise you just got a new version, this section is dedicated to you. Following, you'll find the changelog, starting from the more recent so that you can jump directly to the new or updated sections.

- 2 April 2021 - Ver. 2.2.5 - major
 - General review, text improvements and update of the paper version.
- 25 March 2021 - Ver. 2.2.4 - minor

⁵<https://leanpub.com/Scrum-For-Hardware/>

- Chapter 7 - Rewriting of the [Scrum](#) chapter, to align with the Scrum Guide 2020.
- 25 March 2021 - Ver. 2.2.3 - minor
 - Chapter 8 - Grammar improvements and typo fixing.
- 23 March 2021 - Ver. 2.2.2 - minor
 - Chapters 4,5,6, and 9 - Grammar improvements and typo fixing.
- 14 March 2021 - Ver. 2.2.1 - minor
 - Chapters 1,2, and 3 - Grammar improvements and typo fixing.
- 28 December 2020 - Ver. 2.2.0 - major
 - New case study: [Pietro Fiorentini Spa](#)
- 1 November 2020 - Ver. 2.1.0 - major
 - New case study: [Sisma Spa](#)
- 18 October 2020 - Ver. 2.0.0 - Second Edition
 - New chapter [Case Studies](#) with a first story: Vimar Spa.
- 7 December 2018 - Ver. 1.3.1 - minor
 - Fixed typos. Thanks to Joe, Mark and Dee
- 18 August 2018 - Ver. 1.3.0 - major
 - New chapter in the Appendix: [Popcorn Flow](#)
- 14 August 2018 - Ver. 1.2.1 - minor
 - Fixed many broken links, thanks to Allen Jones!
- 11 August 2018 - Ver. 1.2.0 - major
 - New Story: [On the Shoulders of Giants](#)
 - [Scrum@Scale Guide](#)
- 27 May 2018 - Ver. 1.1.0 - release candidate 3
 - Foreword by Joe Justice.
- 2 February 2018 - Ver. 1.0.1 - release candidate 2
 - Fixed typos and stylistic improvements.
- 24 January 2018 - Ver. 1.0.0 - release candidate 1
 - Completed the “Scrum” chapter with the “[Pattern of Performance](#)”.

- Completed the [Other Ingredients](#) chapter.
- The book is now released under the Creative Commons BY-SA license terms.
- 16 January 2018 - Ver. 0.9.0 major
 - New paragraph in the “Scrum” Chapter
 - * [Develop competencies](#)
 - * [How to choose the Scrum Master](#)
- 17 November 2017 - Ver. 0.8.0 major
 - New chapter: [Scrum](#)
- 9 November 2017 - Ver. 0.7.0 major
 - New chapter: [Cynefin](#)
- 8 November 2017 - Ver. 0.6.0 major
 - New chapter: [eXtreme Manufacturing](#)
 - Updated the [Scrum Guide](#) at version November 2017
- 4 November 2017 - Ver. 0.5.0 major
 - New chapter: [Three Meters above the Sky](#)
- 21 October 2017 - Ver. 0.4.1 - minor
 - New chapter: [Introduction](#)
- 19 October 2017 - Ver. 0.4.0 - major
 - New story: [A New Industrial Revolution](#)
- 30 September 2017 - Ver. 0.3.0 - major
 - New story: [Summer 2016](#)
 - Fixed some typos in previous chapters.
- 26 September 2017 - Ver. 0.2.0 - major
 - New story: [Paolo](#)
- 24 September 2017 - Ver. 0.1.0 - major
 - New story: [Joe](#)

Book Structure

This book is divided into three parts: the Stories, the Method, and Case Studies. The stories go with the reader along with the same understanding I have experienced with **Scrum for Hardware**. I have chosen this approach to allow everyone to become familiar with the topic more lightly and smoothly, using a narrative style. The second part of the book, however, summarizes the methodology, and it can also be used as a reference for quick access. The third part contains Case Studies I personally implemented. This section will evolve and extend over time and is the most iterative and incremental part of the publication.

SHU - HA - RI

The progression of the ideas expressed in the stories follows the *SHU-HA-RI* scheme, used to describe the stages of learning to mastery in Japanese martial arts.

The **SHU** stage can be described as “*Follow the rule*”. In this beginning stage, the student follows the teachings of one master precisely and he concentrates on just practicing thoroughly in order to acquire the basic knowledge of the main moves. The teacher, according to his experience and style, decides what the student must learn at this stage.

In the **HA** stage, described as “*Use the rule*”, the student begins practicing the art, learning the underlying principles and variations of already-learned moves. He enriches his language and departs from the orthodoxy of the previous phase.

The **RI** stage is described as “*Be the rule*” or “*Transcend*”. At this stage, the student begins to build his own style: he knows the rules and can deliberately decide to break some to create his own style.

Of the five stories in the first part, the first two chapters introduce the characters, the third chapter sets the basic concepts (SHU), the fourth illustrates some motivations and alternatives (HA) and the fifth shows advanced concepts and personal interpretations of methodology (RI).

Now, it is time to dive into the stories. Enjoy your read!

The Stories

Joe

In 2008, Joe Justice was a software consultant living in Denver, Colorado. He worked for Avanade, a large software company, a joint venture of Microsoft and Accenture, developing interesting software projects for large businesses.



At the beginning of the year, he received a phone call: an Accenture employee was forming the team for a new project for the Bill & Melinda Gates Foundation, founded by the American magnate and patron of Microsoft and considered the richest man in the world. Joe's curriculum seemed highly suitable for that project: besides learning about the .NET development environment and Microsoft Sharepoint, the two leading technologies of the project, Joe also had experience with Scrum⁶, the Agile development⁷ method that the Gates Foundation had decided to adopt for all new projects.

⁶In the second part of the book, you will find the description of [Scrum](#) and all the technical terms used hereafter.

⁷https://en.wikipedia.org/wiki/Agile_software_development

Scrum's experienced staff was scarce in Accenture, so they offered Joe to fly to Seattle every Sunday and go back home every Thursday night for the following months. The idea of working with the Bill & Melinda Gates Foundation was inspiring, and Joe did not hesitate to accept; he would be the Scrum Master of the Avanade team at the Foundation and would teach Scrum to the entire organization. Joe knew Scrum well; he had used it since his first job in Denver as a developer; he considered it the only serious way to develop software in a business context.

Joe had started to become interested in computer science since he was a kid. Being the youngest of six children, Joe was very intrigued by the games of his four sisters and his older brother John. In particular, that strange object – a computer called Commodore Vic 20 allowing to watch new worlds and live exciting adventures on his TV thanks to some tapes – really fascinated him. When he was about to go to university, Joe chose the faculty of computer science, emulating his older brother, who had already graduated and was enjoying the [economic boom](#)⁸ in the late 90s, earning good money. Joe had received a scholarship offer from a very prestigious university, and he was enthusiastic about starting this journey. However, something went wrong: shortly before starting the courses, he received a letter from the university stating that the scholarship was allocated to the Hispanic minority and there had been a mistake. He was not qualified to access it. Joe, an adolescent and inexperienced person at that time, did not think to seek advice from a lawyer; he consulted with his school secretary. Thanks to the student placement officer's knowledge, he obtained a scholarship from the University of Wyoming. It was an alternative far below his expectations, but Joe was just OK with it and decided to accept.

Ai, a young Japanese student, was attending classes on the same campus, where she also held a language and culture course about her country, as required by the international scholarship that had brought her to the US.

⁸https://en.wikipedia.org/wiki/Dot-com_bubble

Joe made no secret with the friends of his passion for the Japanese culture: he had received it from his mother, who had spent her childhood in Japan to follow her father, a prominent US Army General, on a mission to the island. Joe's roommate, who knew about this, met Ai in class and told him immediately: "You must know my Japanese teacher; she is definitely your type. I'm sure you'll like her". "I don't like older women," Joe replied. "She is our age! Trust me, you must know her".

For Joe, it was love at first sight, and as soon as he left university, he asked her to marry him. They were young, newly graduates, and with little money. They decided to get married and to celebrate their wedding in Hawaii so that friends and families could join them more easily from Japan and the United States to celebrate all together. They would then spend their honeymoon exploring Hawaii, renting several cars along the road.

One morning, great sports car enthusiast Joe was driving a small convertible on the road to Hana. He just felt in heaven, with his young wife sitting by his side and a gentle breeze coming from the forest and refreshing his face. Suddenly, despite feeling so well with a smile spread from ear to ear, he saw that paradise slowly blurs in front of him. "If every single individual of the 7 billion populating the planet would like to enjoy this same pleasure – he thought – the forest could no longer exist. It would be replaced by a bare clearing devastated by acid rain, and the air would smell of exhaust gas."

Ever since he was a child, Joe had naturally developed a strong ecological sensitivity. He still remembers that when he was 4 or 5, he prevented his older sister from killing a grasshopper with ether, which she needed for science school research. In an attempt to save the insect, Little Joe cried and threw such a tantrum that he lost his senses by hyperventilation, alarming the whole family.

And now, the only thought of a devastating forest made him feel almost physically distressed. Such stomach-burning feeling wiped that smile off his face for the rest of the trip, and that disturbing

image began to haunt him even at night. He felt guilty as if he was doing something wrong or unfair. It was precisely during this trip that Joe all of a sudden fully understood the ecological meaning of the word “unsustainable.” This thought was disconcerting to him, and he felt he had to react and do something. But what exactly?

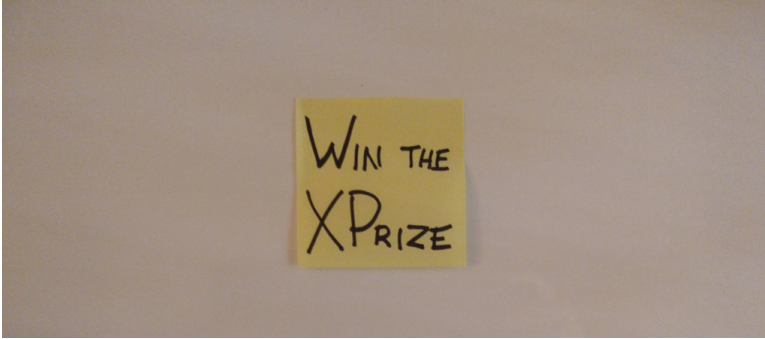
The Challenge

The XPrize Foundation is a nonprofit organization based in St. Louis, Missouri, which organizes public competitions to encourage technological innovation. It is a moral institution aiming to identify solutions to complex problems with its initiatives and facilitate the financing of projects that can benefit humanity in different fields (medical, aerospace, environmental, etc.). In 2008, with sponsorship from Progressive Insurance, the Foundation announced an Automotive XPrize competition with a ten-million-dollar prize. Participants were challenged to build a four-seater eco-friendly vehicle that could be legally registered in the United States, producing less than 200 grams/mile CO₂ equivalent emissions, able to achieve 100 MPGe (100 miles per gallon equivalent of petrol, that is 100 km per 2.8 liters) and that could be manufactured for the mass market. Over one hundred competitors took part in the competition, including individuals, companies, and universities from all over the world.

Wikispeed's Birth

It was immediately clear to Joe: he had to participate in the XPrize. Contending with the construction of an ecological car would have been the best way to overcome the discomfort he had felt during his honeymoon. Unfortunately, while being a car enthusiast, Joe was new to any mechanical expertise. Before that moment, he had not even ever changed the oil in his car, and he was well aware of the need to learn many things. However, he did not let himself be

scared by these initial obstacles and decided to focus on his goal: he placed a large board in his garage, and he hung there a sticky note saying, “Win the XPrize.”



How to proceed? Where to start? Joe knew only one method to develop something serious: **Scrum**. He began to apply the “user story splitting” method to his car. Targets were broken down into sub-objectives, thus becoming smaller and more reachable in acceptable times. Joe wrote the first two objectives on two different sticky notes: “build a car that can be registered” and “build a 100MPG car”. Joe recurrently split them into subtasks so that his board got full of sticky notes within one afternoon only. He knew that he could not do it alone, so he began to share this idea on his blog, telling the world about his experiments, mistakes, and new learnings. He asked specialized communities for help and advice, and people from around the world began to answer, offering suggestions and opinions. Joe replied to anyone who could provide a little support. He updated his followers and asked for further information. Many mechanics, electric technicians, and simple hobbyists began to be interested in the project. Someone even wanted to meet in person “that guy on the internet” who tried to build the most ecological car ever designed, and strangers started arriving to spend the weekend with Joe after flying at their expenses over the US. Wikispeed⁹ was born: a community of enthusiasts who, like Wikipedia, was

⁹<http://wikispeed.org>

developing collaboratively and openly a 100 MPG car to participate in the XPrize competition.

Toward XPrize

In 2010, Joe and his wife had moved to Seattle, Washington for some time. The Bill and Melinda Gates Foundation project had been going on for two years, and some weekends, instead of going back to Denver, Joe had asked Ai to join him in Seattle. Like any good Japanese, Ai has a vast food culture. The excellent cuisine of the typical restaurants in Seattle, along with the variety of choice of international restaurants, had convinced her that it was worth moving there. Also, Seattle was the headquarters of significant companies, including Amazon, Microsoft, and Starbucks; it seemed an exciting city from different perspectives.

The Wikispeed project was going on quickly: it counted a group of 44 people coming from 4 countries and actively helping Joe. It had a [Facebook group](#)¹⁰ with a thousand fans already and a [Youtube channel](#)¹¹ with many followers. After the evaluation phase of the documentation for admission to the competition, Joe and his team started the operation phase, and they had built in three months only their first prototype called SGT01, Super Grand Touring 01.

The [SuperGT](#)¹² class is a car racing championship in Japan with road cars. They are probably the fastest vehicles that resemble standard cars; better performance is obtained only from cars similar to Formula 1. Joe had always been fascinated by those competitions, and, in his imagination, the car he was planning would have to look as much as possible like a racecar, beautiful and charming. Simultaneously, it had to consume so little to be the most ecological car ever built.

¹⁰<https://www.facebook.com/WIKISPEED/>

¹¹<https://www.youtube.com/user/WIKISPEED>

¹²https://en.wikipedia.org/wiki/Super_GT

The first simulated tests [showed](#)¹³ that the car could reach 104MPG on urban cycle and 114MPG on extra-urban cycle: already perfect to win the contest! Also, weighing only 1300 Lbs. (about 589 Kg), it could go from 0 to 60 miles per hour (nearly 100 Kph) in less than 5 seconds and reach a top speed of 149mph (about 240 Kph). The prototype went like greased lightning! On April 6, during a trial run, Joe ended up colliding with a wall. Luckily, the crash tests carried out on the simulator confirmed very realistic: Joe did not hurt too badly and, with a one-day work and not too much expense for the materials, Wikispeed was as good as new. On April 12, the team obtained the official [confirmation](#)¹⁴ so longed-for by everyone: Wikispeed had been admitted to the final selection, called Shakedown, which was to be held from May 2 to 8, 2010 at the international circuit of Michigan, 100 km west of Detroit and location of the famous NASCAR racing. It was great news.

The development team at the Bill and Melinda Gates Foundation was also very excited by the idea, and everyone went out of their way to allow Joe to take the necessary vacation to get the business done.

However, it became necessary to find a specialist mechanic quickly, as Wikispeed had the Honda Civic engine. If necessary during the final selection, the team had to be able to intervene without hesitation. Moreover, the race was only less than three weeks away! Joe and his friends published an ad on Craigslist humorously titled “Mechanic/MacGyver (Michigan International Speedway)”:

Team WIKISPEED is competing in the final rounds of the Progressive Automotive X Prize, and we need a fantastic Honda mechanic to support our team at the Michigan International Speedway the week of May 2-8. We are building a prototype car that will go 100

¹³<http://wonderfulworldofwikispeed.blogspot.fr/2010/04/faq.html>

¹⁴<http://wonderfulworldofwikispeed.blogspot.it/2010/04/we-did-it-detroit-here-wikispeed-comes.html>

mpg and will retail for under \$20k. The challenges we will hit will probably be pretty novel—no repairs are routine on a prototype car. Ideally, the candidate would be willing to work at a reduced rate or gratis since we are a small volunteer team—an attitude similar to the TV show *MacGyver*'s help.

With that single ad, they got an answer from Bryan, a certified technician with experience on Honda engines. In addition to working for free and taking part in the Wikispeed project, Bryan refused some job offers, which were not so profuse in that crisis period in the Detroit area.

Moreover, a certain Todd, owner of a company producing Plexiglas material, offered his help to build and install for free the transparent canopy that would protect the pilot, in return for the only flight to Seattle.

Finally, Mike, a robotics enthusiast attending a Yahoo-themed forum, showed up unannounced at Joe's garage where volunteers were working at Wikispeed. No one had ever seen him before, but he spent the whole afternoon working hard and solved some wiring problems that Joe, despite his efforts, had not been able to come to grips with for weeks.

The Big Day

May 5: eventually, the big day! The entire Wikispeed team is along the Michigan International Speedway – palpable excitement is in the air. The team members have not slept for three nights to finish the car according to the competition’s rules.



Everybody invested time and expertise into the project, and everybody also feels it as his own. It’s Wikispeed’s turn. The jury examines the prototype, and some problems arise. The team does not let this get it down and keeps working: in a few minutes, Wikispeed is disassembled into its main modules (chassis, engine, front dashboard, etc.), and all the participants work in pairs and parallel on the components.



The jury and rival teams are impressed by the speed and readiness with which the Wikispeed team solves the highlighted problems one by one and congratulates them several times. After finishing the work, the team rolls the car in the designated area for the final inspection. All together towards glory!



Just before the inspection, Joe asks his brother John to help him move the seat belt straps. It was an optional recommendation in the list of change requests, but it seemed like a simple thing to do in a

few minutes. Lack of sleep and lucidity played their part. Drilling the frame with the drill, Joe accidentally shears an electric cable inside it. Turning to Mary Wilkes, the team's expert electrician, he begged her: "Can you fix it?" Unfortunately, it was not possible in the few minutes left before the final inspection, and when the judges arrived, the car could not start. The team appealed to the judges asking a little more time to solve the electrical problem by showing that it had just occurred, but the extension was not granted.

However, that was a moment of great disappointment for everyone, compensated by the satisfaction of being positioned tenth on the final ranking, surpassing prestigious and well-funded competitors as TESLA, TATA Motor, and the Team from Boston MIT.



Wikisppeed SGT01

More importantly, Wikisppeed obtained a wide media coverage: the story of Joe and his volunteers appeared on numerous blogs and online magazines, the number of fans continued to grow steadily after the end of the competition and, despite having no victory in the XPrize, the Wikisppeed project began to be considered a triumph.

The Ingredients for Success

Sometime later, an [article on Fortune](#)¹⁵ listed some elements that had led to the success of Wikispeed, suggesting that firms should consider the following four principles that helped them:

1. Reach out passionate people

“No matter how many smart people you have at your firm – said the article on Fortune – there are a lot more on the outside. Competitive success hinges upon the ability to connect with others and take advantage of the knowledge that they can bring to the table. So, the benefits of connecting with and bringing together passionate people can be significant.” Since the very beginning, Wikispeed uses social networks and specialized forums, getting help and suggestions from passionate people around the world.

2. Keep timelines short

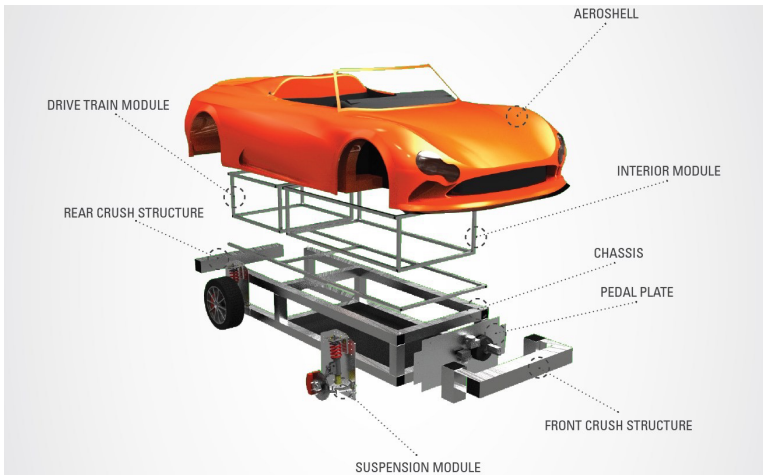
Traditional corporate projects require the creation of two- to five-year strategic plans and detailed blueprints. On the other end of the spectrum, Team Wikispeed works in 7-day cycles – they’re constantly reflecting on different results and what they can do better in the next cycle and the learning and adaptation cycle is so fast that it also allows non-skilled people to quickly achieve very ambitious results.

3. Make the project modular

If you have a monolithic product, it will be very difficult to evolve and improve quickly, because the impact of any change will be such as to compel you to review important parts of the entire

¹⁵<http://fortune.com/2012/06/18/how-companies-ought-to-train-their-staffers/>

work. On the opposite, Wikispeed consists of independent modules, connected to each other through clear and predefined interfaces. This way, Team Wikispeed manages to improve a single module with no recourse to the entire work, with the possibility to see the results of the changes within the same iteration week¹⁶.



Wikispeed's Modular Architecture

4. Create opportunities for hands-on learning

At Wikispeed, continuous learning is encouraged and planned. Volunteers work in **pairings** of inexperienced and experienced individuals who take on small projects and skills are quickly and mutually transmitted between team members. Volunteers work as much as possible on different modules, so they acquire **skills**¹⁷ on the entire car.

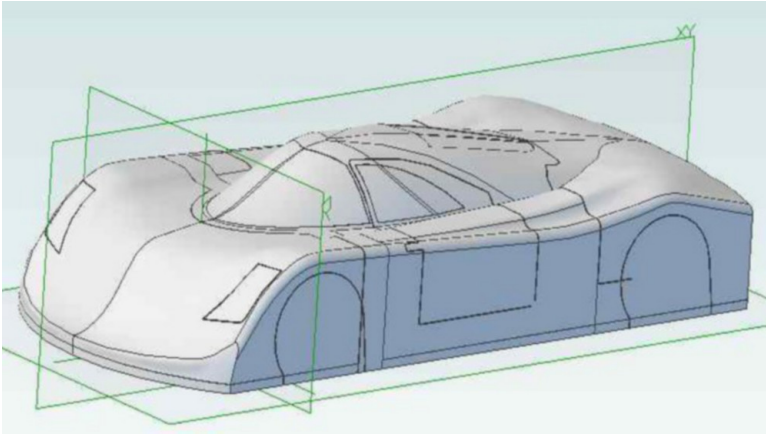
¹⁶Further details in the [Agile Architecture](#) section.

¹⁷See the [T-Shaped Skills](#) section.

Detroit Auto Show

In January 2011, Team Wikispeed received one of those offers one cannot refuse: they were invited to participate free of charge at the most famous car show in the world, the Detroit Auto Show. All of the most important car brands on the planet would be present. The team members were extremely excited but also literally terrified by the opportunity they were offered. Wikispeed's body used for the competition and nicknamed the "orange shoebox" was not up to the task. For an international auto show, it was necessary to design something more attractive. The team contacted some distributors of composite materials. Still, estimates and conditions were desolating – they would need 36,000 USD and three months to get the desired results, but there was no time or money. What to do?

Once again, the connection was decisive. A design-specialized, Wikispeed-enthusiast technician spent various sleepless nights to create the design and sent his CAD project for a new bodywork from Germany, which was later called the "Le Mans Version." In this case, nobody had ever met the author of a contribution that proved to be decisive.



CAD of Le Mans version

In Joe's garage, volunteers began modeling the bodywork with pressurized foam, first on a reduced scale, and then, with the aid of a CNC machine, they generated a real-size 3D model.



Bodywork Model

Joe took a vacation to attend a course on composite materials, and after a few days, he had already acquired the basic knowledge to attempt an experiment. The team used carbon fiber sheets softened with a special solvent to perfectly adhere to the model. They then

painted the bodywork of a lovely “race black” and, with a strenuous smoothing work and some stickers, the most beautiful Wikispeed that had ever been seen came into existence. It was an incredible achievement, especially considering that the car body cost only 800 USD and three days of work.



Painting Stage



Transport of New Body

The fact that Wikispeed, in addition to offering outstanding performance, was also beautiful was, in turn, a decisive factor because, with great team surprise, the car was placed on the main floor of the show, right in the middle of Ford and Chevrolet.



Detroit Auto Show

Joe was still frightened by that environment – he expected to be snubbed by the other booths' white collars. Instead, one by one, the managers of each automobile company shook hands, complimented him, and many wished him to start a real automobile company of his own. Joe was astonished: why did his competitors encourage him? Subsequently, Joe stated in an interview that, in his view, the managers of the big companies were frustrated by the slowness with which things changed in larger companies and hoped that a new, small, aggressive, and ecologic competitor would put the proper pressure needed to generate a fundamental change in their organizations. This explained, according to Joe, the warm welcome he was given that day. Again, media coverage was massive. Wikispeed was mentioned by prominent newspapers such as Wired, National Geographic, New York Times Online, Forbes, and many specialized blogs including [Autoblog](http://www.autoblog.com/2011/01/12/detroit-2011-wikispeed-sgt01-low-cost-super-mpg-car/)¹⁸.

¹⁸<http://www.autoblog.com/2011/01/12/detroit-2011-wikispeed-sgt01-low-cost-super-mpg-car/>

TEDx Rainier

The peak exposure stage for Joe and the Wikispeed team arrived in December 2011, when Joe was invited to speak to [Rainier's TEDx](#)¹⁹. TED is the most prestigious conference format in the world. The main event, which takes place in California annually, can only be attended by invitation; the videos of the TED talks, on the other hand, remain available free of charge online and have a great follow-up. TEDx is events independently organized according to TED format and rules, and in short, have reached such a level of interest that many of the highlights in the [TED site](#)²⁰ are just shot at TEDx. Joe's video on Wikispeed, which at the time of writing this book has reached 90,000 views, was the turning point for the project.



Joe Justice at TEDx Rainier

From a costume phenomenon, Wikispeed was starting to become an example to follow. Even important companies, who knew the Agile software development methodologies and were looking for a way to innovate their product creation process, saw in Wikispeed

¹⁹<https://www.youtube.com/watch?v=x8jdx-lf2Dw>

²⁰<https://www.ted.com/>

the proof that improvement was possible and began contacting Joe and Team Wikispeed.

John Deere

John Deere is one of the world's largest agricultural machinery manufacturers. John Deere, a blacksmith, founded the company in 1837 at Grand Detour, Illinois. He was also a great innovator who, like the others, produced pitchforks, rakes, horseshoes but one day created a steel plow that for pioneering peasants became the conquest tool of Midwest grassland. On that innovation alone, the company grew for almost two centuries billing about \$24 billion in 2007. John Deere executives learned about the story of Wikispeed in 2012 from this TEDx video and some articles in magazines. Curious, though they knew more, they sent three managers to Joe's garage in Seattle, over 3,000 miles away. Shortly after their return, Joe received an invitation to the headquarters of the company in Milan, Illinois, to illustrate the story of Wikispeed during the initiative "Frugal Engineering and Innovation." They talked about modular tractors and a startup that was creating open-source agricultural modules called Open Source Ecology. At that time, John Deere was building the 8030 model, a large modular tractor platform, and Joe projected a statement during his talk that had been given five years earlier by the chief engineer of the company:

The development process of the 8030 model is entirely predictable: we know how much we will spend, how many resources we need, and when we deliver the product to the market.

Just after that, however, Joe exposed exciting information contained in a document that the company had sent to him before the meeting:

The 8030 project had been delayed by six months, the staff involved worked 12 to 14 hours a day, and some key features had to be omitted.

The tractor that was launched on the market had great commercial success and was very profitable. But despite this, Joe showed the executives that the development of new products was becoming more and more complex, as the world around them was changing very quickly, and it would be wise to review the way budget estimates and schedules were processed. John Deere had been producing tractors for 175 years; the company was very self-confident, and, in showing the quotation and data that denied it, Joe feared being sent away, or at least criticized. It was not so: on the contrary, the managers invited Joe to repeat that intervention on a cruise ship during the company's annual meeting, and on that occasion, Joe said clearly that in his view, the annual budget planning should not be done annually anymore. In an interview, Joe later stated:

I cannot tell you the details because I signed a confidentiality agreement, but the other day I received a phone call from a John Deere manager asking me what a Wiki-Deere might look like.

Boeing

Not long after, Boeing also contacted Team Wikispeed. It was easier this time, as their headquarters are about a 20-minute drive from Joe's garage, but it was not less exciting. Joe and other volunteers were invited to see the 787, 777, and 767 production lines in the world's largest enclosure. Boeing's production facility is so large that clouds form inside, and sometimes even rain falls from them! People in the distance look tiny, yet they are only at one-quarter of the building. Entering, Joe felt being on the set of "Indiana Jones and the Raiders of the Lost Ark." After a guided tour of the production

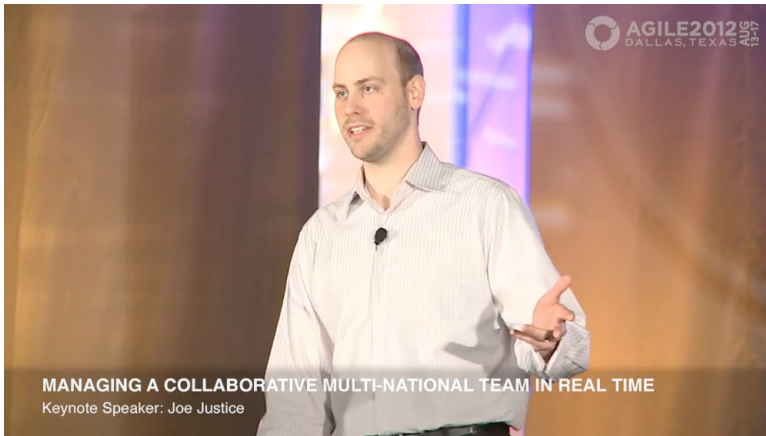
line, Joe met some Boeing executives. They were interested in learning more about Wikispeed and finding out if there was “a Wiki project” in their field. At the meeting, Joe mentioned [Maker Plane](#)²¹, an Agile company that declares to use the “Wikispeed method.” Joe knew the founders and had exchanged emails with them. “They are building two models, a 4- and a 6-seat. It will be exciting to see what they can do”, Joe said in a subsequent interview. In the same interview, Joe explained the reason why more and more companies began to be interested in Wikispeed. The widespread fear of the eventuality that more and more sectors would see the birth of another “Google,” or “a group of guys, who in their garage, invent a way to make a better product, spending less, faster, and that with this idea create a competitor that cannot be bought.”

Agile Alliance 2012

In 2012, the Wikispeed Team was well known on the international Agile scene, and Joe was invited as a keynote speaker to one of the most prestigious Agile conferences in the world: [Agile 2012 of Agile Alliance](#)²² in Dallas, Texas.

²¹<https://makerplane.org>

²²<https://www.agilealliance.org/resources/videos/keynote-joe-justice/>



At the end of his speech, a participant asked a question to Joe:

Joe, do you see Wikispeed manufacturing becoming a large-scale manufacturer?

His answer explains why, at the same time, he changed his profession and, from a software developer, he became Agile Coach:

About 76 million new cars were built and sold last year. Current analysts predict that about that same number will be made again this year. We think at least 60 million of those should get 100 miles per gallon. That said, I don't want to figure out how to do the economies of scale on 60 million cars manufactured in a year. Even worse than that, I don't want to see the news that some manufacturing plant was shut down, and 4,000 people in a neighborhood were laid off at once because they've just been put out of business by Wikispeed. I want Wikispeed to succeed. I want it to grow in hundreds of thousands of cars a year because that's the number that will make an appreciable difference in the amount of fuel consumed and the number of emissions emitted.

We could sell ten of these at 100,000 USD each, and my pocketbook would be pretty happy, or we could sell 100,000 of these at almost cost and make a difference for the environment. That's much more what I'm interested in.

Joe was only interested in creating a positive impact on the planet. And he began to understand that teaching others to do likewise, according to the Wikispeed model, was the best way to boost its impact in less time.

Scrum Inc

Scrum Inc is the consulting firm founded by Jeff Sutherland, inventor, and co-author of Scrum. Joe had known Jeff as he had attended a training session, and Jeff had visited the Wikispeed garage curious about the project. On September 9, 2013, Joe's entry into the team [was announced](#)²³ on the ScrumInc website. Joe started to hold his workshop: in Boston's garage, he taught people how to apply Scrum to constructing a Wikispeed vehicle. Not long after, ScrumInc published a [webinar](#)²⁴ where Joe and Jeff showed the secrets of the success of Wikispeed and what Scrum for Hardware was. In May 2015, Joe became [Certified Scrum Trainer](#)²⁵ for [Scrum Alliance](#)²⁶, the nonprofit association founded by Scrum's pioneers around the mid-2000s. From Joe's entry on, ScrumInc began to include Scrum Master Courses examples from various areas, releasing the methodology from software alone. In the second [Webinar](#)²⁷ regarding Scrum outside Software, which ScrumInc published at the end of October 2015, Joe has the title of President Scrum@Hardware. He had gained a stake in ScrumInc

²³<https://www.scruminc.com/joe-justice-joins-scrum-inc-team/>

²⁴<https://www.scruminc.com/scrum-in-hardware/>

²⁵<https://www.scruminc.com/the-awesome-joe-justice-is-now-a-cst/>

²⁶<https://www.scrumalliance.org>

²⁷<https://www.scruminc.com/scrum-for-maximum-awesome/>

and was now the leader of this new movement. The international community of Scrum for Hardware was already growing, but Joe wanted to see it grow even more. And he was wondering what to do.