

## Agile Scaling — Scaled Agile

**Agile teams boost efficiency, innovation and competitiveness. When well implemented, they deliver higher productivity, faster time to market and better quality. However, many companies face challenges when scaling Agile. More than half of agile transformations are cancelled. How to sustainably ramp up Agile development? How to scale Agile methods for critical systems, complex supplier networks and distributed teams? Vector has summarized here best practices for implementing agile in practice. The article provides experiences from Bosch, Daimler, Festo, Knorr-Bremse, ZF and Vector. Hands-on industry case studies emphasize how to scale Agile methods to specific environments.**

“Well tailored agile methods boost team motivation and reduce engineering cost. But there is no one size fits all agile method or scaling framework.” With two decades of agile transformations in many Fortune 100 companies worldwide, **Dr. Christof Ebert**, CEO of Vector Consulting Services condenses his experiences to such short yet thought-provoking summary.

Global economics are weakening. So, companies across industries are interested to cut engineering cost. The demand for agile has increased recently – across industries. Agile is often seen as the cure for all problems. However, agile transformation is far from trivial and more than half of all trials fail. Many companies underestimate the change needs and end up in what we call agile mushrooming and stagnation. A little bit has been achieved, but it won't sustainably scale, and new challenges arise from cutting necessary processes. **Samir Sarkic**, safety expert at Bosch, has experienced it many times in his professional career: “Agile is often translated in throwing processes to the garbage can and thus reduce method adherence.” Over the past two decades many companies misperceived agile as getting rid of systematic processes. At Vector we face today many clients which once had good processes on maturity level two or even three, that today have big deficiencies in traceability, project management and configuration consistency. To avoid the agile traps, this article will provide hands-on case studies and experiences from companies in different industries such as Bosch, Daimler, Festo, Knorr-Bremse, ZF and Vector. More information on each case study is available from Vector Consulting.

Traditional agile cookbook recipes won't work for Industry-scale software development. Neither do complex scaling frameworks, which often rather drive bulky process overheads. Developers and managers are puzzled by agile themes such as “customer on board”, “collocated team” and “software before documentation”. Rarely such dogmatic agile constraints apply to industry projects. Customer on board is highly disturbing in most cases as it opens tunnels and invites for ad-hoc changes. Collocated teams might be possible in educational settings, but practically all software today is developed in multi-site teams. Having insufficient documentation is not accepted in safety-critical systems, because product liability laws globally demand to have records on each design decision.

This is where agile scaling and tailoring comes into the picture. The ambition is to benefit from agile flexibility while satisfying industry needs for complex products, extensive supply chains, distributed teams and critical constraints. The answer is tailored agile scaling to blend agile and lean practices. Such agile scaling addresses different dimensions (fig. 1):

- > **Business:** From static business models towards flexible eco-systems and continuous delivery models to target even single-customer segments—and classic selling from license schemes towards adaptive usage-based models such as pay per ride.
- > **People:** From silo organizations of functional know-how towards IT as a core competence of all engineers—and knowledge management from domain experts towards empowered teams with efficient sharing principles.
- > **Process:** From the traditional V model with rather heavy release cycles towards scalable agile processes—and governance from simple IT systems and throw-away apps towards interwoven quality assurance with auditable product liability, functional safety, cyber security, privacy, and availability.
- > **Technology:** From localized features towards service-oriented patterns, dynamic composing, and convergence of embedded electronics and open IT systems—and architecture from modular components and functions towards distributed architectures with service-orientation.

Engineering of industry-scale critical systems obviously need practical guidance to work flexible, while considering product liability and governance needs. Critical projects are complex in scope and span distributed teams and supply chains. Global software engineering demands scalability of agile practices. Safety-critical systems need thorough documentation, once neglected by agile proponents. Critical systems should be developed flexible and lean, but also with distributed teams, expandable and comprehensible. Governance and compliance need to be balanced with lean practices in the specific context. For instance, governance is necessary in safety-critical domains and for cybersecurity to have traceable design decisions.

### Agile Scaling and Tailoring

**Daimler** currently heavily invests in its software factory with modern facilities to bring the various agile competences as much as possible under one roof. **Michael Klingler**, Senior Manager for Infotainment Software at Daimler, underlines the quest for quality in all critical systems: “The major challenge today is reliably shipping features in a safety-critical context.” Managing multiple depending projects in a dense timeframe becomes hard. Complex systems don’t fit anymore to existing processes, while at the same time political constraints and commercial aspects impact system development. He underlines that agile principles must ensure quality rather than over-simplifying and thus endangering product quality and performance. This hold specifically in infotainment which is the “business card of the OEM” and demands highest quality across its many interfaces for cybersecurity, safety and real-time performance.

One key element is a scalable organization and development strategy (fig. 2). Classic component teams with focus on technology and architecture evolve towards feature teams with focus on customer value. These feature teams are responsible on one or several related feature and adapt multiple components, often across platforms. Each team can deliver features without waiting on other teams, which requires access to source code of all impacted components. The effect is empowerment and ownership even for complex features.

**Festo** on its way to digital products and services sees agile processes as a key element for the underlying culture change. Therefore, Digital Business drives the transition from a project culture to product orientation (fig. 3), which is an ambitious task. According to **Thomas Stauß**, Head of Development Engineering Software at Festo, a key element are product teams, rather than classic project teams. These product teams like Daimler's feature teams have a value perspective. They are self-contained with all necessary competences and roles being included. People allocation must be high to ensure availability and thus ownership for results. Stauß points to an immediate effect: "Projects end... but the product won't go away." Often teams change with one version being released, which is highly inefficient as it drives overheads and accumulates technical debt. The entire lifecycle of the product needs to be covered, which is the task of so-called product teams. The first benefits are tangible at Festo with agile teams, more direct market interaction of engineering, and continuous deployment. Time from customer input to delivery is drastically faster with release cycles that today take two weeks, where it was until recently half year. DevOps and continuous deployment have cut the release process from two months to one day with the target of one hour. The "eat your own dogfood" paradigm means better quality and sustainability because the team knows they have to maintain their products and services later on.

**ZF** has heavily invested over the past years in continuous processes, starting with continuous build towards continuous deployment. With safety-critical products, a global organization, and a high number of diverse projects which run in parallel, this is far from trivial and cannot be compared with IT developments that focus only on a single product which by nature facilitate continuous deployment. **Dr. Joachim Fox**, Global Chief Engineer of Braking Software at ZF is proud that continuous integration (CI) has been identified ZF wide as one of the top five software technology topics. With quality entry gates, scalable build cloud, smoke test center and data analytics, ZF is creating a pipeline approach for all their software. Customers increasingly demand agile collaboration models, and suppliers must provide the necessary process and technology. The agile cultural change has created a strongly increased focus on "always working software". Close monitoring of the integration processes avoids integration traffic jams and ensures a fast feedback to developers (fig. 4). Fox removes a classic agile dogma which has often created severe quality issues: "Speed of delivery must never be a goal in itself. Most relevant is to not break the flow of development which requires speed of feedback instead."

**Bosch** has introduced agile principles to safety-critical products. Often safety and agile are perceived as incommensurable. This might have been the result of inexperienced agile evangelists which doomed

documentation and planning for sake of speed and perceived cost reduction. **Helmut Bunge**, program manager at Bosch, observed that “discipline is often seen subordinate to delivery.” That of course is not feasible in critical product development such as automotive, medical or industry. With their wide experience in functional safety they underline: that safety actually benefits from agile development methods, if the organization manages to coordinate their agile teams regarding: safety methods, interfaces, tools and change waves. Of course, there are some challenges such as distributing and integrating safety tasks within the teams, lack of concepts for encapsulation and dependency management, and the still insufficient automation for dependency analyses, on which Bosch is working with Vector. They recommend several best practices, such as

- > Apply automated code and model checks with static and symbolic analysis with direct feedback to developer,
- > Evaluate data from software analysis tools such as resource flow graphs and compare those against software models to find architecture inconsistencies,
- > Use model-based systems engineering (MBSE) to make completeness checks, data flow checks, and thus check if all system elements are analyzed for ASIL consistency.

Agile tailoring is key, as is emphasized by Daimler, Vector and ZF. Their guidance is to avoid overly complex safety methods which always need a highly competent expert (which however is rarely available in agile teams) and rather keep safety methods as simple as possible for the team to provide the safety input and parts of safety analysis.

## People and Agile Culture

**Vector Consulting** brings agile expertise from nearly two decades of change projects across industries and benefits from having seen practically all culture obstacles. **Dr. Ulrich Bodenhausen**, manager of the agile competence at Vector Consulting summarizes experiences in working with ABB, Bosch, Daimler, Thales, ZF and many more on agile projects: “Method and delivery have to be pragmatically combined.” He has seen many teams and organizations which have strangled their development with overly dogmatic agile frameworks such as SAFe. Such frameworks are well-equipped with providing all bells and whistles from project to portfolio management, but in their demand for roles, work products and heavy workflows, they typically create complexity and confusion. States Bodenhausen: “Agile processes must always be built on the basis of simple yet effective mechanisms that suit the culture and market needs of a company.” Methods must follow the need to deliver (fig. 6). Some organizations like methods as they give structure, and in overemphasizing process and method create overhead. Other organizations only look to delivery and thus ruin quality thus creating rework and low performance. Since many years he is applying agile methods for change processes in transformation projects. Agile change sprints ensure tangible results and allow retrospectives on each change increment. Many companies call Vector after they have unsuccessfully mushroomed an agile transformation. Internal teams are strong in their networks, but often weak in change, because they have not seen much other set-ups. He

concludes: “Agile is easy to start, but hard to get real long-term benefits. Agile strongly benefits from tailoring and embedded engineering best practices which only experienced consultants can deliver.”

**Knorr-Bremse** has understood the culture challenges of agile transformations. **Alexander Dobry**, as manager responsible for development processes at Knorr-Bremse, has lined up agile patterns for distributed teams:

- > **Team:** Agile teams are independent, autonomous, stable, co-located, of broad knowledge, and small size with maximal seven to nine persons. They make their work visible, communicate daily face to face and collaborate with high focus.
- > **Flow.** Agile teams split work into small independent batches, limit work in progress and reduce context switching. They receive frequent feedback from management and other teams on weekly or biweekly basis to adapt to uncertainty quickly.
- > **Practices.** Agile teams use loosely coupled architectures with contracted interfaces and integrate frequently, if necessary several times per day for even critical systems.
- > **Leadership.** Agile teams get autonomy, ownership and purpose by a servant leadership. They determine their content and progress and thus improve motivation.

The four patterns together ensure, agile teams actually deliver. All agile theory is pointless if teams get stuck in individualism and forget about business needs. Alexander Dobry of Knorr-Bremse builds upon simple elements which are adapted for the specific environment. He summarizes: “The basis for agile success is the Scrum method and high stakeholder involvement.” No complex frameworks, but rather specifically tailored methods as he outlines in his adaptation of the work flow pattern. His team works in biweekly cycles and reduce batch size of work to stories with few days’ duration. Work in progress (WIP) is limited to ca. 8 independent stories, and even less when swarming or pairing. Context switching is reduced by “stop starting, start finishing” rule and clear cadence of meetings. Work dependencies are controlled by defining interfaces to other teams or splitting stories differently. Priorities are key with enforced top-down ranked prioritization of product backlog and agreed sprint backlog and swim lanes. Large work packages are split in multiple releases with committed acceptance criteria and binary measurable definition of done. Immediate feedback is achieved with work results being reviewed biweekly in defined Sprint reviews with stakeholders. Obviously agile development and management need continuous re-planning – even if some agile protagonists claim that plans are past. The good news, as observed at Knorr-Bremse is that discipline and fast learning foster agile culture (fig.7)

### **Cost Savings in Weakening Economic Climate**

Weak economic perspectives historically stimulate three behaviors for immediate cost reduction – which in most cases actually worsen the situation:

- > Short-term expense cuts for trainings, process, quality etc. and thus accumulating technical debt.

- > Moving development to so-called low-cost countries, while not considering the necessary investment in competence, collaboration and knowledge.
- > Focus investments to immediate ROI, thus overlooking the need for innovating to stay competitive.

These perceived cost reductions might have short-term straw fire effects but reduce competitiveness. History of software industries is littered with companies which run in one or more of above-mentioned traps and eventually completely failed. Prominent examples include ITT, Lucent, Motorola and even big parts of IBM and GE. They all felt an immediate necessity to cut cost but did so without adequate people and portfolio management and thus weakening their core assets. History tends to repeat, especially in fast-changing technology business. 1994, 2008 and today, high-tech industry is approaching stormy waters. A first reaction is often to reduce process focus and terminate innovation programs and thus accumulating technical debt which eventually killed entire business units. Amazon, Apple and Microsoft are examples of having understood such vicious effects and working counter-cyclic. They invest consistently, thus attracting excellent engineers which keep the innovation pipeline full of competitive products in order to arise stronger from a crisis.

During these weakening global economic trends, Vector Consulting has been asking industry partners worldwide to provide their view on industry challenges. We have been asking almost 2000 decision-makers in companies in worldwide business-to-business (B2B) context on the top-three challenges that they face (for details see [www.vector.com/trends](http://www.vector.com/trends)), Two major themes dominate software industry at this point

- > Competitiveness, i.e. the urgent need to deliver with competitive cost and quality, while at the same time competing on competences. This is clearly a short-term need and reflects the currently increasingly perceived economic weakness across sectors. Only with the right amount of quality, efficiency, competences and mastering distributed teams, companies will survive the upcoming tough times.
- > Innovation, i.e. the demand for new solutions from markets regarding connectivity, autonomy, digital transformation etc. Markets expect innovative products. Digital transformation and related technical topics are driven by industry leaders that increasingly have their roots in classic IT business. Amazon, Apple, Google and Microsoft all approach the service industries. They will not stop in front of previously incumbent territories, such as Google with its Waymo mobility services and autonomous cars.

Productivity and innovation are mandatory to survive in uncertainty and competitiveness. The answer to these two trends is agile development. Done well, it also avoids above-mentioned three traps of unintelligent cost-cutting. Agile facilitates competitiveness and innovation.

A recent survey which Vector has done with the prestigious industry journal “**IEEE Software**” ranked Agile highest in terms of past and future impact. Agile methods have been successfully applied for three

decades and are today in wide use across industries. From the early nineties when Microsoft invented most of what was later called agile, these principles have evolved towards applicability in critical systems, global settings and complex supply chains and eco-systems such as automotive, IT and medical industries.

### Where Do We Go from Here?

Agility has arrived in real-world development and must be used to boost team motivation and cut on engineering cost. In various companies, where we implemented agile transformations we found two main patterns:

- > Agile transformation needs quite some effort to tailor and adapt. There is no “out of the box”. One should not assume assembling agile elements will pay-back. Stakeholders must be careful not to create an “anything goes” culture. Agile needs professional change management and benefits from benchmarks of what works and what would not work.
- > Agile scaling demands a comprehensive look to the specific constraints, environments, organization, culture etc. Agile is a transformation process that spans much more than only engineering. The entire organization must grow and evolve which goes far beyond theoretic frameworks.

To be successful an agile transformation requires long-term commitment, big investments and customization to each company's specific situation. **Michael Klingler** summarizes Daimler experiences along agile transformation in a nutshell: “Learning Agile is easy, the difficulty is unlearning past behaviors and practices, especially when behaviors have been associated with success in the past.”

Product development will evolve to a continuous process which will fully decouple the rather stable hardware from fluid services driven by continuous software upgrades. Agile service delivery models combining DevOps, micro-services and cloud solutions will allow functional changes far beyond the traditional life-cycle models. Better and earlier connecting business processes, functionality and architecture allows early simulation while ensuring robustness, governance and product liability. Dr. Christof Ebert of Vector underlines this continues change and reminds that if people can't say how they continuously make their company a better place, they are out.

For more information on agile transformation and current technology advances plus access to the mentioned presentations and videos, please visit: [www.vector.com/consulting](http://www.vector.com/consulting)

**Figures:**



Figure 0 / Teaser image

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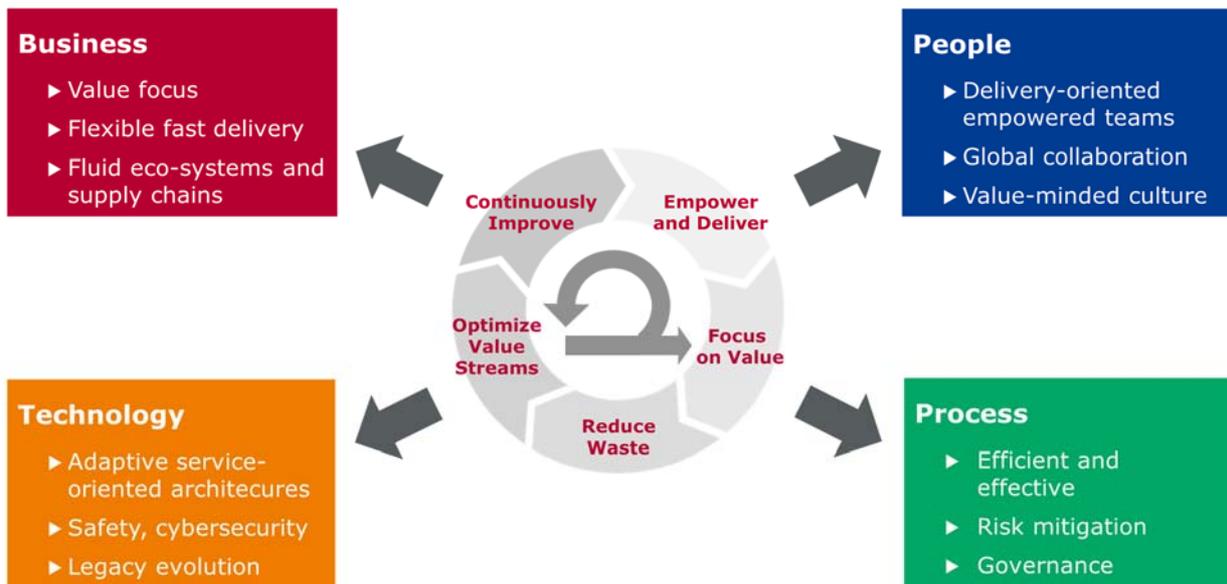


Figure 1: Agile Must be Scaled for “Critical” Industry Needs.

Image rights: Vector Consulting Services

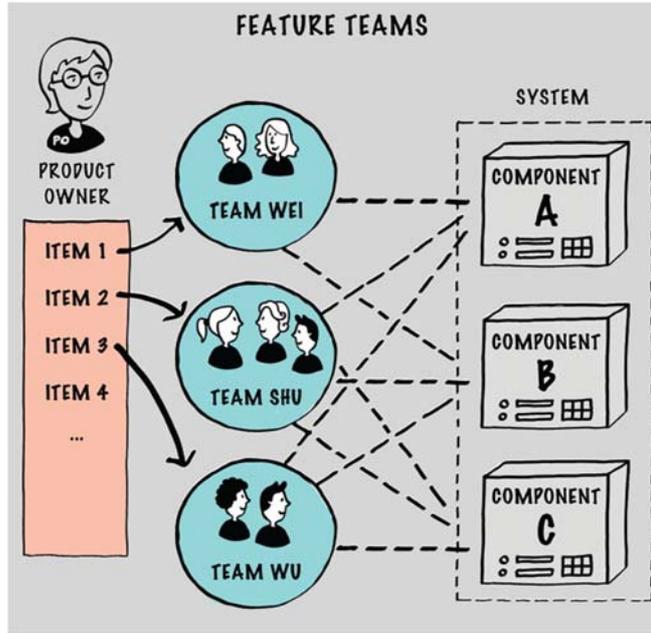


Figure 2: Development Strategy – Scalable Organization with Feature Teams.  
Image rights: Daimler

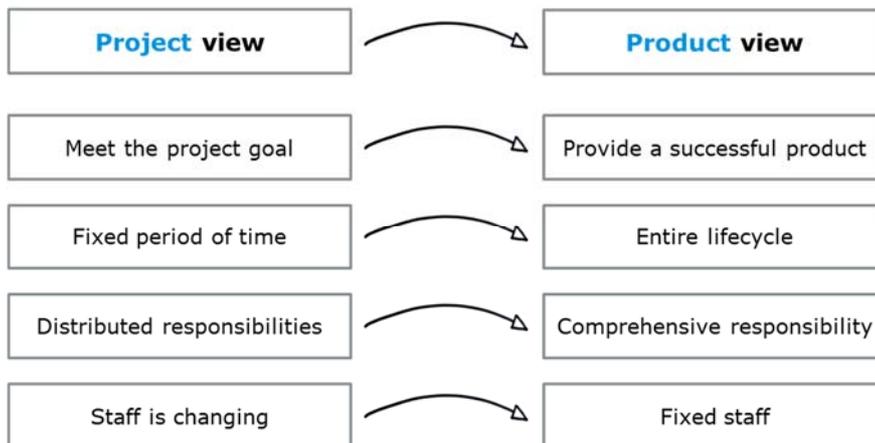


Figure 3: Scaled Agility Demands a Change of Perspective.  
Image rights: Festo

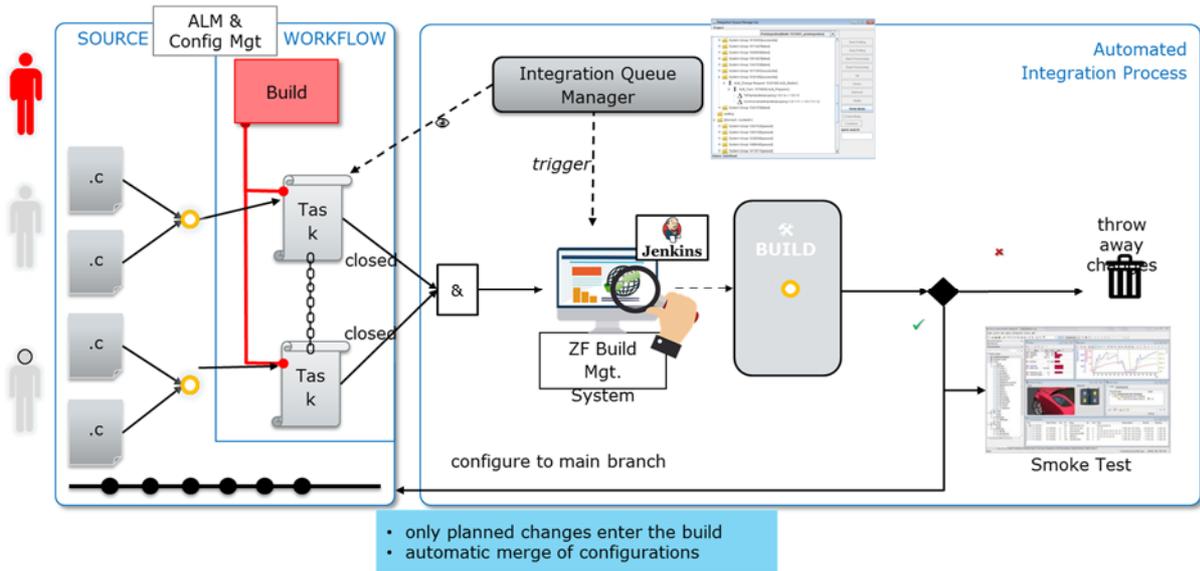


Figure 4: Strong Coupling of Planning and Integration

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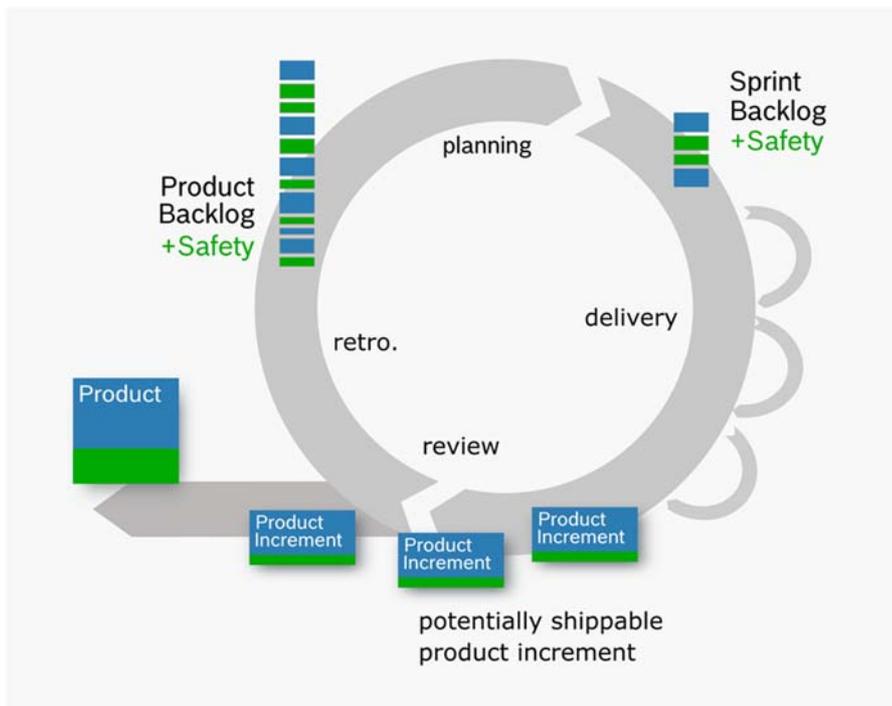


Figure 5: Agile Backlogs for Safety-Critical Products

Image rights: Bosch

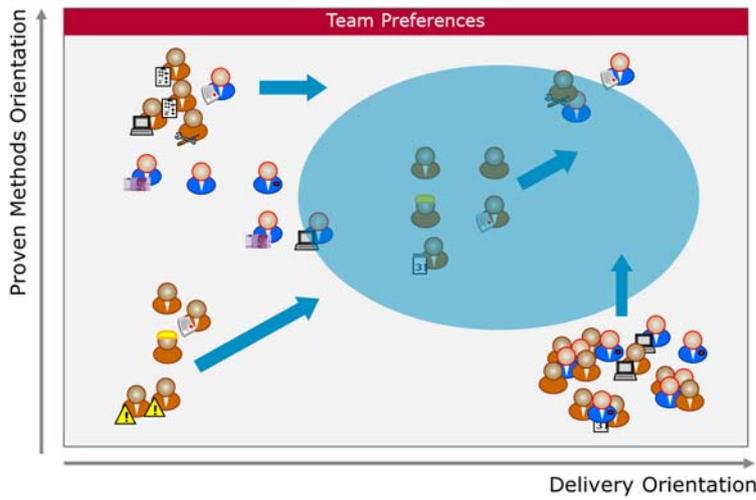


Figure 6: Need for Combined Delivery Orientation and Methods Orientation

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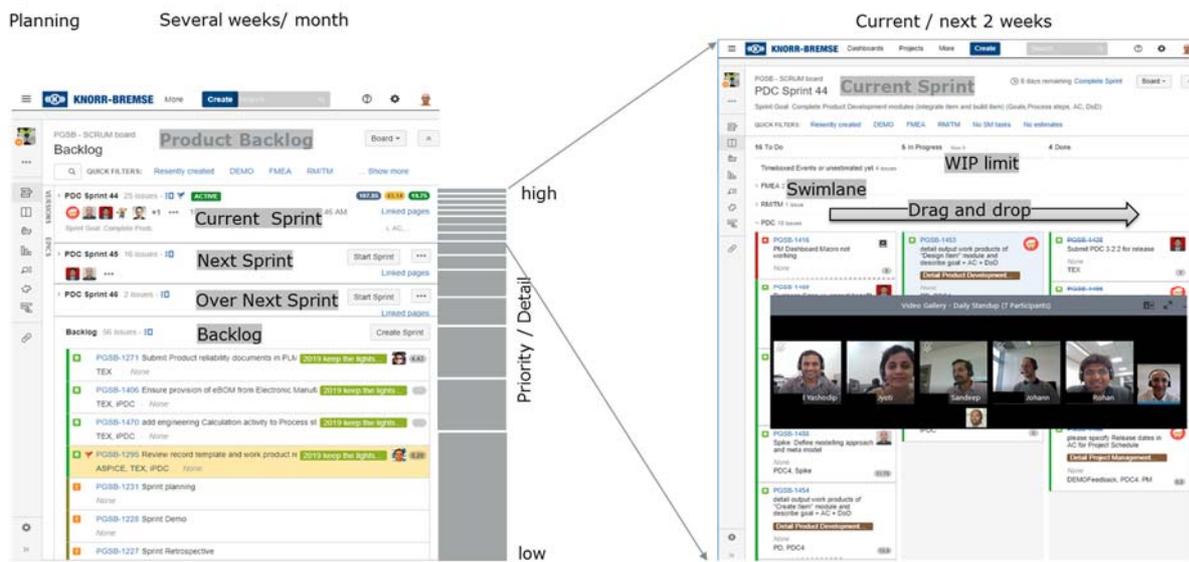


Figure 7: Scaled Planning

Image rights: Knorr-Bremse

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