“Rise of Agile in Automotive R&D?”

Achim Kostron
Andreas Brauchle
Dr. Bastian Hanisch

2016
Current challenges lead to agile approaches in automotive R&D

Challenges of operationalizing strategy

The automotive industry is confronted with transformative change. Well-established mechanical engineering-centered companies need to compete in an increasingly digital world with growing and diversifying customer demands, ambitious governmental regulations, and intensifying competition from China and Silicon Valley. These external trends have implications for the entire automotive value chain, but especially for automotive R&D systems.

Today’s automotive R&D activities are in large part about creativity, risk-taking, and sometimes following the path of unknown factors, especially in the pre-development phase, but also for software and mechatronic systems. Therefore R&D systems need to help engineers design the most innovative products in a short time to market by simultaneously handling complexity, dynamics, and cost pressure. The existing product creation processes are highly structured, robust, and made for efficient and predictable environments. But the fact that they are so rigid makes them insufficient in this unpredictable environment.

In the context of these uncertain conditions, agile approaches to automotive R&D systems are often considered the "new logic." A Tier-1 CEO stated: “Agility is a key success factor for established companies in the digital and connected age.” New methods introduce short development iterations that are conducted by self-organized and cross-functional teams. Changes with regard to customer requirements or technologies are considered the norm rather than the exception and can be incorporated rapidly since agile processes leave room for variation.

Agile is not only about methodical change; it is more holistic by nature. Agile methods are a subsystem of agile approaches that are rooted in agile values, like “individuals and interactions before processes and tools” or “customer collaboration before contract negotiation.” They foster short and iterative planning and learning cycles with fast (customer) feedback as well as interactive and interdisciplinary teamwork across locations.

Popular agile approaches are, for example, Design Thinking, Lean Startup, Scrum, or Kanban. Further general initiatives to increase the overall agility of the organizational R&D structure, the organizational R&D culture, or the R&D support functions might be complementary.

A study by Horváth & Partners with R&D top managers of major German and selected international automotive manufacturers and top tier 1 suppliers was conducted to derive methods for successful implementation and rollout of agile approaches in and beyond software (pre-)development. Expert interviews have been conducted to analyze the following aspects:

- Drivers for agile R&D approaches in automotive R&D systems
- Status quo of agile practices and application contexts
- Implementation barriers and success factors
- Performance outcomes among a multitude of automotive R&D projects across disciplines

The following presents the results of the study concerning these four aspects, derives implications for automotive R&D systems, and provides information about Horváth & Partners’ approach to agile implementation.

Study results

Agile R&D is mainly driven by the desire to improve efficiency

Some R&D managers cite market trends and their dissatisfaction with current R&D processes as drivers for the implementation of agile R&D. Especially the trend of digitalization is thought to raise the demand for agility.

Considering both agile development theory and these aspects, one could assume that agile approaches are implemented into R&D systems to build more innovative and consumer-centric products by handling complexity and dynamics. Interestingly however, most of the interviewed R&D managers considered the major driver for agile approaches to be the desire to increase efficiency – more so than effectiveness or steering ability.

![Fig. 1: Drivers for agile implementation in percent](image-url)
increase effectiveness. However, reduction in time to market was not predominated by cost efficiency aspects or speed and “fast effectiveness.”

R&D managers who decide to implement or roll out agile approaches need to be aware that agile is not just about exploiting efficiency potentials. Agile is about building an innovative R&D culture and fostering the responsiveness of R&D activities, in particular. Since agile fosters team collaboration, employee motivation, and performance transparency, increased efficiency can of course be an attractive side effect.

**Agile is mostly manifested in the form of Scrum and applied in software development**

As mentioned above, a multitude of agile development approaches exist. However, across all studied automotive companies, only (customized) Scrum is currently applied. Additionally, one supplier plans to expand agile activities by becoming a network organization and implementing elements from the Lean Startup methodology. Corresponding initiatives comprise the creation of a platform that fosters the lean foundation of spin-off startups built around ideas from informal groups of employees. In this context, Lean Startup ideas should trigger a shift of managerial mindsets to support customer-centricity and collaboration, including early measurement of the market response of prototyped products.

**Automotive agile software development**

Since software development is providing the perfect basis for rapid iterative development cadences, Scrum is mostly applied for automotive software development projects. Examples for these agile software projects are:

- An OEM and a supplier collaboratively deliver software into a cloud platform in four-hour iterations
- A multitude of enterprise IT development projects at another OEM
- A software innovation project and enterprise IT projects at a supplier

**Automotive agile non-software development**

While Scrum is mainly used in product, software, and enterprise IT development, proof of successful application in mechanics development exists. Three tier 1 suppliers have validated that Scrum can successfully be applied to embedded systems and mechanics development projects (see Figure 2).

Non-software development projects that are carried out with agile approaches are, for example:

- A multitude of diverse interior series-development projects
- A gearbox pre-development pilot project with 20 engineers
- Projects across disciplines, including steering devices, powertrain technologies, battery management systems, and autonomous driving topics

Due to transition risks in customer-facing projects, Scrum is mostly applied in the field of pre-development rather than series-development. Especially OEMs are careful concerning the rollout of agile activities: Non-software development activities as well as series-development projects are still consistently carried out according to traditional waterfall rather than agile approaches.

**Benchmarking maturity of agile adoption**

A variety of interconnected aspects determines the adoption maturity of agile approaches in automotive R&D systems. Some of them are the diffusion of agile in terms of employee scope and R&D disciplines, the cultural assimilation of agile values, awareness among engineers, management support and methodical coverage by the Project Management Office, organizational experience, as well as the maturity of agile methods.

These aspects have been analyzed within the studied companies and used to benchmark the companies in an adoption model (adapted from Christensen’s change management theory).
Figure 3 shows that most studied automotive IT and software organizations are beyond the agile pilot phase. First cases of Scrum application go back to 2005. On average, the first pilot projects were launched in 2010. Automotive companies, that are relatively mature in terms of agile adoption (acceptance phase), have at least six years of organizational experience with agile approaches: Agile implementation requires incubation time.

However, for all of them, the journey towards agile mastery is long and many hurdles need to be overcome. But what does agile mastery entail? Agile mastery includes a wide diffusion of agile approaches, such as the adaption of support functions and the assimilation of an agile R&D culture.

**Four organizational domains need to be addressed when implementing agile**

Based on the inductive question “Which barriers did you face when implementing and rolling out Scrum in your R&D area?” the interviewed R&D managers referenced 42 different implementation barriers. It can be derived that a multitude of different barriers impede a fast journey to agile mastery. Implementation barriers are mostly individual rather than collective.

Similarly, 26 different success factors have been mentioned. The referenced barriers and success factors were structured into four organizational domains: support functions, R&D process landscape, R&D culture, and engineering and leadership mindsets.

Consequently, to holistically implement and roll out agile initiatives in automotive R&D, managers need to respectively resolve barriers as well as nurture success factors in all four domains.

**Implementation barriers for automotive agile**

Major barriers for implementing agile in automotive R&D systems are:

- Domain of support functions consists of quality management (esp. ISO 26262, ISO 15649, etc.), procurement procedures, and prototype production time.
- Domain of R&D process landscape involves a relationship between agile methods and the corporate product creation process, inconsistent agile understanding, and splitting mechanical products/systems into increments that suit agile sprints.
- Domain of R&D culture includes an ingrained hierarchical role structure, low organizational maneuverability, and low entrepreneurial responsibility for managers.
- Domain of engineering and leadership mindsets comprises the change affinity of employees, mindset of leaders (authoritarian rather than cooperative leadership styles), and leadership skills for agile roles (Scrum Master and Product Owner).

**Success factors for agile implementation**

Major success factors for agile in these four organizational domains are:

- Domain of support functions incorporates top management support, rapid prototyping and testing technologies (3D printing, simulation, road to rig testing, etc.), and methodical coverage by PMO.
- Domain of R&D process landscape provides an analysis of project typology, project environment, etc. for suitable application of agile methods in R&D projects, systematic adoption of agile framework, and early integration of employees in definition of processes/agile framework.
- Domain of R&D culture embodies an intrinsic manifestation of agile values, bottom-up pull for agile, and management mandate to transfer power.
- Domain of engineering and leadership mindsets involves coaching, servant leadership styles, and experienced, but not solely as specialists (“T-shaped” engineers).

Some of the success factors, like 3D printing, can be considered counteractions to barriers, like long prototype production times. Interestingly, in the domains of support functions and mindsets, few counteractions for the mentioned implementation barriers have been referenced.

<table>
<thead>
<tr>
<th># Implementation barriers</th>
<th>Domain</th>
<th># Success factors</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Support functions</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>R&amp;D Processes</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>R&amp;D Culture</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Engineering and leadership mindset</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>42 different barriers mentioned</td>
<td>26 different success factors mentioned</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4: Compares quantity of referenced implementation barriers and success factors in four domains

Agile implementation in automotive R&D is different from agile implementation in the software industry. Figure 4 indicates that, in automotive R&D, support of functional and individual mindset issues often impedes R&D systems from achieving agile mastery. Literature mostly focuses on agile principles and values rather than individual change issues and the adoption of the corporate governance models.

When transitioning from waterfall to agile, individual change management initiatives (e.g. coaching) need to be defined and recruiting patterns adapted. Considering the issue of support functions, implementing agile incorporates more than just changes in R&D project teams and their processes: The governance model, ingrained product creation processes, as well as support functions like quality management systems, procurement procedures, project controlling mechanisms, prototype production technologies, testing procedures and technologies, and many more need to be adapted.

© Horváth & Partners 2016
Agile projects show high performance, however, they often require incubation time

77 percent of interviewees mentioned that the implementation of agile approaches has a (highly) positive impact on overall project performance (see Figure 5).

The high overall performance of agile projects is often explained by increased employee motivation (62 percent), intensified collaboration (54 percent) and improved transparency concerning team performance and impediments (31 percent).

For example, the representative of a supplier that is applying agile across many interior development projects mentioned that “agile helped many R&D teams regain high motivation.” The PMO manager of one supplier that has just launched an agile pilot project to develop a gearbox mentioned that “the implementation of agile naturally fostered the communication density of our engineers.” A head of an R&D division at an OEM mentioned that “the implementation of agile has improved the communication and reporting effectiveness, since the daily visualization of the project status serves as a consistent and clear overview for all project stakeholders.”

![Performance Outcomes and Reference Frequency](image)

Due to a lack of comparability, a specific, measurable performance impact of agile approaches has not been provided. The collective body of subjective positive performance results however, indicates that project efficiency, responsiveness to volatile requirements, and steering ability can be drastically improved by agile approaches.

Negative impacts on long-term project results have only been mentioned by one R&D manager who perceives an increased risk for product quality after implementing agile, since testing procedures are not able to keep pace with fast, iterative agile development cycles.

To achieve the performance gain at all, boundary conditions of the projects need to suit agile approaches. Thus, the project typology, including the discipline, cycle, and the novelty of the developed technology need to be analyzed to determine if an agile approach is preferable, or if the project is predictable enough to be managed by a waterfall approach. Differentiating between complicated and complex development projects by considering a framework can support this decision. Moreover, distinguishing between capability exploration (suitable field for agile approaches) and capability exploitation (potentially more suitable for waterfall approaches) might serve as a tool to determine an appropriate R&D approach.

Achieving high performance in agile projects often requires incubation time and overall target setting with regard to effectiveness as opposed to focusing on the desire to reduce costs. When implementing agile in the first place, 46 percent of managers faced (tremendous) setbacks. For example, the PMO manager of one company was quoted as saying “we had to relaunch the agile pilot project after four weeks since we did not initially understand agile and its values.” The head of the agile coaches at an automotive mechanics supplier that supported the set-up of more than 70 agile teams said “with nearly all new agile teams we have passed through the valley of tears.”

Implications for the journey to agile mastery

Nearly all interviewees agreed that their R&D divisions plan to progress on the path towards further agile diffusion. As indicated above, increasing the maturity of agile activities requires change management regarding individual mindsets and cultural values, methodical transition of the R&D process landscape, as well as orchestration of the governance model’s respective support functions.

Best-practice implementation needs to be replaced by tailoring and experimentation

The diverse range of implementation barriers and success factors that R&D managers experienced when implementing agile approaches in their R&D projects indicates that agile implementation is not about copying Best Practices.

Insights from systems theory support this notion since they claim that in complex and dynamic project environments, which are the primary application field for agile approaches, Emerging Practices replace Best Practices.

To a large extent, agile implementation and rollout need to be based on tailoring initiatives in the fields of change management, methodical transition, and functional orchestration support. These tailored approaches should be continuously adapted in a “probe, sense, and respond cycle.” In other words, implementation of agile approaches requires an agile implementation procedure.
A systematic comparison between “Agile High Performers” and “Agile Conservatives” supports the aforementioned notion. The comparison showed that there are only three generic differentiators between Agile High Performers and Agile Conservatives:

- Higher degree of integration of processual, thematic, and organizational silos
- Orchestrated governance model (process landscape and support functions) for iterative, agile R&D
- Management-supported, bottom-up implementation of agile initiatives

Implications for the journey to agile mastery

The analysis of current agile practices revealed that these are often limited to pre-development and software development, and are rarely applied to collaborative OEM-supplier projects.

Strict processual, thematic, and organizational silos are impeding agile from diffusing into these fields.

Processual silo integration

The full potential of the agile approach for performance and organizational adaptability is only gained if it is applied throughout all development cycles. Thus, agile pre-development projects with a Lean Start-up philosophy, for example, will overcome the virtual border to series development by using their pre-dominant customer focus to accommodate both internal process customers and external customers.

Thematic silo integration

One of the interviewed R&D program managers expressed the thematic silo situation by saying, “in our device evolution steering project, our hardware and software development are strongly separated – our hardware developers typically never get in touch with the software developers.” Similarly, a R&D manager at an OEM addressed the issue of having “a product creation process with two velocities”. While the software product creation process is already agile-enabled and shows a higher development velocity, the vehicle development process is still rooted in a waterfall mentality.

Since agile requires cross-functional collaboration, convergence of software and non-software engineering teams, development activities, corresponding departments and managerial roles is required. Customers are looking forward to seamless digital-physical experiences, so automotive R&D organizations should fuse their digital and physical teams accordingly.

Organizational silo integration

Agile development requires close customer collaboration to get early product feedback. In automotive R&D value chains, agile mastery requires supplier integration. Suppliers and OEMs should form trusted partnerships with frequent feedback meetings rather than infrequent sales pitches. For example, one interviewed OEM R&D manager has just launched an intense supplier partnership like this for one agile software project. In four hour iterations, the OEM and the supplier team deliver into a cloud-based collaboration platform.

Agile mastery means adoption of the governance model with iterative R&D

The identified implementation barriers in the domain of support functions indicate the need for levers and instruments to face these challenges.

Additionally, in the context of product creation processes, the ingrained R&D process landscape requires adaption to the new customer time frame, and flexibility to integrate agile projects. In short, the overall corporate governance model must suit agile activities. Without an agile-enabled governance model it becomes difficult to extend agile approaches from team level to project level and finally the organizational level.

To reduce performance losses, an update of the entire Development Process to an integrated agile one with agile-oriented governance and steering mechanisms is necessary. For example, support functions like quality management systems, procurement, and project controlling or supplier relations need to be aligned. State-of-the-art and new technologies like virtual design and rapid prototyping (fostered by additive manufacturing) are levers for applying agile outside the arena of software development.

Speed up incubation with management-supported, bottom-up implementation

Agile implementation requires committed individuals who are intrinsically willing to work in an agile environment. For high performance employees who focus on team achievements rather than only personal achievements and who are willing to work in a culture of trust and transparency rather than control, agile approaches can enrich work life. On the other hand, employees who prefer traditional approaches rather than challenging the status-quo find agile initiatives difficult to accept.

A systematic performance evaluation of agile projects revealed that projects in companies where agile was triggered from the bottom up show 81 percent higher performance than the ones where agile had been triggered from the top down.

One interviewee, for example, reported superficial implementation of agile approaches after a management objective to transform waterfall methodologies into agile approaches had been declared. True employee engagement and cultural change is difficult to achieve with a solely top-down approach.

On the other hand, employees in software development at an interviewed OEM were willing to work according to agile approaches and founded a grassroots movement to pursue the
path towards agile R&D. They gather in Communities of Practice to design and implement aspects of Scrum into their R&D process landscape. Their ambition of transitioning 60 percent of the software projects to agile-driven projects is now supported by top-level management.

With this in mind, R&D managers who are willing to foster agile activities should consider themselves as enablers. Identifying and empowering teams that are willing to implement e.g. Scrum and create the right environment to let agile pilot projects and rollout initiatives flourish.

**Agile implementation requires a holistic and human-centric approach**

We have analyzed a variety of automotive agile projects. Many of them failed because agile was implemented as a purely methodical transition. To succeed, implementation and roll out of agile approaches to automotive R&D require a holistic approach.

First of all, an analysis of the (sub)project typology should be conducted to determine whether agile is an appropriate approach, regardless in what phase (pre-development or series development), domain (E/E, powertrain, etc.), or topic (connected car or assistance systems, etc.).

Secondly, managers need to avoid many different kinds of implementation barriers with regard to success factors in the domains of support functions, processes, culture, and mindsets. This requires tailored initiatives concerning change management, methodical transition, and organizational orchestration.

Iterating and adapting those initiatives based on agile process performance ensures achievement of agile mastery.

Horváth & Partners’ iterative implementation procedure is based on this framework and helps clients exploit the full potential of agile transformation in automotive R&D.

**What role does agile play in your organization?**

We would be happy to discuss the relevance of these challenges for the development of your organization with you. We will help you see what specific steps can be taken to secure the financial success of your company from an organizational perspective.
Horváth & Partners – Management Consultants

Horváth & Partners are independent, international management consultants with over 600 highly qualified employees. Founded in 1981 and headquartered in Stuttgart, Germany, we have offices at locations in Germany, Austria, Hungary, Romania, Saudi Arabia, Switzerland and the United Arab Emirates. Moreover, Horváth & Partners are a proud member of the Cordence Worldwide global management consulting partnership, which strengthens our ability to undertake consulting projects in important economic regions of the world with the highest professional expertise and precise knowledge of local circumstances.

Our core competences lie in the fields of Corporate Performance Management and Performance Optimization - both for the entire company and for the business and functional areas of Strategy, Innovation, Organization, Sales, Operations, Controlling, Finance and IT. Horváth & Partners stand for project results which create sustainable benefit, which is why we accompany our clients through the entire process from developing the business concept through to anchoring via integration into processes and systems.