BUSINESS AGILITY IN AUTOMOTIVE

How to transform towards an adaptive
organization for the future of mobility
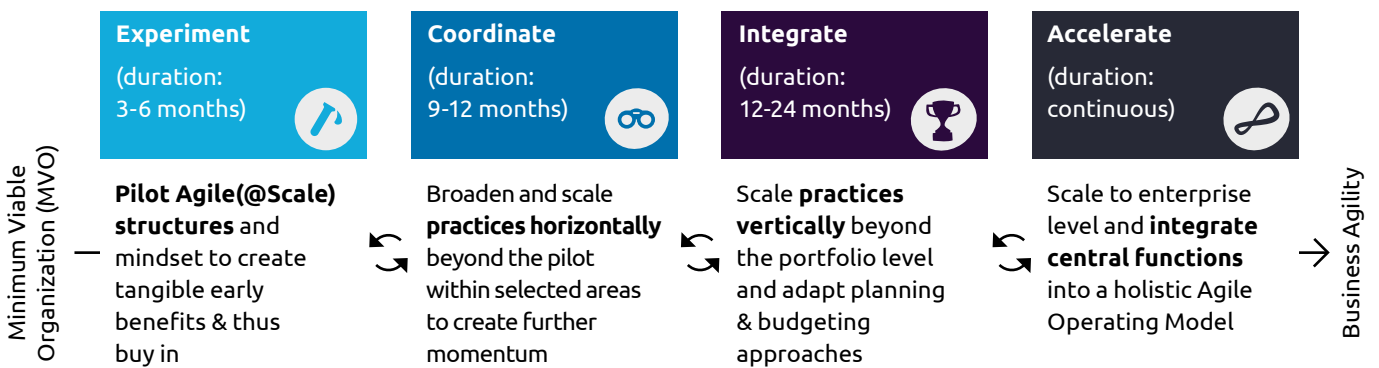
MANAGEMENT SUMMARY

Software is increasingly business critical to the automotive industry, but OEMs cannot achieve the necessary end to end softwarization without Business Agility. That means adopting Agile approaches right across the organization not just within software development but also for embedded software and even in central functions such as marketing.

Without Business Agility, OEMs will be unable to compete with new market entrants or adapt to a world that is transforming rapidly towards customer-centricity, sustainability, and electrification. Nor will they be able to recruit the talent that they need. At worst, an automotive company could become the new Nokia.

However, working with Agile presents special challenges to the industry – for example the need to comply with exacting regulations, and the difficulty of combining an Agile software development process with the more conventional development (and quality control) processes used for hardware. Those challenges become all the greater when Agile methods have to be scaled across the enterprise. The biggest single challenge, however, is probably the industry's current mindset.

Capgemini recently conducted qualitative and quantitative research into how successfully these challenges are being overcome and what still needs to happen.

Transforming a traditional carmaker with its established structure towards Agile is not done overnight, however it is possible. A four step approach is recommended for piloting Agile, then scaling it horizontally and vertically, and finally achieving true Business Agility.

Experiment (duration: 3-6 months)	Coordinate (duration: 9-12 months)	Integrate (duration: 12-24 months)	Accelerate (duration: continuous)
Pilot Agile(@Scale) structures and mindset to create tangible early benefits & thus buy in	Broaden and scale practices horizontally beyond the pilot within selected areas to create further momentum	Scale practices vertically beyond the portfolio level and adapt planning & budgeting approaches	Scale to enterprise level and integrate central functions into a holistic Agile Operating Model

Minimum Viable Organization (MVO) → Business Agility

Through numerous Agile transformations that Capgemini Invent has successfully led, we summarized our key learnings and good practices as follows:

1. Becoming more software-centric and orchestrating the related decoupled development processes in the context of SOPs

2. Articulation by senior management of the culture change needed.

3. Transformation towards a servant-leadership mindset.

4. Transparency around role change for middle management.

5. Finding innovative ways to remain compliant while becoming Agile.

6. Adapting ways of planning and executing, especially for cyber-physical products.

7. Applying Lean-Agile principles to central functions (finance, marketing, etc.)

8. Use of frameworks such as SAFe to kickstart Agile transformation.

9. Collaborative models based on long term partnerships with external suppliers.

10. An inclusive culture to attract and retain top talent.

Above all, success depends on OEMs' leaders keeping an open mind about Agile in all phases of the enterprise and, especially, "walking the talk." If they do, they can reap the rewards of Business Agility and ensure that their company continues to thrive in the new world that is emerging with the decline of the internal combustion engine.

CONTENTS

WHY AGILE MATTERS TO AUTOMOTIVE COMPANIES

The automotive industry environment is increasingly characterized by volatility, uncertainty, complexity, and ambiguity (VUCA). Companies are having to cope with rapidly changing customer demands, government regulations especially around sustainability, and technological developments such as electrification and autonomous driving. In response, OEMs are realizing that they need to "softwarize" their products, putting software at the heart of their product's value proposition[1].

To deal with this environment, and particularly with the softwarization challenge, companies know that they must overhaul their organizational structures and processes. Having looked to see what has helped "digital native" companies to succeed in a similar situation, nearly all our automotive clients agree that the answer is to become more adaptive as an organization – something that is commonly summarized by the word Agility. This is also strongly supported by the findings of our quantitative survey as the **vast majority (85 % of respondents) consider becoming an adaptive organization as a critical success factor** for the future of mobility

Becoming Agile is not straightforward, of course. Automotive organizations can be viewed in terms of three distinct areas of activity, each with its own Agility needs:

1. Software development (Process IT): e.g mobile apps or digital services solutions

2. Embedded software product development: e.g. autonomous vehicle (AV) and advanced driver assistance system (ADAS) solutions

3. Central functions: e.g. Finance & Accounting, HR, Marketing

While all three can benefit from an Agile way of working, they will need to think about and implement it in a very different way.

Defining Agile and Lean-Agile

The term Agile refers to the mindset and behaviors that support an iterative, incremental approach to manage the continuous development of products in a highly flexible and interactive manner. Typically, it involves self governing, crossfunctional teams working on the product. In this case, "product" might be any kind of deliverable from an Agile team, such as software, a customer product, a process improvement, or a marketing campaign.

The concept of Agile originates from Toyota's Lean manufacturing approach, first introduced in the 1940s to promote continuous improvement and elimination of waste. From the 1990s onwards, these principles have been adopted by the software industry in the form of iterative software development. Agile has developed further to address incremental software development, delivering customer value, and human elements such as team autonomy and self organization.

In recent years, Agile has evolved from being focused purely on the IT domain to non-tech parts of the business, supporting the broader remit of organization-wide Agility, with a focus on creating the right culture and mindset to achieve business objectives. To emphasize the Lean roots of Agile and also to underscore the importance of some Lean concepts not normally attributed to Agile alone, we refer to this aspect of Agile as Lean-Agile throughout this study.

The future of automotive lies in becoming more software-centric, which necessitates a decoupling but orchestration of the development process and timelines of hardware and software, with their respective orientation towards Start of Production (SOP) and over-the-air (OTA) updates.

[1] See also "Next Destination: Software - How automotive OEMs can harness the potential of software-driven transformation"
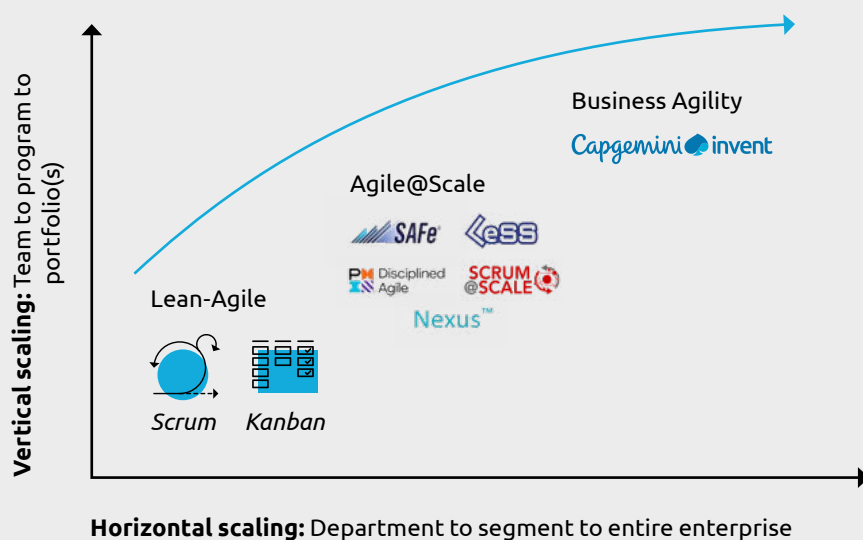
NOT JUST AGILITY BUT BUSINESS AGILITY

Many organizations start by implementing Agile on individual software development projects. While this is fine as a start, it is not enough to achieve what they ultimately need to benefit mostly by working in an Agile mode. This requires what we call Business Agility. Let's look more closely at these terms and how to differentiate them.

In its simplest form, Agile can be applied to product development at team level and that is a good place to start. However, to create a holistic Agile organization, the Agile values, principles and practices, as well as the underlying mindsets, must be scaled beyond individual teams. They should be scaled **horizontally** across entire segments and **vertically** to whole product development programs and portfolios. We call this approach **Agile@Scale**. A number of scaling frameworks are available to help

achieve it, including the Scaled Agile Framework (SAFe), Large-Scale Scrum (LeSS), Nexus, Scrum@Scale, and Disciplined Agile (DA). We will cover these in more detail in later chapters.

Scaling Agile across all product development activities is a good starting point but not enough, however. Organizations need to go further in order to build their ability to rapidly adapt to market and environmental changes in a productive and cost-efficient way. **Business Agility** is achieved when a company is operating in an Agile manner at scale, which means extending Agile approaches to central functions such as HR or Finance & Accounting. As Figure 1 shows, this can be seen as the logical next step after Agile@Scale.

Figure 1. From Lean-Agile to Agile@Scale and onwards to Business Agility

The term Business Agility encapsulates what businesses need to do to adapt to rapid change and to achieve current goals around not just softwarization but also customer-centricity and sustainability. Research confirms that applying Agile in this way brings business value in multiple ways, starting with focusing on what is important to the business and delivering better customer value. It aligns work across the organization and matches it against available development capacity, establishing clear priorities based on a shared vision across teams while empowering employees to take charge.

CHALLENGES OF ACHIEVING BUSINESS AGILITY IN THE AUTOMOTIVE INDUSTRY

Achieving Business Agility is challenging for any company. Horizontal and vertical scaling alone takes several years and needs a strong vision, committed leadership, and a considerable investment. Each individual organization needs to develop its own roadmap for change, since although frameworks exist, they cannot prescribe every detail of what an individual organization needs to do.

Crucially, people at all levels and in all parts of the organization need to own and shape the new way of working: Research shows that for the vast majority of companies, culture and mindset are the main barriers to Agile transformation. Other common challenges are shown in Figure 2.

In addition to these common challenges, automotive companies face some specific challenges of their own.

One such challenge arises from the industry's increasingly exacting regulatory environment, including standards such as Automotive SPICE (ASPICE). It can be challenging to implement Agile processes while maintaining compliance with all relevant regulations, but there is no alternative.

Another automotive-specific challenge is the need to combine an Agile software development process with the more conventional development processes used for hardware, including rigorous quality control processes. At first sight, the two disciplines may look incompatible.

These are daunting challenges, but they must be overcome. If automotive companies do not achieve Business Agility, they will be unable to compete with new market entrants from the high-tech industries. It will also be difficult for them to achieve goals such as customer-centricity, sustainability, and electrification. Nor will they be able to offer the dynamic environment needed to recruit the best talent.

The dangers of not being ahead of the curve here can be seen in the mobile phone industry over the last decade and a half. The benefits of succeeding, on the other hand, are summarized in Figure 3.

1. Culture and leadership

2. Lack of expertise

3. Regulatory requirements

4. Collaboration with external parties

5. Governance structure of the organization

1. Focus on what is important for customer

2. Deliver better customer value

3. Faster value delivery/quicker releases

4. Better employee morale

5. Streamlined work

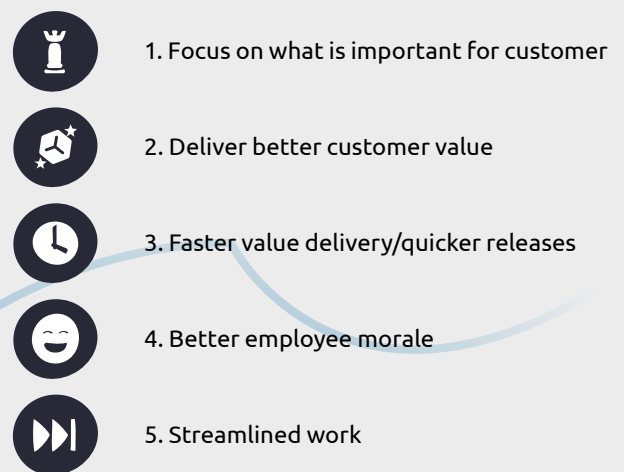Figure 2. Key challenges in scaling Agile

Figure 3. Top five sources of business value from scaling Agile

METHOD: OUR HYPOTHESES AND NEW RESEARCH

The automotive sector urgently needs to understand how it can overcome the challenges and achieve Business Agility. Drawing on our earlier research and our work with clients who are striving to adopt Agile, we formulated some hypotheses about how to achieve success in this area. These cover topics such as software-centricity, senior and middle management leadership, regulatory requirements, central functions, frameworks, collaborative models, and culture.

We recently decided to conduct further research to see how far, and how successfully, Agile is being adopted by the automotive industry, and at the same time to test our hypotheses. This research has both qualitative and quantitative elements:

Quantitative: We created an online questionnaire to better understand where the automotive industry sees itself in terms of Agility. We targeted five of the biggest automotive countries and recruited 1,000 participants representing OEMs, suppliers, and dealers. Germany, the USA, and China each provided about 21% of our sample, while the remainder came from other parts of Europe.

We also conducted one to one interviews with selected senior experts within the automotive industry.

In the following sections, we describe the findings and highlight some resulting recommendations
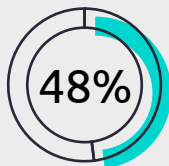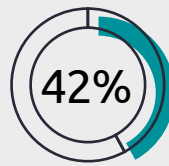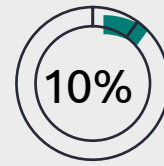
Gender

33% Female

67% Male

Age

48% 18 to 34 years

42% 35 to 54 years

10% 54 to 74 years

Management responsibility

> 10 years	15%
6-10 years	17%
25 years	24%
< 2 years	14%
Non	31%

Industry role

Car Manufacturer	33%
Dealer	25%
Supplier	31%
Others	11%
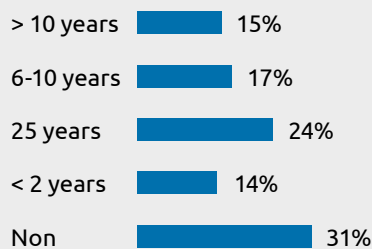
Nationality

21.3% United States

21.3% China

36% Rest of Europe

21.3% Germany
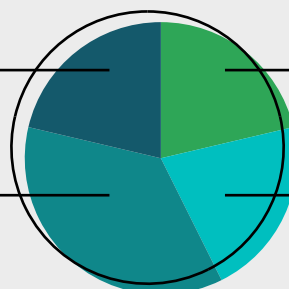
Figure 4. Participants' gender, age, management responsibility, industry role, and nationality

THE AUTOMOTIVE INDUSTRY

Our latest research confirms the importance of Agile to the industry. **Nearly 85% of participants** in our quantitative survey are **convinced** that the **implementation of an Agile way of working is a must for the automotive industry**. The main reasons given are the need to react to changing market and customer requirements, and to address the growing importance of software as part of the vehicle, as well as the integration of hardware and software.

When it comes to the practicalities, however, we found that progress so far is limited, and that our research participants are very aware of the obstacles. As one interviewee put it, *"Mindset is the biggest problem in larger companies – even small decisions are pulled across multiple reporting lines. People have to learn to take responsibility and make decisions. Even if they are not 100% correct, you can always adjust them quickly. The management level must actively participate and accompany the change to Agile with acceptance. Many executives see this as a loss of control."*

"The role of software in Automotive has moved from being a mere enabler to the heart of the value proposition and hence is absolutely crucial for future success!"

GÜLNAZ ÖNES
DIRECTOR ENGINEERING IT & CTO, DAIMLER TRUCKS AG

Overcoming classical TOM implementation with MVO approach

To investigate how far companies have come and what they need to do next, we compared our findings with Capgemini's model for adopting Business Agility. Central to this model is our concept of the Minimum Viable Organization (MVO). This applies Agile's iterative and incremental approach to the task of defining and establishing a suitable Agile Operating Model (AOM) for achieving Business Agility, taking into account the specific context of each organization.

This overcomes the difficulty of understanding up front how - what is normally called - the Target Operating Model (TOM) should look once Lean-Agile has been adopted throughout. Our model starts with a high-level vision of the organizational processes and structures that based on our experience work, and gradually evolves the AOM based on what is learned on each successive MVO iteration. Early in the journey towards Business Agility, it is advisable to establish mechanisms for continuously enriching and improving the AOM repository: These may take the form of a transformation team or center of excellence, as outlined in more detail on page 25.

Below, we discuss our research findings in relation to each of the four steps as well as our original hypotheses and derive recommendations for achieving Business Agility in Automotive.

A well-known example of an MVO-style approach is provided by Spotify. Although the socalled "Spotify model"[2] is not a framework, it is often treated as such. The Swedish media company developed it by gradually introducing a scaling model and iteratively adjusting it based on feedback – exactly the mindset we recommend. To quote a Spotify blog article: "Spotify is (like any good agile company) evolving fast. This article is only a snapshot of our current way of working – a journey in progress, not a journey completed. By the time you read this, things have already changed."

[2] https://blog.crisp.se/wp-content/uploads/2012/11/SpotifyScaling.pdf

STEP 1.
EXPERIMENT

Piloting Agile structures

The keys to success in this step are (1) to start with customer focused initiatives, (2) to adopt the right Agile@Scale framework, and (3) to engage middle management.

Start with customer-focused initiatives

When embarking on an Agile transformation, it's important to quickly provide some tangible benefits to convince stakeholders that the Agile approach will work. Therefore, instead of spending months drawing up a perfect plan and a detailed TOM, it is much better to just get started. If an MVO has been defined early on, a pilot can be selected based on the identified strengths and weaknesses. If not, a pilot area can be defined based on a pilot selection workshop with the goal of showing how to bridge the business-to-IT gap in product development.

To avoid disenchantment and ensure sustainable change, it's best to start small. An individual department or digital hub may be a good place for a pilot, because it is likely to be involved in pure software development, where complexity is typically much lower than for development of cyber-physical systems.

Suitable initiatives for pilots are often to be found within customer-focused functions such as eCommerce, after-sales, or customer self-service. Because these functions are relatively close to the customer, it is easier to try out ideas and get quick feedback. This makes the functions more suitable for an Agile pilot than, say, infotainment development, which is relatively remote from the customer. Customer-focused teams also tend to be more attuned to the type of cross-functional collaboration required in Agile, which reduces the need for a change of mindset early in the Agile transformation.

Adopt the right Agile@Scale framework

Leveraging a proven Agile@Scale framework helps early pilots to achieve transformation benefits faster. They can gather first-hand experience while also building upon existing experience and good practices, both internal and external.

This also means that the organization can more easily scale vertically from team to program level in subsequent steps, without having to reinvent the wheel.

"Agile@Scale frameworks are key to gain speed early in an Agile transformation as they help to avoid reinventing the wheel."

HEAD OF MOBILITY INNOVATIONS AT A PREMIUM OEM

3%
Nexus

3%
Large Scale Scrum (LeSS)

3%
Disciplined Agile (DA)

5%
Spotify Model

9%
Scrum of Scrums

19%
Dont't know

20%
Other
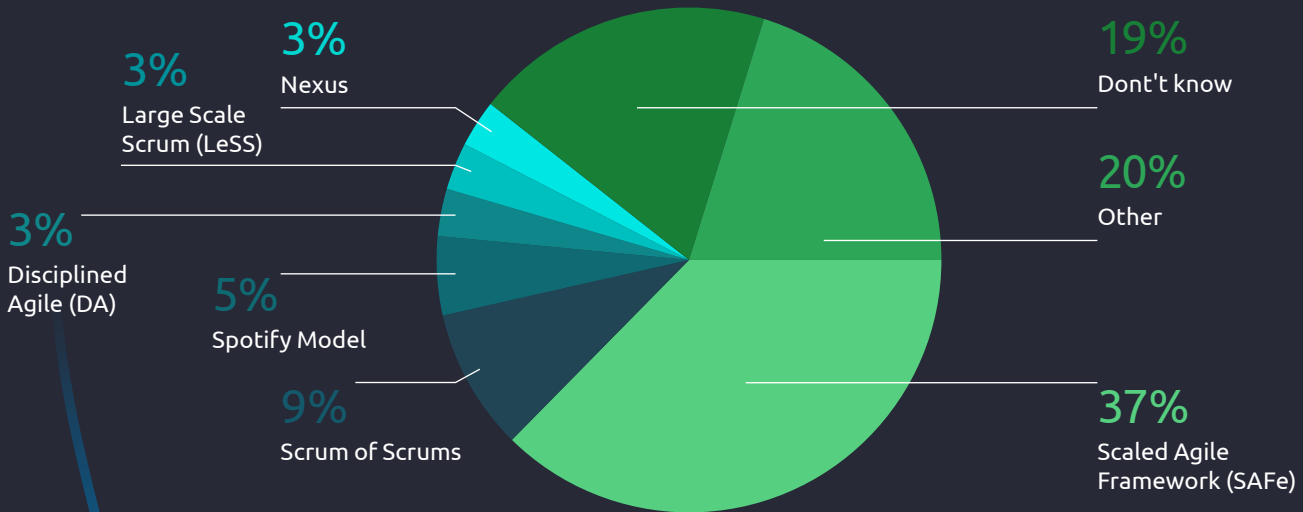
37%
Scaled Agile Framework (SAFe)

Figure 5. Adoption market share of Agile@Scale frameworks

Agile@Scale frameworks (e.g. SAFe) are key to kickstarting an Agile transformation and enabling the organization to avoid reinventing the wheel where there are already proven good practices.

Our qualitative interviews confirm the many benefits of these frameworks. For example, participants say that they promote collaborative working and help participants understand priorities and value streams. When it comes to scaling up Agile or linking Agile processes with conventional ones, they have an important part to play.

So it is slightly worrying to find that only **around 40% of survey participants are familiar with Agile@Scale frameworks** and their content. More than half have not heard of any of the frameworks that we asked about in the survey. These were SAFe, LeSS, Nexus, Scrum@Scale, Disciplined Agile, and also the Spotify model, which, though not a formal framework, is often treated as one. This is even more surprising as, based on our experience within the Automotive sector, Agile@Scale is usually strongly linked to discussions around established frameworks, especially SAFe, which is by far the leading choice, as can be seen above in Figure 5.

Fortunately, this Experiment step provides ample opportunity to increase familiarity with such frameworks prior to scaling Agile further or applying it to more complex product developments.

Engage middle management

The roles of middle managers are usually among those that are affected most by an Agile transformation. It is therefore vital that middle managers view the Agile way of working as an opportunity rather than a threat. To ensure that happens, they should receive early training, and ideally also on the job Agile coaching, so that they understand what the change means for them. While it is important to start the leadership journey as early as possible, especially for middle managers, it will be continued in the further steps, as detailed below.

For the move to an Agile way of working to stick, the commitment of middle managers has to be secured by making it clear how their role may change, and also how they can benefit from this change.

STEP 2. COORDINATE

Horizontal scaling

In this step, organizations start to extend the Agile approach by moving further product development teams, or teams of teams, to the new way of working. Some of these initiatives can be similar to the pilots from the Experiment step, while others can start to tackle more complex product development (e.g. cyber-physical systems) that require the orchestration of more than a couple of Agile teams. The goal should be to use the traction gained from successes during the previous step to expand the application of Lean-Agile principles.

A danger here is that initial successes in the Experiment step may tempt management to try to scale too fast. This can lead to frustration, not least because it takes time to grow the right organizational culture. It is also important to scale – e.g. by setting up a team of teams only where a given product development actually requires it, e.g. due to the number of teams involved, not for its own sake. A coordinated approach to horizontal scaling can often be best achieved by establishing a local Lean-Agile transformation team or center of excellence (see Step 4).

Other keys to success here are (1) to change culture by changing behavior, (2) to adapt leadership skills and styles, and (3) to tackle compliance & regulatory challenges.

Move towards shared ownership

Developing a suitable culture is known to be one of the most important success factors in Agile transformation, as well as one of the hardest aspects to carry out. As Agile is applied to more product developments, and especially to more complex ones, it's essential to also promote a DevOps, or rather DevSecOps[4], mindset and toolchain. The reasons for doing this are not only technical ones. This mindset also raises everyone's awareness of the business value of investments in enablers, e.g. test automation. That in turn makes it easier to further increase the benefits from the new way of working by reducing the time to market, thus avoiding a plateau.

Employees must be encouraged, perhaps with support from the HR department, to develop "T-shaped skills" – that means, the organization should show that it values cross-collaboration as well as individual competencies. Leveraging an Agile@ Scale framework (as outlined in Step 1) can facilitate collaboration by ensuring that people who are working together use the same cadence and terminology.

Senior management needs to articulate a vision and purpose for the type of organizational culture that it is striving for, to guide the overall Agile transformation.

[4] DevOps with security awareness built in at each stage
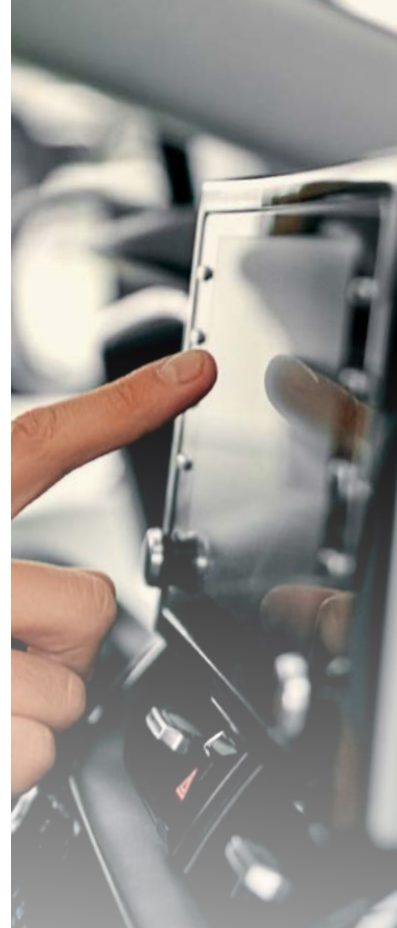
This is especially important when multiple locations are involved, and even more so with multiple continents or time zones.

Figure 6 summarizes some of the most important ways to create a suitable culture.

Leadership level

Onboard executive level

Make leaders at all levels accountable for agility

Showcase value

Encourage adopting Agile practices for leaders and provide coaching support

Team level

Clarify individual roles; empower teams to self-organize and delegate decision making

Bring psychological safety

Enhance transparency through open communication

Market initial successes

Figure 6. Key elements in creating an Lean-Agile culture

Adapt leadership skills and styles

Leaders, as well as employees, must change their behavior for the new ways of working to be sustainable. An important factor in cultural change is empowering employees, while engaging and inspiring them to new ways of working. This need for empowerment implies that leadership must change radically. The aim should be to delegate decision making across all hierarchical levels based on trust and reciprocal transparency, something we call the "Agile trust handshake."

Agile requires managers to provide a clear strategic direction ("what") without micromanaging the operational process ("how"). In other words, managers should serve as enablers and coaches for their teams, rather than traditional bosses who micro-manage everything.

This change of mindset and behavior requires the support of the HR department. It is essential that the new roles required for an Agile way of working are integrated into new career paths and incentive models.

This motivates employees at all levels to buy into the change.

Reluctance to relinquish control in this way is one of the biggest obstacles we usually observe in an Agile transformation, and our research confirms this. Participants most frequently cite organizational culture and leadership as the main obstacles to Agile implementation – with more experienced participants tending to place even more emphasis on this area.

In other words, leaders are often still behaving as they did before, relying on top-down management, status reports, tracking, milestones, and intense upfront planning. It's vital to overcome these challenges and secure genuine management buy in and commitment to Agile. The way to do this is by building on and intensifying the leadership training and coaching established in the previous step.

The importance of lean-agile leadership and culture was also underscored by the outcomes of

our quantitative survey: 70 % of respondents named it as the main challenge and it by far outranked other challenges like e.g. compliance & regulatory ones discussed below.

Transforming towards a servant-leadership mindset and culture is critical in order to unleash the creative energy of self-organized teams and so stay competitive in tomorrow's automotive industry.

Tackle compliance & regulatory challenges

The freedom that an Agile team requires can often be limited by regulatory challenges, particularly for OEMs and suppliers. ASPICE, for example, seems at first glance to conflict with certain areas in the Agile manifesto, with an apparently incompatible view on documentation being the obvious topic.

To prevent this challenge from becoming a distraction from the overall goal of achieving Business Agility, each company must decide how Agile can coexist with ASPICE and other regulatory requirements based on its own specifics. Generally, it can be helpful to involve the quality management function more closely with the development process – perhaps even attending planning sessions. The earlier the change effort begins, the more open-minded people are likely to be, resulting in more innovative adaptations.

Combining Agile with regulatory compliance may require adapting methods of achieving compliance goals; the goals themselves remain as important as ever. For example, a given regulatory requirement could be satisfied piece by piece at different stages of product development, rather than all at once at a specific milestone or quality gate.

Regulatory requirements (e.g. ASPICE) present challenges to applying Agile in automotive but these can be solved through openness to innovative ways of staying compliant.

SINCE THIS IS ONE OF THE KEY CHALLENGES WE EXPERIENCE AT MANY OF OUR AUTOMOTIVE CLIENTS, ON THE NEXT PAGES WE WILL TAKE A DEEP-DIVE INTO HOW WE HAVE HELPED OUR CLIENTS ACHIEVING AGILE PRODUCT DEVELOPMENT FOR COMPLEX AUTOMOTIVE SYSTEMS IN THE CONTEXT OF REGULATORY CHALLENGES

# Deep dive: Agile product development for complex automotive systems?

Statements like "Agile and ASPICE/ ISO 26262 compliance are incompatible" are quite common when talking to many of our Automotive clients about transforming towards Business Agility. This begs the question, whether Agile is only applicable to software development or also for embedded systems engineering?

In the automotive industry, the socalled V-model builds a common foundation of a product development process for embedded and complex systems. While the left side of the V-model represents the interdisciplinary system design beginning with requirements definition to the actual design of the system both hardware and software, the right side describes the system integration and validation activities.

ASPICE follows this V-model structure to achieve process maturity, a major challenge especially in the context of product features like autonomous driving, as process maturity contributes to product quality in that a more structured approach is deemed to reduce the likelihood of initiating systematic faults into the product. ASPICE classifies the maturity of the relevant processes into different capability levels against a standardized baseline.
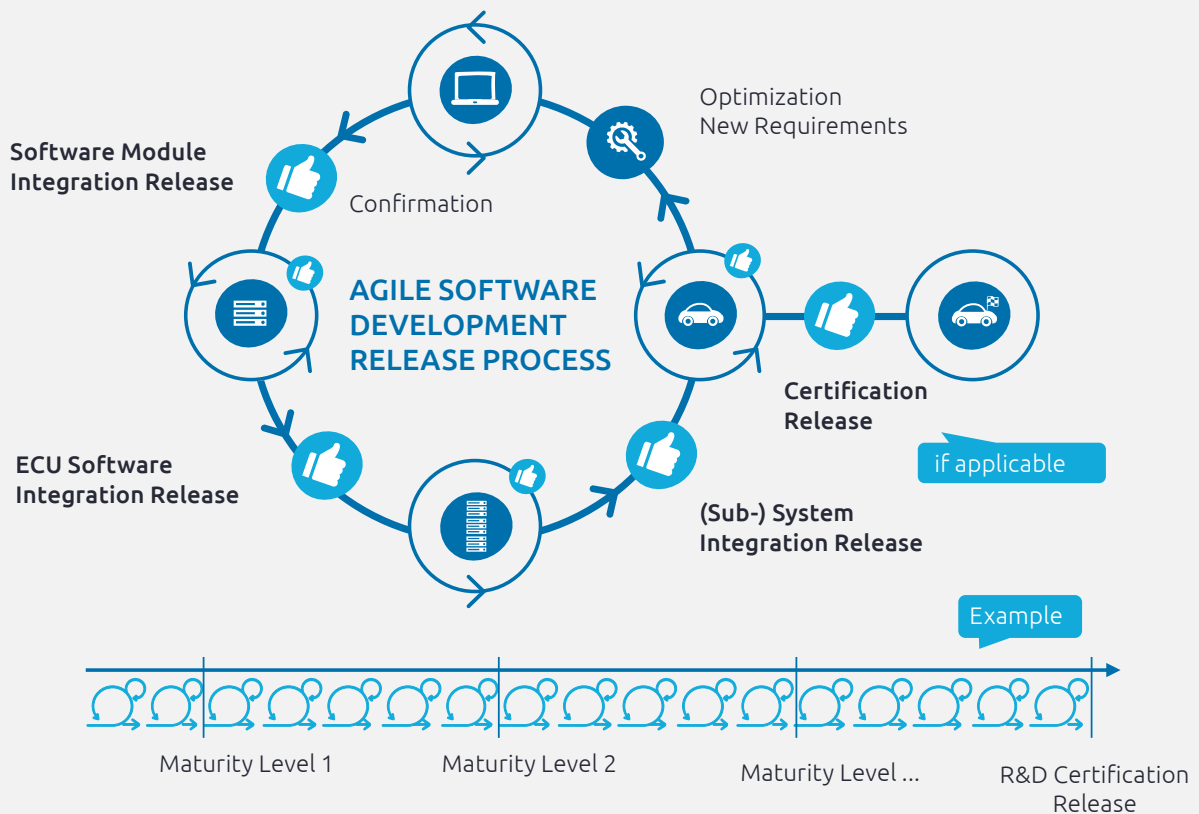
SOFTWARE RELEASE PROCESS
Multiple release stages

- 👍 Software Module
- 👍 ECU Software
- 👍 (Sub-) System
- 👍 Certification

Safety critical embedded software needs to be developed with multiple integration stages to ensure system integration. Continuous reviews of all deliverables in each integration stage ensure product and process quality.

Figure 7. How to achieve software compliance through multiple integration and release stages

As we described earlier in this study (see page 4), Agile refers to an iterative and incremental approach, where product requirements and solutions evolve through collaboration between selforganized, cross-functional teams. It promotes incremental planning, evolutionary development and delivery, a time boxed iterative approach, and encourages a rapid and flexible response to change as well as fast feedback loops of the development team with the customer or its proxy.

To allow such fast feedback loops and iterations in product development, digital technologies are a key enabler to accelerate the cycles from requirement specification through design to implementation and testing. As we outline on the next page, virtualization of key process steps like prototyping and testing enables us to run multiple development iterations in very short, agile style iterations.

Based on our practical project experience, in the table below we have outlined some misconceptions and our point of view around Agile and ASPICE. To navigate through regulatory requirements, it helps to differentiate between "what" they are trying to accomplish and distinguish that from "how" compliance can be achieved.

Common misconception	Our point of view
ASPICE (V-model) requires waterfall ASPICE necessitates a waterfall model lifecycle while iterations and incremental product development are not allowed or possible. Further it is said that ASPICE requires predefined work products which need to be available at predetermined point in time.	ASPICE focuses on the "what", meaning it does not require any specific lifecycle model. Therefore, it does also not predefine any specific activity sequence nor due dates of deliverables. On the contrary, ASPICE prescribes the selection and usage of an appropriate life-cycle model, defining process sequences. The selection of such a model is part of the "how" to achieve the regulatory requirement, a question that each respective organization has to decide for themselves.
ASPICE requires predefined work products: ASPICE defines socalled work products and raises certain content expectations towards them. This means all the work products need to be created in the same way following a predescribed structure. Since work product characteristics are comprehensive, extensive documentation is the result.	The actual structure, form and content of work products must be decided by the organization itself, ensuring that it is appropriate for the intended purpose and needs of its product development goals. This means that work products that are perceived as extensive or without purpose are a sign of not being pragmatic and a lack of focus on added value.
Agile has no defined processes: Self-organized teams allow members to change the way they work from day to day. Therefore, there are no mandatory process elements or documentation requirements.	Agile frameworks such as Scrum do very clearly describe roles, ceremonies, and artefacts. Since these are fundamental elements of any process definition, they can absolutely be the basis to also fulfil formal requirement.

Documentation can be neglected when working Agile:

The Agile Manifesto states that "working software is valued more than comprehensive documentation". This is interpreted as if creating anything beyond the working software (e.g. documentation) is not relevant nor wanted

There often is a misunderstanding based on the values of the Agile Manifesto, as readers forget that it also clearly mentions that the second part of each statement is still of value and relevant. Furthermore, documentation should be differentiated between volatile and permanent documentation, of which the latter should absolutely be following predefined standards. Last but not least, while documentation does have its role, it will probably be incrementally created based on the way work is being performed (e.g. user stories).

Agile does not work for larger (distributed) product development:

Scrum focus on single teams with fewer than 10 team members, whereas it doesn't outline how to collaborate across multiple teams. On the other hand, traditional project management and ASPICE processes are designed to handle large projects

While it is true that Scrum originally only focused on the team-level, socalled Agile@Scale frameworks (see also page 11) have since been developed which help scaling to larger settings or even geographically distributed environments. In addition, this is another case in which ASPICE through its focus on the "what" leaves flexibility in terms of "how" an OEM decides to achieve process maturity.

As we outlined common misconceptions and our point of view, it becomes clear that Agile and regulatory requirements such as ASPICE do not necessarily contradict each other. But how do you comply with ASPICE requirements while developing in an iterative and incremental manner?

The traditional design-flow procedure of the V-model has a general performance issue: in the past software was developed after the hardware was delivered and change requests would end up in huge documentation effort and raising development cost. To master this situation of complex cyber-physical development and the pressure with respect to time to market, cost and engineering efforts, frontloading through virtual prototypes and continuous integration is the key which allows for a shift to the left of the right side of the V-model. As a result of this "shift to the left" approach towards a parallel execution of decomposition, definition & design, implementation, integration & testing, transforms the V-model rather into an II-Model. Based on virtual prototyping, not only the advantage

of a reduction in time to market, cost and effort via frontloading can be achieved, but also a general increase of product quality which can result for example in fewer product recalls.

Virtual prototypes are based on socalled X-in-the-Loop practices and are used to reduce the distance between the traditional V-model phases.

- **Requirements in the loop** allows system architects to analyze system specifications, which make it possible to detect incorrect, missing or even conflicting requirements before any design or coding is initiated

- **Model in the loop** is applied in early stages to verify basic decisions about architecture and design and test whether it is implementable

- **Software in the loop** tests the functions of the program code complied for the target Electronic Control Unit (ECU) but without including real hardware

- **Processor in the loop** performs further tests in an environment

model to verify code before it is inserted into the ECU

- **Hardware in the loop** replaces the model with hardware and verifies and validates the software in the physical target ECU

- **Virtual hardware in the loop** analyzing virtual hardware in order to verify software deployment and the functional realization of hardware functions

These approaches enable fast, iterative and Agile verification on a given system architecture level that represents the software and hardware entities of a product. To achieve full compliance to both, requirements and standards (ASPICE, ISO26262), the supporting IT landscape should provide full, bidirectional traceability and transparency of the development maturity with ad hoc reports. Leveraging advanced, integrated systems and tools along the systems engineering process enable the benefits of an Agile way-of-working while still complying to the compliance requirements, thus helping to master the challenges of the "software-defined car".

To summarize, instead of incompatibility, Agile Development Practices are a key accelerator for embedded systems engineering, when applied smartly. Based on our experiences, we are convinced that there is no alternative to challenge and overcome the status quo, especially where it matters most: Automotive R&D and car software development.

STEP 3.
INTEGRATE

Vertical scaling

The achievements and insights from the Experiment and Coordinate steps are now extended to the level of program, portfolio, and beyond. The aim is to achieve alignment between the different Agile product developments and the overall enterprise strategy. This is vital because the new way of working can only be sustainable if it is integrated and in sync with the way the enterprise strategy is broken down and operationalized, e.g. through planning & budgeting.

Key considerations during the Integrate step are to (1) realign around value streams from a customer perspective, (2) rethink planning & budgeting methods to increase adaptability, and (3) adopt new partnerships with a long-term horizon in mind.

Realign around value streams from a customer perspective

At this stage, it becomes increasingly important to move from multiple Agile product developments, which are often still operating as Agile islands, to a set-up that is more oriented towards customer value creation. To fully align the relevant parts of the organization from a customer perspective, ways of working need to become more product-center, which necessitates realigning the operational (as opposed to organizational) structure and processes around so-called value streams.

The way to do this is to look at the products being developed for customers and decide who should be collaborating regularly on each product to help the organization to become more customer-centric and offer a seamless customer experience. This requires cross-functional teams integrating all skills to build end-to-end products. This decision should be made without regard to people's location within the organizational chart. The individuals and teams selected to collaborate more closely constitute a (development) value stream.

It is not necessary to integrate the entire company into the Agile model at this stage. To decide who should be integrated, it is helpful to focus on functions that have tended to become critical to go-live near the end of the development process. These tend to be functions that are not obviously part of development but do get involved at later stages, e.g. at traditional quality gates, where functions such as Quality Management suddenly become mission-critical to product go live.

This analysis will reveal that some functions do not need to be integrated into the value stream because they are not (directly) involved in creating customer value. These functions can be kept isolated from major changes at this stage using a dual operating model. However, for the duality to work, it is vital to integrate the Agile parts of the organization – the value streams – into the overarching strategy process governance and steering mechanisms which align with the separation of disciplinary from functional leadership roles.

Rethink planning & budgeting methods to increase adaptability

Above, we noted the importance of synchronizing the Agile parts of the organization with the operationalized enterprise strategy. This is a way to increase adaptability, but it implies a variety of changes. For example, companies must move from traditional multi-year project budgeting to more dynamic, venture capital style budgets for value streams that can typically be adjusted on a quarterly basis. The idea here is that funds are released incrementally as product development progresses against outcome-based metrics. Funding should be reallocated from product developments that are not delivering the intended value to others that are.

Traditional lagging key performance indicators (KPIs) and other measures focusing on process adherence need to be replaced by leading indicators focused on business value. One common approach is the use of Objectives and Key Results (OKRs) to establish a closed-loop system that creates transparency about how decentralized decisions are affecting strategic ambitions.

Within the development of cyber-physical products, e.g. embedded software, this paradigm shift becomes highly challenging. On the one hand, there is a detailed, multi-year product development process including seemingly immovable milestones such as an SOP. On the other hand, Agile acknowledges that planning too far into the future is unrealistic. While at first glance this looks like an unsolvable puzzle, in practice it can be addressed by a shift to using milestones that are oriented towards outcomes rather than output. In addition, architectural advances such as OTA updates facilitate decoupling of hardware and software development cycles, even for embedded systems that in the past were absolutely critical to a SOP.

Figure 8 summarizes some of the industry's key success factors for vertical Agile scaling.

To fully benefit from the Agile way of working, the end to end product development process for cyber-physical products needs to be aligned around a more adaptive way of planning and executing.

Define outcomes not output focused requirements

Establish innovative approaches to stay compliant

Implement flexible contracts (shared risk and reward)

Educate finance and legal on Agile principles

Figure 8. Key success factors for vertical Agile scaling in automotive

"Especially due to higher complexity of underlying technologies, a partnership-based collaboration model is increasingly mission-critical for both OEMs and suppliers!"

HEAD OF PROCESSES, METHODS AND TOOLS (PMT) AT AUTOMOTIVE SUPPLIER

Adopt new partnerships with a long-term horizon in mind

Agile transformation brings a need for effective collaboration as a way to supply missing capabilities fast and increase responsiveness to change. Our research participants emphasize the value of forming strategic partnerships, as opposed to traditional supplier-customer relationships; there must be a common understanding of what is to be achieved. This implies that the connection between the partners must be fairly close, and that key partnerships will probably be long-term ones.

This has implications for procurement. Processes need to be adjusted to allow for closer and more durable collaborations, while also aligning time horizons with shorter planning cycles.

Some of our research participants **strongly advocate a shift to special Agile contracts** that are **more flexible** than traditional ones, since rigidly defining contractual terms (e.g. fixed scope) at the beginning of a multi-year engagement is both impossible and inappropriate. The Agile contractual framework should certainly be flexible, but also concrete enough to preclude opportunistic behavior on either side. In addition, joint ventures can be a good alternative to traditional contracts in some situations.

Collaborative models based on long-term partnerships with external suppliers are vital if the organization is to capitalize on the full benefits of the Agile way of working.

STEP 4.
ACCELERATE

Business Agility

In this step, the company moves from Agility within the context of development towards true Business Agility. This means extending the approach to the remaining parts of the organization, especially central functions such as Finance & Accounting, Marketing, etc.

As the majority of the quantitative survey participants have confirmed, unless these functions are on board Agile will be limited to individual developments, and even those may run up against barriers when, for example, finance is not aligned with venture capital style budgeting. Thus, benefits such as increasing customer-centricity would not be realized.

Lean-Agile principles also apply to central functions (HR, Finance & Accounting, Marketing, etc.), meaning they need to align their mindset with the product-oriented parts of the organization.

Leverage cross-functional teams during year-end closing process to achieve earlier stability of figures

Shifting from traditional long booking and review cycles to small, low-risk campaigns aligned to product development cadence

Integrate Legal & Compliance into value streams to ensure products integrate compliance aspects continuously

Integrate HR into value streams to help broadening of skillsets and optimizing career paths around new roles

Early and continuous QM activities to ensure quality is built-in, thus avoiding costly rework later

Finance and Accounting

Sales and Marketing

Legal & Compliance

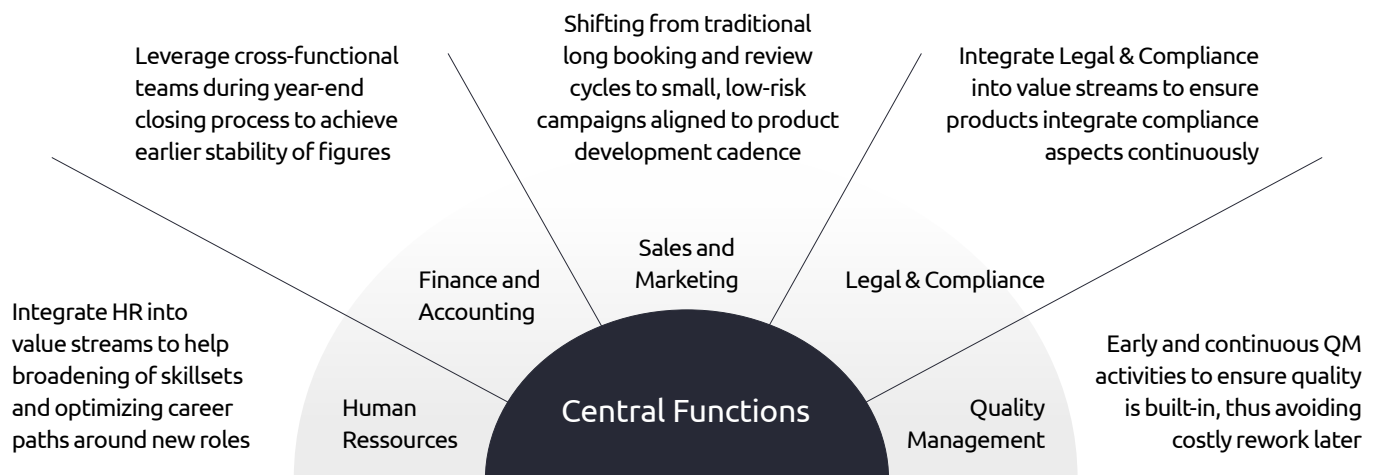Human Ressources

Central Functions

Quality Management

Figure 9. Use cases for Business Agility of Central Functions

At present, few companies have reached this step and so their central functions still tend to be characterized by static hierarchies and silo thinking. In our latest research, **40% of participants see these central functions and their processes as a major obstacle to realizing Agility**. Based on the companies that have reached true Business Agility, Capgemini's experience confirms that this step is where the biggest benefits arise, and so it is important to address it sooner rather than later, without of course bypassing the steps outlined in the previous sections.

Keys to success in this step are to (1) apply Agile in the broadest sense to meet differing needs, (2) embed ongoing improvement in the organization, and (3) continuously improve the culture.

Apply Agile in the broadest sense to meet differing needs

Agile will not look the same in every part of the company. Techniques like Scrum may have little meaning in corporate functions such as finance, but nonetheless some of the fundamental principles of Lean-Agile will be relevant and valuable to them, e.g. applying Kanban during an annual financial close process. Pilots in different central functions may be needed to determine the best approach.

Beyond adjusting the way of working within central functions, employees from central functions will need to work more closely with product development teams, and hence will no longer technically be working in a central function. For example, they might become part of an Agile team of teams (e.g. a product controller in a SAFe Agile Release Train). This approach facilitates cross-functional collaboration, leading to more adaptability and thus a shorter time to market and greater customer centricity.

Other central function employees, by contrast, will remain within their functions, because their work is not directly related to product development. Instead, the way they perform their work will change. Perhaps the central function will restructure itself around its "internal products." For example, an accounting department might form an Agile team of teams, with one such tribe focused on creating the annual financial statement, and so on.

Embed relentless improvement in the organization

Continuous learning and relentless improvement are needed to maintain Business Agility. For example, it can be institutionalized by establishing relevant retrospective ceremonies across all levels of the organization.

It is important to keep integrating feedback on the MVO into the AOM repository. Over time, it should stabilize and the gap between the two parts of the dual operating model established in the Integrate step should narrow. For example, certain value streams could make their way into the organizational chart, thus becoming more stable elements of the Agile Operating Model.

Continuously improve the culture

The new way of working requires a "growth mindset" rather than a fixed one, especially from leaders, together with an open and inclusive organizational culture. Given the ongoing battle for top talent, organizations must continuously check whether their culture is able to attract and retain that talent, and if not make the necessary adjustments. These might relate to mindset, contractual models, remote working, and so on.

Leadership should emphasize the importance of continuous learning. For example, although as noted above the AOM should stabilize during this step, it should never be regarded as set in stone. Rather, it should be kept up to date based on continuing feedback and empirical data (see panel below).

"If traditional OEMs and suppliers want to attract and retain the world's top talents, an inclusive culture is paramount for competing with up-and-coming rivals!"

GÜLNAZ ÖNES
DIRECTOR ENGINEERING IT & CTO, DAIMLER TRUCKS AG

An inclusive culture is key for automotive companies in their quest to attract and retain top talent. That culture must include the right mindset, contractual models, remote working arrangements, etc.

Agile development of the new Operating Model

During the journey to Business Agility, lessons will be learned through MVO iterations about what the Agile Operating Model should look like, and these should be continuously fed back into the AOM repository. It is advisable to create an entity with responsibility for this task.

As early as in the Coordinate step, it makes sense to form a local Agile transformation team or center of excellence to (among other tasks) maintain the aforementioned repository, and generally to consolidate and share the lessons learned. Initially, the team can sit within the relevant department or division.

In later steps, this local team or center can evolve into an enterprise-wide Lean-Agile transformation team or center of excellence. This entity will become increasingly valuable as more and more parts of the organization come within the scope of Agile transformation, increasing the flow of MVO feedback.

Even in the Accelerate step, the AOM should always be regarded as changeable rather than fixed: a mindset that should be nurtured on an ongoing basis. The Agile transformation team or center of excellence should continue to monitor experience and collect feedback from across the enterprise, using it to further enrich and update the Agile Operating Model.

RECOMMENDATIONS

Based on the hypotheses derived from earlier work plus the findings from our latest study, we believe that the following recommendations are fundamental to automotive companies' success in adopting Business Agility.

1. The future of automotive lies in becoming more software-centric, which necessitates a decoupling but orchestration of the development process and timelines of hardware and software, with their respective orientation towards Start of Production (SOP) and over-their (OTA) updates.

2. Senior management needs to articulate a vision and purpose for the type of organizational culture that it is striving for, to guide the overall Agile transformation.

3. Transforming towards a servant-leadership mindset and culture is critical in order to unleash the creative energy of self-organized teams and hence stay competitive in tomorrow's automotive industry.

4. For the move to an Agile way of working to stick, the commitment of middle managers has to be secured by making it clear how their role may change, and also how they can benefit from this change.

5. Regulatory requirements (e.g. ASPICE) present challenges to applying Agile in automotive but these can be solved through openness to innovative ways of staying compliant.

6. To fully benefit from the Agile way of working, the end-to-end product development process for cyber-physical products needs to be aligned around a more adaptive way of planning and executing.

7. Lean-Agile principles also apply to central functions (Finance & Accounting, Marketing, etc.), meaning they need to align their mindset with the product-oriented parts of the organization.

8. Frameworks such as SAFe are key to kickstarting an Agile transformation and enabling the organization to avoid reinventing the wheel where there are already proven good practices.

9. Collaborative models based on long-term partnerships with external suppliers are vital if the organization is to capitalize on the full benefits of the Agile way of working.

10. An inclusive culture is key for automotive companies in their quest to attract and retain top talent. That culture must address issues such as mindset, contractual models, and remote working arrangements.

CONCLUSION

In the age of disruption, automotive companies no longer have a choice about whether to adopt Agile. They must achieve Business Agility in order to successfully tackle imperatives such as the moves towards softwarization, customer-centricity, sustainability and electrification. Without making these changes, they will be unable to recruit the talent needed to stay ahead of new competitors such as those from high-tech industries.

At present, although many automotive companies have been working with Agile for years in specific areas, very few have a cohesive approach that directs the efforts of different teams towards a common vision of Business Agility.

To succeed, it is not enough just to **do** Agile – you have to **be** Agile. This involves putting less emphasis on generic frameworks and more on customizing the approach to suit the organization's culture, while still adhering to Lean-Agile principles. It also implies implementing Agile at organizational level, bringing together the entire product portfolio and all processes.

Working systematically through the four steps described in this report, and following the ten recommendations, will help organizations achieve Business Agility faster and more confidently. Crucially, it will help them adopt the right culture: one of experimentation, learning, and adaptability to changing conditions.

Organization wide Agility is not a destination – it is an ongoing commitment to deliver customer value faster and adapt better to changing conditions. Only when an organization recognizes that the goal posts will and must keep shifting will it truly achieve Business Agility.

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