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MHPSTUDY

AGILITY IN THE AUTOMOTIVE INDUSTRY

Constitutive factors and effects on corporate performance

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Executive Summary

Agility has been a focus of the automotive industry since before the coronavirus crisis: "Some people don't like change, but you need to embrace change if the alternative is a disaster." Quotes such as this from Tesla CEO Elon Musk address the disruptive transformation of the automotive industry – and the demand for agile approaches to change design. This topic is becoming increasingly relevant in view of the coronavirus crisis and the associated uncertainty.

Agility is a key word of the moment – and an important success factor for the future. But what exactly does agility mean? What strategies really influence the agility of original equipment manufacturers (OEMs) in the automotive industry? And how closely are these strategies interconnected?

This study will address these and other questions. The answers are drawn from the latest research, as well as a survey of 26 experts from OEMs in Germany and almost 1,000 executives and employees of the automotive industry. The results of the automotive industry were also compared with a cross-sectoral sample.

Understanding of the concept of agility has grown in recent years. Agility is often associated with flexibility, speed and anticipation of customer needs. But when it comes to specific measures, agile methods at the team level, such as Scrum, Design Thinking or Kanban, are dominant. For example, when asked about the factors that influence agility, over 90% of the OEM representatives surveyed in this study think of the application of methods. Further measures at the level of the corporate structure or the anchoring of agility in structures and processes are mentioned much less frequently. Comprehensive measures to promote agility are therefore rare. In addition, when evaluating the depth of implementation of agile methods, there are clear differences in the perceptions of managers and employees. At the employee level, such methods are little known and poorly defined.

This study clearly shows that increased agility has a positive impact on business performance. However, the promotion of agility does not require individual actions, but a network of different measures. This includes, for example, the adaptation of the organizational structure, the promotion of internal communities, the establishment of competence centers and coaches, as well as the design of decentralized decision-making processes and cross-functional teams.

In addition, leadership and the development of an agile corporate culture are of particular importance. Both factors have a causal influence on the effective design of the aforementioned influencing factors. Managers are therefore particularly important with regard to agility. However, this study shows that there is a clear need for action in this area, as there are significant differences of perceptions between managers and employees, particularly with regard to the status quo of management behavior.

The study also indicates that agility develops in stages, rather than in a linear fashion. The experts surveyed see the crisis as an opportunity to further expand OEMs' capabilities in terms of their own agility. This is urgently needed if OEMs are to take a leading role in shaping the upcoming disruptive transformation of the mobility market.

This document is a short version of the full study. References to the literature used have therefore been omitted.

1) The full study is available at the following link: https://www.researchlab-db.com/agilitaet-in-der-automobilindustrie/

"Some people don´t like change, but you need to embrace change if the alternative is a disaster."

Tesla CEO Elon Musk

01

Introduction and Problem

A multi-stage approach is used to conduct the study. First, relevant issues relating to the design of agility are derived from the available literature. These are then used for expert interviews with managers and employees from different areas and functions of companies in the automotive industry. The aim of the qualitative survey is to identify relevant design elements for agility and to evaluate the status quo in the automotive industry. A quantitative survey of a larger sample of managers and employees of companies in the automotive industry and other sectors is then conducted on this basis.

A network analysis is used to visualize and assess the interactions between different areas of agility design and the impact on business performance. By examining correlations and causal relationships between the various areas, it is shown how individual activities can be bundled effectively and summarized strategically. In addition, the study provides quantitative data on the impact of agility on various aspects of business performance, providing answers to the following questions:

- How is agility defined at a conceptual level?
- What approaches to promoting agility can be distinguished in a corporate context?
- What strategies influence the agility of companies?
- Does agility impact business performance?
- How are the various factors for promoting agility networked?

02

Research Methodology

This study on "Agility in the Automotive Industry" is based on two independent tests and samples.

Expert Interviews

The sample of the qualitative survey is made up of 26 experts from the automotive industry who deal with the topic of agility in their daily work in different functions and forms. The experts surveyed are assigned to seven different OEMs whose parent companies are headquartered in Germany.

In order to cover a broad picture, when selecting the sample it was important to survey interviewees from different functional areas and hierarchy levels (see Figure 1 and Figure 2).

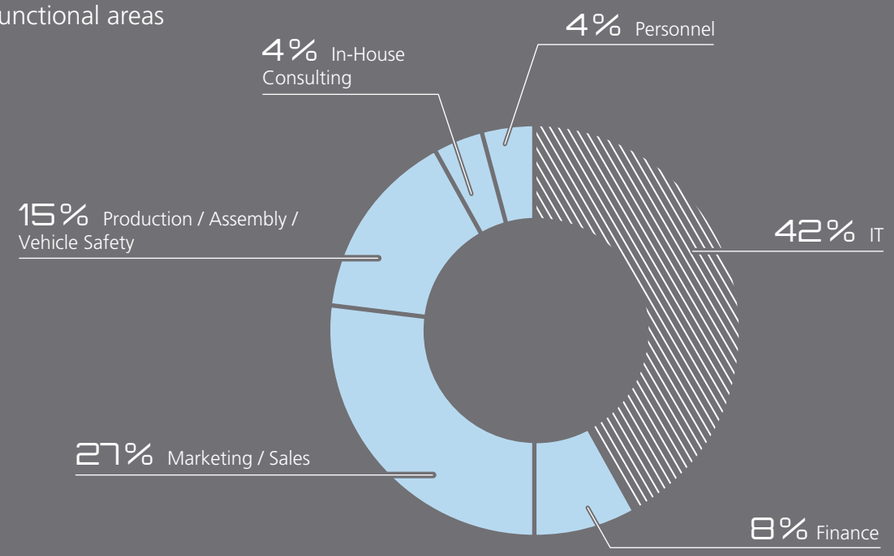
Online Survey

The results of the expert interviews serve as essential input for the subsequent standardized online survey of over 1,386 managers and employees from the automotive industry and other sectors.

As shown in Figure 4, the majority of the participants in the quantitative sample are assigned to the automotive sector, at 68 % (947 respondents). The sample was deliberately chosen in such a way that non-automotives were also questioned, enabling a statement to be made about the degree to which the level of agility in the automotive industry differs from other sectors.

Figure 1

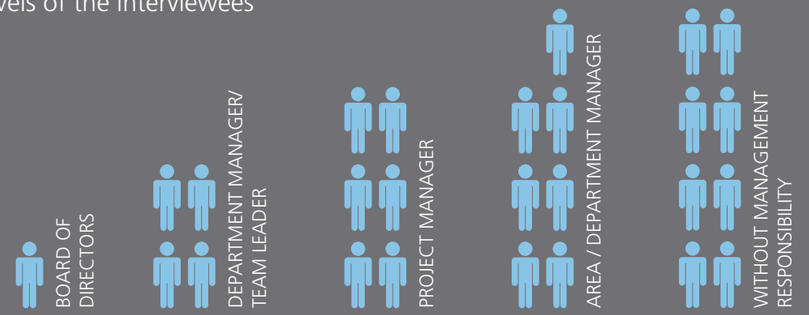
Assignment of the respondents to functional areas



n=26

Figure 2

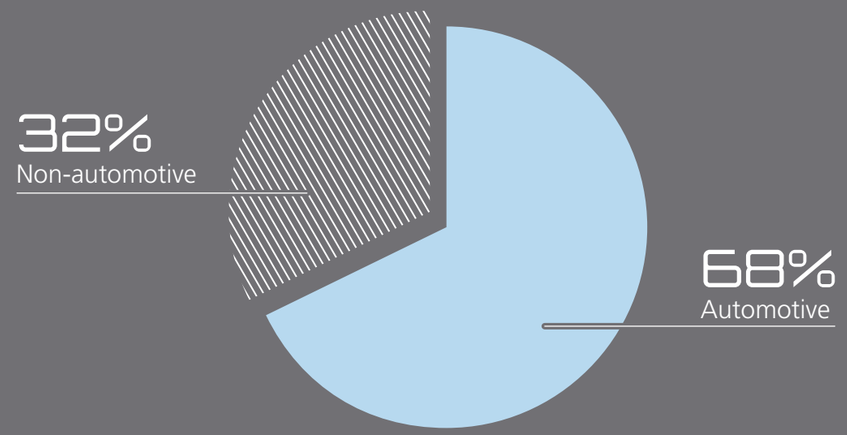
Hierarchy levels of the interviewees



n=26

Figure 3

Composition of the quantitative sample



n=1.386

03

Results of the Expert Interviews

3.1. Importance and Development of Agility in the Automotive Industry

Agility has been a specific topic in the OEMs of the experts surveyed for an average of three to four years. In some companies, this has been the case for only one to two years. Only a few companies have been dealing with this topic for five years or more. In some cases, the promotion of agility is already explicitly part of the corporate strategy, but at least implicitly anchored in the corporate goals. This shows that agility is playing an increasingly important role in the automotive industry. According to most respondents, agility is developing in stages. Crises are often identified as drivers for the promotion of agility. For example, some of the experts surveyed see the diesel crisis as an accelerator for agility, e.g. to develop transparency, error culture and openness. In addition, individual initiatives such as the establishment of dedicated units and central competence centers generate a step-by-step improvement in agility. In this context, software development is considered to be a pioneering field that used agile methods at a much earlier stage.

3.2. Measures to Promote Agility and Their Impact

The most important measure to promote the agility of OEMs is the introduction of agile methods, followed by internal communities, training concepts and structural measures (e.g. organizational changes and competence centers for agility). Figure 4 shows the evaluation of the survey in detail (multiple answers were possible).

However, the implementation of individual measures is generally not sufficient. The individual influencing factors are interconnected. Programs to increase agility should therefore be comprehensive in scope. In future, further measures will focus on areas such as structural support for the application of agile methods and establishing appropriate cultural conditions

The majority of respondents use at least one agile method in the company. The results show that Scrum enjoys widespread use among the companies surveyed. As Scrum is often mentioned in the context of agility, this confirms the general picture of the application of agile methods. In addition, the

Figure 4
Measures to increase agility

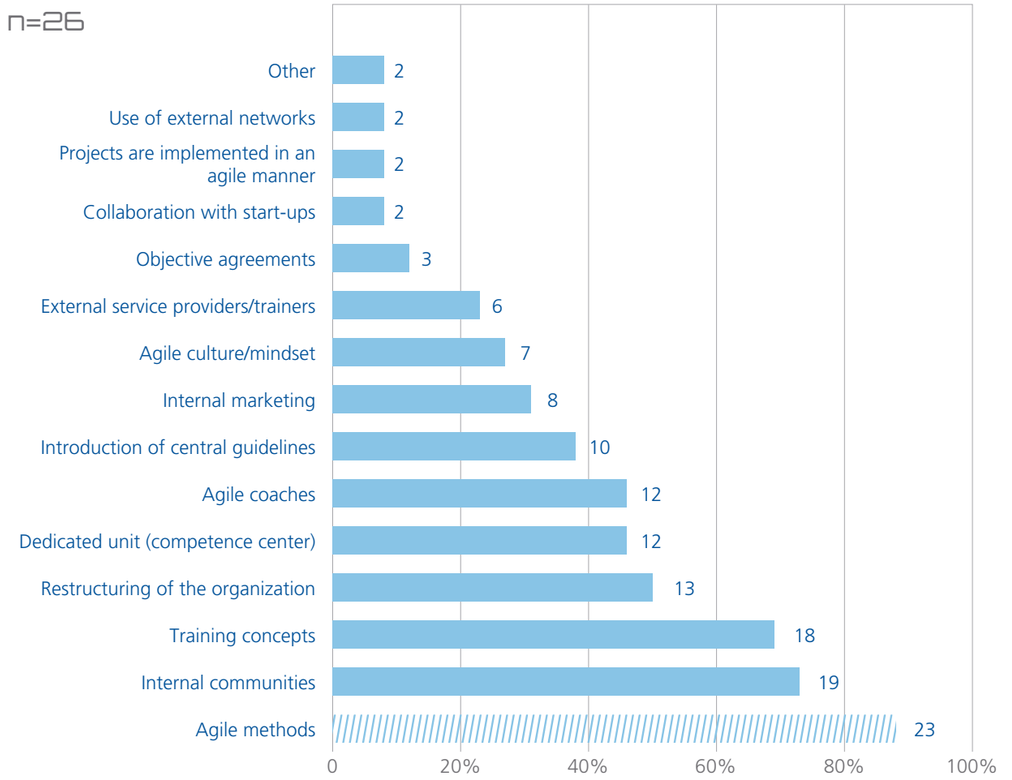
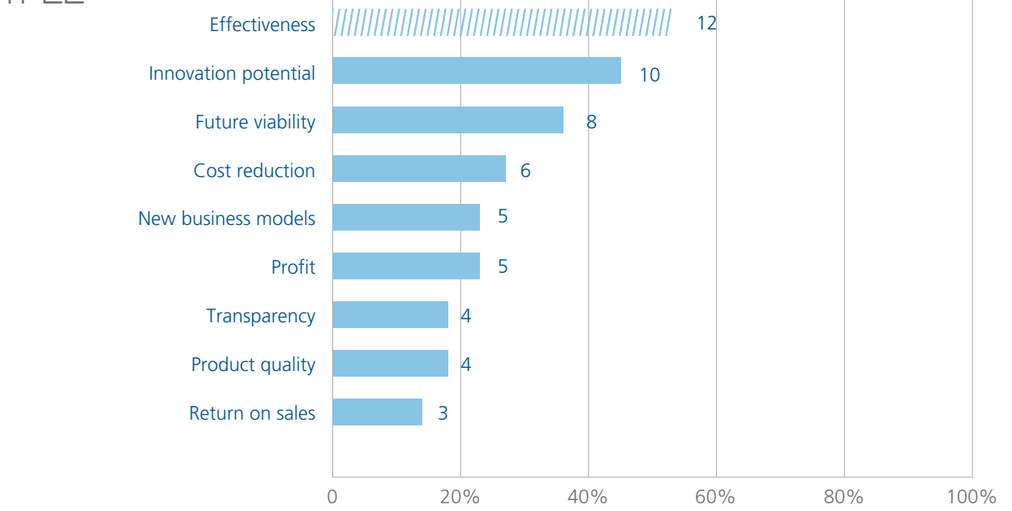


Figure 5
Improved aspects of business performance (multiple answers)



respondents state that Scrum often provides an introduction to agile approaches in companies. Furthermore, Kanban or the combination of Kanban and Scrum have become established as typical agile methods at team level. The organizational model SAFe® is also frequently mentioned. Design Thinking is used less or, in the opinion of the respondents, is not a focus when it comes to drivers of agility.

Initiatives to increase agility primarily result in a higher level of awareness of the subject and stronger employee motivation. Agility also establishes transparency throughout the work process. These and other factors lead to different impacts on business performance. Agility is often interpreted as a basic prerequisite for conventional success indicators.

3.3. Impact of Agility on Business Performance

A clear majority of 85% of respondents highlight an improvement in business performance through agility and link this to conventional success indicators.

The majority (55%) of respondents make reference to increased effectiveness. The respondents make reference to effectiveness in the implementation of processes and projects. The respondents attribute the increased effectiveness to three main aspects: (1) Agile methods produce partial results that work faster, (2) customer satisfaction with results and communication increases, and (3) agile methods motivate the employees involved as they are granted greater degrees of freedom and responsibilities.

3.4. Strategic Importance of Agility

The automotive industry in particular faces considerable challenges due issues such as e-mobility, autonomous driving, integrated mobility concepts, the application of artificial intelligence (AI) methods and the design of flexible and networked production. In the context of the survey, the interviewees compared these subjects in terms of their strategic importance to the promotion of agility. For this purpose, the respondents assessed the specified topics in relation to their relevance to the corporate strategy and prioritized them in relation to each other. For the evaluation, the highest priority (1) was given a value of 5 for the calculation. Participants were able to assign the same priority to multiple topics if they considered it appropriate.[2]

Some 35% (9/26) of respondents note that agility should not be considered in relation to the other listed topics, as agility should be used as the basis for the implementation of the other specified topics. One of the interviewees therefore completely refuses to prioritize the topics.

Some 68% of respondents say e-mobility is the most important factor in the direction of corporate strategy. Future-oriented innovation topics such as integrated mobility concepts and autonomous driving, on the other hand, are rated as priority 1 in only one case. The distribution shows that respondents place these issues below e-mobility and, at most, consider them to be secondary. The use of AI is also perceived to be less relevant than e-mobility: Some 40% (10/25) of the participants assign the topic of AI to priority level 4.

3.5. Challenges in Using Agility

The concept of agility has a disruptive influence on existing structures, processes and the corporate culture. The company-wide introduction and implementation of agility must therefore be accompanied by comprehensive change management.

The majority (55%) of interviewees report that the management culture in their organization inhibits or even prevents the implementation of agility. Very often, the respondents attribute this to the fact that managers see the application of agile working methods as a risk to their position and responsibility. They assume that agility will lead to a loss of responsibility for them. In this context, it is reported that managers prevent the use of agile methods in individual cases.

In addition, the interviewees report that acceptance or knowledge of the relevance of agility is lacking, especially at senior management level. The demands of managers are often not compatible with the iterative approach of agile methods. Some examples include the requirements regarding the reporting of project progress or the changed requirements for the output of a project.

The responses to a proposition regarding incentive systems for managers support this result.

Only 19% of respondents say their organization gives managers an incentive to promote agility. None of the respondents fully agrees with the statement. Half of the respondents actually rejected this proposition. At the same time, however, the experts surveyed stress that management awareness is an important factor in promoting agility. Awareness among managers is therefore particularly important, but is given little systematic promotion.

2) In two cases, priority 5 was not assigned: Instead, in one case, two topics were assigned priority 4; in another case, two topics were assigned priority 3.

Figure 6
Priority of selected topics for the corporate strategy

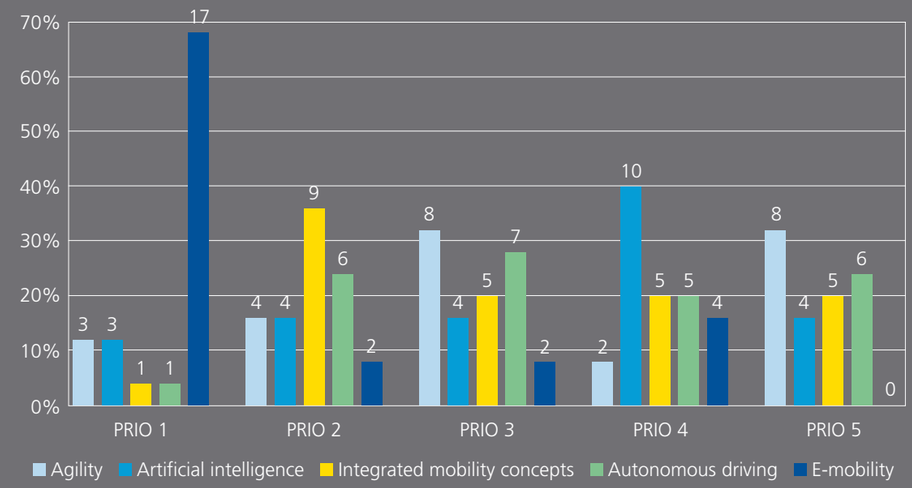


Figure 7
Frequently cited challenges in implementing agility (multiple answers)

n=20

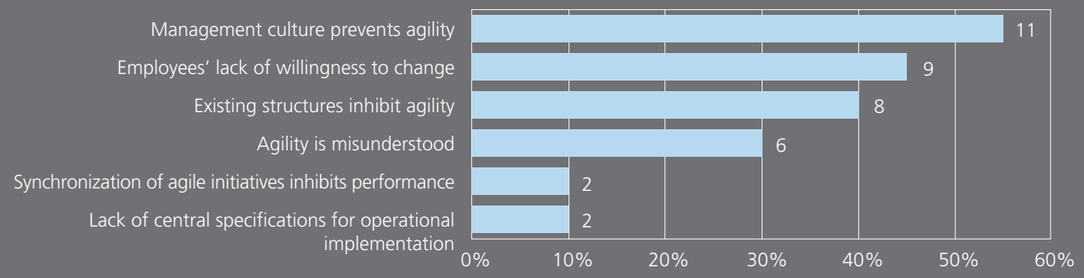
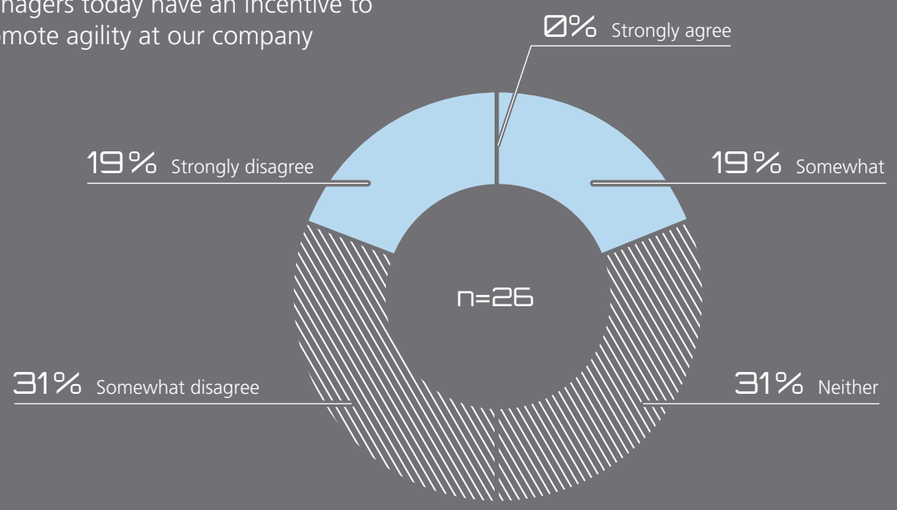


Figure 8
Managers today have an incentive to promote agility at our company



04

Research Results from the Quantitative Survey

4.1 Structure of the Quantitative Survey

The quantitative data collection was based on a standardized online survey. A detailed description of the composition of the quantitative sample can be found in Chapter 2. The questionnaire is divided into three parts: (1) Factors influencing agility, (2) Dimensions of agility and (3) Impact of agility on business performance, and consists of a total of 65 standardized statements to which the respondents were able to express their approval or disapproval on a 7-point Likert scale[3] from 1 (strongly disagree) to 7 (strongly agree).

3) Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-somewhat applicable, 6-mostly applicable, 7-applies in full.

4.2 Descriptive Analysis

4.2.1 Automotive Sample

The following descriptive analysis relates to a sample of 947 fully completed questionnaires from participants in the automotive industry. The individual propositions of the survey are integrated into the analysis as items and can be analyzed in groups, i.e. multiple items are assigned to a specific central topic, which is called a factor. Consequently, the results of the survey are interpreted in groups with respect to the higher-level factors. The factors themselves are segmented into three main areas of analysis:

(1) Influencing factors to promote agility
(2) Items for measuring the factor of agility itself
(3) Factors for measuring business performance

The following diagram illustrates the assignment of the items and the structure of the subsequent analysis.

Figure 9
Grouping of the survey results into items, factors and areas of analysis

Areas of analysis	Factors	Items	
Factors influencing agility	Management	F1 to F6	**e.g. Item F1:** "Managers at our company promote fast and flexible decision-making processes."
	Culture	K1 to K6	
	Strategy	S1 to S4	
	Processes	P1 to P6	
	Structure	ST1 to ST9	
	Personnel tools	PT1 to PT4	
	Employee competence	M1 to M4	
	Other items	V1 to V4	
Measuring agility	Agility	A1 to A9	**e.g. Item A1:** "Our company is particularly agile compared to other companies."
Business performance	Classical indicators	PE1 to PE5	**e.g. Item PE1:** "Compared to other companies in our industry, our company has a particularly good reputation."
	Classical indicators	PE6 to PE11	
	Classical indicators	PA1 to PA3	

Factor of management			
ID	**Item**	**Mean value**	**Standard deviation**
F1	Managers at our company promote fast and flexible deci-sion-mak-ing processes.	4.70	1.55
F2	Managers at our company promote agile working.	4.83	1.52
F3	Managers at our company embody agile working (role model).	4.39	1.68
F4	My manager promotes self-organized working.	5.28	1.57
F5	My manager understands methods of agile working.	4.70	1.59

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 1 Descriptive analysis, items for the factor of management

Analysis group (1): Factors influencing agility

Overall, the mean values of all items surveyed are significantly higher than the mean value of the Likert scale (4.0). The higher the mean value of a factor, the more positive the respondents' assessment for this item is on average. This means that the promotion of agile methods by managers is rated somewhat positively overall, and very positively for certain items. In particular, management behavior regarding the promotion of self-organized forms of working is rated as particularly positive (F4, mean: 5.28). By contrast, the average rating of the role model function is significantly worse (F3, mean: 4.39). It can be concluded from this that managers in the automotive sector have so far rarely embodied the implementation of agile forms of working. For all items, the standard deviations are close to 1.50. This means that the survey results are distributed relatively strongly around the mean value of the Likert scale.
A further five items are assigned to the factor of culture in analysis group (1). These items are used to study the implementation of various cultural measures to promote agility. The focus is on the orientation of the corporate culture on the basis of agile principles, as well as the integration of trust, error tolerance, transparency and autonomy.

The survey participants' assessment of the majority of the items is also positive with regard to the factor of culture. This

Factor of culture			
ID	**Item**	**Mean value**	**Standard deviation**
K1	Our corporate culture is oriented on the basis of agile principles.	4.20	1.37
K2	Our corporate culture is characterized by mutual trust.	4.64	1.64
K3	At our company, errors are tolerated and seen as an opportunity for learning processes.	4.61	1.52
F4	At our company, decisions and the processes behind them are made transparent to all those affected.	4.21	1.63
K5	Employees at our company can make farreaching decisions independently.	3.85	1.62

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Tabelle 2 Deskriptive Analyse, Items des Faktors Kultur

Factor of strategy			
ID	**Item**	**Mean value**	**Standard deviation**
S1	Agility is anchored in our corporate strategy.	4.29	1.50
S2	Our company's strategy is customer-focused.	5.43	1.34
S3	Feedback from our customers is regularly integrated into our development processes.	5.13	1.52
S4	Products and services are developed in such a way that they can be further developed while they are being used by the customer.	4.74	1.60

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 3 Descriptive analysis, items for the factor of strategy

means that the majority of respondents can confirm the implementation of various cultural measures to promote agility in the respective company. In particular, the aspects of trust and error tolerance are well-defined with above-average frequency (K2, mean: 4.64; K3, mean: 4.61). The orientation of the corporate culture on the basis of agile principles is reported to be applicable slightly less often (K1, mean: 4.2). In addition, the distribution of the survey results in the case of this item is comparatively small. It can be concluded from this that a large proportion of the respondents cannot make a clear statement for the respective company, but instead use the available answers in the middle field of the scale. This indecisiveness among the respondents can be explained by the fact that the degree to which agility is developed in a company varies within different areas.

The participants' assessment regarding decision-making freedom among employees is slightly negative. A large proportion of those surveyed say that employees in the respective company are granted little or no autonomy.

Four items are subsumed under the factor of strategy that represent the strategic orientation of a company.

As the values in the table show, the survey results show clearly to very clearly positive trends for all items of strategy. In particular, the customer-focused orientation of the strategy as well as the orientation on the basis of customer needs during the development process are specified as applicable by a majority of the respondents (S2, mean: 5.43; S3, mean: 5.13). It is also notable that newer instruments for an increased customer focus are already being used. This is shown by the fact that a large proportion of respondents confirm the use of Continuous Deployment (S4, mean: 4.74). This approach ensures that products and services can be further developed even while the customer is using them. In comparison, the respondents' feedback regarding the anchoring of agility in the corporate strategy is only slightly positive (S1, mean: 4.29). It can be concluded that agility in companies in the automotive industry has not yet been put in place as part of the strategy on a comprehensive scale. This result underlines the corresponding results of the expert interviews (see Chapter 3.1).

The fourth factor is assigned items for the central topic of processes, which are used to investigate the influence of process measures on agility. They analyze whether agile standards are established throughout the company, whether agile methods are used and whether the internal processes enable incremental working and are transparent to the employees involved.

Factor of processes			
ID	**Item**	**Mean value**	**Standard deviation**
P1	Standards for agile procedures are widely used across our company.	4.06	1.66
P2	Our company uses agile methods such as Scrum, Lean Startup or Design Thinking.	3.52	1.88
P3	We review our goals during the year and can also make adjustments if necessary.	4.70	1.63
P4	The planning and implementation of projects at our company is carried out incrementally (in small steps).	4.28	1.55
P5	Within our company's teams, there are transparent working processes that can be viewed by every employee at any time.	4.19	1.77
P6	Our company uses standard methods to measure the progress of the project.	4.27	1.69

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 4 Descriptive analysis, items for the factor of processes

The participants' assessment of procedural measures is also positive on average. However, in the case of most items, the mean values are only very slightly above the mean value of the Likert scale. As there is a strong distribution of the survey results around the mean value for these items (cf. standard deviation values), it can be concluded that there is disagreement among the participants. Nevertheless, the feedback from the participants regarding the application of planning intervals during the year shows a clearly positive trend (P3, mean: 4.7). Finally, the discrepancy in relation to the results of the expert interviews should be emphasized (see Chapter 3.2). Although the use of agile methods was reported to be very widespread within the interviews, and they are attributed a kind of pioneering role in promoting agility, the results of the quantitative survey clearly show that typical agile methods are not yet widely used in companies in the automotive industry (P2, mean: 3.52). This is due to the selection of the sample for the expert interviews, which mainly relates to study participants with experience in the topic. In this respect, the results of the quantitative study indicate a discrepancy between the expert view and the general industry average.

A further nine items are assigned to the factor of structure. The items are used to investigate the influence of structural and organizational measures on agility. On the one hand, it is investigated whether typical agile structural components such as competence centers, agile coaches or multipliers, which could be identified within the framework of the qualitative survey, are used. In addition, the establishment of cross-functional teams is investigated; both the actual application of such teams and the organizational requirements for their application are questioned.

For four structural items, the average rating of the participants remains below the mean value of the Likert scale. In particular, the use of typical agile structural components (competence centers, agile coaches) does not seem to be widespread or well-known in companies in the automotive industry (ST1, mean: 3.52; ST8, mean: 3.46; ST9, mean: 3.93); the survey results for the relevant items indicate a comparatively strong distribution. In terms of establishing cross-functional teams, the survey results do not produce a clear picture. The respondents' assessment of the possibility of forming cross-functional teams is positive (ST2, mean: 4.58; ST3, mean: 4.34; ST5, mean: 4.25), but a majority of respondents say they do not work in such teams (ST4, mean: 3.39). In addition, the majority of respondents are undecided on how to adapt the organization to agile working models.

The factor of personnel tools includes items that examine the application of various tools to promote agility in the personnel department. This includes objective agreements, regular feedback and the compensation and career model.

Factor of structure			
ID	**Item**	**Mean value**	**Standard deviation**
ST1	Our company has introduced a competence center for agile working.	3.52	1.87
ST2	Our corporate structure allows teams to be formed across areas.	4.58	1.77
ST3	The teams at our company are set up on a cross-functional basis when required.	4.34	1.69
ST4	Today, I spend a significant part of my working time in cross-functional teams.	3.39	1.80
ST5	Our departments are structured in a way that makes agile working possible.	4.25	1.62
ST6	Many of our company's teams now work in product or customer organizations rather than in specific functions.	4.04	1.68
ST7	We adapt our organization to agile working models.	4.05	1.64
ST8	Our company uses coaches to support agile procedures.	3.46	1.86
ST9	Individual employees in our company act as multipliers to spread agile working methods.	3.93	1.74

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 5 Descriptive analysis, items for the factor of culture

Factor of personnel tools			
ID	**Item**	**Mean value**	**Standard deviation**
PT1	The promotion of agile procedures plays an important role in objective agreements between managers and employees at our company.	4.33	1.64
PT2	Our company regularly holds discussions between managers and employees in order to optimize working processes.	4.71	1.7
PT3	Our company's remuneration model promotes agile working.	3.76	1.83
PT3	The career model at our company includes not only management careers but also professional careers.	4.21	1.85

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 6 Descriptive analysis, items for the factor of personnel tools

Factor of employee competence

ID	Item	Mean value	Standard deviation
M1	At our company, there is a uniform understanding of agility.	3.86	1.63
M2	The added value of agile working is recognized by employees at our company.	3.88	1.67
M3	Most employees in my area have received training on agile working methods.	3.06	1.84
M4	Employees at our company are very well qualified to make decisions autonomously.	3.86	1.74

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 7 Descriptive analysis, items for the factor of employee competence

Other items

ID	Item	Mean value	Standard deviation
V1	Project teams at our company sit in a shared project space (or otherwise sit together).	4.12	1.90
V2	Our company has an internal community for promoting agility.	3.67	1.83
V3	Our company works with external service providers to promote agility.	3.62	1.85
V4	Our employees are networked across areas through the IT systems at our company.	4.99	1.77
V5	Our company cooperates intensively with start-ups.	3.14	1.89

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 8 Descriptive analysis, various items

The average assessment of the participants regarding holding regular discussions to optimize working processes is particularly positive. The majority of respondents indicate that such discussions take place (PT2, mean: 4.71). In addition, the feedback regarding the integration of requirements for the implementation of agility in objective agreements (PT1, mean: 4.33) and the existence of professional careers as a career model (PT4, mean: 4.21) demonstrates a positive trend. On the other hand, the participants' assessment of adapting the remuneration model to promote agility is slightly negative (PT3, mean: 3.76).

In contrast to the application of specific personnel tools, four items are assigned to the factor of employee competence. In this context, measures are questioned that examine the influence of employee knowledge on the promotion of agility.

What is striking is that the average assessment of the participants for all items in this factor is slightly to significantly negative, which distinguishes this factor from all other model factors. It is particularly important to note that the majority of respondents do not agree with the proposition that most employees have been trained in agile working methods (M3, mean 3.06). By contrast, the participants' assessment of established knowledge of agility is only slightly negative (M1, mean: 3.86; M2, mean: 3.88). The same applies to the participants' assessment regarding the qualification of employees for autonomous decisions (M4, mean: 3.86). In this case, the content of the item is related to item K5 for the factor of culture. It is clear that employees are often granted little or no decision-making autonomy. Consequently, in these cases, there is no need to qualify employees for autonomous decisions if no cultural provisions are made for employee autonomy.

Finally, certain other items were integrated individually into the analysis as they cannot clearly be assigned to any of the factors, or the assignment of the items appears to be open to interpretation. The following items are therefore to be understood as individual influencing factors of agility and are integrated into the causal analysis accordingly.

The survey participants' assessment of the IT systems in the respective company is particularly positive: A large proportion of the respondents agree that the IT systems support cross-functional networking (V4, mean: 4.99). The participants' evaluation of the use of project space is also slightly positive (V1, mean: 4.12). On the other hand, the participants' assessment of the implementation of further specific measures to promote agility is slightly to significantly negative. A large proportion cannot confirm the existence of internal communities or collaboration with external service providers (V2, mean: 3.67; V3, mean: 3.62). The proportion of companies planning to cooperate intensively with start-ups appears to be even lower (V5, mean: 3.14). In addition, in the case of all other items, a very strong distribution of the survey results must be noted. This means that individual responses to these items vary significantly and there is no consensus among respondents.

In a summary evaluation of the individual items or the corresponding factors, it is noticeable that the data for most survey results is distributed around the mean value. However, there are some exceptions. These relate, for example, to the role model behavior of managers – which is open to improvement – or to the disproportionately poor distribution of agile methods and structural units. It is also noticeable that the factor of employee competence is consistently poorly evaluated and decision-making processes are correspondingly less autonomous and self-organized.

Analysis group (2): Items of agility

Analysis group (2) refers to items that are used to measure the factor of agility. Accordingly, all of the following items examine the development of agility from the perspective of the respondents. Typical agile characteristics of a company such as reaction speed, proactive approach and customer orientation are examined. In addition, the existence of typical agile interim results (minimum viable products [MVPs] and prototypes) is questioned.

Overall, the participants' assessment of the agility of their own company is slightly negative. This assessment is made particularly clear by the fact that a larger proportion of respondents cannot agree with the central statement that their own company is particularly agile compared to others (A1, mean: 3.74). In addition, there is disagreement about the anchoring of agility within companies (A8, mean: 4.04). The participants' assessment does not have any clear tendency in this case. As in the case of the factor of culture, the heterogeneity in the development of agility in different business areas may be the cause of this indecision.

In contrast, the participants' assessment of typical agile characteristics of a company is slightly positive (A2-A5). The ability to take proactive actions as well as a rapid response to changing customer requirements (A2, mean: 4.44; A4, mean: 4.76) should be highlighted in particular and can be confirmed by a majority of the respondents. The survey results are very consistent with the results of the factor of strategy in terms of customer focus. The assessment regarding the promotion of data-based decisions is also slightly positive (A9, mean: 4.29). On the other hand, the participants' assessment of the use of prototypes does not show a clear tendency (A7, mean: 4.05). In this case, the mean value of the survey results corresponds to the mean value of the Likert scale used. In this context, the use of MVPs should also be emphasized; these cannot be confirmed by a large proportion of the respondents (A6, mean: 3.37). As has been noted with regard to item P2 for the influencing factor of processes, agile methods sometimes do not find widespread use. The results in this case underline the feedback from the participants, since the use of prototypes and MVPs would typically be accompanied by the application of agile methods.

Factor Agility

ID	Item	Mean value	Standard deviation
A1	Our company is particularly agile compared to other companies.	3.74	1.72
A2	Our company is proactive in responding to external changes.	4.44	1.61
A3	Our company can adapt very quickly to changes in environmental conditions.	4.29	1.67
A4	Our company responds very quickly to changes in customer requirements.	4.76	1.60
A5	Our company is very good at anticipating changes in the environment.	4.19	1.63
A6	Our company uses Minimum Viable Products (MVPs).	3.37	1.66
A7	Our company reviews the progress of projects or working processes using live demos or prototypes.	4.05	1.85
A8	Agility is only anchored at the level of individual teams. (i)	4.04	1.61
A9	Our company promotes data-based decision-making.	4.29	1.55

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 9 Descriptive analysis, items of agility (i = inverse)

Factor of performance – standard items

ID	Item	Mean value	Standard deviation
Compared to other companies in our industry...			
PE1	... our company has a particularly high capacity for innovation.	4.62	1.64
PE2	... our company has a particularly high level of customer satisfaction.	5.16	1.40
PE3	... our company has a particularly high level of product quality.	5.35	1.41
PE4	... our company is particularly profitable.	4.69	1.56
PE5	... our company operates particularly cost-effectively.	4.53	1.50

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 10 Descriptive analysis, performance – standard items

Analysis group (3): Business performance items

Finally, **analysis group (3)** comprises different factors and items for measuring business performance. It is necessary to measure these indicators in order to conduct investigations into the effect of agile procedures on business performance in the subsequent causal analysis. All the related items for the factors for examining the company's performance require that the study participants make an assessment of their own company compared to the industry.

The first performance factor refers to conventional performance indicators that have already been used several times in comparable studies. These include a company's capacity for innovation, degree of customer satisfaction and product quality, as well as measures such as profitability and cost-effectiveness in relation to the entire company. The descriptive analysis of the related items is shown in the following table.

As shown in Tabelle 10, the results for all items are above the mean value. The assessment of the automotive groups compared to the competition is therefore consistently positive. This is most evident in the study participants' assessment of product quality and customer satisfaction. With mean values of 5.35 (product quality PE3) and 5.16 (customer satisfaction PE2), these items are significantly above the mean value and indicate that German car manufacturers remain convinced of the high quality of their products and the resulting customer satisfaction. Respondents also consider their profitability (PE4, mean: 4.69), capacity for innovation (PE1, mean: 4.62) and cost-effectiveness (PE5, mean: 4.53) to be disproportionately positive compared to the rest of the industry.

The second factor of the **analysis group (3)** Business performance refers to supplementary performance indicators that are used to measure business performance. The discussion here is whether, in an industry comparison, the company has a high response rate and a short time-to-market, employees are satisfied and confident, and the company operates efficiently and enjoys a good reputation. The descriptive analysis of the associated items is shown in table 11.

The values of the second performance factor are also all above the mean value – in some cases significantly so. A company's own reputation (PE6, mean: 4.96) is assessed most positively compared to the industry average. This shows that employees of German OEMs are convinced by their employer, and that their employer enjoys a good reputation, despite diesel scandals and discussions surrounding possible failures with regard to alternative drive systems. Respondents also rate their own company as more efficient than the industry average (PE8, mean: 4.63).

The assessment of the future viability of their own company is somewhat more restrained. With a mean value of 4.5 (PE7), the ability to respond to disruptions is estimated by the study participants to be above average. However, in terms of the time-to-market for new products and services, the respondents rated their own company only slightly above average (PE10, mean: 4.2). As a result, the use of agile methods and working methods in isolation allows a better response to changing market conditions or customer requests, but it is not yet implemented sufficiently in established companies such as OEMs to bring products and services to market faster. The results also show a slight advantage for the respondents' own company in terms of reliability and satisfaction (PE9, mean: 4.43; PE11, mean: 4.42).

The third performance factor relates to automotive-specific performance indicators that allow statements to be made solely about the performance of companies in the automotive sector. The associated items deal with specific trends such as e-mobility, integrated mobility concepts and artificial intelligence. Accordingly, these items were only put to study participants whose companies are in the automotive sector. The descriptive analysis of the specific items is shown in the following table.

Factor of performance – additional items

ID	Item	Mean value	Standard deviation
Compared to other companies in our industry...			
PE6	... our company has a particularly good reputation.	4.96	1.42
PE7	... our company responds particularly quickly to disruptions.	4.50	1.40
PE8	... our company is particularly efficient.	4.63	1.45
PE9	... our employees look to the future with particular confidence.	4.43	1.64
PE10	... our company is characterized by a short time-to-market.	4.20	1.52
PE11	... our company has a high level of employee satisfaction.	4.42	1.65

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 11 Descriptive analysis, performance – supplementary items

Factor of performance – specific automotive items

ID	Item	Mean value	Standard deviation	Missing values
Compared to other companies in our industry...				
PA1	... our company is a leader in the development of e-mobility.	4.08	1.87	21
PA2	... our company is a leader in the development of integrated mobility concepts.	4.21	1.81	32
PA3	... our company is a leader in the application of artificial intelligence solutions.	3.53	1.87	72

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 12 Descriptive analysis, performance – automotive-specific items

The consistently relatively high standard deviations for these performance indicators indicate a pronounced diversity of opinions regarding the items presented. The study participants rate themselves best in terms of integrated mobility concepts (PA2, mean:4.21), followed by development in the field of e-mobility (PA1, mean: 4.08). This is interesting because in the qualitative survey, e-mobility was ranked top among the trend topics in OEMs. What is striking is that the self-assessment in the application of artificial intelligence solutions is below average (PA3, mean: 3.53). This suggests that automotive companies do not see themselves as leaders in the development of artificial intelligence solutions and are only beginning to use the appropriate technologies.

Overall, the study participants consistently provide a very positive assessment of the performance indicators for their company. However, the assessment is somewhat more cautious on future-related issues such as confidence, time-to-market and the development of e-mobility.

4.2.2 Subgroup Analysis

Various control variables are defined for the evaluation of the quantitative survey results by subgroup. First, the participants are asked whether they are working in a position with management responsibility. Other control variables relate to the age and gender of the respondents and to the size of the company. Similar to the procedure for the previous chapter, the results are compared for each subgroup in order to determine relevant differences. The results for the subgroups are explained according to management responsibility below. Only data from the automotive sample is used as the basis for the subgroup analysis. The following explanations therefore refer to the sample of 947 fully completed questionnaires from participants in the automotive industry.

Subgroup analysis: Management responsibility

Within the following subgroup analysis, the survey results from participants with and without management responsibility are compared. For this purpose, the differences of the mean values are calculated for all items. A difference of >= 0.6 for the relevance of an item is calculated for the comparison of these subgroups. This difference leads to the selection of a set of 13 items whose characteristics are relevant for the subgroup analysis of management responsibility.

It is notable that in the case of this subgroup analysis, there are significant differences only for items of the analysis group (1): Factors influencing agility. For items for measuring agility as well as for all items for measuring business performance, the comparison of the survey results from participants with and without management responsibility does not reveal any relevant differences.

The dominance of the differences in the factor of management is particularly notable in the comparison of these subgroups. An analysis of the individual differences provides a uniform and predictable picture for these items. In the case of all items, the evaluation of the subgroup with management responsibility is significantly more positive than that of the comparison group without management responsibility. The evaluation from the managers therefore demonstrates a very high level of approval for all items and consequently more positive evaluations. Despite this difference, the evaluation from the comparison group without management responsibility is also positive for all items in the factor of management.

A similar ratio exists in the case of the items from the factor of culture, where only two of the total of five items appear in the set of relevant differences. Despite the differences, it is clear that both subgroups confirm that cultural measures to promote agility have been established. However, the perception of managers is once again more positive.

In terms of the distribution of standards for agile procedures (P1), the two subgroups differ greatly. Only the subgroup of managers rates the distribution as positive overall. With regard to the results of the qualitative survey, this discrepancy may be due to the fact that agile standards are not yet sufficiently established at the operational level.

Finally, in the case of the influence factor of structure, the subgroup of managers evaluates all relevant items on average more positively than the comparison group. However, unlike in the case of the factors of leadership and culture, several evaluations from the subgroup without management responsibility are slightly to significantly negative, while the evaluations of the managers are mostly in the clearly positive range.

These differences are of particular importance in relation to those structural measures that should be in place as a prerequisite for agile working (ST2, ST5). The more negative perception of employees without management responsibility suggests that there is often no opportunity for agile working in their daily work. In this context, the feedback regarding working in cross-functional teams also seems plausible (ST4). While the group of managers is undecided on average, a large proportion of operational employees say they do not work in cross-functional teams. Finally, there are particularly clear differences in the case of the adaptation of the organizational structure and for the establishment of individual employees as multipliers (ST7, ST9). While managers tend to confirm the implementation of these measures, the majority of the comparison group is unaware of their implementation.

In summary, managers are more positive about the factors of leadership and culture in particular than employees without leadership responsibility. From a social point of view, the differences are understandable, but indicate a clear difference in perception between the two subgroups.

Subgroup analysis for management responsibility – analysis group (1)

ID	Item	Mean value Management responsibility	
		Yes	No
Factor of management			
F1	Managers at our company promote fast and flexible decision-making processes.	5.32	4.42
F2	Managers at our company promote agile working.	5.36	4.59
F3	Managers at our company embody agile working (role model).	4.99	4.11
F4	My manager promotes self-organized working.	5.72	5.07
F5	My manager understands methods of agile working.	5.20	4.47
Factor of processes			
K1	Our corporate culture is oriented on the basis of agile principles.	4.62	4.01
K2	Our corporate culture is characterized by mutual trust.	5.10	4.43
Faktor Prozesse			
P1	Standards for agile procedures are widely used across our company.	4.48	3.88
Factor of structure			
ST2	Our corporate structure allows teams to be formed across areas.	4.99	4.39
ST4	Today, I spend a significant part of my working time in cross-functional teams.	4.01	3.10
ST5	Our departments are structured in a way that makes agile working possible.	4.74	4.02
ST7	We adapt our organization to agile working models.	4.50	3.85
ST9	Individual employees in our company act as multipliers to spread agile working methods.	4.38	3.72

Likert scale: 1-does not apply, 2-tends not to apply, 3-rarely applicable, 4-neutral, 5-tends to apply, 6-mostly applicable, 7-applies in full
Table 13 Descriptive subgroup analysis, management responsibility, analysis group (1)

4.3 Causal Analysis

The following section provides a detailed analysis of causal relationships between the individual factors based on latent structural equation models using partial least squares structural equation modeling (PLS-SEM). The analysis is based on the classification between the three analysis groups already outlined: 1) influencing factors, 2) agility and 3) performance. It is theoretically plausible to design a basic model with causal relationships between the influencing factors and the degree of agility and the relationship between agility and business performance (see figure 10).

The experts in the qualitative survey attribute a positive effect on the agility of the company to the above dimensions. The experts also say that the agility of companies has a positive impact on business performance. The items presented in the descriptive analysis are therefore summarized as a measurement model for the individual factors and grouped as follows in the form of a basic model.

In order to assess the quality of the measurement models (i.e. the summary of the items within a higher-level factor), reference is generally made to reliability and validity indicators. The present study is based on the recommended indicators and thresholds according to Hair et al. (2016). Reliability is considered to be present once the indicators of a construct correlate sufficiently. A "Cronbach's alpha" between 0.7 and 0.9 and an "average variance extracted" greater than 0.5 is required for all constructs. In this basic model, these conditions are met.

It must also be ensured that the assigned indicators do not correlate too strongly with other constructs of the model and are therefore actually different from the other constructs. This is expressed by the discriminant validity and measured by the "cross-loadings" and the "heterotrait-monotrait ratio (HTMT)." For the present model, this can initially be confirmed.

Only the HTMT of the performance constructs and the personnel and employee constructs slightly exceed the threshold. However, this is to be expected due to the diversity of the performance indicators collected and the theoretical relationship between the personnel and employee constructs. Likewise, the performance constructs correlate with each other. Since both constructs describe different dimensions of business performance, this correlation is justifiable.

4.3.1 Automotive Sample

For a detailed analysis, the basic model can be tested with the sample taken from the automotive industry (n=947). The measured effects largely confirm the impressions from the expert survey. First of all, the relationships of the constructs are considered. It is particularly important to note that the direct effects in the basic model appear to be weak in places. This is particularly clear in the coefficients of management on agility (.009) and culture on agility (.002). However, based on the theory of agility and the results of the expert survey, an effect of management and culture cannot be ruled out. Rather, the results of the causal analysis suggest that there is no direct effect of the two constructs on agility. However, indirect effects, i.e. management and culture, may influence the effectiveness of the other influencing factors. The corresponding considerations are examined in more detail in other models (see figure 12 and figure 13).

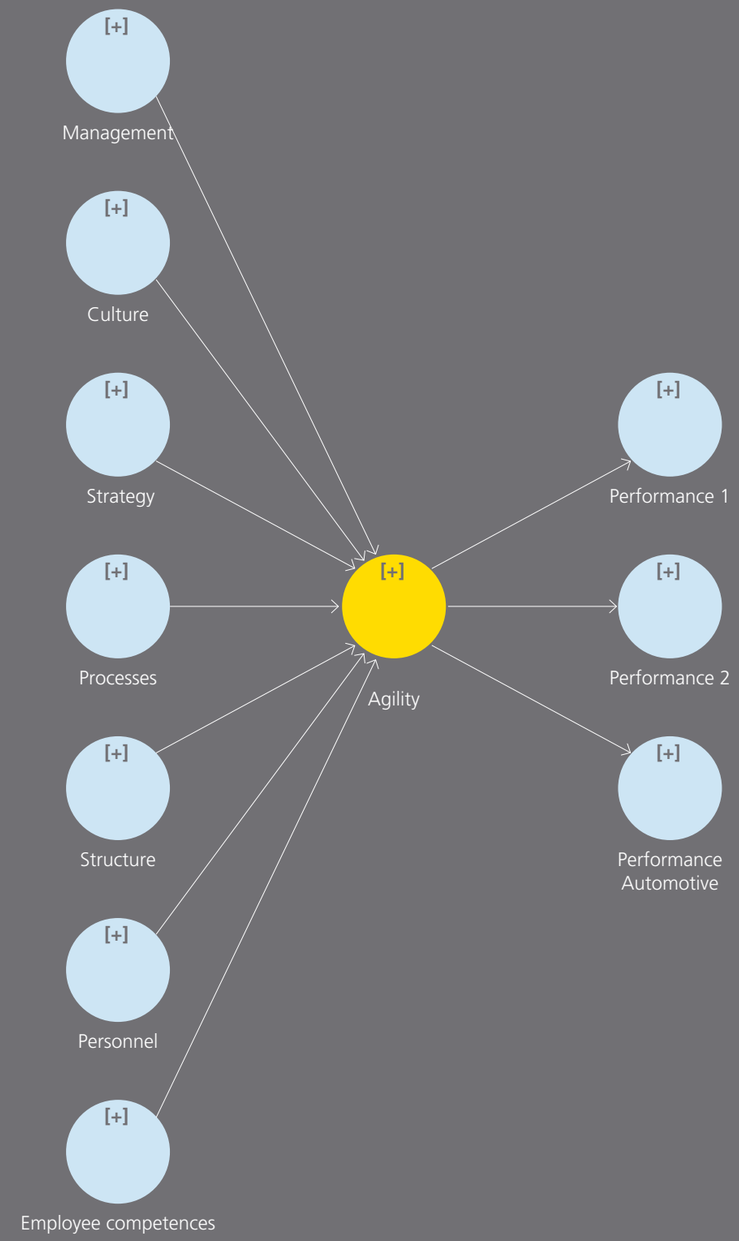
The direct effects of the other influencing factors strategy (.156), processes (.253), structure (.270), personnel tools (.102) and employee competence (.149) on agility are clearly pronounced and significant. The influence of the identified constructs on agility is therefore comprehensively confirmed. After that, improvements in the procedural and structural items have the greatest impact on the promotion of agility in companies. In a second group of influencing factors, this is followed by constructs from the areas of strategy and employee competence with a somewhat weaker causal effect. The personnel tools in this group have the weakest influence on the promotion of agility. However, a small causal effect can also be presumed here.

Furthermore, the path coefficients of agility on the performance dimensions (.518 to .742) lead to the conclusion that agility has a significant effect on the performance of automotive companies. The only surprise is the slightly lesser effect of agility on the specific performance dimensions of the automotive industry (competitive advantages in relation to e-mobility, integrated mobility concepts and the application of artificial intelligence approaches). Clearly, other factors that are not covered by the current model are relevant to promoting performance in the field of e-mobility, integrated mobility concepts and artificial intelligence.

In addition to the strength of the relationships between the individual factors, the degree to which agility and performance are explained by the respective influencing factors is also relevant. This can be evaluated using the R^2 values. The R^2 values indicate the explained variance of the associated constructs and can assume values between 0 and 1.[4] A high R^2 therefore explains a reliable causal relationship of the tested model in the sample. Using the constructed model, an R^2 of .740 can be measured for the construct of agility. This further confirms the high impact of the preceding factors on agility. In addition, the performance variances can be explained by the causal model .551 (Performance_1), .625 (Performance_2), and .268 (Performance_3). This confirms the substantial impact of agility on business performance of automobile manufacturers.

The preliminary results of the quantitative survey confirm the impressions of the experts from Chapter 3. The only surprise is that management and culture have no direct impact on the agility of companies. This contradiction suggests that management and culture have an indirect impact on the agility

Figure 10
Basic model



Performance 1: Conventional performance indicators such as profitability, customer satisfaction;
Performance 2: Supplementary performance indicators such as time-to-market;
Automotive performance: Automotive-specific performance indicators such as e-mobility. See Chapter 5.2.1

Figure 11

Basic model for causal relationships in the automotive sample

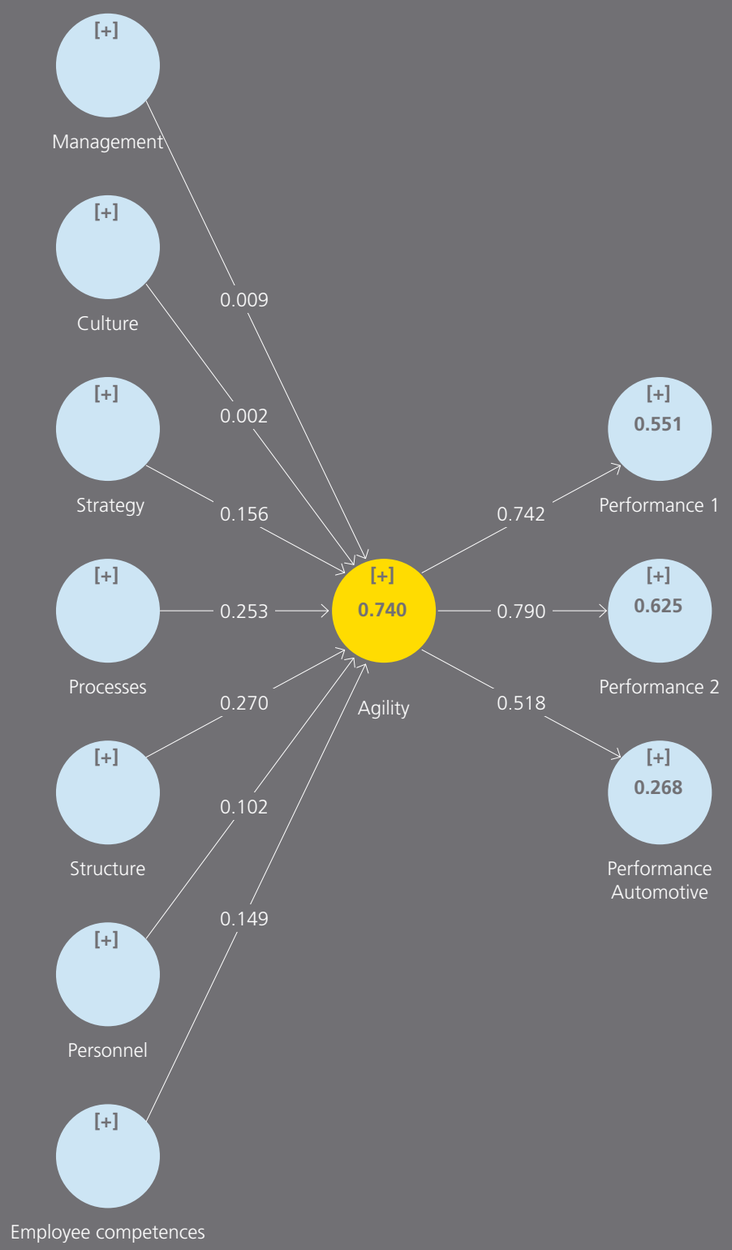


Figure 12

Management model

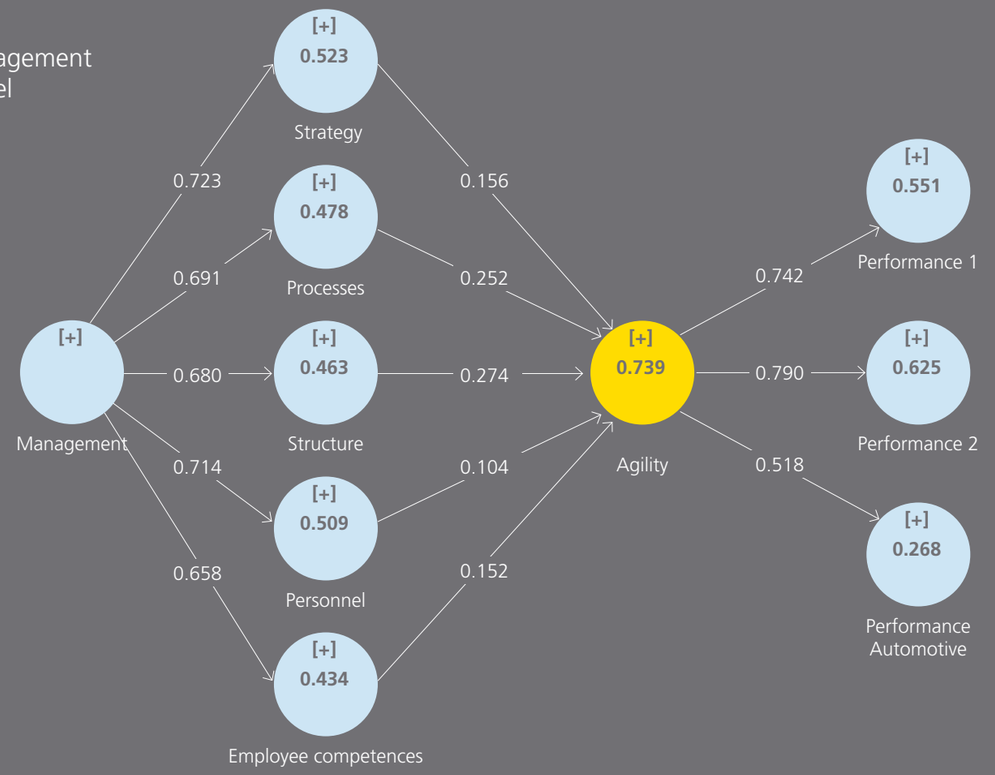
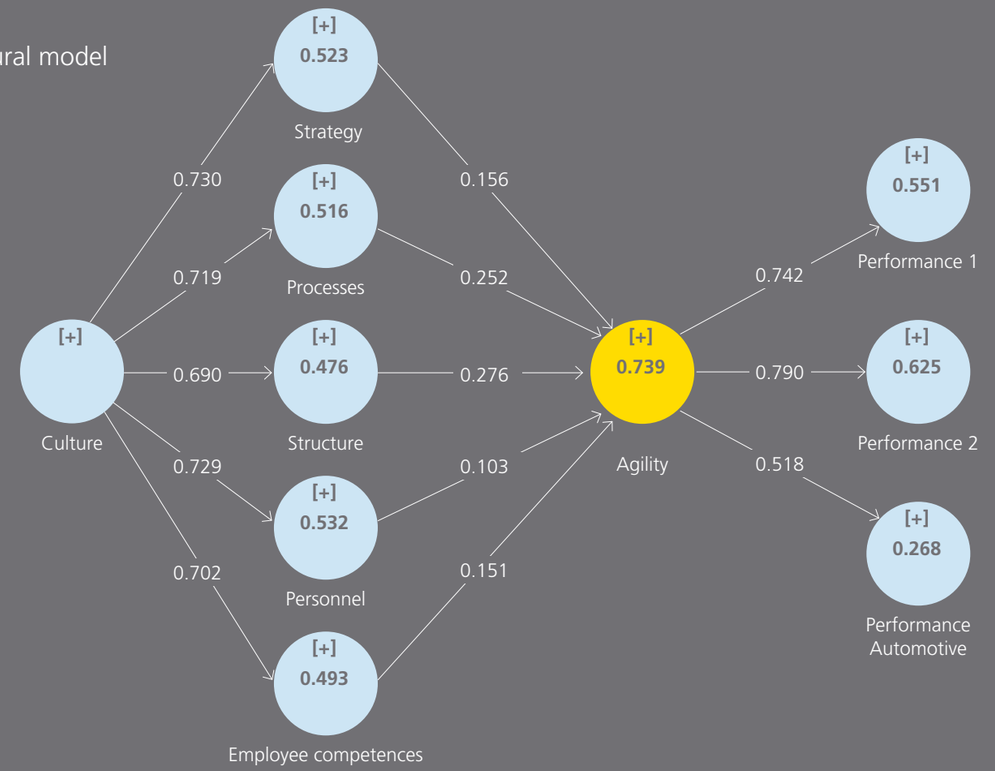


Figure 13

Cultural model



of OEMs. The further analysis therefore focuses on modeling these effects. Management aims to achieve the strategy, processes and goals of a company in a uniform manner. Particularly in an agile world, managers are considered coaches or moderators in the achievement of their own goals. Management is also responsible for the uniform execution of the structures and processes. Furthermore, managers are responsible for the design of all general conditions for personnel. This includes the design of the target model, salary structures and the development of employee skills. Accordingly, management influences the preceding constructs of agility. Figure 12 shows this relationship.

4) The R2 value (= coefficient of determination of regression) is defined as the ratio of the sum of squares explained (SQE) by the regression to the sum of squares total (SQT).

$$R^2 \equiv \frac{SQE}{SQT} = \frac{\sum (\hat{y}_i - \overline{y})^2}{\sum (y_i - \overline{y})^2}$$

The strongly pronounced path coefficients clearly confirm the hypothesis put forward. The total effects of management on the influencing factors range from .658 to .723. The resulting R^2 values are around .5 and confirm that management has a significant influence on the constructs described.

The statements in the expert interviews and explanations in previous chapters demonstrate that it can be assumed that the corporate culture has a significant influence on the success of agile projects. However, the effects of the basic model tested in Figure 11 initially contradict this thesis. In a similar way to the factor of management, corporate culture has no direct effect on the agility of companies. However, the corporate culture is embodied and developed by the employees. The corporate culture therefore finds its expression in other factors, such as the implementation of structures and processes, and directly in the corporate strategy. In this way, cultural effects also have an indirect effect on the agility of a company.

This thesis can be adequately confirmed by the culture model tested in Figure 13. Path coefficients between .690 and .730 confirm a significant effect of the culture on the influencing factors in the sample. R^2 values around .5 lead to a high average explained variance of the constructs.

The models tested show that management and corporate culture in automotive companies have no direct impact on agility. However, it can be seen that the two constructs have a significant impact on the other factors influencing agility. Therefore, management and culture can be understood as meta-constructs that have a strong influence on operational measures to promote agility. The significant impact of agility on business performance throughout all models is also notable.

4.3.2 Cross-Industry Sample

For a more detailed assessment and determination of special features of the automotive industry, the models defined above are subsequently tested in the non-automotive sample. The differences from the automotive industry are highlighted here.

The basic model corresponds to that of the automotive sample, though the automotive-specific performance indicator is omitted. First, the path coefficients are discussed. In a similar way to the automotive sample, the two constructs of management and culture have only a small effect on the construct of agility. In the non-automotive sample, the effect of strategy on agility is approximately twice as strong (.310) as in the automotive sample. Processes have a similarly high effect of .281. The effect of structure on agility is much lower at .160 compared to .270 in the automotive sample. What is surprising is the small but negative effect of personnel tools on agility. Similarly, employee competence has approximately double the effect on agility (.312). The numbers are shown for comparison purposes in table 14, with notable values highlighted in red.

An interpretation of the differences in the path coefficients suggests that the corresponding items relating to strategy in the automotive industry have an influence on agility. However, this is not as strong as in other industries. Specific measures regarding structure and processes seem to be more important among OEMs. Establishing employee competence is also important for OEMs, but not as important as in the cross-industry sample.

The comparable R^2 values in table 15 demonstrate the cross-industry validity of the model. The results show that the effects measured in the automotive industry are different, but the constructs of agility in the companies are defined in a similar way.

The approach explained in 4.3.1 regarding the indirect effects of management on agility applies across industries. This is confirmed in detail by the results in table 16. The effects of management on the influencing dimensions of agility remain largely the same in the non-automotive sample model. Only the effect of management on structure (.587) is slightly lower. The other differences in the effects of the influencing dimensions on agility differ in the same way as the basic model.

The validity of the theses of this study is confirmed in depth by the stable R^2 values. When testing the management model on the basis of the non-automotive sample, only the R^2 value of the structure construct is lower. The results of the culture model behave in a very similar way on the basis of the non-automotive sample. There are no notable differences. The corporate culture therefore has a very similar influence in the automotive industry as in other sectors.

	Automotive	Non-automotive	Difference
Management → Agility	0.009	0.023	0.014
Culture → Agility	0.002	0.055	0.053
Strategy → Agility	0.156	0.31	0.154
Processes → Agility	0.253	0.281	0.028
Structure → Agility	0.27	0.16	-0.11
Personnel → Agility	0.102	-0.076	-0.178
Employee competence → Agility	0.149	0.312	0.163
Agility → Performance_1	0.742	0.781	0.039
Agility → Performance_2	0.79	0.801	0.011

Table 14 Comparison of indicators in basic model path coefficients

	Automotive	Non-automotive	Difference
Agility	0.74	0.771	0.031
Performance_1	0.551	0.61	0.059
Performance_2	0.625	0.642	0.017

Table 15 Comparison of indicators for basic model R^2

		Non-automotive	Difference
Management → Strategy	0.723	0.691	-0.032
Management → Processes	0.691	0.669	-0.022
Management → Structure	0.68	0.587	-0.093
Management → Personnel	0.714	0.652	-0.062
Management → Employee competence	0.658	0.652	-0.006
Strategy → Agility	0.156	0.293	0.137
Processes → Agility	0.252	0.285	0.033
Structure → Agility	0.274	0.163	-0.111
Personnel → Agility	0.104	-0.086	-0.19
Employee competence → Agility	0.152	0.299	0.147

Table 16 Comparison of indicators in management model path coefficients

	Automotive	Non-automotive	Difference
Strategy	0.523	0.477	-0.046
Processes	0.478	0.448	-0.03
Structure	0.463	0.344	-0.119
Personnel	0.509	0.425	-0.084
Employee competence	0.434	0.425	-0.009
Performance_1	0.551	0.61	0.059
Performance_2	0.625	0.642	0.017

Table 17 Comparison of indicators for management model R^2

In summary, the comparison shows moderate differences in the automotive industry in terms of the effects and dimensions of agility. The comparison with the non-automotive sample shows that individual factors such as strategy and employee competence in the automotive industry have a lower effect on agility than in other sectors. The personnel tools that have been applied have a bigger effect in the automotive industry. The R^2 values show that the applied models are just as valid in the automotive industry as in other sectors. The effects of business performance are clear in both the automotive industry and the non-automotive sample.

		Non-automotive	Difference
Culture → Strategy	0.73	0.023	-0.707
Culture → Processes	0.719	0.055	-0.664
Culture → Structure	0.69	0.31	-0.38
Culture → Personnel	0.729	0.281	-0.448
Culture → Employee competence	0.702	0.16	-0.542
Strategy → Agility	0.156	-0.076	-0.232
Processes → Agility	0.225	0.312	0.087
Structure → Agility	0.276	0.781	0.505
Personnel → Agility	0.103	0.801	0.698
Employee competence → Agility	0.151	0.801	0.65

Table 18 Comparison of indicators in culture model path coefficients

		Non-automotive	Difference
Strategy	0,523	0,521	-0,002
Processes	0,516	0,518	0,002
Structure	0,476	0,443	-0,033
Personnel	0,532	0,523	-0,009
Employee competence	0,493	0,511	0,018

Table 19 Comparison of indicators for culture model R^2

4.4 Interim Conclusion

Based on the analysis of the data from the quantitative survey, the following interim conclusion can be drawn. The results of the causal analysis indicate a strong correlation between the agility of a company and business performance. Companies with higher agility also demonstrate higher performance. The results of this study therefore correspond to comparable studies on the correlation between agility and business performance. This can be applied to all relevant performance categories. The correlation between agility and performance indicators such as customer satisfaction, capacity for innovation and product quality is particularly strong. In addition, a higher degree of agility also forms the basis for the successful design of development and transformation processes in the areas of e-mobility, artificial intelligence and the development of integrated mobility concepts. The results of the quantitative survey support the findings of the qualitative expert survey: Agility drives business performance and provides a basis for shaping digital innovation.

With regard to the analysis of the key factors influencing the promotion of agility, it can be seen that it is the interaction of numerous factors that is of crucial importance, rather than a single factor in isolation. On the basis of the results of the quantitative survey, structural and procedural measures demonstrate the greatest influence on the agility of a company. This includes the adaptation of the structure and process organization as well as the use of agile methods. Structural measures such as the establishment of competence centers for agility, the structural expansion of cross-functional teams and an orientation toward a product and customer organization are of central importance. In parallel to this, procedural measures must be designed that relate, for example, to standards for agile procedures, agile methods and the adaptation of communication and decision-making processes.

In addition to the structural and procedural design areas, the quantitative analysis also shows a second group of influencing factors for promoting agility. This relates to the promotion of employee competence, the anchoring of agility in the corporate strategy and the adaptation of personnel tools. The promotion of employee competencies shows the strongest proportional effect, i.e. measures to train employees and to promote a basic understanding of agility in the workforce have a positive impact on the agility of companies. This also applies to the anchoring of agility at the corporate strategy level. In this sense, it is helpful if agility is explicitly anchored as a goal in the corporate strategy. The adaptation of performance reviews, objective agreement systems and compensation models also has a significant impact on the agility of companies.

What is surprising here is the lack of direct influence of the factors of management and culture on agile procedural models. Both factors have almost no direct impact on organizational agility. This contradicts the results of the expert survey, which assign a particularly important role to management in companies. An extended analysis clearly shows that management and culture are to be interpreted as superordinate influencing factors or meta-constructs. Both factors have a strong influence on all of the design areas already outlined, such as structure, processes, strategy, personnel or employees. Management and culture are therefore indirect influencing factors or basic prerequisites for the design of operational measures in the fields of action outlined above.

The descriptive analysis also shows the need for action in relation to individual factors. With regard to the introduction of competence centers for agile working, coaches and multipliers, the study shows a clear need for expansion. Although the relevant measures are perceived as relevant, they are, in many of the companies surveyed, disproportionately poorly implemented or less well-known. Cross-functional teams are generally possible, i.e. they are known strategic components for agile working. However, a majority of the managers and employees surveyed do not work in such teams, i.e. the degree of implementation is still open to improvement. This also applies to the application of agile methods and procedures such as Scrum or LeanStartup. A majority of respondents do not use these methods, or use them very little. The results are also open to improvement in terms of employee competence, e.g. training measures. A majority of the managers and employees surveyed therefore feel little qualified or unqualified for agile working and autonomous decision-making processes.

In this context, the interim results of the two superordinate factors of management and culture are also interesting. They make it possible for managers to work in an agile manner in the first place. The managers are familiar with agile forms of work. However, the role model function of managers is still open to improvement. When it comes to agile working, managers must therefore embody agile working methods more strongly and integrate them into their own field of action. When considering the corporate culture items, the poor evaluation of the status quo in relation to autonomous decisions is particularly noticeable. A majority of employees do not think that far-reaching decisions can be made independently and autonomously at OEMs.

Overall, the model presented here can be seen as a reference and general guideline for the relationship between different factors influencing agility, the measurement of agility and business performance. Currently, only a few scientific studies are available that investigate causal models of agile organizations. This model can be adapted as a general reference model for further investigations. In-depth investigations are required in individual design areas.

05

Implications and Conclusion

This study on the subject of agility in the automotive industry gives rise to a number of implications. These can be used for the purposes of concrete implementation in corporate practice. The implications are summarized below in the form of core theses. The theses are based in parallel on the theory outlined and on the results of the qualitative and quantitative investigations.

01

Agility has a strong impact on business performance.

The results of the study consistently provide evidence of a strong, positive impact of agility on business performance. This is expressed at different levels. With regard to decentralized units and individual teams, agile working methods lead to increased levels of productivity, customer orientation and employee satisfaction. On an aggregated level, this has an impact on conventional performance indicators such as product quality, sales and profitability. In addition, agility has a strong influence on the design of innovations.

02

Agility has been a critical issue in automotive companies for three to four years and is now part of corporate strategy.

On average, automotive companies have been systematically dealing with the subject of agility for three to four years. In the meantime, the promotion of agility in most organizations is an explicit or implicit part of corporate strategy. However, large-scale projects to promote agility continue to be exceptions.

03

The agility of automotive companies has evolved. There is still significant potential for development.

Agility at OEMs has evolved gradually over the past few years. Companies are therefore more agile today than they were a few years ago. Within their own industry, OEMs believe they are equal when it comes to agility, but there is a need to catch up with leading companies from other industries. Overall, the industry still has significant development potential in relation to promoting agility.

04

Agility is evolving gradually – the crisis is an opportunity.

Agility has evolved gradually in many companies over the past few years. As a result, the promotion of agility is not so much a linear process, but rather is shaped by individual events. The crisis caused by coronavirus may be interpreted as an opportunity in this regard. When familiar working methods are questioned, it becomes possible to develop agile forms of work in a particularly effective way.

05

The status quo of agility in the automotive industry is characterized by significant differences in individual business areas.

Although OEMs' agility has developed positively in recent years, significant differences are evident in individual company areas. The agility of IT departments is often particularly well-developed. By contrast, production, procurement and various administrative areas often follow traditional and hierarchical procedural models. Agile procedural models, however, are not seen as a pure IT issue by the respondents. It is therefore highly important to broaden agile principles beyond IT.

06

The various influencing factors for promoting agility are strongly interconnected.

Different influencing factors are relevant to the promotion of agility. The approaches range from anchoring agile principles in the corporate strategy to changing processes and methods, and adapting the organizational structure. Personnel tools and employee training as well as the design of suitable management and cultural models also achieve a high level of effectiveness. A combination of processes, methods and structural adjustments to promote agility is particularly effective from the perspective of the quantitative research. This is underlined by the expert survey. The most frequently mentioned starting points relate to the promotion of agile methods, internal communities/coaches/competence centers for the promotion of agility and the adjustments of the organizational structure. In addition, training concepts are required to prepare employees for agile working practices in a targeted manner.

07

Current measures in the automotive industry are focusing too heavily on agile methods.

As far as OEMs are concerned, the above measures are being pursued at varying levels of intensity. The findings regarding agile methods are mixed. These have now been implemented in many OEMs. However, it is often the case that they relate to individual areas. Agile methods have still not been implemented on a widespread basis. In addition, agile methods are too rarely supported by structural measures. The creation of competence centers, the availability of agile coaches and the adaptation of the organizational structure to support agile forms of work have special significance. Without structural components, the effectiveness of agile methods is limited.

08

Management and culture are important indirect factors influencing agility and are the basic prerequisites for promoting agility.

With regard to the promotion of agility, the design of management and the building of an agile mindset or the creation of an appropriate corporate culture are outlined as important framework conditions. However, these factors have no direct effect on the promotion of agility in the quantitative survey. An extended analysis shows that management and culture impact all relevant factors influencing the promotion of agility. Further development in these two areas is therefore a basic requirement for the further promotion of agility. However, the findings of the expert survey also suggest that managers are still too rarely offered an incentive to promote agility. As such, an important starting point for the further design of agile organizations can be found in this area.

09

There are significant differences in the perceptions of managers and employees regarding the assessment of the status quo.

The quantitative study points to significant differences in relation to the perceived status quo of agility in automotive companies between managers and employees. This also relates to the role of management in supporting agile forms of work. The managers surveyed paint a more positive picture across all relevant items than the employees surveyed. This applies, for example, to the promotion of flexible decision-making methods, the support of agile forms of work by managers or the role of managers as role models for agile working. From the perspective of the employees surveyed, there is still a need for improvement when it comes to the factor of management. This also applies to the development of an agile corporate culture. From the perspective of the employees surveyed, the corporate culture of the OEMs is only partially oriented toward agile working. Managers provide a slightly more positive picture in this case too. The differences in the assessment of managers and employees are again made clear in relation to the structural factors. Today, employees rarely find themselves in cross-functional teams, and from the employees' point of view, the organizational structure is not adapted to agile forms of working. Agile coaches are also rarely available from the employees' point of view. The managers surveyed see more marked progress on these items. It can therefore be concluded that the views of the two groups surveyed differ significantly. Managers must therefore question their own picture of the status quo of agility or communicate the available options more clearly toward employees.

10

Agility is the basis for key innovation topics in the automotive industry.

Agility is an essential requirement for the promotion of technical innovation topics such as e-mobility, integrated mobility concepts or the application of artificial intelligence methods. The results of the expert survey indicate a clear correlation between advancements in technical areas and the promotion of agility. This causal relationship is supported by the quantitative study. Agility is therefore an essential basic factor in promoting the resilience of automotive companies. Factors such as flexibility, creativity and the creation of an appropriate error culture are essential to the success of innovation projects in the core areas of the automotive industry outlined. For the industry, this is associated with changes, as new questions come into focus in addition to conventional success factors such as quality and brand image.

11

Understanding of agility is strongly influenced by agile methods. There are differences in relation to the specific measures to promote agility.

Agility has become a buzzword – but a consistent, fundamental understanding of the meaning of the term has now been developed. This can be stated at least on the basis of the results of the qualitative study. Agility is often associated with issues such as speed, flexibility and adaptability. Often, the study participants associate agility with agile methods. Less pronounced, however, is the view of agility as a cultural issue and a mindset for the organization as a whole. The combination of agility with structured forms of work is also recognized less frequently. Therefore, within the OEMs surveyed, further awareness training is needed regarding the importance and promotion of agility beyond the application of agile methods. Agile methods are an important component in the promotion of agility. However, the process of change must not end with the methods. There are still significant differences among the respondents, particularly with regard to the design of the other factors influencing agility.

Overall, it can be concluded

that the agility of OEMs in the automotive industry has developed positively in recent years. However, this development process has not yet been completed and is inadequate in view of the importance of agile working methods for business performance. Agility is not a bonus in this respect, but an essential building block for the success of organizations. The design of agile organizations must therefore not stop with agile methods. OEMs need to improve in this area. The introduction of agile methods is being promoted, but they are still a long way from being implemented at employee level. In addition, a significant expansion of the implemented measures for the structural and procedural consolidation of agile methods is required, for example by adapting the organizational structure or by establishing agile coaches and competence centers. In this respect, the demand for and promotion of indirect influencing factors in the areas of management and culture is also of particular importance.

Agility is evolving in a gradual manner. The crisis triggered by Covid-19 therefore offers an opportunity for fundamental change. A key focus of this change must be on expanding the capabilities of automotive companies in terms of agility. This will also make it possible to seize the opportunities offered by automotive innovation topics in a more effective and sustainable way.

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