Professional MBA
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Examination of strategic challenges for powertrain component suppliers to fulfil the changing demands of OEMs during the transition from traditional combustion engines to the electric mobility

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by

Prof. Dipl.-Ing. Dr. Daniel Palm

Ulrich Lauda

0551267

Steyr, 29.09.2017

Affidavit

I, **ULRICH LAUDA**, hereby declare

1. that I am the sole author of the present Master's Thesis, "EXAMINATION OF STRATEGIC CHALLENGES FOR POWERTRAIN COMPONENT SUPPLIERS TO FULFIL THE CHANGING DEMANDS OF OEMS DURING THE TRANSITION FROM TRADITIONAL COMBUSTION ENGINES TO THE ELECTRIC MOBILITY", 77 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 29.09.2017

Signature

Acknowledgements

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Abstract

Several different forecasts regarding the market shares of different ICE-technologies (Internal Combustion Engine - technologies) and electrified cars makes a prognosis of the needs of engine parts nearly unpredictable. Especially during actual nomination processes of Diesel engine parts OEMs have to cover a broad spectrum of scenarios which results also in new evaluations of suppliers. Challenging requests of the customers purchasing departments shouldn't exacerbate offer processes, but rather prepare part providers and make them aware about upcoming difficulties.

Therefore the examination shall cover the biggest challenges for suppliers during the transition to electric vehicles in the automotive premium segment and show how to prepare themselves for the nomination process. The changing demands and priorities of original equipment manufacturers during nomination processes of combustion engine components and the suppliers possibly to prepare themselves for requests for quotation (RFQ) concerning upcoming combustion engine projects will be analysed.

To create a meaningful overview suppliers will be evaluated with a questionnaire, generated in collaboration with the strategic purchasing department. The readiness regarding the volatility of the market and the general future orientation shall be identified and also integrated in the final decision making process. By comparing the results of several part providers of BMW (Bayerische Motoren Werke) which were finally nominated for combustion engine projects from 2020 onwards the relevance of the new criteria shall be proofed. Deviations have to be analysed to get an idea under which circumstances suppliers were selected with at least single negative evaluations.

By showing the necessity of fulfilling these new demands the most important points for applying suppliers are summarized to provide some identified key characteristics for a successful nomination. Besides the overall comparison of theoretical requests and real criteria for a supplier nomination especially the analysis of exceptions shall give an idea about the possibility to get nominations without fulfilling all demands of the OEM.

After the analysis of combustion engine parts the differences to electric vehicle components shall be shown and how traditional suppliers can follow the path to the E-Mobility. Finally the necessary adaptions of the questionnaire shall be examined to identify the volatility challenges also for electric component RFQs.

Table of content

1 Introduction

1.1 General introduction

The first reactions of people after reading the front-page of my thesis were raised eyebrows followed by the question “why a thesis always has to have a hyper-complicated title”.

As an employee in purchasing I will try to show why my daily business in times of a nearly unpredictable final-customer-market is at least as complex as the title itself.

The base of my problem is pretty simple and hundreds of papers and books are dealing with the road to different propulsion strategies, new demands of new generations and several influencing factors which are accelerating or decelerating the transition to a new age. First I was looking for a visualisation to underline the changing process and for giving an impression about the market situation in 2030, but while I was searching for the right source I recognised that different forecasts look pretty different and no one is able to predict the real scenario for the upcoming years. The key message is that something is definitely going to change and nobody knows exactly when and how it will finally happen.

OEMs are reacting flexible, from an external perspective it could also be interpreted as nervous, and are focusing on different directions and solutions to cover the mentioned scenarios. During these times a high focus is put on the supplier industry, especially on parts which are only used for combustion or electric engines, because the volatility mostly affects several powertrain solutions and not the car sales in general. Car manufacturers are not trying to outsource the problem to the supplier industry, but the flexibility of OEMs can only be fully used if the same abilities regarding fast reactions and adaptability are held by the entire supply chain. The weakest links in this chain has to be identified to assure the adaptability in this instable transition to the next generation of mobility.

Different forecasts are often talking about 2025 or 2030, but the transition is already happening right now. Not only the uncertainty when the electric engines will replace combustion engines is important but also the question “which combustion engine will

exist in ten to fifteen years" dominates actual nomination procedures for future projects and increases the challenges for potential suppliers.

The focus of my thesis will lie on the upcoming years until 2025 when OEMs are still focusing on combustion engines and are mainly confronted with changing demands and predictions for the downturn of Diesel and gasoline engines. My main intention is to generate a guideline for suppliers, how to prepare for upcoming RFQs in a volatile market situation to fulfil the customer needs. I won't concentrate my effort on the question "when and how the switch to the electric mobility will happen" because of the already mentioned unpredictability.

1.2 Problem definition

The project lifetime of part provisions of suppliers for OEMs is limited and these delivering companies need new nominations for projects to keep and hopefully also increase their business. A concrete offer is only possible with specific volumes over a defined amount of years, because for example sub-supplier nominations and the calculation of internal capacities can rapidly change a positive into a negative business case.

In my introduction I have been talking about "abilities" of suppliers, but what are these skills exactly? The fulfilment of the needs of the OEMs resulting out of the volatile market is often a bigger challenge than expected and not focusing on the entire spectrum of different strategical aspects can affect the overall evaluation of an offer tremendously. Additionally the supplier industry has to consider that an ability cannot be learned from one day to the other – actions have to be set preventive to fulfil those mentioned new needs of their customers.

The task for the customer is not only getting a good overall offer anymore, but also assuring the suppliers ability to keep the negotiated values in different scenarios. Already in the past, in times of limited volatility, several part providers were struggling in case of requests of increased volume fluctuation.

1.3 Scientific question

Regarding the problem definition I will try to identify the biggest challenges for suppliers and OEMs during the transition from traditional combustion engine vehicles to electric vehicles in the premium segment and how can traditional suppliers prepare themselves for this change.

Which criteria ICE-suppliers have to fulfil to reach high ratings regarding their future orientation in combination with the expected transition to E-Mobility and for being considered for nominations for the years from 2020 onwards? What are actually the biggest difficulties for suppliers of combustion engine components to reach a high evaluation and how can they prepare for the actual increasing requirements?

1.4 Method and structure

The first part of my empiric research will focus on the new priorities regarding volatile parts. In detail I'm going to show the differences between former nomination goals and new requests in the RFQs of combustion engine components. The identified differences will be proved by interviews of specialists of the strategic purchasing department of BMW to not only summarize the priorities, but also understand the reasons for them.

In the 2nd step I will develop a questionnaire to examine if nominated suppliers for components of new combustion engine projects from 2020 onwards are really fulfilling these new demands. Therefore the successful suppliers of over 30 RFQ-processes of BMW in the upcoming three months will be investigated to prove the existence of new criteria in the decision making process.

Consequently the most important new demands will be summarized. By clustering the nominated suppliers the focus will be changed from the single supplier perspective to an overview of the actual supplier industry.

In comparison to the demands in combustion-engine-RFQs I will finally analyse in interviews with the strategic purchasing specialists the needs in nominations for electric vehicles. Which adaptions have to be done to use the generated questionnaire also for E-Mobility component suppliers?

1.5 Target

The goals of my thesis are identifying the most important new priorities of OEMs regarding a supplier nomination process and consequently developing strategies for traditional combustion engine component suppliers to fulfil those needs.

Besides the overall comparison of theoretical requests and real criteria for a supplier nomination especially the analysis of exceptions shall give an idea about the possibility to get nominations without fulfilling all demands of the OEM.

After the analysis of combustion engine parts the differences to electric vehicle components shall be shown and how traditional suppliers can follow the path to the E-Mobility. Does an orientation of suppliers in the electric mobility segment already influences the nomination for combustion engine parts or can those business fields been seen individually?

2 The volatility in the automotive industry

As theoretical background a short overview about the industry itself is necessary. To understand the “changing demands” as written in the title it’s essential to also get an idea about the market and the main influencing factors.

Furthermore the analysis is strongly related to future scenarios, especially to the years 2020 until 2025, wherefore an outlook about possible future scenarios shall be given, which will be examined regarding the strategic actions of OEMs in the empirical part. This should show not only which new demands OEMs, in the concrete examination later on BMW, request from their customers, but also why they ask for new additional abilities or characteristics of their suppliers.

2.1 Drivers of change

To start with and to get an impression about the changing demands the most important macro-economic trends have to be understood.

Over the last years the environmental thinking got more and more important for customers, not only regarding climate and health protection but also the consumers thinking about limited resources. This increased awareness led to stricter legislation and the acceptance in society of new technologies. Combined with growing oil prices and higher costs for combustion engine technologies to meet the legal targets, alternatively powered cars got continuously more attractive regarding costs. Additionally OEMs will have to face new challenges in their further emerging markets and in (mega-) cities where mobility is already today requested in a completely different way, especially by young generations.[1]

These drivers of volatility are not making a claim for completeness, but are showing several examples for influencing factors which shall emphasize the difficulties regarding forecasts of future scenarios. For the upcoming examination of combustion engine component suppliers the different separate trends are less important than the overall impact on future demands. The combination of many different trends shows

[1] Schramm, Koppers, p.3 ff., 2014

already the complexity of the automotive future and leads to the necessity of various scenarios during the following chapters.

2.2 Actual and future engine market situation: Gasoline – Diesel – Electric

After having a deeper look on the mentioned megatrends the turning point will be 2020. To reach the upcoming new fleet emission goals of the European Union regarding CO2, alternative propulsion technologies besides the combustion engine will be definitely needed. In combination with these tendencies the electric engine is often mentioned as the most likely solution in the next ten to fifteen years.[2]

To understand the initial situation completely it's necessary to give an overview about the actual market situation and the main tendencies in the automotive market. Due to nearly daily changes and big differences between OEMs it's not easy to describe the actual situation in general or with literature, because information is actualized minute by minute.

The annual global automotive supplier report of 2016 by Roland Berger underlines the market volatility and sensibility of the public and the media. They described it as an "acceleration of debate on the future of powertrain" which has started right after the "Dieselgate". Mentioned aspects like the price of technologies, regulations of governments and the necessity of Diesel engines for CO2 goals were cited on their summary.[3]

Regarding the dynamic behaviour of these nearly daily news and publications the actual market situation will be described by providing the content of several newspaper articles in a period of two weeks in July 2017.

The negative image of Diesel engines didn't stop over the last year and last week it was Porsche who will maybe ditch diesel engines.[4] Even more radical Volvo

[2] Lenz, Tober, p.1, 2016
[3] Berret, Fellhauer, Mogge, Schlick, Schmidt, Söndermann, p. 26, 2016
[4] Cremer, Wissenbach, 2017

announced that they will “phase out combustion engine for electric motors starting in 2019” which means each car from 2019 will be offered as Electric or Hybrid vehicle.[5]

Consequently the obvious question is “Are the days of combustion engines numbered?”? Pushing governments, the high importance of combustion engines until at least 2025 and the first mover China is mentioned, a country which tries to generate with a lot of know-how a technological advantage.[6]

As OEMs like Volvo, also countries are acting in very different ways. China is not only pushing the technology but also having ambitious goals regarding the car sales of electric vehicles. The “EU car makers join others in pleading for slower electric vehicle action by China” to have a more controlled transition to the electric mobility, which shows that national as well as global interests are affecting the future developments.[7] Besides the governmental interests also the question of “socially unacceptability” was discussed in another article where the combustion engine was compared with smoking which seems to be in some points culturally nonacceptable.[8]

The presented articles and the start with the “Dieselgate” definitely shouldn’t have the claim for completeness, but show some examples for influencing factors, different approaches of various parties and consequently the difficulty of predicting the future. At this point the wording of the introduction has to be repeated a bit more precisely: Everybody is aware of a change, but nobody exactly knows when and how. The expected change affects the combustion engine which will be replaced by the electric engine in the long-run. Regarding the downturn of combustion engines specialists definitely believe that in the first step the amount of Diesel engines will decrease.

How fast the sales of electric vehicles will finally increase is also strongly related to different drivers. Accenture tried to summarize them in the paper “The Electric Vehicle Challenge” in 2014 which is still valid in some points. Especially government regulations and subsidies, the relevant charging infrastructure, adaption of core operations and processes at OEMs, the anxiety of customers regarding the range of electric vehicles or the collaboration within the E-Mobility Value Chain are some

[5] Glinton, 2017
[6] Mitchell, Pierson, 2017
[7] Radosavljevic, 2017
[8] Corfield, 2017

mentioned points. The criterion “integration of electric vehicles within the product portfolio of OEMs” is already increasing pretty fast and the numbers of offers will continuously increase in the upcoming years.[9]

The volatility of the future volumes is shown in another study by Roland Berger, published in 2016, where two different scenarios are shown regarding the future powertrain mix in sales from 2015 to 2030.[10]

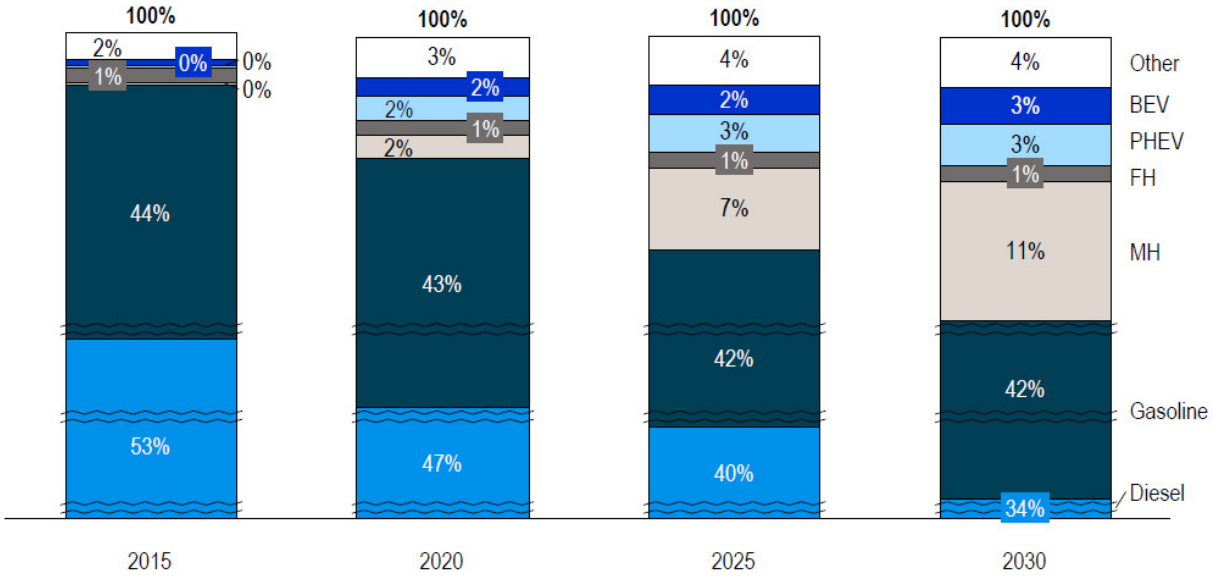

Figure 1 Powertrain shares scenario 1[11]

In comparison to Figure 1 where a continuously dominant combustion engine is shown image 2 gives us an impression how a scenario with a faster increasing non-combustion engine vehicle market could look like.

[9] Raab, Huber, Trenka, Wahl, p.2, 2014
[10] Van der Slot, Schlick, Pfeiffer, Baum, p. 45, 2016
[11] Ibid, p. 46, 2016

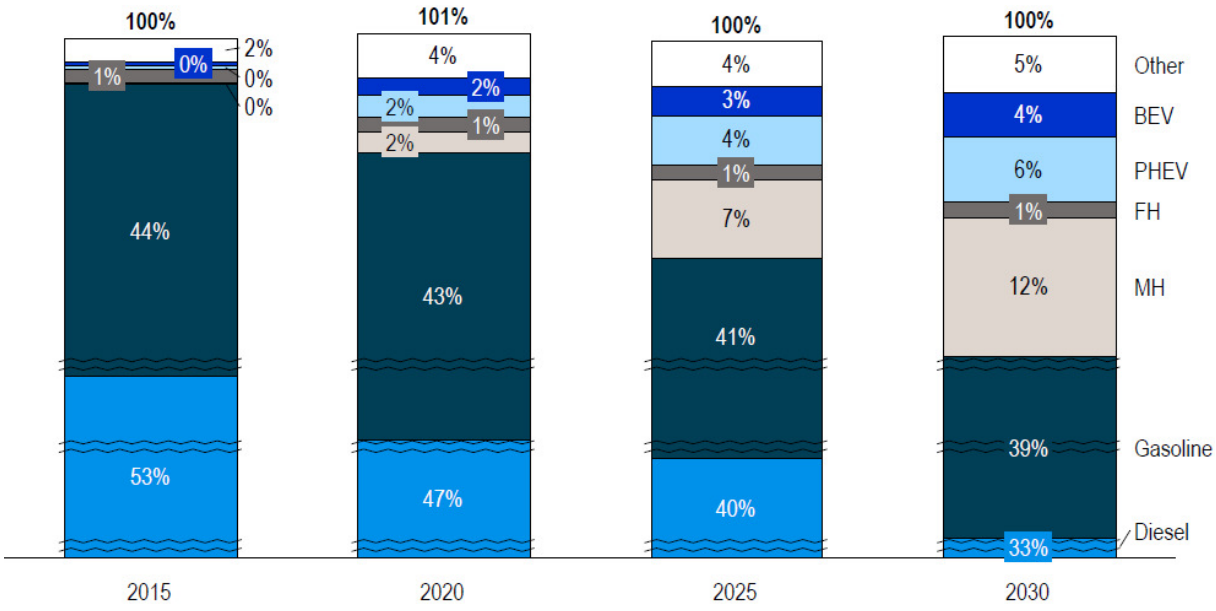

Figure 2 Powertrain shares scenario 2[12]

The interesting fact is that the 2nd scenario is not considering all uncertainties. It only considers a faster decreasing battery price, which will be definitely important for the increase in sales, but is only one of many factors which affects the transition to E-Mobility.[13]

By providing these two different scenarios the effect of only one single impact shall be shown to underline the instability of forecasts. The sum of several drivers leads to equations with a high amount of variables and the deviation of one scenario to the other is consequently much higher.

[12] Van der Slot, Schlick, Pfeiffer, Baum., p. 88
[13] Ibid, p. 45 ff., 2016

2.3 The supplier industry

The supplier industry as a complex vertical supply chain was already mentioned in 1990 in the book “The machine that changed the world”: Already 27 years ago a typical car was built out of over 10000 parts and from the beginning of the 20th century the amount of in-house produced parts were continuously reduced. The development from single part suppliers to module and system suppliers led to complex tier-n structures where a lot of research and development work is nowadays included. The increasing importance of the suppliers regarding the technology and the value adding steps behind the parts led to a strong customer-supplier-relationship. A large number of suppliers is responsible for high specialisation and competition which is still typical for our today’s supplier industry.[14]

Automotive suppliers are strongly dependant to OEMs and consequently also to the decisions of the final customer. The whole supplier industry is dominated by the technological superiority of the largest firms which are often even bigger than many OEMs. The profitability can vary a lot between build-to-print parts and highly large-scale systems or components, but also with specialisation and niche products high profits can be generated. Parts with the highest complexity are mostly provided by Tier-1 suppliers. Sub-suppliers are often providing less complex parts and have consequently a lower bargaining power which is finally also visible in the profit share. An increasing complexity of the component leads to a stronger resistance against substitution, but in general the industry is well known for an extremely small amount of monopoly situations of suppliers. The more common situation is a high pricing and cost reduction pressure from OEMs. This economical urgency creates a trend of shifting production facilities to low-cost countries by traditional European and American suppliers and a general globalisation tendency with several new market entrants especially from the Asian market.[15]

The reason for the highly competitive market is its attractiveness. McKinsey is forecasting an increase of the annual powertrain market revenue from 190 billion Euro to 460 billion until 2030. If the regulations regarding emissions will get stricter than

[14] Womack, Jones, Roos, Sammons Carpenter, p. 141 ff., 1990
[15] Streda, Hon, Beauchemin, p. 5, 2016

expected also the estimated market revenue have to be corrected to an even higher number.[16]

2.3.1 Effects of the volatile market on suppliers

The mentioned effects of the “Actual and future engine market situation Gasoline – Diesel – Electric” in chapter 2.1 from page 5 onwards have various consequences on the whole supplier industry and the following key actions were identified by Roland Berger:

As the most important point the scenario planning was mentioned regarding the possibly disruptive transition to the E-Mobility. Consequently the shift of innovation efforts into the same direction and a high flexibility in those R&D actions are additional points in the list of Roland Berger. Considering the economical perspective suppliers have not only to be successful in the long-term with new components but also mid-term solutions in their business planning. Finally the cost management in times of increasing complexity plays still a dominant role for suppliers.[17]

With the right strategy it’s still possible to increase business with the OEMs, because the market value of automotive components is continuously increasing. Figure 3 shows an increase by about 21%. Another aspect which can be easily seen in the visualisation is that the market is changing and many winning and losing components are leading to new suppliers or increasing businesses for actual serial suppliers.

[16] Kampker, p. 4 ff., 2011
[17] Berret, Fellhauer, Mogge, Schlick, Schmidt, Söndermann, p.37, 2016

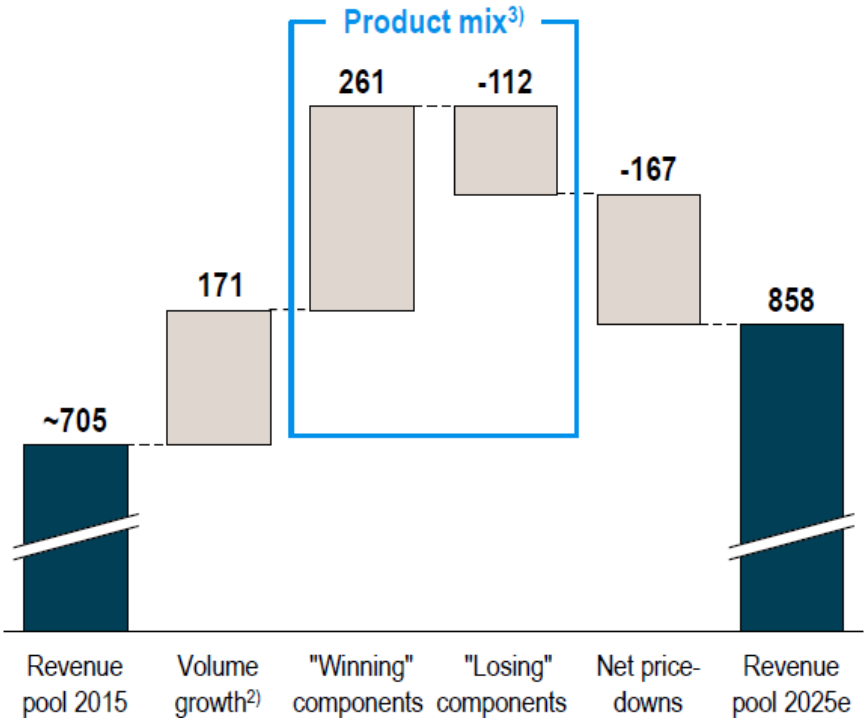

Figure 3 Revenue pool for suppliers[18]

The mentioned “losing components” will be especially diesel parts like unit injectors, indirect injectors and turbo chargers. The winning components are of course special parts for BEVs and hybrid cars which are facing increasing demands as shown in the first two figures (powertrain shares scenario 1 & 2) regarding the market situation.[19]

For representatives of OEMs the influence of the dynamic market on the suppliers industry is often at least partly ignored or neglected. Often the first step is to increase flexibility rates in RFQs, but this should only be one single important aspect for the evaluation of a supplier.

To get shares of the interesting supplier market, part providers have to be prepared for the value chain transformation and have to position themselves correctly. It is not surprising that McKinsey identified similar criteria as Roland Berger. The biggest growth opportunities are the new emerging power train technologies as the battery electric vehicle. Generally the creation of new fields of competences regarding ICE engines or for future powertrain technologies is the key to get or keep a high percentage of the global market. For ICE businesses the management of the decrease

[18] Berret, Fellhauer, Mogge, Schlick, Schmidt, Söndermann, p.36, 2016
[19] Ibid, p.36, 2016

of units and balancing the reduction with a broad product portfolio leads to a high level of trust of the customers (OEMs). ICE-focused suppliers have to consider different scenarios and develop strategies for several possible situations. In times of uncertainty OEMs want to have confidence in strategic partners with whom the car producers can pass the transition to the E-Mobility. The answer of the question “make or buy?” is often buy extended by “cooperate”. It is necessary that both parties are aware of the value chain shift and are preparing for this difficult period commonly. For the purchasing departments in automotive OEMs a strongly deliberated supplier strategy during volatile periods prevents problems which can be in worst-case-scenarios the insolvency of a supplier which can lead to enormous problems in the part provision.[20]

The transition process can’t be seen as a continuous process. Often using the wording “disruptive” for this expected behaviour of change describes the opposite of a smooth changeover. The part providing industry has to face the fact that their customers are preparing for disruptive changes in their field of business and suppliers who want to keep the business have to follow.[21]

The challenges for suppliers are pretty different for the different powertrain technologies: In comparison to the ICE suppliers for example BEV component suppliers can be confronted for example with assuring raw material access, capacity increases and handling the ramp up in the upcoming years.

In the practical part the key actions mentioned by Roland Berger and McKinsey will be expanded by some further important criteria which are meaningful for evaluating the future orientation and perspective of suppliers. In the first steps the goal is to identify those additional characteristics and to prove their relevance by comparing them with the attitudes of the nominated ICE suppliers for the next engine generation.

[20] Kampker, p. 10 ff., 2011
[21] Matzler, Bailom, van der Eichen, Anschober, p. 103 ff., 2016

3 Supplier selection and evaluation process

In the upcoming chapter an overview will be provided which shows the development of the supplier nomination process and purchasing in general. The main focus will be put on the preparation of the supplier selection during which suppliers are analysed and rated.

3.1 Challenges for purchasing departments

3.1.1 Historical development of purchasing

After starting at the beginning of the 19th century as a competence of the selling agent in the textile industry soon the importance of purchasing was identified. The importance of purchasing increased in the 1850s during the growth of the American railroad system where the position of the purchasing agent got departmental status. The agent was already reporting to the head of the president of the whole railroad. Due to the increasing recognition after the success of the railroad the purchasing department changed in the late 1800s from a single person function to an organized corporate function with a higher degree of specialisation. In the first half of the 20th century the importance of a big focus on purchasing was transferred from the railroad industry to other industry and first books regarding techniques and purchasing systems were published. Especially during the world wars the relevance of the provision and assurance of material was obvious and after the 2nd world war already 49 courses regarding purchasing were offered. In comparison in 1933 only 9 lectures were offered. In the post-war years until the 1960s many specialists noted that the possibility to influence purchasing actions in a positive way are limited and the departments are just costly. Material shortages in the mid 1960's led the to the department material management which combined the purchasing department with the inbound and inventory control. The purchaser didn't look at the supplier as a partner – he set the focus on price competition combined with assuring the supply by multiple sourcing. From the 1970s to the year 2000 the global era resulted in a high increasing competition which also led to shorter life cycles and a global supply network. To keep businesses under control managers focused more and more on supply chain

management to control the flow of goods. By these tendencies the value adding processes along the supply chain got visible and were increasing and the purchasing departments had to acknowledge the suppliers importance and concentrated on their customer-supplier-relationships to fulfil the customer expectations in a fast changing market regarding the technological developments. To focus on the customer needs a strong horizontal cooperation with other internal departments and vertical integration along the supply chain is indispensable. Therefore the importance of the purchasing department to meet future requirements and customer needs is getting more and more important. [22]

3.1.2 Today's challenges

Actually and in the past decade new challenges and trends occurred.

The amount of the purchasing volume is 40 to 60 percent of the turnover which creates a huge potential for the purchasing department to influence the annual result of the company. Stocks are getting lower and lower to reduce the binding of capital which could lead easily to shortages in production. It's necessary to assure shore restocking times to reduce threads of discontinuities in production. OEMs focus a lot on their customers to avoid extended waiting times for cars to maximize the consumer's satisfaction. Requirements regarding the efficiency and effectiveness are targeting the processes to increase quality and services. The mentioned strategic partnerships and cooperation with suppliers raises the outsourcing activities to Tier-1 suppliers which is not allowed to affect the quality of the final product. Outsourcing activities are automatically increasing the complexity in the supply chain and generates consequently risks which has to be kept under control by additional quality assurance actions and high efforts already long before a supplier is nominated for projects. The increasing value-adding processes should result in cost savings for the OEM, but non-detected quality issues can have the opposite effect as consequence. The final mentioned trend is the word "sustainability" which is more and more often used by OEMs and the society. The OEMs are tracked and examined until their sub-supplier activities and further to prevent topics like the use of rare earth, the caring about

[22] Monczka, Handfield, Giunipero, Patterson, p. 24 ff., 2016

environmental issues, working conditions of the supplier's employees and further more along the whole supply chain. Besides the long term goal of financial performance the described main challenges for purchasing departments are strategic purchasing actions and risk management. [23]

3.2 Targets and responsibilities in purchasing

If the different challenges and responsibilities over the last two centuries are compared it's obvious that new goals and new functions for the purchasing department were defined.

The upcoming image shall show the former and the actual goals which buyers have to face during supplier nomination processes.

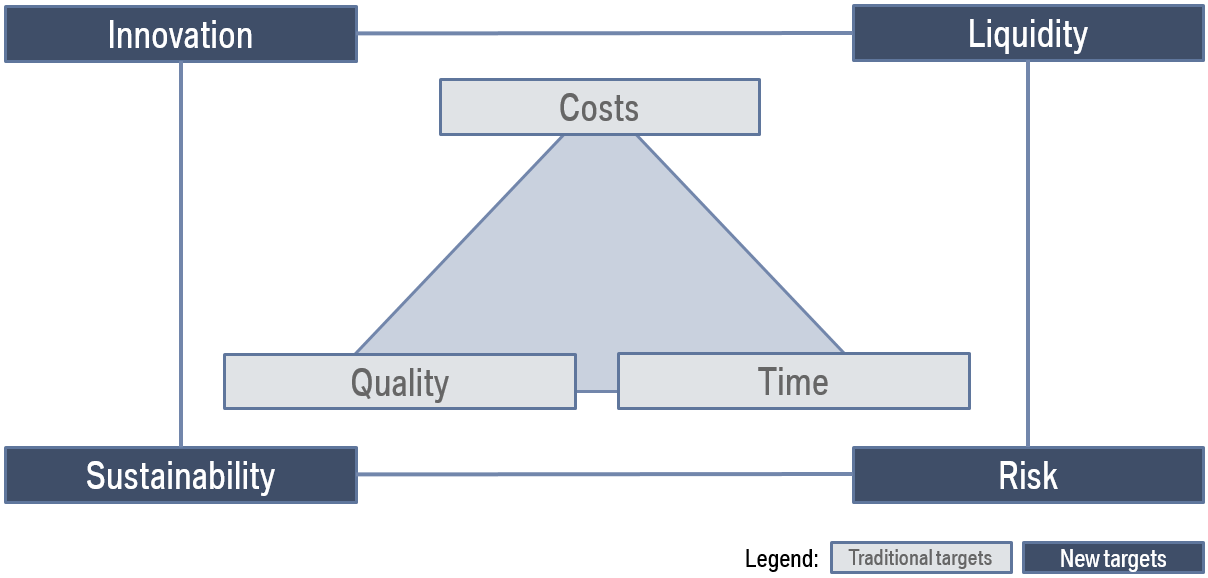

Figure 4 Target enrichment[24]

At the beginning it was sufficient to have the right part in the right quality for the lowest possible costs in the OEMs production plant. Those factors can be seen as hygiene factors and are still valid and important, but the target enrichment shows already

[23] Locker, Grosse-Ruyken, p. 8, ff., 2015
[24] Locker, Grosse-Ruyken, p. 14, 2015

several new directions in the dark blue boxes surrounding the triangle of sole former priorities.

Innovation is driven by the continuous technological changes which have to be brought to series as fast as possible. Sustainability results out of the fact that also OEMs see the environmental responsibility, it is more and more requested by customers and society and several resources are limited. Liquidity is not in general a new topic, but investments, especially for the transition to the electric mobility, are extremely high and continuously changing regulations and norms are strong cost drivers. Shorter life-cycles in combination with the mentioned ongoing innovations are requesting high financial efforts.[25] Various risks can be identified out of these new criteria, which will be shown in the chapter 3.5 “Risk management in purchasing” in one of the upcoming chapters beginning on page 26.

As already mentioned the general importance of improving the cost position is still given, but nowadays the cost orientation is more or less seen as a base requirement. Non-financial KPIs and value-oriented supplier selection decisions were tendencies which let serial suppliers expand their perspective internally by the optimization of processes and externally by switching from the price orientation to a holistic supplier management. Consequently several new tasks broadened the task spectrum from a primarily operative dimension to a more and more strategic one. Decisions in the purchasing departments are therefore not only affecting the price and profit anymore, but also influencing the strategy of the whole organisation.[26]

The function of a serial buyer in the automotive industry changes to a combination out of a value chain manager and an innovation scout which leads generally to a higher integration in different internal business fields. High flexibilities are demanded, the amount of the mentioned operative and strategic tasks are increasing which finally led to the necessity of dividing these responsibilities into different departments.[27]

The mentioned value chain and innovation orientation underlines again the transition to strategic partnerships with suppliers. The goal of all OEMs of reaching a competitive

[25] Locker, Grosse-Ruyken, p. 14, 2015
[26] Schumacher, Schiele, Contzen, Zachau, p. 99 ff., 2008
[27] Ibid., p. 174 ff.

advantage with key suppliers in comparison to the main competitors often limits those partnerships. All consumers have the target to generate also strategic advantages by being a preferred customer.[28]

Those targets are causing a huge job enrichment for buyers which can be divided in tasks regarding the overall goals, strategic actions and tactical responsibilities visible in the upcoming image.

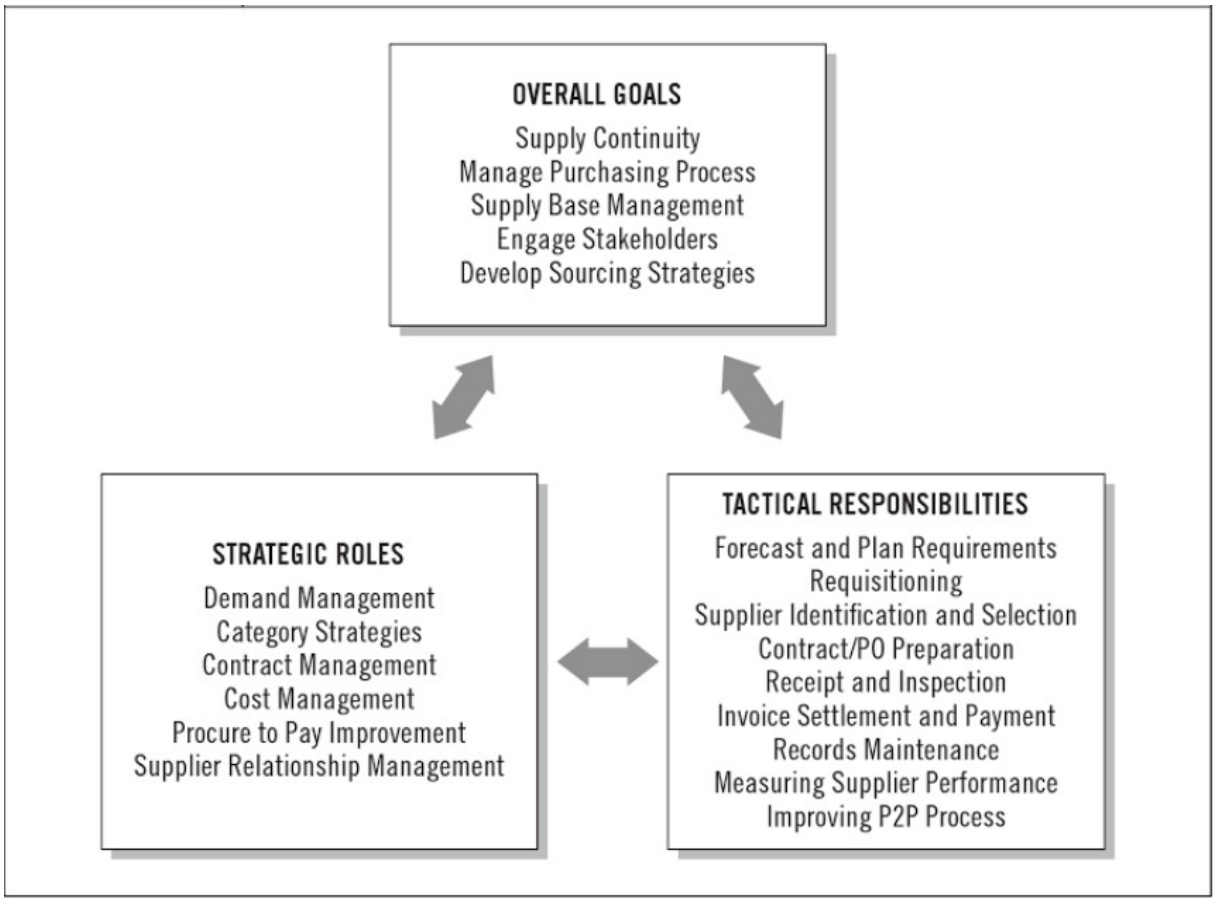

Figure 5 Purchasing roles and responsibilities[29]

The overall goals are for example the topics mentioned in the previous paragraph. Strategic actions are necessary especially for interactions between the purchasing department and several other internal resorts. Purchasers need to have the authority to make decisions and have to consider to represent also the interests of the various other functional groups. It's not requisite to go into detail about all mentioned points in

[28] Schumacher, Schiele, Contzen, Zachau, p. 272 ff.
[29] Monczka, Handfield, Giunipero, Patterson, p. 42, 2016

figure 5, but to sum it up the strategic supply management role deals with analysing historical data, forecasting of internal demands, deriving RFQ strategies and also customer-supplier-relationship topics not only in combination with the decision-making process. A point which has to be underlined regarding the practical part of this thesis is “establishing a fixed set of standards to limit options, and restricting the supply base to include only preferred suppliers who comply with risk and compliance requirements”.[30]

Regarding the tactical responsibilities forecasting is again an important issue, but now it is prepared for the external use for specific suppliers. Other points which are of big importance are additional internal needs, many administrative and controlling actions like invoicing and contract topics. Additionally tactical actions are often based on da collection and monitoring the performance especially about the historical, actual and forecasted status of the supplier.[31]

3.2.1 CSCS - Commodity supply chain strategies

All shown targets and responsibilities especially in combination with the described new challenges for purchasing departments underlines the necessity of a more intense preparation for future supplier nomination processes. The discussed volatility in chapter 2 “The volatility in the automotive industry” starting on page 6 is only one driver which increased the focus on specific strategies for various components.

The supply strategy is mostly focussing on a part family wherefore specific targets, goals and a roadmap with a defined plan is elaborated. Those different functional groups are confronted with several boundaries which is the reason why the strategy has to be done for each group on his own. Synergies or similarities are often existing, but no standards are available to duplicate a strategy for all part families. In 2007 deriving a strategy from the value of the product and the number of market competitors was the main factor for different strategies. The essential inputs for evaluating a product group were a high knowledge of the market situation combined with the internal and external constraints. For a correct evaluation a detailed assessment was

[30] Monczka, Handfield, Giunipero, Patterson, p. 45 ff., 2016
[31] Ibid., 54 ff., 2016

necessary. The allocation of one part regarding the market situation and the value of the product is no definition in general. It can change from time to time depending on developments on the market.[32]

[32] Trent, p. 125, 2007

3.3 The supplier nomination process

The upcoming figure shows the whole procurement process to get an idea when the supplier evaluation have to be done to let the results of the rating have an influencing impact on the final decision.

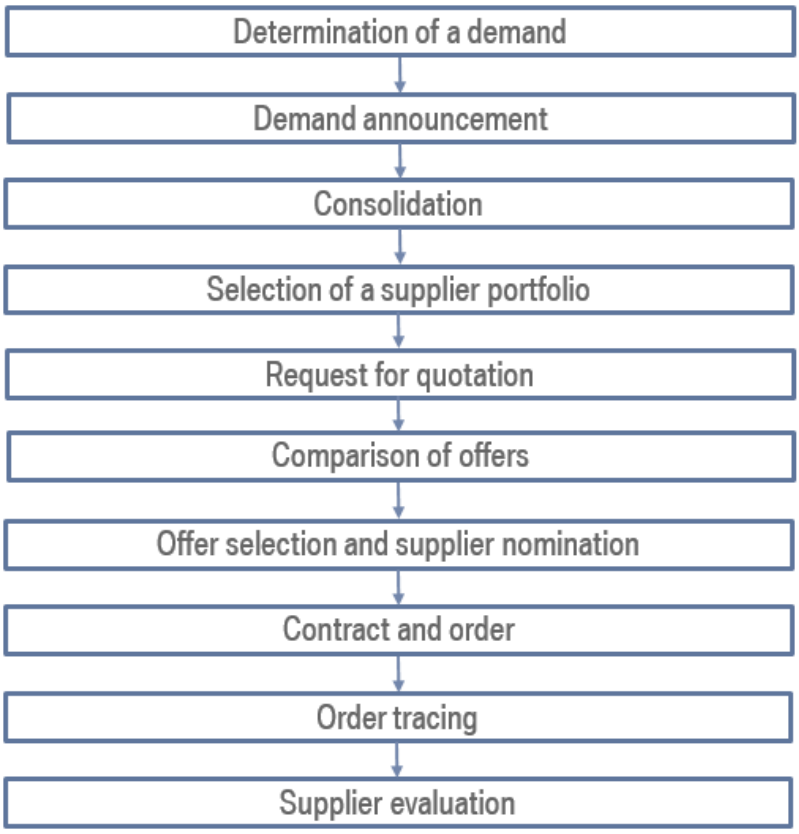

Figure 6 the operative procurement process[33]

The base of the supplier selection is the technical definition of the product which is specified in the specification sheet resulting out of an internal demand. The standard approach is sending this document to a various amount of potential suppliers. After the comparison of the different offers the purchasing department recommends a supplier for a nomination. The process after receiving a detailed offer with a concrete technical solution for the request includes also a general analysis of the supplier. The pre-selection regarding the supplier's perspective for the future is one of the key activities

[33] Wannenwetsch, p.107, 2007

in this period to prevent hopefully all possible problems. Also for more or less predefined serial suppliers the RFQ-phase is the right period of time to ask for further commitments regarding new market challenges.[34]

A good example for increasing efforts for the mentioned general analysis is the globalisation of the market. The global competition was the final input that sourcing was globalized. The reduction of procurement costs driven by the fight for market shares led to a need of much higher work inputs regarding the assurance of quality and delivery. Additionally the reduction of the production depth at the OEM the purchasing volume is continuously increasing and is nowadays a strong instrument to reach the goals of the company. Due to the fact that the total purchasing volume is normally much higher than the profit, a price reduction of all purchased parts by 1% leads to a profit increase of a much higher percentage.[35]

3.3.1 Demand and capacity planning

The base for each nomination is a specific volume demand in the RFQ.

From this point of time on the supplier has his first forecast for a specific volume. The first real planning prognosis is provided about 24 months before the final need. The strategic numbers are replaced by a program and forecasts which are getting more and more detailed dependent from the time to the specific need. The final order and the call offs of an amount per day follows several weeks before the final day of production. The communication along the supply chain is often delayed from the OEM over the Tier-1 to his sub-suppliers.[36] The different planning periods can be divided into the operative, tactical and strategical periods related to the time to the forecasted date.

[34] Arnold, Dettmering, Engel, Karcher, p.73 ff., 2011
[35] Reese, p.12 ff., 2013
[36] Gehr, Hellingrath, p.23, 2007

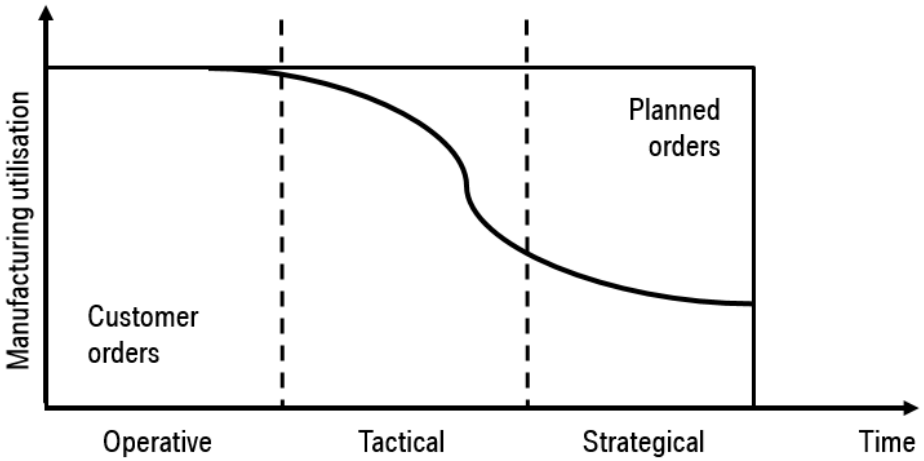

Figure 7 Time-related order types[37]

In the meantime the orders are varying several days before the final need and adaptions are automatically transferred by an enterprise resource planning tool from the materials requirement planner to the suppliers.[38]

[37] Comp. Dörr, p.51, 2007
[38] Dörr, p.50, 2007

3.4 Supplier evaluation

Area of evaluation	Criteria
Delivery and performance of the supplier	- Quality - Price - Conditions - Reliability of delivery - Supply loyalty - Services (e.g. disposal)
General supplier evaluation	- Legal entity - Financial rating - Cost structure - Market share / market share development - Management structure and quality - Quality standards - R&D efforts - Image - Willingness to cooperate - Willingness for countertrades
Environment of the supplier	- Location / society / population - Local ecology - Local economics - Balance of payments - Currency / Cash / Capital - Technology - Economic territory

Table 1 Criteria for supplier ratings[39]

[39] Vgl. Wannenwetsch, p.120 ff., 2007

As shown in table 1, the supplier evaluation during the process step “comparison of offers” can be split up in several criteria which have to be considered during a complete rating of a part provider. The criteria of 2007 are definitely some of the most important review values, but cannot be seen as a complete list of the important key data. By the reason of the described volatile market, the top management is continuously demanding new assessments to prevent negative impacts of different threats.

To get an overview impression about different suppliers the shown criteria can be rated by different models. An easy way is to contrast them by points. Very useful for this method is to prioritise the values, because the importance often varies a lot. The utility analysis which is pretty similar to the evaluation by points with the difference that the prioritisation is done in percent. After an evaluation by points those values are multiplied by the particular percentage-value.[40] The strength-weaknesses-profile evaluates again by points and visualises the different criteria to have a better overview regarding the critical values.[41]

3.4.1 Key Factor “flexibility” and “adaptability”

Already in the early two-thousands flexibility was mentioned as the most important directive because of a high fluctuation at the market. In these early periods the focus was set on flexibility in the internal production regarding the usage of space, adaptions in production, short-time capacity increase by additional shifts or also a fast reaction on call-off decreases. The key wording was “process standard”, similar to Japanese producers, to have defined solutions in case of various changes regarding customer demands. The second necessity besides flexibility is the often mentioned “adaptability”. OEMs and consequently also suppliers have to be able to react to market demands and change approaches and possibly also business models. Logistics were identified as “strategy enabler”, because they are always affected in case of changes and has to establish processes.[42]

Flexibility was mostly relevant in times of high insecurity and special incidents like recessions, the oil crises or economic crises. Also if those tendencies are predictable

[40] Kluck, p.60 ff, 1998
[41] Aichbauer, Wannenwetsch, p.84, 2003
[42] Rinza, Boppert, p.27, 2007

and the development is definitely going to happen, a higher amount of flexibility is requested.[43]

An example for the problem of high flexibility delivers Contnental Automotive Systems a global provider for electronic components. The limiting factor for flexibility is the procurement of sub-supplier components or material which has to be considered in the flexibility context. OEMs are mostly providing forecasts with deviation rates of up to plus/minus 20%. The final purchase order normaly comes several days before the specific need.[44] This increasing complexity was primarily driven by the switch from a build-to-stock to a build-to-order strategy and the increasing change flexibility until some days before the delivery to the final customer. These general difficult sub-supplier structures, late changes and low stock levels have the result that extreme differences between forecast and real call-offs of the OEM can exist. These general high demands of flexibility by the OEM are even increased by a volatile market.[45] Tier-1 suppliers in the automotive industry are often confronted with a lack of information by their Tier-2 supliers or are reduced willingness to cooperate regarding flexibility topics.[46]

3.4.2 Rating companies in the automotive supplier industry

To compare internal ratings to external ratings in the upcoming chapter an approach of a rating agency is provided which shows some differences to the analysis by the OEM. [47]

The focus of the external evaluation lies on obligations, creditworthiness or security. During the rating process “historical and expected business and financial risk factors as well as industry-specific issues, regional nuances and other subjective factors and intangible considerations” are considered. In comparison to the external rating of an agency the internal view of delivery and the performance of the supplier, which was describe in the previous pages, is often objective evaluated and not only based on facts. The rating agency normally doesn’t have the intense business-to-business

[43] Voigt, p. 605, 2007
[44] Monsees, Saatmann, Schorr, p.54 ff., 2007
[45] Voigt, Saatmann, Schoff, p.84, 2007
[46] Petri, Hooites Meursing, p. 471, 2007
[47] Streda, Hon, Beauchemin, p.3, 2016

contact with the evaluated supplier in their daily work, wherefore the quantitative and qualitative analysis can only be based on numbers and facts. The following figure shows the procedure starting with an overview of the industry and continuously going more and more into detail regarding the company. The issuer rating is combing the ratings and creating the overall performance overview of the specific supplier.[48]

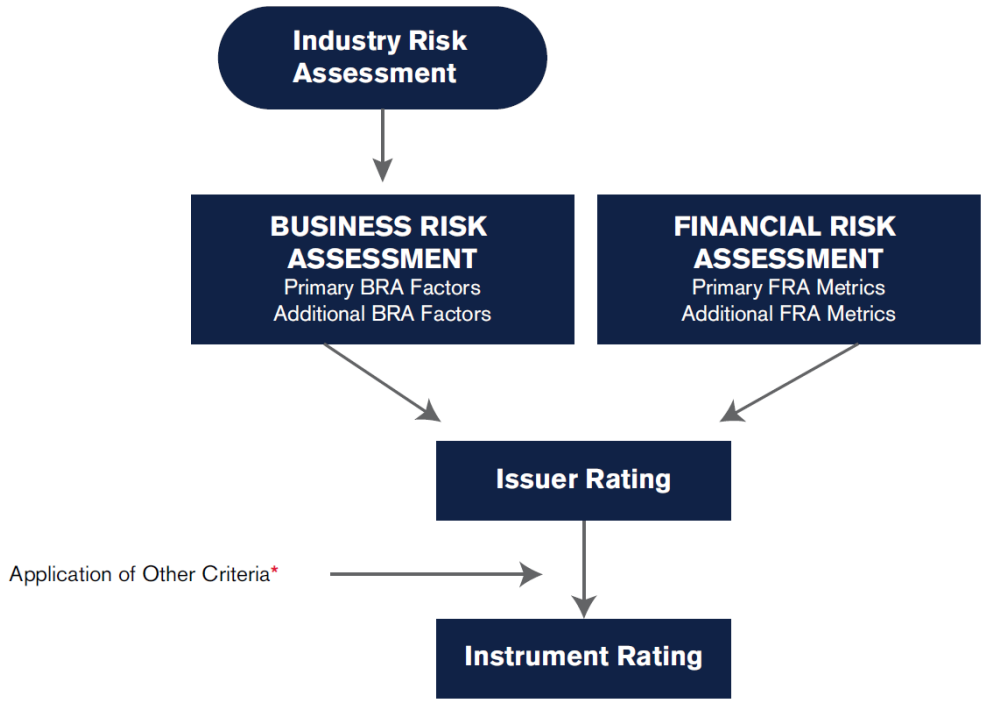

Figure 8 Supplier evaluation by a rating agency[49]

The industry risk assessment starts with the overview of the industry and is normally based on an average company in the industry. The most important factors during this evaluation are profitability and cash flow, competitive landscape, stability, regulations and other influencing things. The comparison to an average company in the industry can also be finally considered in the issuer rating. During the business risk assessment the following aspects are mostly examined:[50]

- Product complexity in combination with its substitutability
- Geographic and customer diversification

[48] Streda, Hon, Beauchemin, p.4, 2016
[49] Ibid., p.4, 2016
[50] Ibid., p.6, 2016

- Operating efficiency
- Sovereign risk and corporate governance

Additional factors, which are also mentioned besides the primary ones, are labour, supply chain management and raw-material cost management. In the financial risk assessment key figures like liquidity, profitability and free cash flow are considered. Regarding the already described issuer rating often the business risk assessment has a higher influence than the financial one. If the ratings are not examining investment questions other criteria are additionally added which leads to the final instrument rating.[51]

3.5 Risk management in purchasing

The risk management process has nowadays a broad spectrum of tasks which have to be assured. Most of them are focusing on the health of the supplier (e.g. financial strength) and on the supply assurance. Therefore not only supplier specific values are compared, but also political, economic, ecological or legal regional aspects are compared. In combination with external issues also strategical aspects on the OEM side are considered like sourcing strategies or stock levels. Especially supplier ratings are often outsourced to highlight that the evaluation is impartial and only facts are considered, for example by financial rating agencies. Consulting agencies also often have a larger database and are therefore much more efficient in the creation of ratings. For nearly all kind of risks various indices are existing which help buyers to get an impression about additional assurance actions regarding a nomination of a supplier of a specific country. Another advantage of an external analysis is the fact that ratings can change rapidly and therefore the responsible departments have to look continuously on the regional developments.[52]

Especially in cases of environmental or sustainability issues the societies belief in the independency of an evaluation, e.g. of sustainability issues regarding environmental topics, can also be supported by agencies which have nothing to do with the company in its daily business.

[51] Streda, Hon, Beauchemin, p.7 ff., 2016
[52] Wannenwetsch, p.381 ff., 2013

Regarding the mentioned increasing challenges OEMs are setting several actions. The awareness of new threats and task enrichment was for example also identified by the BMW Group and consequently an own board member has been implemented for the sector “Purchasing and supplier network”. Besides the definition of several targets in the year 2012 to cover the increasing complexity in the purchasing area, one of the most important points was to define a consistent risk management structure to attack eight risk groups:[53]

- Financial risks
- Quality risks
- Capacity risks
- Technology risks
- Risks in internal processes
- Raw material risks
- Location risks
- Currency risks

To continuously reduce the threats companies are heading during the supplier selection process, exemplarily Daimler shows in the upcoming figure their risk management to assure the attainment of the goals of the company.

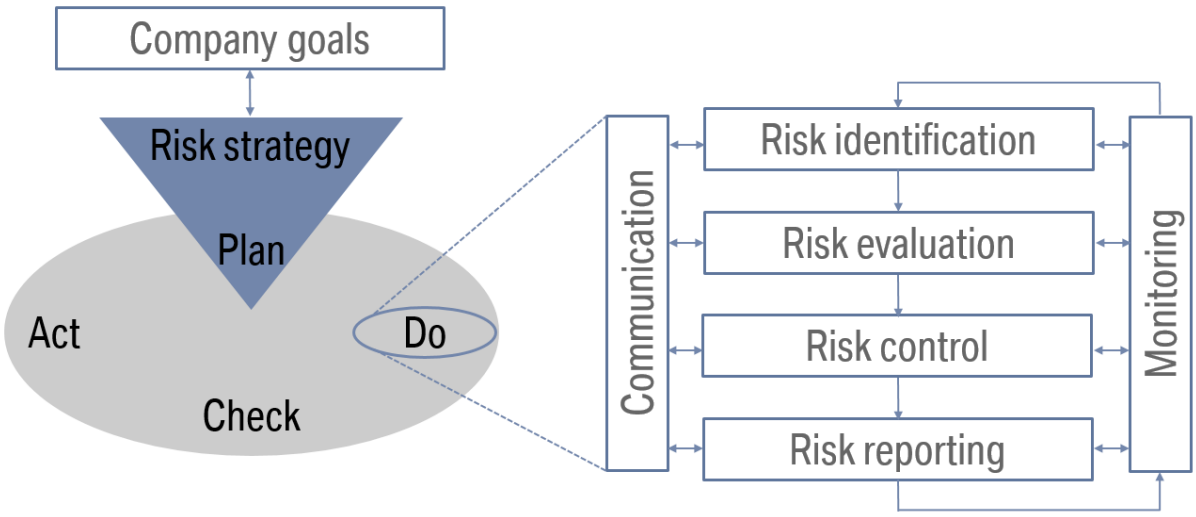

Figure 9 Risk management process at Daimler[54]

[53] Locker, Grosse-Ruyken, p. 13 ff., 2015
[54] Ibid., p.68 , 2015

An own risk management committee which assesses those risks was authorized by the supervisory board which gives the tasks and actions of this committee a high significance.[55] A standard PDCA-cycle shows the continuous improvement where all risks during changes are systematically assessed and finally reported and monitored. The final points, the documentation and visualisation of the identified topics, and specific counteractions are extremely relevant for the traceability of recommendations and decisions.

The previously mentioned supplier rating respective specific risks is only one part which is rated in standardized risk management models like in the one shown by Daimler.

The overall evaluation of a nomination is finally visible in the purchasing scorecard where the overall aspects material cost reduction, supplier and employee performance and the internal processes are rated.

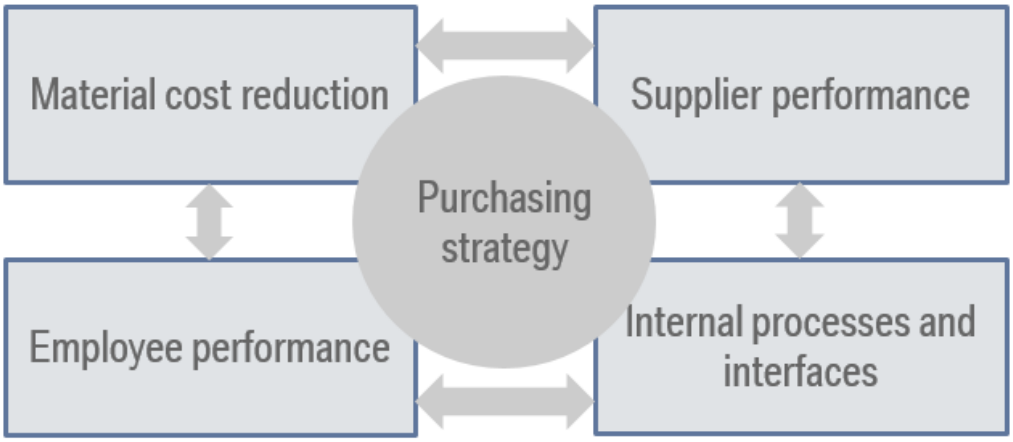

Figure 10 Purchasing scorecard[56]

It's one more time easily visible that the supplier evaluation focuses not only on the supplier's performance. All key productivity indicators are summarized and provided for the final overview in the board meeting where the decisions are finally made. The monitoring of activities concerning purchasing actions provides a solid base not only for the decision making process but also for the continuous improvement process.

[55] Locker, Grosse-Ruyken, p.68, 2015
[56] Wannenwetsch, p. 386, 2013

The final steps shown in the operative procurement process in figure 6 are examples for the long-term use of the purchasing scorecard. “Order tracing” and “supplier evaluation” are located after the supplier nominations which shows that the data collection doesn’t stop after the communication of the official decision. After a nomination the judgement of serial performance starts and information for future businesses are already gathered. Possible topics are the adherence of dates, part quality and supply amounts and the final attainment of product targets.[57]

[57] Wannenwetsch, p.107, 2007

4 Methods

To get an impression about the preparation of supplier for the actual volatility of the market in the first step the customer has to identify criteria to make the performance of the part provider measureable. The identified main characteristics of suppliers are the base for the following practical analysis of really nominated suppliers. During this second step the final relevance of the combustion engine supplier's preparation for the transition to electrified mobility shall be examined.

Both investigations will be done in cooperation with BMW. On the one hand specialist interviews will help to understand the main criteria and in the second step nominated suppliers will be analysed regarding their volatility sensitivity.

4.1 Practical approach of the OEM

The shown effects of the volatility of the market on the supplier industry in chapter 2.3.1, "Effects of the volatile market on suppliers" from page 10 onwards, are some of the key points for the practical part in this thesis. The result of those volatility drivers is the described job enrichment for purchasers and the additional actual tasks in purchasing departments, but it is not described how big the awareness and how ambitious the actions of the suppliers are regarding those topics!

To assure that suppliers are prepared as well, the OEM would like to generate inputs for their supplier selection process. The main goal in praxis is to provide a decision support tool for the purchasing department to evaluate the future orientation of different possible supplying companies.

Based on the described literature of the supplier nomination process and the risk management procedure the process could look like the following:

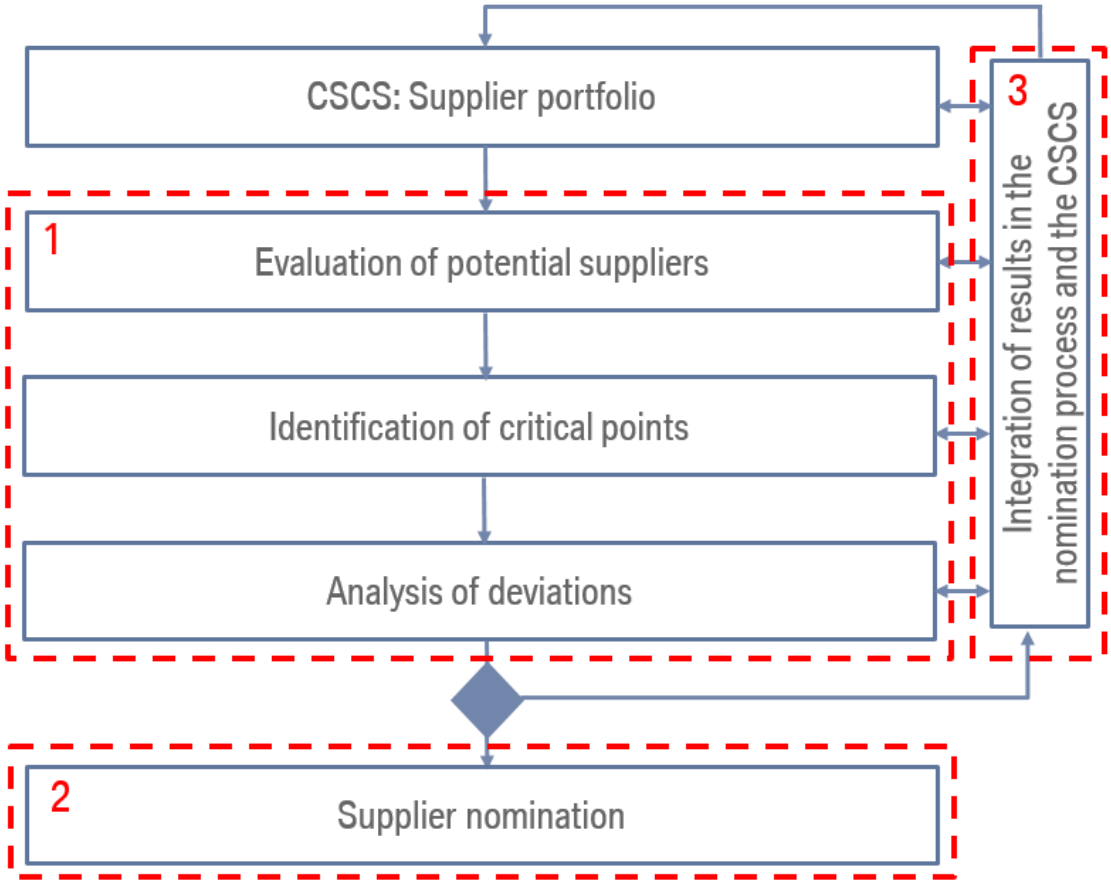

Figure 11 Risk management during the transition

The former supplier portfolio and the identified potential part providers were defined in the commodity strategy and have to be evaluated regarding the new threats through the transition process. Identification of critical points and its analysis if those points are acceptable or not can be put on a level with risk control. The risk reporting and monitoring happens in a possible actualisation of the commodity supply chain strategy or the final supplier nomination.

The three red marked boxes are the aspects which will be examined in detail.

After identifying the main risks for the transition to E-Mobility for ICE-component suppliers, a method will be developed to examine the awareness against the detected threats. Box 1 in figure 11 shows the evaluation and analysis of critical points and deviations from the ideal results. On the one hand it's necessary to examine if the nominated suppliers are aware of those risks and in the second step OEMs have to

check if they can minimize the risk during the nomination process. In the operative procurement process, shown in figure 6, Box 1 is part of the comparison of offers which is one of the most important tasks for the purchaser.

Box 2, the final supplier decision, shall finally show how well nominated suppliers are really prepared for the future. Furthermore it shall be examined if the preparation is only part of the strategy or has also a real relevance for decisions in the supplier nomination process.

Regarding the third marked area it shall be investigated if those new challenges can also be applied for supplier of E-mobility components. The importance of the supplier evaluation for future commodity supply chain strategies can be only evaluated in the upcoming years during the creation of those strategic papers.

4.2 Empiric examination of nominated suppliers regarding their preparation for the future volatility

The first step, identifying the threats, will be done by analysing the risks which are seen by BMW described in chapter 3.5 “Risk management in purchasing” on page 26.

To generate in the next step reliable date the evaluation of the suppliers will be done by the responsible serial supplier in collaboration with the supplier. To cover all topics a questionnaire is provided for the responsible person in the purchasing department according to which a supplier interview can be done. As a result of the depth of the questions a preparation time of at least one week should be planned. The topics of the questionnaire were sent to the supplier without providing the questionnaire and the evaluation method to limit the possibility of optimizing the result. Subsequently to the interview the summary was filled out and added to the internal documentation.

To have a high degree of traceability an explanation of the evaluation of each question has to be provided by the buyer. The questionnaire was created with contribution of the strategic purchasing department. To make the results comparable to other suppliers and the average evaluation, all questions have specific target which can be evaluated from 1 “no future” up to five “future”.

This evaluation method can be compared with the strength-weaknesses-model which is originally used for the identification of possible patronised suppliers. The range of the rating in this model was from “desourced” (suppliers which shouldn’t be considered in the future) to “preferred” (benchmark suppliers) and the main target of this evaluation was the long-term assurance of part delivery and long-term price agreements or arrangements. Those goals are matching with the main objectives of the OEMs in the actual market situation.[58]

With the total overview of the results of all questions it shall be evaluated if a supplier is a possible strategic partner for the future. The focus was put on tier-1 supplier, because for answering the questions in detail a deep exchange is necessary. As described in the chapter 2.3 “The supplier industry” on page 9 the tier-1 industry has

[58] Wannenwetsch, p.313, 2013

the biggest complexity in the tier-n chain and consequently a higher development effort which is also part of the form.

To evaluate suppliers which are definitely relevant for the OEM the focus regarding the comparison was put on those who were finally nominated for engine generations from 2020 onwards. By examining not only the general market, but also assigned supplying companies a correlation to the relevance of the requested topics can possibly be derived.

The general supplier performance and an overall evaluation of the supplier industry should be consequently possible and leads hopefully to a ranking regarding the importance of the questioned issue.

The supplier selection of suboptimal evaluated suppliers will be analysed by the detailed description of the serial purchasing department to answer the following questions:

- In which cases a negative rating is acceptable?
- What are the reasons for this non-positive judgement?
- Were specific actions set by the OEM to compensate the evaluation and to prevent negative effects?

Finally the applicability of the questionnaire or similar questions for further departments of the purchasing department shall be examined and especially an adaption for future E-mobility nominations is an upcoming target.

The whole process of the empiric research is shown in figure 12, which summarizes the explanations about the theoretical approach and compactly visualises the process one more time.

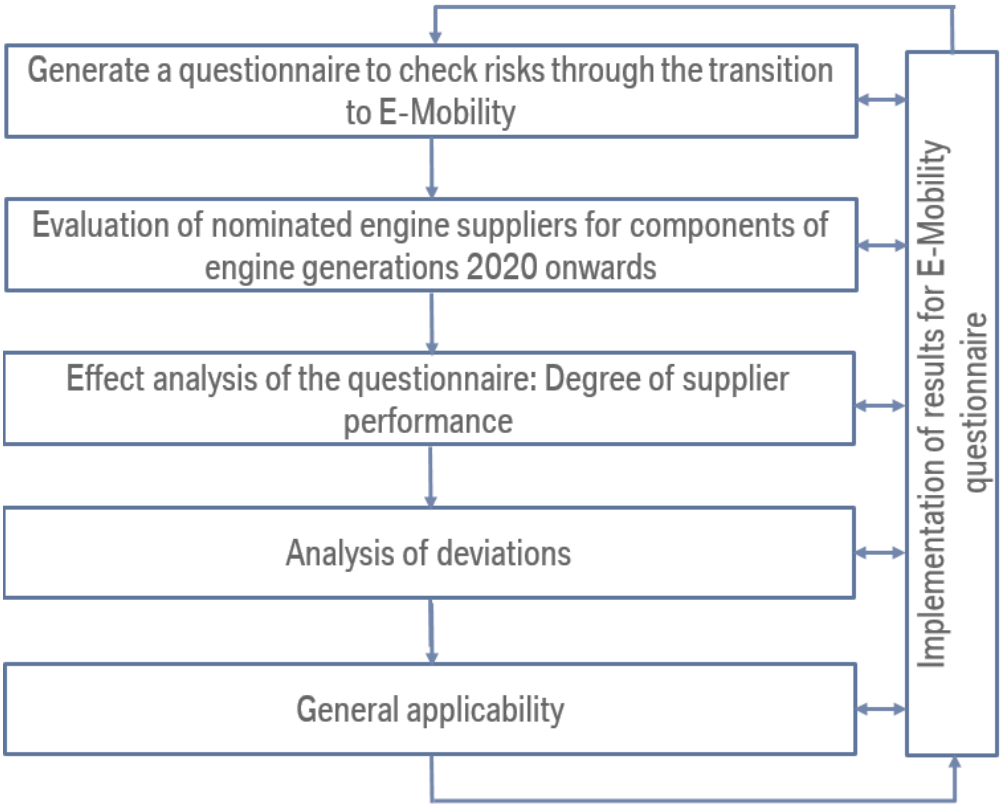

Figure 12 Process of analysis

5 Practical implementation

After taking a look at the mentioned purchasing department tasks in chapter 3.2 “Targets and responsibilities in purchasing” from page 15 onwards the risk evaluation can be seen as a typical strategic role and tactical responsibility as part of the demand/cost management and forecasting and planning requirement. Considering the “time related order types” in figure 7 on page 20 we are talking in the strategical and tactical time period about planned orders which underlines one more time the insecurity and volatility. The replacement of planned orders by customer orders is often happening five to ten years later. Consequently the questions for the survey were created in combination with the strategic purchasing department for the early phase of BMW.

After the identification of relevant questions and the evaluation, the risk control and reporting have to be monitored until the replacement is finally done and the real call offs are appearing in the enterprise resource planning system.

To be able to react properly on the results of the supplier assessment, the questionnaire has to be analysed early during the supplier nomination process or in the best way have to be integrated in the commodity supply chain strategy. Compared to the shown supplier nomination process in figure 6 the risk evaluation should be part of the selection of the supplier portfolio or latest considered during the comparison of the offers and the offer selection before the final decision.

In the practical implementation the questionnaire was effectively used during the supplier comparison for nominations for the years from 2020 onwards and also presented at the final management meeting where the supplier decision was made.

5.1 Increased risks through the transition to E-Mobility

Out of the eight main types of risks regarding financial, quality, capacity, technology, internal processes, raw material, location and currency issues identified by BMW, two main threads which are even increased by the expected reduction of Diesel engines in the upcoming years were finally identified. The financial risks hit suppliers when nominated volumes don't reflect the reality. It is understandable that the supplier tries to transfer the losses to the OEM, because lines or machines are reserved for the customer and cannot be used to full capacity from one day to the other with other orders. Tier-1 suppliers have to make contracts with sub-suppliers long before the volume fluctuation occurs, which increases the negative financial effect. In the end non-occurring profits and turnovers could push the providers into huge problems if their financial rating wasn't that balanced even before they were confronted with the call-off reduction.

The second risk affects mostly the gasoline engine, because the mentioned expected increase of call-offs cannot be considered during investments in production lines without concrete demands. Part providers always try to use the full capacity and often cannot increase their production over an agreed flexibility.

Quality, technological, raw material, location, currency risks or threats regarding internal processes are not affected by the fluctuating demands or are already assured by other internal departments. To cover these main threats regarding the transition to E-Mobility and consequently defining counter-actions are the main goal of the following questionnaire. It is not sufficient to increase the flexibilities this would only transfer the threat from the present at the OEM to the future of the supplier. From the OEM's point of view part or module providers which are prepared and accordingly having a great evaluation in the questionnaire are potential strategic partners for the next engine generations and long-term partnerships with the customer.

Those identified main topics shall be inquired in the questionnaire in the upcoming chapter which has the focus on being easy to use and understandable for the suppliers and the serial purchasers. Most of the topics are strongly related to the described flexibility and adaptability, often not in the usual understanding regarding the production, moreover in several ways and situations, for example the product portfolio, the production capacity, future developments, etc.

5.1.1 Questionnaire for ICE components

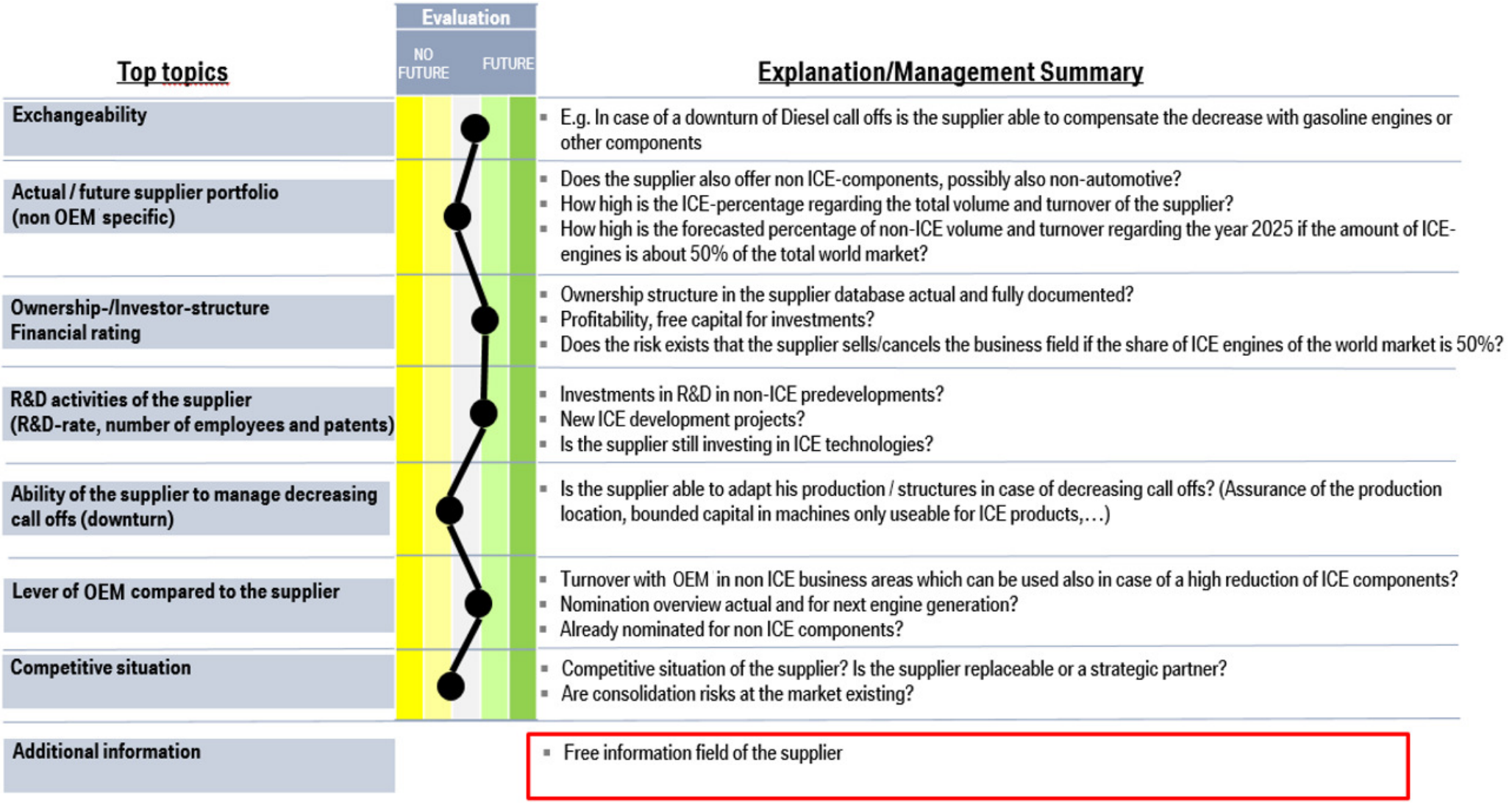

Figure 13 Questionnaire for ICE suppliers

In the upcoming sub-chapters I will describe the reasons for the different questions to give an impression what OEMs try to assure. For the seven queries no “no-gos” are existing or defined, but they shall show points where specific actions are helpful. It’s necessary to add that evaluations can’t be seen individually: Some points are targeting the same problems and can possibly deliver solutions.

The supplier evaluation is similar to the ratings of external agencies, because they are mainly focused on facts regarding the supplier in general. It can be seen as a rating of an investment, an investment in the future of the supplier, manage the transition to the E-mobility commonly.

5.1.2 Exchangeability

As described before changes in volumes of different powertrain solutions are not completely sure, but tendencies can be derived. For a high evaluation the supplier of a Diesel component should also have a comparable gasoline part with which the total turnover of the supplier should stay stable. Another possibility to balance the total turnover are parts for electric engines. This question is not only interesting for Diesel nominations but also relevant for gasoline parts, because if Diesel parts are replaced by gasoline parts the gasoline part supplier will need additional capacity. The free Diesel capacity can be used in these cases for the increasing gasoline parts.

Those nominations of different powertrain solutions can be combined to have a bigger volume for the request for quotation and an assurance against remanences if the total volume stays constant.

5.1.3 Actual / future product portfolio (non OEM specific)

The question regarding the product portfolio of the supplier shall give an impression how dependent the supplier is on combustion engines. Suppliers who are specialists for Diesel parts have to be other business units to secure their overall turnover. A reduction in all business fields is seen as a huge threat for the health of a supplier. A broad product mix helps to balance volatile situations. As mentioned in the title shares

in other industry fields beside the automotive industry help to reduce the risks of fluctuating products.

5.1.4 Owner-/Investor-structure (financial KPIs)

The ownership structure can be seen in combination with the market situation described in the first two questions. If one business unit is making continuous losses the owner of the company can easily think about selling parts of the company or cancel future productions. In cases of insolvencies different ownership structures also have impacts on the liability of the supplier.

Financial KPIs describe the vulnerability of suppliers on variations in call offs in both directions. The supplier can make investments for increasing demands or is able to handle the reduction turnovers or profits resulting out of decreasing utilization rates.

5.1.5 R&D activities (R&D rate, number of employees, patents)

Question Nr.4 gives and impression about the supplier's intention to improve products and develop new parts. After asking in general about R&D rates the more specific analysis starts regarding investments in combustion engines and future powertrain technologies. Both points are important, because on the one hand the OEM wants to have a continuously improved engine and on the other hand a nomination should be a start in a long-term relationship where the battery electric vehicle is seen as the future technology from the actual point of view.

5.1.6 Ability of the supplier to manage downturn of requested parts (ICE/Diesel)

Like most of the matters before again the downturn of the Diesel engine is the main topic. In comparison to the first request about the exchangeability in an economical way the fifth issues is focused on the production and manufacturing abilities of the supplier. Is the supplier able to adapt his structures to produce Diesel to gasoline engines on the same line and consequently make a switch from one product to other more easy. Does the supplier offer increased flexibilities in his offer over the normally

agreed standard rates? How fast can the supplier increase capacities and are the supplier's lines extendable for big increases in the gasoline sector? The available free space at the production site is just another example for a fact which is considered in the supplier interview.

5.1.7 Lever of OEM compared to the supplier

Pooling different parts to have a stronger level is an important possibility. Not all RFQs are as interesting as the components which offer long-term increasing profits and turnovers. Therefore it's necessary to have an overview about all business fields of the supplier which are interesting for the OEM. Often suppliers have a broad product portfolio and offers or is able to offer several parts. The knowledge of these other requests helps to bundle products and also gives the supplier the chance to offer products for additional business fields.

5.1.8 Competitive situation

The final evaluation results mostly of the mentioned strengths of the supplier during the interview. A high evaluation in "Market/competitive situation" gives an impression about the other potential suppliers in contrast to the evaluated one. Often a specific industrial area shows specific habits and some questions cannot be fulfilled in a satisfactory way.

Additionally some suppliers have particular advantages like a technological market leadership which is necessary for a differentiation against the competitors of the car manufacturer.

5.2 Clustering of the „future“-evaluation

As described before the questionnaire is not only used for Diesel component suppliers. All powertrain nominations shall be assessed, but not all for the same reason.

The x-axis shows the product portfolio of the suppliers. From the left to the right side the increasing market potential is shown. On the left side suppliers are placed which only offer parts with a decreasing demands. The sole E-Mobility providers are facing the biggest market increase in percent which is located on the right side of the x-axis. In the middle a diversified product portfolio leads to a constant market share. Also gasoline engines are positioned more central in the middle of the right sector with continuous more moderate increasing volumes. The y-axis is evaluated by questionnaire.

The size of the bubble shows the actual yearly turnover with BMW in three sizes (low/middle/high). The arrow beside the bubble gives an idea about the expected turnover in the year 2025 and can also describe a tendency of the importance for the OEM about seven years.

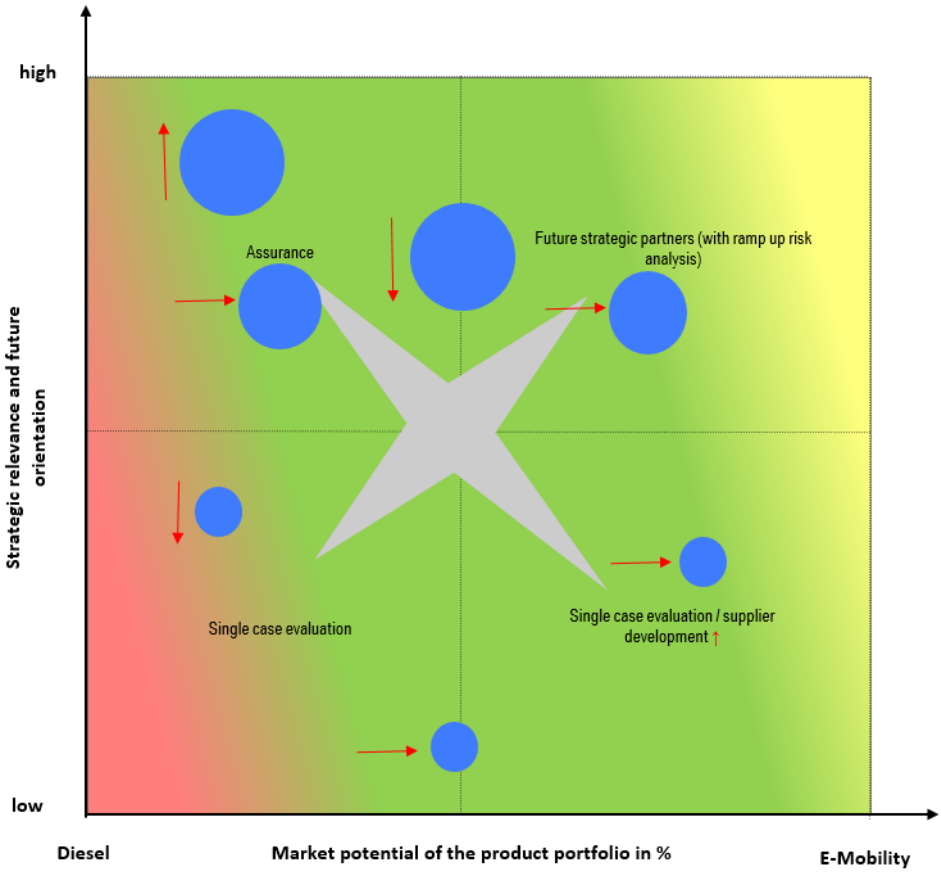

Figure 14 Clustering of suppliers

5.3 Consideration in the CSCS

The monitoring of suppliers in Figure 14 helps to understand the general risk regarding a possible nomination of various part provider. For the integration in the CSCS suppliers of similar parts or technologies can be put in the same diagram to show the theoretical best and worst case scenarios.

The colours give an idea about the critical suppliers, but there is no clear transition from critical to uncritical. The clustering shall provide a prioritization help to set the focus on those suppliers which are mostly affected by the switch to electric mobility combined with the downturn of Diesel engines. In the two sectors with a low strategic relevance and future orientation the single cases have to be evaluated if alternatives with similar conditions are available on the market. Suppliers in the right bottom sector are capable to provide E-Mobility components or have a growing market potential and can possibly be developed to the right upper corner.

With suppliers with a good “future”-evaluation on the left side it’s necessary to check bad single points and possibly define actions that those points have no negative impact on the overall performance of the supplier. Suppliers with a diversified product portfolio with a good overall evaluation are the most wanted suppliers in the time of transition. Suppliers which are only focused on electrified vehicles are in a yellow marked area, because the fast ramp-up with no or low experience in the automotive industry can also generate serious problems regarding fulfilling the growing demands.

By the position in the four sectors no clear statement about the overall risk can be done, but regarding the volatile market a prioritization in the risk management processes is possible.

6 Analysis of results and outlook

On the upcoming table the detailed feedback of the nominated suppliers is visible.

	Number of nominations	Total amount of suppliers	Exchangeability	Actual / future product portfolio (non OEM specific)	Owner-/Investor-structure (financial KPIs)	R&D activities (R&D rate, number of employees, patents)	Ability of the supplier to manage downturn of requested parts	Market position of the OEM vs. the supplier	Market/competitive situation	Average value by suppler
Average	**32**	**28**	**4,00**	**3,84**	**3,64**	**3,96**	**3,64**	**3,54**	**3,95**	**3,80**
Supplier A	2	1	2,0	4,0	4,5	3,5	3,0	3,0	3,5	3,36
Supplier B	1	1	4,5	4,0	3,5	4,5	4,5	3,5	4,0	4,07
Supplier C	1	1	5,0	4,5	4,0	3,5	4,0	3,5	4,0	4,07
Supplier D	2	1	4,0	4,0	3,0	4,0	3,5	3,5	3,5	3,64
Supplier E	2	1	4,0	4,0	3,5	4,5	4,0	4,5	3,5	4,00
Supplier F	1	1	4,0	4,0	3,5	4,5	4,0	4,5	3,5	4,00
Supplier G	1	1	3,5	4,0	4,0	4,0	4,0	4,0	4,5	4,00
Supplier H	1	1	5,0	3,0	4,0	5,0	2,0	2,0	4,0	3,57
Supplier I	1	1	4,0	4,0	3,5	4,5	4,0	4,5	3,5	4,00
Supplier J	1	1	4,0	4,0	3,5	4,0	3,5	3,5	4,0	3,79
Supplier K	1	1	5,0	3,0	4,0	4,0	2,5	3,0	4,0	3,64
Supplier L	1	1	5,0	3,0	4,0	3,0	4,0	3,0	4,0	3,71
Supplier M	1	1	4,5	4,5	4,0	4,5	4,5	4,0	4,0	4,29
Supplier N	1	1	4,5	4,0	4,0	5,0	4,0	2,5	4,0	4,00
Supplier O	1	1	3,5	4,0	2,0	3,5	3,5	3,5	4,0	3,43
Supplier P	1	1	3,0	3,5	3,0	4,0	4,0	4,0	4,5	3,71
Supplier Q	1	1	4,0	4,0	4,0	4,0	5,0	3,5	4,0	4,07
Supplier R	1	1	5,0	3,5	3,5	2,5	3,5	4,0	2,5	3,50
Supplier S	1	1	3,5	4,0	3,0	4,0	4,0	4,0	4,5	3,86
Supplier T	1	1	4,5	4,0	3,5	4,0	4,0	4,0	4,5	4,07
Supplier U	2	1	3,5	4,0	3,5	4,0	4,0	4,0	4,5	3,93
Supplier V	1	1	4,0	4,0	3,5	4,0	3,5	3,5	4,0	3,79
Supplier W	1	1	3,5	4,0	4,0	4,0	3,5	3,0	4,0	3,71
Supplier X	1	1	4,0	4,0	3,5	4,0	3,5	3,5	4,0	3,79
Supplier Y	1	1	4,0	3,0	4,5	3,0	2,5	3,0	4,0	3,43
Supplier Z	1	1	4,0	4,0	3,0	4,0	3,5	3,5	4,0	3,71
Supplier AA	1	1	2,0	3,5	4,0	3,5	2,0	3,0	3,5	3,07
Supplier AB	1	1	4,5	4,0	4,0	4,0	4,0	3,5	4,5	4,07

Table 2 Supplier evaluation

For my analysis I consider the feedback of 32 Tier-1 part providers which were nominated over the last three months. Four suppliers were considered two times wherefore 28 different supplying companies were evaluated. Regarding the upcoming analysis 28 questionnaires are compared to reduce the impact of the multi-nominated suppliers. Due to internal information the suppliers aren't mentioned by name, which shouldn't be of significant relevance for the result of the investigation in general.

Which suppliers are finally part of the survey resulted randomly out of the nomination schedule of the past months. As a result suppliers of different size and background were evaluated. To get an impression about the size of the examined companies the calculated standard deviation of the amount of employees is 19.000. The six biggest companies have over 75.000 employees in comparison to the six smallest companies with less than 5.000 Employees.

The supplier's headquarters are in 21 cases in central Europe, six times in the United States and only one time in Asia. All American companies have their production sites in Europe to regionally close to their customers, because BMW's engines are mainly produced in Europe.

It has to be clarified that the high regional concentration on central Europe is not defined by restrictions of the OEM. Contrariwise a global supplier portfolio during the RFQ process is often appreciated. After fulfilling the hygiene factors like e.g. price and supply assurance, the mentioned new challenges can be a possible motivators for nominating a supplier. The final reason for this high amount of 75% of suppliers with European headquarters is not going to be solved in the upcoming chapters, but the country of origin will be definitely a point of examination.

To make interesting values visible I marked them in the following way:

- The lowest value of each category was marked yellow
- Values lower than 3 were written in read
- The five worst overall evaluated supplier were marked red and next five to them are tagged in orange

To start with a granular analysis of overall values and deviations shall provide a general impression about the nominated suppliers.

In the following step the different questions will be examined regarding their relevance in the nomination process. The result of this investigation will show the most important criterion for assignments with the OEM, in the examined case BMW, and generally high supplier standards which are possibly already state of the art over the whole industry.

In the third step the focus will be put on the evaluated suppliers which got a red or orange mark in the table and are consequently strongly scrutinized. The obvious question “why those suppliers have been nominated although “no future” was predicted before the decision making process” shall be answered. After analysing the specific cases during BMWs nominations, general reasons for the supplier industry shall be examined.

Finally the red written single values have to be investigated, which were rated much below the average of all other evaluations with 2,5 or lower.

Before starting with the detailed analysis of the questionnaire one point has to be underlined at the beginning: After going through all 32 nomination documents it was obvious that the new rating is definitely not replacing any former criteria of OEMs. The most important factors of chapter 3.4 “supplier evaluation” on page 22 can vary a bit from RFQ to RFQ, but in general the challenging factors for suppliers were mainly extended by the additional ones like those in the questionnaire. Some of the former motivators like “sustainability” or a specific level of details in the quotation analysis form were transformed to hygiene factors, seen as mandatory for the offer, and new motivators like exchangeability were born.

6.1 Overall results

The first impressive factors are visible after comparing 196 different values of 28 suppliers in total. The total average is 3.80 points of a maximum of 5 which means a degree of fulfilment of 76%.

No supplier was rated in any segment with 1.50 or lower. These high overall values show that suppliers which were nominated for future businesses generally fulfilled the requested needs. The average standard deviation of all suppliers is an extremely low value with 0.49. The distribution is shown in the upcoming figure:

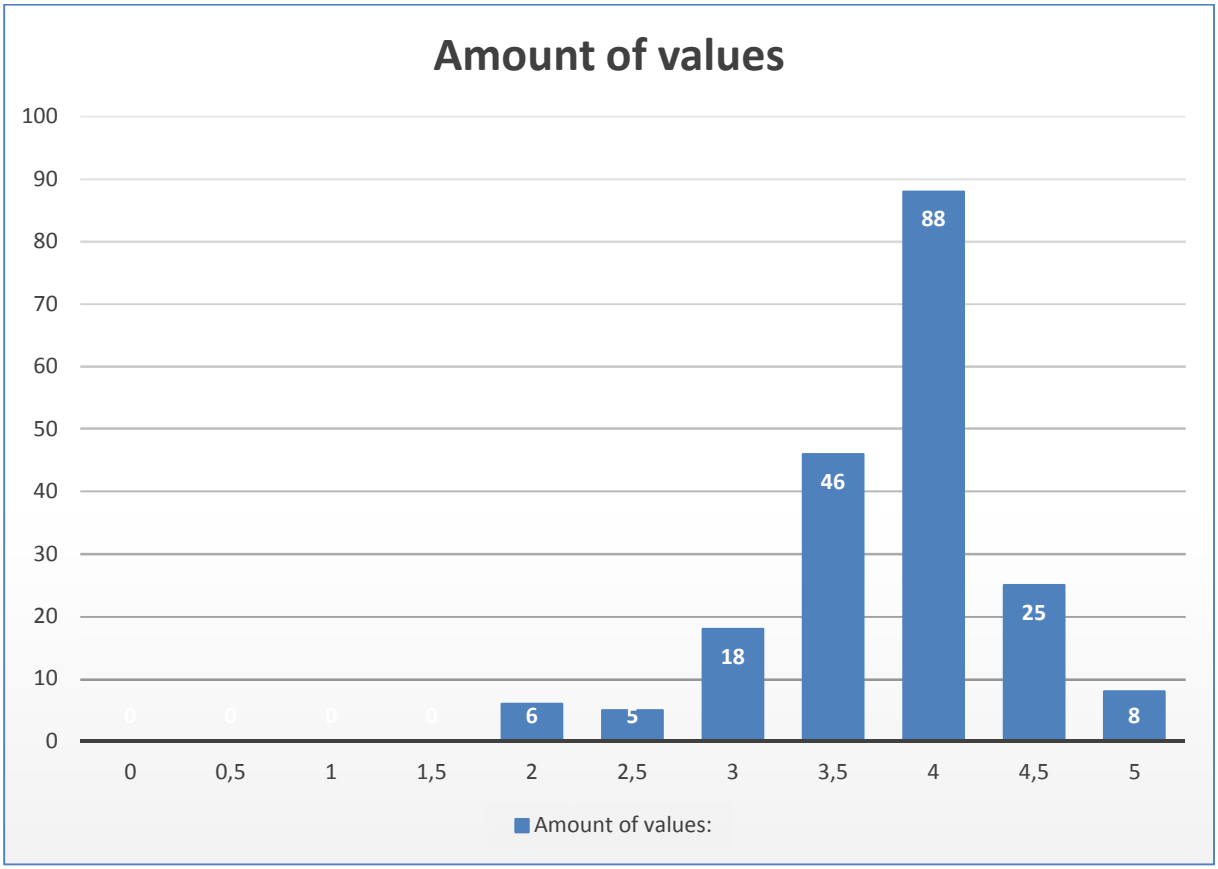

Figure 15 Amount of evaluated values

The low amount of highest values are resulting out of the unpredictability of the market. It's hard to predict a 100% assurance against the identified risks until 2025, because the real development of the market situation can actually be seen as a "black-box" with many possible outcomes.

The country of origin doesn't give an indication about the highest and lowest values, because fives as well as twos are existing at American and European companies. Also the size of the suppliers is not related to minimums or maximums.

Another interesting aspect can be identified after analysing the extreme values. The deviation of the minimum to the mean value is in more than 70% higher than the deviation of the maximum. Taking a look at the remaining 30% the high deviation of the maximum is logically driven by the 8 questions which were answered with the highest value 5.0. The reason for the higher 70% is the fact that suppliers had mainly deviations regarding single values and weren't not generally worse than other suppliers. The 29 values from 2 to 3 were consequently distributed over many suppliers and not resulting out of some bad part providers.

Summary:

- *Suppliers with very high overall values were nominated*
- *The average standard deviation of 0.49 shows relatively constant values of each supplier*
- *The small amount of low values is distributed over many suppliers which limits the deviation between different part providers*
- *The highest values are difficult to reach because of the actual unpredictability*

6.2 Prioritization of criteria

As already mentioned in the previous overall results the supplier evaluation was pretty balanced.

After reviewing the results of the different categories it looks pretty similar. From the highest value 4.00 for “Exchangeability” to the lowest result 3.54 for the “Market position “OEM vs. Supplier” a difference lower than 10% is not alarming for specific topics.

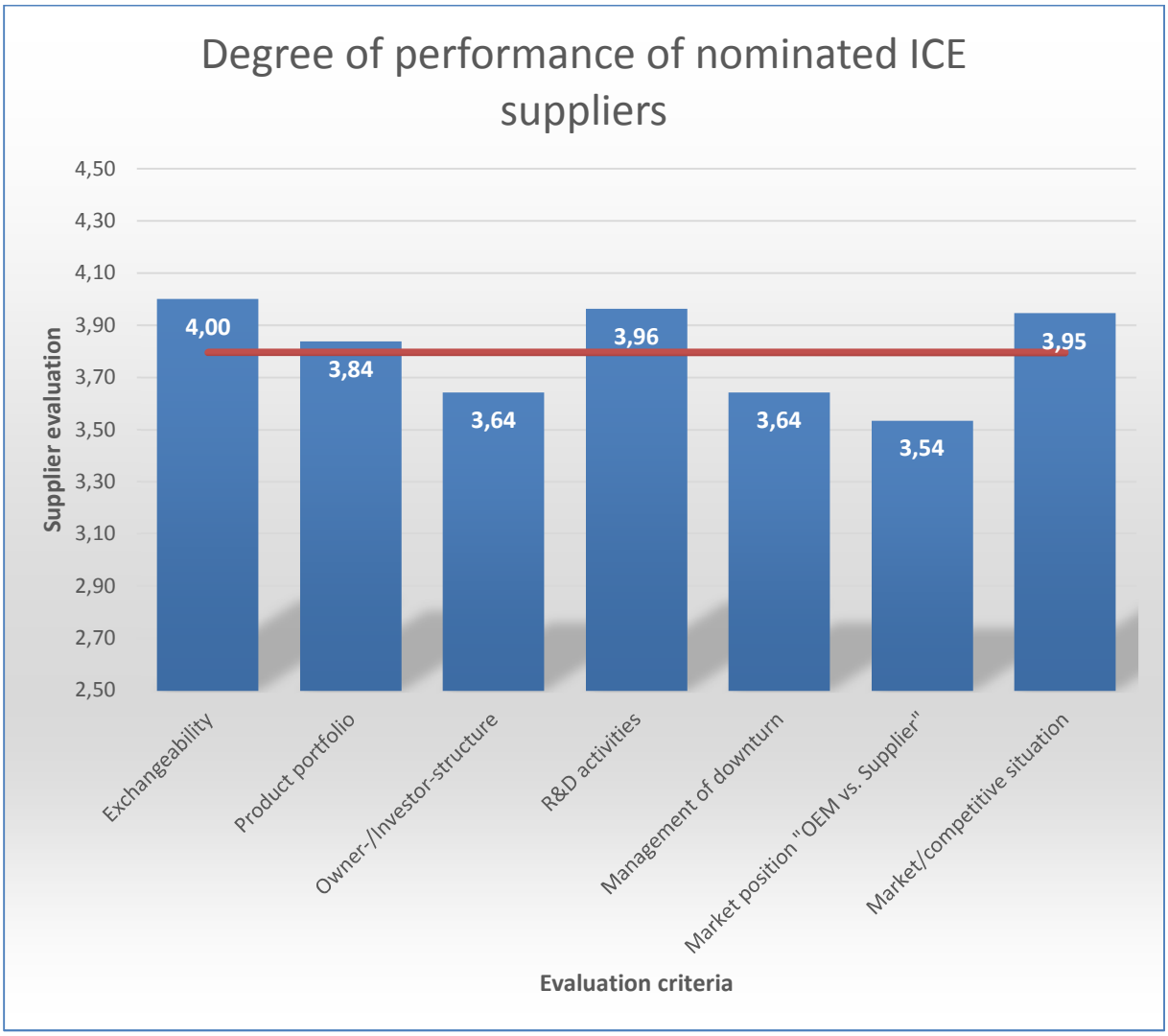

Figure 16 Fulfilment of different criteria

The most interesting aspect about figure 16 is that the willingness to reach a high level of customer orientation is given. The offer of exchangeable products between gasoline and Diesel engines combined with high research and development efforts often leads

to a good competitive situation. A diversified product portfolio is also in many cases the base for the ability to offer exchangeability.

Internal structures are more difficult to change and frequently the willingness is not given. Also strong dependencies of the OEM to the supplier is a competitive advantage for suppliers and won't be changed without any serious reasons. Those two points have to be analysed case by case by the OEM if the situation is acceptable or not and if another supplier provides the same performance with more favourable structures.

The management of the downturn is the most important point to look at in these results. On the one hand internal changes usually take longer than a commitment of the supplier to the customer that he is willing to exchange Diesel by gasoline parts without additional payments by the OEM. Until the start of production of the actual nominated parts suppliers still have time to work on this topic and to adapt their production sites. Because of the small deviation between both questions, "exchangeability" and the "management of downturn", questions could arise regarding the real difference in practice. But on the other hand if the subjective evaluation of the purchasing department shows the real difference between willingness and ability suppliers could get serious problems if the downturn comes faster than from the supplier expected. Especially in combination with a lower financial rating a high awareness of the OEM should be given.

The recommendation is to definitely execute a specific analysis regarding the downturn not only if the value is generally low, but also if the difference between the values of "exchangeability" and "management of downturn" are deviating a lot. Additionally the creation of a high sensibility at the supplier is definitely advisable, because the implementation of actions can take a long time.

Summary:

- *A high degree of customer orientation is given and visible in the evaluations*
- *Values where internal structures are affected are lower and the willingness of suppliers to change them can be scrutinized*
- *The focus should be put on the "management of downturn": The actual evaluation is below average, suppliers could have to face costs if they offered exchangeability and the Implementation can take a long time*

6.3 Relevance for suppliers

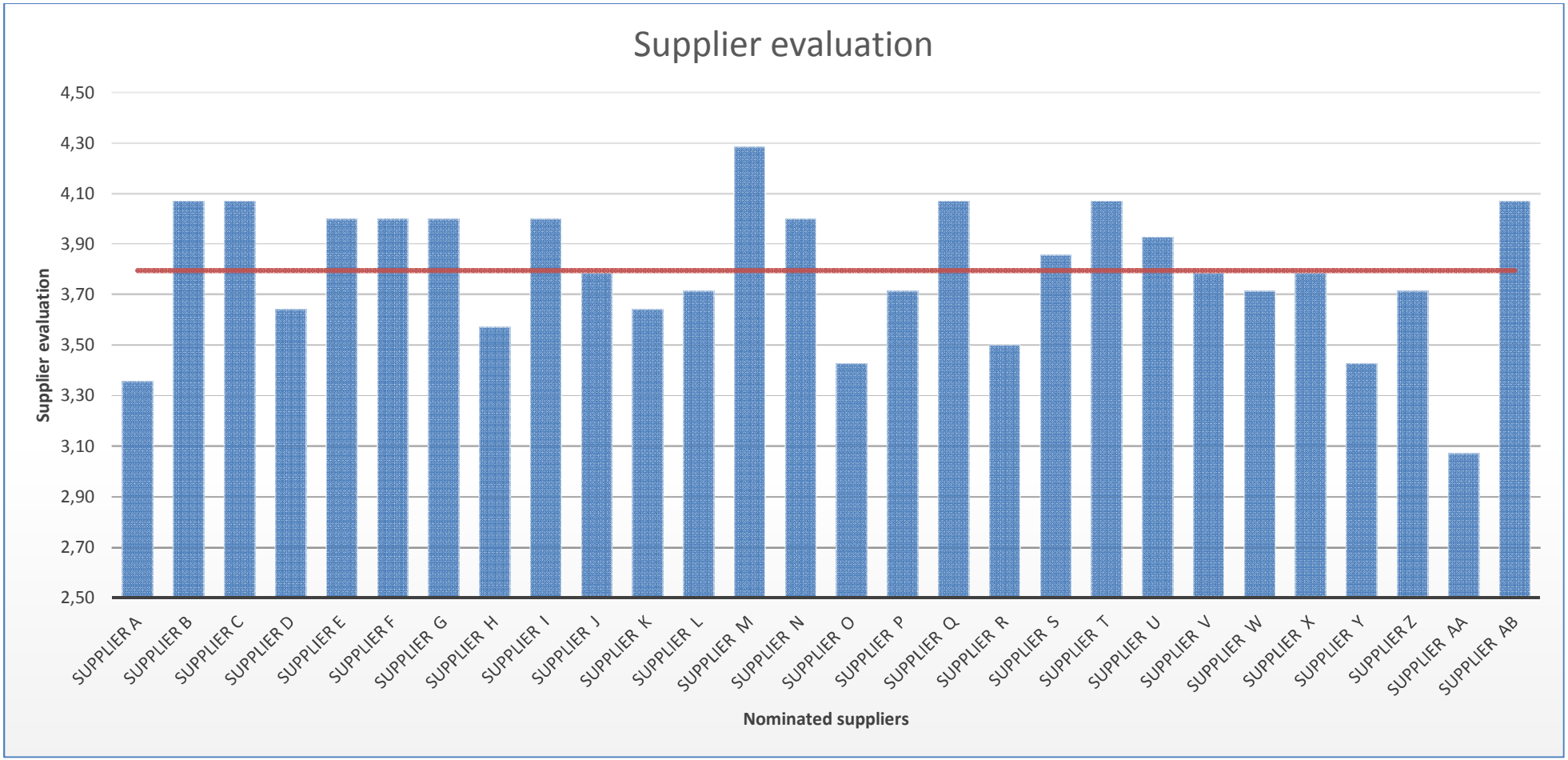

Figure 17 Overall evaluation of different suppliers

Figure 17 is pretty similar to the described facts in chapter 6.1 “Overall results” from page 45 onwards. The low and high values are spread over several suppliers which leads to a really low standard deviation if different nominated providers are compared. The eleven values lower than “3” are spread over eight suppliers. In table 1 it’s visible that only three suppliers have more than one “sub 3”-value.

The standard deviation of the different suppliers from the average supplier evaluation is 0.27 which shows that all nominated part providers are on a comparable level and definitely no “no future”-suppliers.

To get an idea about lower evaluations the red and orange marked suppliers will be compared in the upcoming paragraph regarding their overall rating. After taking a deeper look at the specific backgrounds of the nominated companies the following clusters were identified:

Three of those eleven suppliers have generally lower values, because their size is pretty low compared to the other examined ones. Those part providers can’t have the same diversified product portfolios and possibly also not R&D rates in the same height. The implementation of actions regarding the management of the downturn will take a bit longer, because the free capital of investment is often limited. In such situations it is necessary to define development plans with a detailed timeline and specific milestones. The mentioned companies often had generally a bit lower values than the other nominated big suppliers without values of “2” or rarely “2.5”. The willingness of adaptability and flexibility was given, but the ability of implementing the requested characteristics rapidly was limited.

The remaining six suppliers are in strong competitive situations. Points like technological leadership, patents or a technological cooperation with the OEM help those providers to keep their businesses and obviously also for winning new long-term assignments. Existing high-costly production sites for which a lot of invests were necessary are preventing other competitors from being able to offer competitive prices for those businesses. In those cases suppliers were aware about their strategic advantage and don’t want to fulfil all criteria, especially regarding their company structure, their market position or offering the whole exchangeability.

Two other providers were nominated for specific Diesel components. These two companies are providing technologies which cannot be replaced by other Tier-1

providers with a higher exchangeability. Those two suppliers are no small players and a future exchangeability is expected for the near future. Small companies which are generally offering only Diesel components and which are not considered for gasoline parts or at least planning to extend their product portfolio weren't finally nominated for future engine projects.

Those low evaluations of specific values will be analysed in the next chapter to get an idea about how OEMs can protect the company against threats out of those negative ratings.

Summary:

- *All suppliers are high evaluated and only small differences are existing*
- *Only in the following cases deviations were occurring:*

  a) *Small suppliers with limited capacities who weren't able to prepare completely*
  b) *Big sized, strategic partners or technological leaders with limited ability because of company regulations or limited willingness to adapt*
  c) *Limitations through specific Diesel components*

6.4 Exceptions in the decision making process

In the previous sub-chapters of “Analysis of results and outlook” from page 42 onwards we already got an impression about the very high supplier quality regarding the “future”-perspective of the nominated suppliers. The small standard deviation only left a small amount of values which has to be investigated a bit more in detail. The upcoming figure shows the extreme values, the maximum value 5 in red and values lower than 3 in blue, which occurred during the examination of the supplier’s performance.

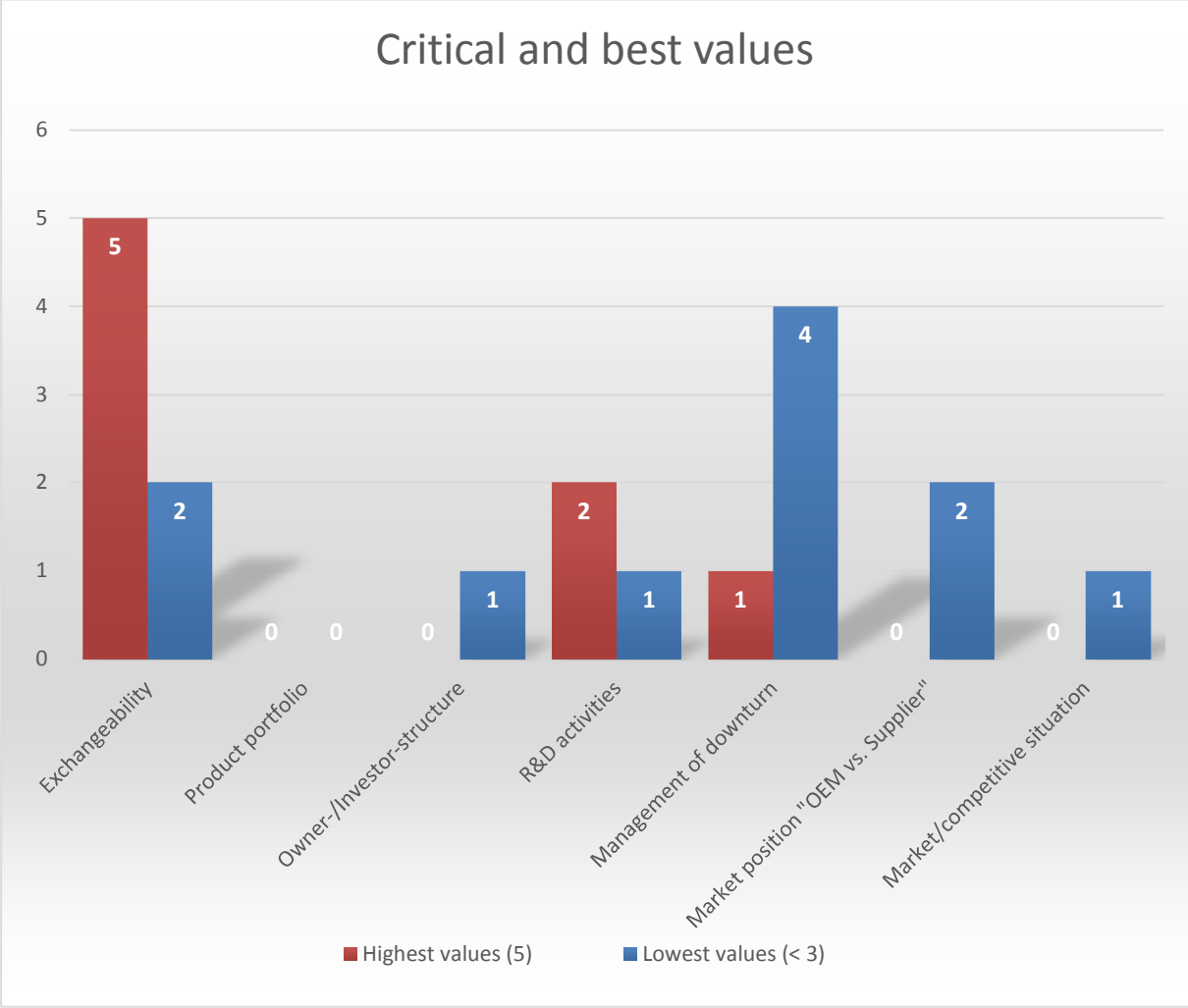

Figure 18 Extreme values of nominated suppliers

6.4.1 Results „Exchangeability“

Suppliers are willing to cooperate and offer often a high degree of exchangeability. The five highest evaluated suppliers offered almost an unlimited exchange of Diesel parts by gasoline components in case of a switch of call offs within the different powertrain technologies. Often the ability to switch between gasoline and Diesel parts was resulting out of common parts between both internal combustion engine technologies. Bit worse evaluated suppliers provided limited exchangeability or at least highly increased flexibility rates. Also the two lowest rated part providers were willing to provide high flexibility rates, but the evaluation was focusing on the supplier’s ability to avoid risks. For the original equipment manufacturer it is not a risk assurance if the supplier takes the whole risk through a high flexibility. Moreover it is inevitable that suppliers stay healthy by their product portfolio and keep a constant turnover also in case of the downturn of the Diesel.

The two suppliers were nominated although the rating was low, but those evaluations were product and not supplier driven. Both parts were specific Diesel parts and the turnover of those products was higher than the gasoline shares of both companies. In both situations it was necessary to examine concrete risk evaluations. The danger of further impacts on the OEM due to the limited exchangeability was extremely reduced by good financial ratings, diversified product portfolios also in business fields outside of the automotive industry and the expectation that those two part providers could also be considered in later gasoline nominations to have at least a monetary exchangeability.

One of the most interesting points during the analysis was the fact that also suppliers saw the interest of the OEM regarding exchangeability very positive. The negative effect of limitations in their production planning ambitions was overshadowed by the chance of constant turnovers and especially the big possibility of having competitive advantages in RFQs of the other powertrain technology. A written commitment in the negotiation documentation increased not only the chance for winning for example the Diesel business, but also augmented the opportunity for getting the big business for the future.

6.4.2 Results “product portfolio”

This topic is balanced over all suppliers. Beside two values of 4.5 all results are between 3.0 and 4.0. Companies which are only offering Diesel parts weren’t considered at all for any nominations for the upcoming engine generations. All product providers have at least Diesel and gasoline parts in their product portfolio and are considered in nomination processes in both powertrain technologies. Therefore the theoretical possibility is given that the suppliers keep a constant turnover also in case of a downturn of Diesel cars.

The suppliers with the worst exchangeability ratings got evaluations of 3.5 and 4.0 in this segment. Therefore those parts which had to be nominated for Diesel engines are specific Diesel parts or have a completely different price structure, but the suppliers which are providing them would at least have a broad product portfolio or are already providing different parts also for the other powertrain technologies. It is now the challenge for the OEM to get also into business in those other business fields and make agreements with the supplier, for example additional overall flexibilities in case of a constant turnover over all products. Especially with “supplier AA” solutions have to be found for the combination out of a low exchangeability and a low ability to manage the downturn.

The optimum portfolio would cover already nominated parts with similar turnover rates in all propulsion system technologies. If suppliers are also already making big businesses with parts for electric engines, not only an exchangeability would be given, but also a mutual growing including the turnover and profit increase would be expected from the actual point of view. The maximum “future”-evaluation can only be given if suppliers are already providing parts with which they are a possible growing long-term strategic partner of the OEM.

Questioning not only the actual, but also the future product portfolio offered suppliers the possibility to present their product portfolio of the future and gave the chance to get support regarding offering those products.

6.4.3 Results “Ownership- and Inverstorstructure”

The outcome of the “ownership- and investor-structure” evaluation is similar than expected. Those criteria are hygiene factors and won’t be evaluated extremely positive. A solid corporate organisation is the base for a cooperation, but there are not that many different structures, only some types of business ownerships were the customer has to keep attention in case of insolvency respectively if they have a critical financial rating.

The financial rating in general has a lower limit which has to be reached to be able to get a business partner of the supplier. Only in some cases with difficult ownership structures the rating philosophy “the higher the better” is applied. If the supplier has a standard structure (e.g. GmbH, AG, etc.) a better financial strength even leads to critical questions regarding too high expenses for the products of the specific supplier. Besides two times a rating of 4.5 and one 2.0 all values are between 3.0 and 4.0 which underlines my former description that there is no perfect evaluation or structure seen to get a value of 5.0.The one supplier with a 2.0 subsidiary company where an additional guarantee was necessary that the business unit is not sold in the future until the end of production and the part provision is guaranteed for a specific time until the end of production (EOP).

What’s not visible in the evaluation, but which was definitely relevant during the supplier selection process is the fact that many suppliers had negative ratings in the pre selection process, which was consequently also the reason for being not nominated. In several cases additional agreements, like comfort-letters of parent companies in case of negative financial ratings, were noted to be theoretically able to be nominated, but finally the only example where special arrangements were done was the one mentioned in the previous paragraph.

6.4.4 Results “R&D activities”

The feedback about the interviews with suppliers concerning research and development activities was extremely interesting, because the original intention was to assure a high technological level of Diesel engines.

After the feedback of some part providers that they are investing their whole research capital into E-mobility components the approach had to be adapted. The evaluation starts now with the necessity of R&D related to the specific part, because in some specific cases no need of further development was identified. In those cases suppliers often reoriented the companies to gain new business in markets with emerging demands.

The range from 3.0 to 5.0 with a pretty high standard deviation was mostly driven by the overall R&D-rate and by the diversification of the research and development activities. In combination with the rate, suppliers, which informed the OEM that they are focussing on one sole technology, got a lower evaluation than those which had a higher flexibility also in their R&D actions. In general it has to be added that the rate and the ambition of the suppliers is often driven by the novelty of the technology the part is based on. The lowest evaluated suppliers, as the only one with a 2.5, made many investments the years before and has parts which weren't changing a lot over the last decades over the whole industry. To sum it up regarding the R&D activities the evaluations were varying much more than in other fields of research, but it always had to be analysed in detail what happened in the background. In combination with the future product portfolio (strongly related to question 2) suppliers at least had to present their strategy for the upcoming years and decades to keep their turnovers generally high and to react on the volatility of the market. Suppliers which ignored the transition to new powertrain solutions at all and had no long-term strategy for the years after 2030 are actually not in the list of the 28 nominated suppliers.

6.4.5 Results "Management of downturn"

The management of the downturn is maybe the most important aspect from the supplier's point of view. The question "did the suppliers make up their mind about the transition?" which should have been answered, cannot be done by this evaluation. In the interviews companies with a low rating often explained how they checked all their possibilities and why they aren't able to integrate a better reactivity and adaptability to their production line.

If the “management of downturn” is negatively evaluated, the OEM has to review two influencing factor which are strongly related to this questioned point and can increase or decrease the risk dramatically.

The first issue is the overall rating of the company.

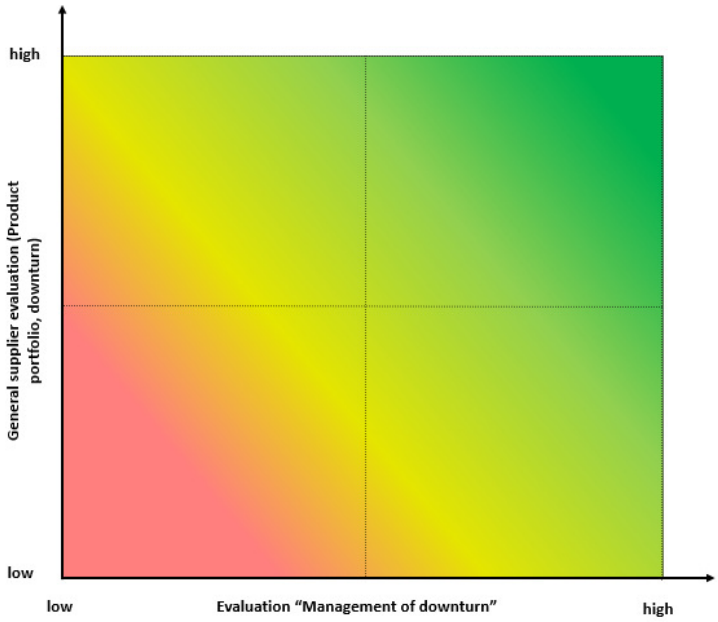

Figure 19 Affection of the management of the downturn by the general supplier performance

Is the financial rating already in a secure area and has the supplier a diversified product portfolio to balance the decreasing demands. The product, customer and industry investigations have to give an overview about general impact of the transition to E-mobility on the part provider. All four suppliers with a negative rating had an “ownership- and investorstructure” of four or higher. Therefore those suppliers should have the financial and organisational background to handle these businesses in more difficult times. The product portfolio of those four companies has three times the lowest noted value of “3”, because all of them are not really big companies and are mostly specialized on automotive parts. The most important fact in those cases was the prognosis for the future where these smaller suppliers plan to catch up regarding the flexibilities of their lines and a new orientation concerning their product portfolio.

Besides the overall supplier performance, secondly the concrete business-to-business offer has to be examined regarding flexibility aspects. The downturn-evaluation shows

a threat for the supplying company in combination with higher flexibility rates to fulfil the customer's needs.

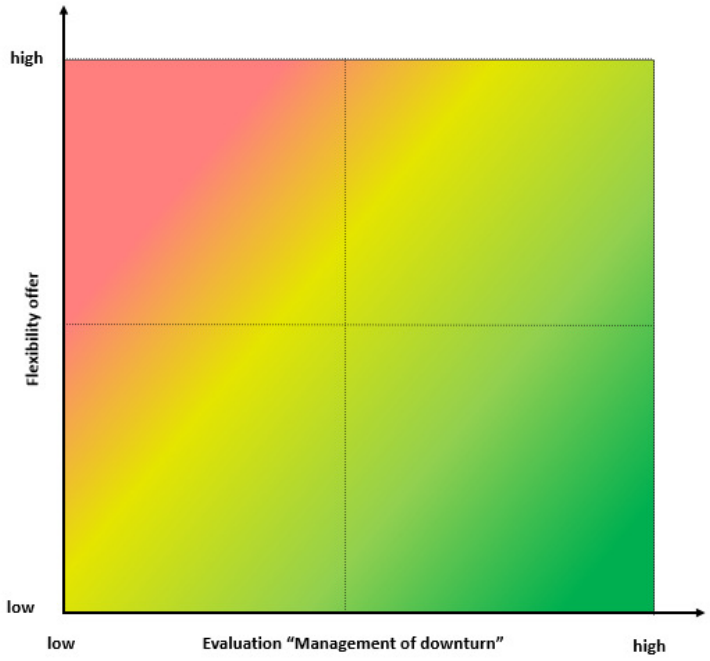

Figure 20 Offer related risks in combination with the management of the downturn

The analysis of the offers of the four affected suppliers showed that they only provide a higher flexibility in case of monetary compensation. Those limitations of cost-neutral flexibility wasn't a criterion for being excluded from the nomination process, but a common evaluation of the price effect was necessary to cover different scenarios with clear monetary effects.

Finally a very interesting point is, that two of those four suppliers had the maximum value of "5" in their exchangeability rating. The reason for this phenomenon is that they also got the gasoline business and can theoretically exchange those products, but due to huge turnover differences between both products the negative impact on the turnover is still existing. If the suppliers are huge companies with many business fields it is much easier to find additional possible nominations to stabilize the imbalance, but as described before, the mentioned suppliers have a limited product portfolio and cannot offer that many different parts.

"Supplier Q" shows that it's also possible to be perfectly prepared for the fluctuating demands and volatile market situations, because he got a rating of "5" due to the fact

that he can flexibly adapt the output and use machines also for products for different technologies and also non-automotive business sectors. Nevertheless it is obvious that the management of the downturn is strongly product related and the requests of the OEM cannot always be fulfilled in the same way. In case of negative circumstances specific action plans have to be cooperatively developed between both parties.

6.4.6 Results "Lever of OEM compared to the supplier"

The question about the market position cannot be seen individually. Again there is a main danger in combination with a low "management of the downturn"-evaluation and the offered flexibility rates.

In two cases we have ratings of 2.5 and lower. In those situations the suppliers definitely know about their technological leadership position. The technological advantage of those two companies is can be seen in the R&D-evaluation which shows the highest values of "5" for both part providers. To get into this position it is not necessary to be a big company with high turnover rates, because both companies are mid-sized suppliers which are offering niche products. Big suppliers which are already providing many different parts to the OEM have often also many businesses they can lose which increases the power of the OEM a bit. Additionally long-term customer-supplier-relationships with big companies are based on hard but fair negotiations, where both parties are aware of the necessity of a good relationship to the other side. Therefore the evaluation of the big players in the supplier industry is mainly between 3.5 and 4.5.

In a nutshell it is legitimate to use his advantages on both sides, but long-term partners identified the positive sides of a strong relationship which is also already described in the theoretical part.

6.4.7 Results "Competitive situation"

The differences between the competitive situation of different parts in the gasoline and diesel supplier industry is extremely low. All suppliers are facing several competitors which keeps the price level at least constant.

The evaluation of the last question should mainly show the amount of alternatives in case of generally low evaluated suppliers, but the low relevance of this criterion was already shown in chapter 6.3 “Relevance for suppliers” on page 49, because all nominated suppliers were on a pretty high level.

Summary:

- *Different categories cannot be seen individually! The criticality is dramatically increased in case of the combination of different low values:*

a) *A positive financial and solid overall rating is necessary for suppliers with a low exchangeability, especially regarding Diesel parts. With a high flexibility suppliers can compensate this criterion, but will consequently be confronted with a decreasing turnover. The benefit regarding a constant turnover and the higher chance for the big business is also seen by the suppliers*

b) *A diversified product portfolio concerning gasoline and Diesel parts is the base for a nomination to permit exchangeability - E-mobility components are actually not absolutely essential for an ICE-nomination*

c) *In cases of a low but acceptable financial rating, in combination with no exchangeability, a limited product portfolio or a difficult management of the downturn, a nomination will only be done in exceptional cases! Overall standards regarding “no-go”-evaluations didn’t change in combination with the additional questionnaire*

d) *Low R&D efforts of suppliers make the OEM curious regarding their future plan: In such cases a long-term business plan for the transition to E-mobility has to be provided by the supplier*

e) *The management of the downturn is an incremental indicator for the ability of the supplier in this volatile situation. OEMs won’t accept offers which are based on volume speculation and cannot cover different scenarios, especially in combination with a low overall rating. The increase of the flexibility of a production site can take a longer period wherefore e.g. smaller supplier can also be decided by providing concrete action plans.*

f) *Regarding a long-term customer supplier relationship suppliers and OEMs have to keep attention about the misuse of dominant market positions. Especially long-term suppliers have a balanced rating in this question.*

6.5 Clustering of nominated suppliers

Clustering suppliers like mentioned in 5.3 led to a pretty distinct result. The general high evaluation had the result that all bubbles are positioned in the two upper sectors.

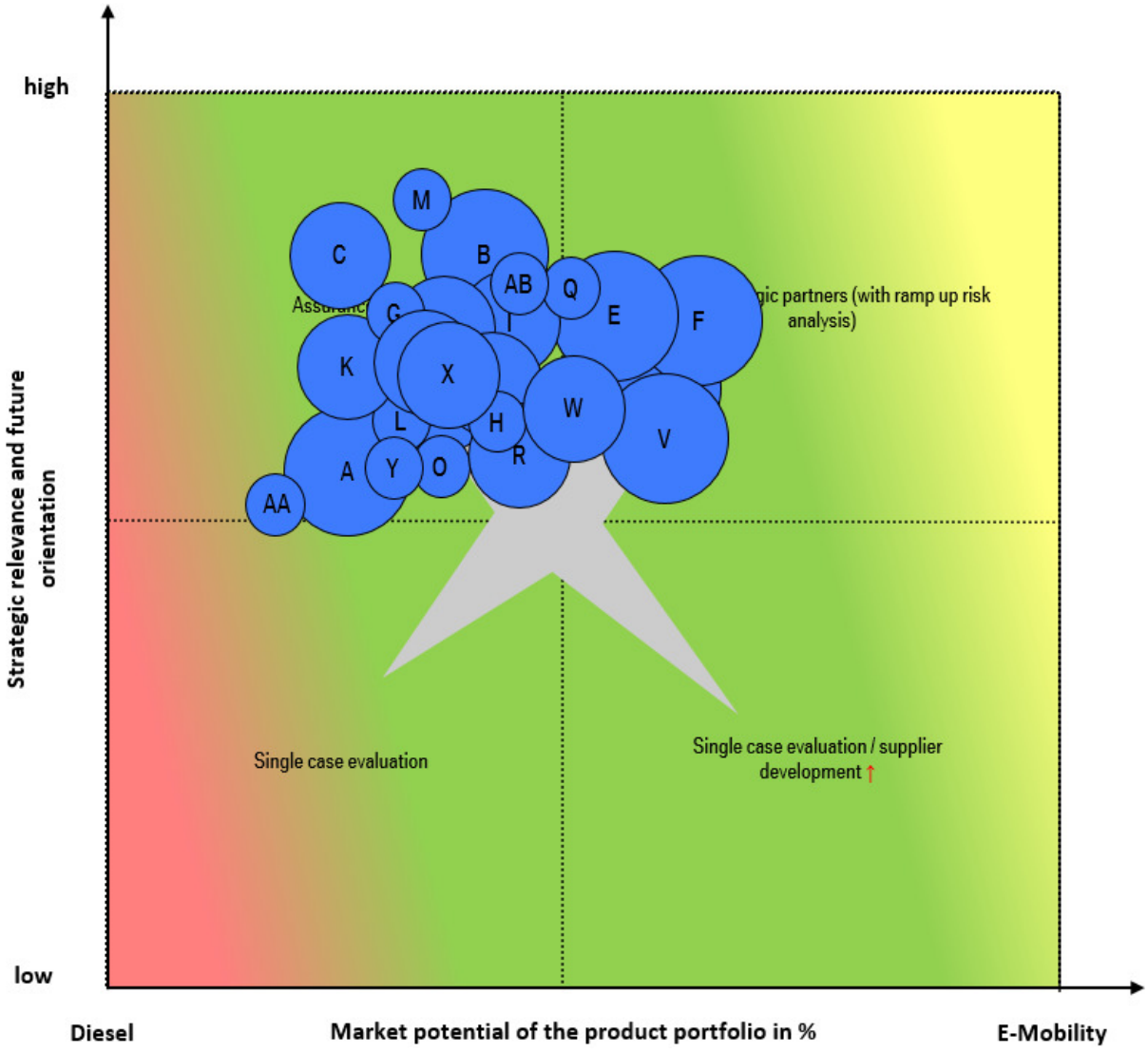

Figure 21 Positioning of suppliers in "future matrix"

The size of the company doesn't have an effect on the future orientation questionnaire, but it is obvious that bigger suppliers are already better prepared E-mobility. Regarding the fact that we examined suppliers which were nominated for future Diesel projects, those suppliers won't be able to reach the right side of the matrix visualization. From the actual perspective we already identified that it's not incremental to have E-Mobility market shares, but it's not possible to predict the necessity for future nomination processes.

The red arrows for the development of the total turnover were left away, because the Diesel turnover at least stays constant (if the suppliers were already nominated for the actual serial products) and the gasoline nomination cannot be forecasted from the actual point of view.

As already described in the previous analysis of results the evaluation and also the clustering of suppliers in figure 21 cannot be taken as a distinct recommendation regarding additional assurance actions or not. The goal is to develop the suppliers from the left upper sector more to the middle or the right upper area to have a balanced product portfolio for businesses from 2030 onwards.

The wording “single case evaluation” could be misleading, because an evaluation also happened during the “assurance”-process in the left upper corner. The matrix should normally be a tool for the creation of a supplier portfolio creation in the strategical period to think about the consideration of lower rated part providers. During the RFQ-process suppliers positioned in the left lower corner were definitely contacted, but the visualization clearly shows that finally no offering company with a critical rating was finally nominated.

For the future new as well as well-performing suppliers will have to face even increasing customer demands.

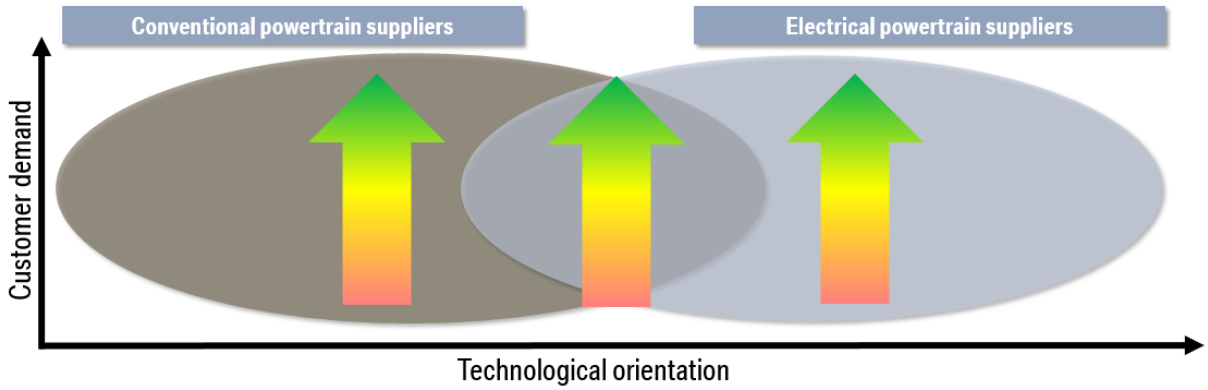

Figure 22 Development of customer demands

Low evaluated suppliers regarding their future orientation will have huge problems to gain new businesses. This tendency which was shown in the analysis of actually nominated suppliers can be extended to electrical powertrain suppliers, because similar questionnaires and challenging demands are forwarded to E-mobility

candidates. Highly evaluated ones doesn't have the guarantee that the evaluation stays continuously the same, because the customer demands will even increase in the future. A continuous improvement process is indispensable to keep the evaluation on a favourable level.

6.5.1 Cross fertilization

The middle section of the x-axis in figure 21 stands for a diversified, at least broad combustion engine portfolio of the examined companies. Besides the mentioned fact that only in exceptional cases part providers with solely Diesel components were finally selected, it is also obvious that the majority of the suppliers is still primarily focused on combustion engine parts.

The identification of new potential suppliers for a quality part producer and the creation of artificial exchangeability is often an extremely difficult process. The questionnaire used for the examination of "future evaluation" already shows the detailed analysis of supplier's performances and the challenging demands of car manufacturers. It is indispensable to use all sources to find new suppliers for new parts, because continuously changing product portfolios of existing suppliers often leads to a limited transparency. Consequently especially in new technological fields the consideration in new RFQ-processes cannot be taken for granted just because a company has a new part in his portfolio.

The question about the actual and future product portfolio not only gave insights into the perspective for the supplier's future, but also offered the OEM the possibility to consider suppliers for other requests for quotation, especially regarding the E-mobility sector. After analysing the questionnaire with the supplier three of the 28 different suppliers were also included in RFQs for electric engine components. New innovative technologies are rarely offered by a broad range of companies and additionally new market entrants mostly doesn't fulfil the high standards which are requested especially by the development and quality departments of the OEMs.

The goal regarding future businesses is definitely not only to have exchangeability between gasoline and diesel engines, but also to develop actual and new suppliers to long-term strategic partners. Therefore internal combustion engine part providers have

to enter the electric engine market and should stop thinking only about today's turnover and profit. The upcoming figure shall show the requested direction of the supplier's product portfolio development combined with the mentioned increasing customer demands.

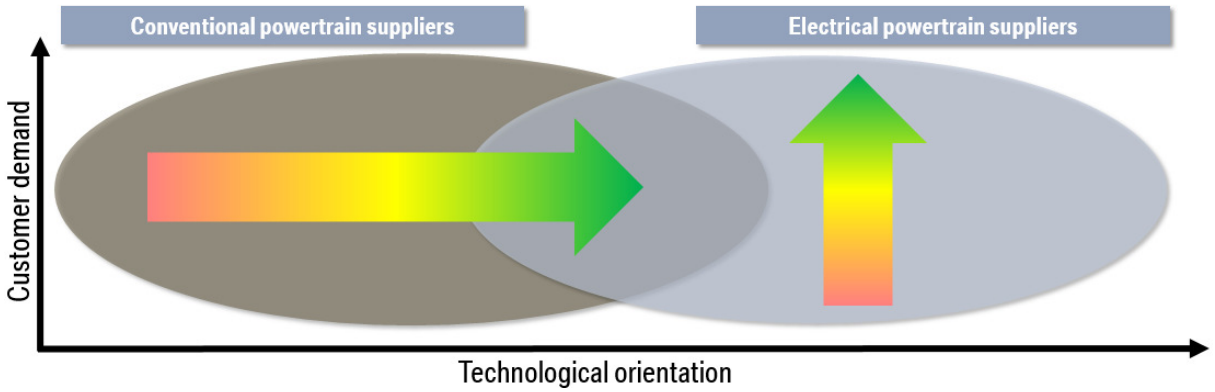

Figure 23 Technological orientation of suppliers

Those mentioned three suppliers, which are perfect examples for cross fertilization during different supplier nomination processes, won't be the last one's which get the possibility to increase their business shares in additional market segments. Specific demands often need several pre-development rounds until a company gets the final request for a new product. It's possible that several other partners will get the chance in the near future to make an offer for additional parts.

Especially regarding E-mobility RFQs existing combustion engine suppliers have to promote their products and new developments to get attention during the market researches of OEMs. During the ramp up the competition is possibly lower than in "state of the art"-technologies, OEMs are strongly searching for a high amount of competitors to achieve the best price and technology and finally combustion engine part providers can differentiate from ICE-market rivals.

6.6 Application of the questionnaire for E-Mobility nominations

The questionnaire was a concrete development for upcoming ICE nominations. Regarding the mentioned risks during the ramp up of E-Mobility components the questionnaire was adapted. Those questions can be used in future nomination processes like for the ICE RFQs to prevent different threats. Therefore the evaluation criteria were switched from “no future – future” to “no risk – risk”. Compared to the ICE form the topics are similar, but the ulterior motive of the question is often a bit different.

The OEM is again looking for a balanced product portfolio. The supplier shouldn’t have the massive volume increase over all of his product. If just one business unit is affected by the fast ramp up it’s expected that he’s able to manage the volume changes more easily.

Question 2 is targeting the ability of the supplier to fulfil the demanded ramp-up and his financial background for investments. An important point represents the ownership structure regarding the acquisition of the company by other OEMs which could lead to shortages in delivery.

The third question is targeting the supplier’s previous presence in the automotive industry. Small suppliers possibly need additional support during the implementation process and are maybe not used to the specific and concrete demands of the OEMs also concerning for example norms, quality or product development process including pre-series, ramp-ups and other issues. In specific cases OEMs would also support suppliers also with higher efforts to assure the capacity and quality, but this additional assistance cannot be provided in general for all companies.

Regarding the capacity and flexibility of the suppler it is indispensable to know the exact production capacities of the part provider and have guaranteed additional assured volumes in case of radical increases. Being the preferred customer is the dominant need of the OEM! Original equipment manufacturers will be competing hard to get the needed demands fulfilled and only with contractual agreements an effective assurance is given. Interesting for OEMs is not only the provision security regarding a specific volume, but also the scalable ramp-up regarding a possible fast turnover increase with a minimal increase of additional invests. These invest boosts are on the

one hand interesting regarding necessary payments and on the other hand related to the needed time to implement the investments for new machines or lines. For those forecasts the purchasing department has to have a detailed overview about the future expansions regarding new lines, because often process innovations in production are necessary to produce the requested product innovations.

Those renewals of the parts is essential for the OEMs. On the one hand the OEM has to assure that the supplier always offers his newest product solution to the car manufacturer and on the other hand the car producer needs strategic partners who have the intrinsic motivation to continuously improve their product. The technological progress is proceeding really fast and OEMs don't want to have a disadvantage against their competitors. In the actual early stage of a new technology the car producers have to keep the pace with the technological leaders especially in cases of disruptive technological jumps. To get the latest product solution can be assured by strong customer-supplier-relationships or by producing the parts on one's own. The make-or-buy decision is another important point which has to be considered during the product development process.

The actual low maturity level is the reason for the sixth question, because from the actual point of view it's not visible which parts or components are outsourced or internally produced. The technological knowledge is often demanded from the supply industry and therefore the provision of complete systems helps OEMs to define the scope of responsibility and to focus on core competences. Often there are different competences in the hands of different supplier and consequently no supplier is willing to take the responsibility for the whole system. To have the commitment of a system provider to supply a complete package probably pre-assembled and ready to be applied in the production line is an important factor to keep the in-house complexity under control. Additionally assuming the obligation for raw material risks, e.g. for rare earth, is again a support for car manufacturers to decrease the internal complexity.

The competitive situation and the additional information can be seen pretty similar to the questions in the ICE questionnaire. The only aspect which has to be considered is that a market analysis to find new possible suppliers and to evaluate them takes possibly a bit longer because of the novelty of this business area. Secondary the potential supplier market is often limited and those few suppliers are saturated by requests for their parts.

6.6.1 Questionnaire for E-Mobility components

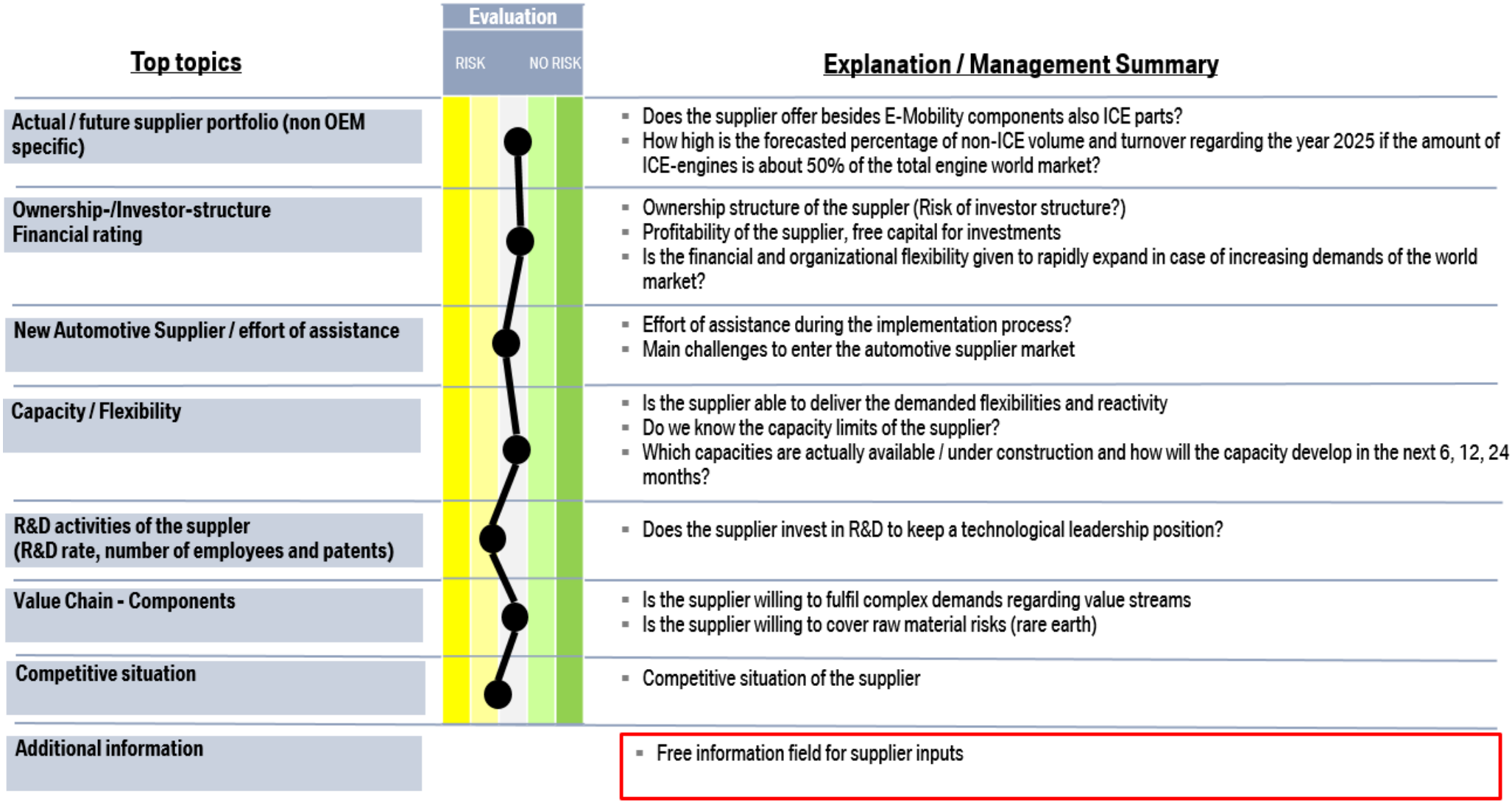

Figure 24 Questionnaire for ICE suppliers

6.6.2 Clustering of E-Mobility suppliers

After the analysis of the suppliers is done it's again possible to visualize those candidates for future businesses regarding the strategic relevance and their maturity or the maturity of their products.

The strategic relevance is again defined by the questionnaire possibly enriched by additional topics. The y-axis shall give an overview about the maturity of the supplier which can change over time. Therefore the proposal is to mark the actual situation with the bright blue colour and a prognosis for 2025 with the dark blue one, to get an impression about the possible development. The reason for an actual state and a forecast is the novelty of the technology and therefore big maturity differences between early movers and actual followers. Nevertheless it could still be possible to catch up and be part of this big future business area.

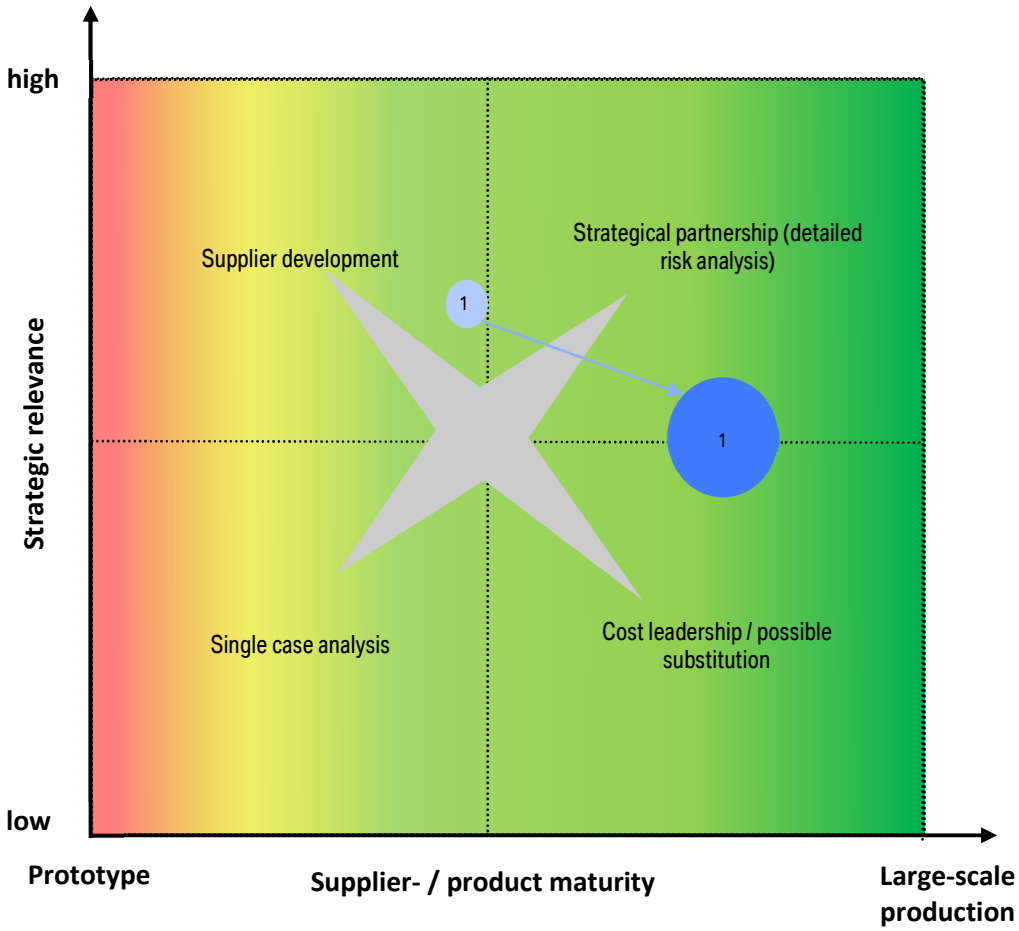

Figure 25 Clustering of E-Mobility suppliers

7 Conclusion

Similar to former risk assessments also today's the actual evaluation of ICE suppliers is mainly focusing on financial risks. The difference to static risk ratings in the past is the integration of dynamic scenarios regarding high volume fluctuation.

The supplier rating should be done as a strategic and tactical action during the creation of the commodity supply chain strategy or latest during the RFQ-process and has to be examined continuously until the final call-offs are visible in the ERP-system (Enterprise Resource System). By getting a continuous overview regarding the readiness of suppliers the continuous improvement of suppliers can be shown.

Regarding E-mobility components a specific analysis is necessary, because not only financial aspects are of importance but also primarily OEMs have to face capacity risks which have to be evaluated in a different way. Therefore the general applicability can only be confirmed for actual RFQs of combustion engine parts and will have to be continuously adapted regarding new challenges.

In deep exchange with the strategic purchasing department the following main criteria for future nominations regarding flexibility during volatile market situations were identified:

- High exchangeability between different powertrain technologies to balance the overall volume (Diesel – Gasoline)
- Offering a diversified product portfolio
    - Gasoline and Diesel parts definitely necessary for "future"-evaluation
    - E-Mobility parts and non-automotive parts are additional benefits
- A solid ownership structure in combination with a good financial rating
- R&D activities regarding actual and future technologies
- Defined internal strategies regarding the flexibilisation of the production to balance the volatility of the market
- A good customer-supplier-relationship and a cooperative behaviour of both parties with the goal of generating a win-win-situation

Those criteria have to be seen in combination and not separately. Single points can be revised also after nominations and during the preparation of the projects. Especially the flexibilisation and the diversification of the product portfolio cannot be adapted from one day to the other. Especially smaller suppliers regarding turnover and employees often need time for facing all future challenges. Individual low evaluations are not seen as “no-go”-criteria, but have to be analysed in detail, discussed during the nomination process in the board meeting and action plans have to be defined to assure those topics.

The results of the survey summarizes the overall orientation of suppliers, which were nominated for future businesses from 2020 until 2025, regarding their future orientation:

Generally spoken the overall average value of 3.8 shows that only suppliers were nominated which are fulfilling these mentioned new criteria. Some single low values show definitely potential for the preparation for the upcoming volatility of the market. Due to the fact that several topics are pretty new part providers rarely fulfil the demanded points completely. The highest evaluation can be seen in product topics like exchangeability and the product portfolio including the connected research and development. Structural topics regarding the company itself or the production strategy (management of the downturn) were evaluated a bit lower than product based topics, but in those cases a short-term adaption is often not possible.

Deviations from high values only occurred in three cases and were always be assured by action plans:

- Small sized suppliers with limited capacities to cover all tasks in parallel
- Big sized suppliers with limited ability or willingness to adapt
- Diesel specific components

Not only the specific Diesel component suppliers, but also imbalanced volumes and turnover regarding the different combustion engine technologies led to a strong tendency to the left side in the “future matrix” on page 60. Consequently often additional assurance actions were necessary to cover different threats. Because of those insecurities and with the target of developing a supplier to a strategic partner

cross fertilisation of E-mobility RFQs has been already three times successful. The status concerning the future evaluation of the nominated values only led in exceptional cases to concrete actions, but can definitely not be seen as a frozen value. The demands and challenges of OEMs will increase step by step and without a continuous improvement suppliers will move to the left lower corner of the matrix.

In a nutshell it has been proven that the identified criteria which were seen as relevant topics on the customer side were finally also fulfilled by the supplier industry. A lower maturity level is only acceptable in the three mentioned exceptional circumstances. The main requirements which suppliers have to satisfy to get an overall high rating are summarized in the upcoming final chapter.

7.1 Guideline regarding new challenges for the supplier industry: What to do to keep a high market share?

After analysing the examined 32 nominations the following reasons for high values were identified and consequently for fulfilling the OEMs demands specific strategic actions have to be derived by the supplier for improving the rating of the customer. These different operating nominations can not only be used for short-term wins regarding ICE nominations, but also for being more profitable in volatile market situations during the transition to E-Mobility:

The former hygiene factors shown in figure 4 (cost, time, quality, etc.) are still valid and necessary. The new challenges can be mainly seen as a criteria enrichment driven by the volatility of the market. Therefore the awareness of the supplier concerning market developments is essential and the strategic orientation of suppliers gets more and more important. In combination with the new challenges and at least a long-term vision regarding the future supplier portfolio, a high customer orientation regarding flexibility and adaptability is the key factor.

Suppliers have to consider that the offer of exchangeability is not sufficient: The OEM doesn't want that the supplier takes the risk, he should prevent it! A low flexibility in production combined with an offered high flexibility can affect the supplier's profit tremendously. The key to be economically successful lies in the flexibilisation of production which can't be seen as a short-term task. Especially small companies with limited resources have to prepare early for the transition to adapt internal structures in time.

Topics examined by the questionnaire were reasons for nomination decisions and only in the unusual cases deviations were temporarily accepted:

Small suppliers with limited capacities should prepare proactively action plans how they are going to cover the new challenges. A reduced willingness or limited abilities to adapt of mostly big suppliers have to be strongly considered in combination with the supplier's power and the competition. The actual requested flexibility goes hand in hand with a high degree of cooperation and several big long-term partners weren't finally considered for the investigated RFQs. If specific Diesel component suppliers were able to keep their business and weren't replaced by part providers with a more

diversified product portfolio, they will be confronted with a high volume fluctuation/reduction.

Simplified it can be said that different categories cannot be seen individually! The criticality is dramatically increased in case of the combination of different low values:

Suppliers with a low exchangeability can compensate this criterion with a higher flexibilities. As already mentioned a positive financial and solid overall rating and a suitable production system and company structure is necessary. The benefit regarding a constant turnover and the higher chance for the big business has to be seen also by suppliers.

A diversified product portfolio concerning gasoline and Diesel parts is the base for a nomination to permit exchangeability and is an important point during the final decision making process. E-mobility components are actually not absolutely essential for an ICE-nomination, but will get a higher significance in the future when the turnover with electric parts increases rapidly.

Standards regarding limits in the financial rating reports didn’t change because of the transition to E-Mobility. In cases of a low but acceptable rating in combination with no exchangeability, a limited product portfolio or a difficult management of the downturn a nomination will only be done in exceptional cases!

In case of lower R&D efforts suppliers should be able to present their long-term business plan for the transition to E-mobility. The necessity of being already nominated for E-mobility components for getting nominations for the upcoming ICE projects was not given in the examined supplier decisions.

The management of the downturn is an incremental indicator for the ability of the supplier in this volatile situation. OEMs won’t accept offers which are based on volume speculation and cannot cover different scenarios, especially in combination with a low overall rating. The increase of the flexibility of a production site can take a longer period wherefore e.g. smaller supplier can also be decided by providing concrete action plans.

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9 Figures

10 Tables

11 Abbreviations

€	Euro
BMW	Bayerische Motoren Werke
CSCS	Commodity Supply Chain Strategy
e.g.	Exempli gratia
EOP	End of production
ERP	Enterprise Resource System
EV	Electric Vehicle
ICE	Internal Combustion Engine
KPI	Key Performance Indicator
MBA	Master of Business Administration
OEM	Original Equipment Manufacturer
R&D	Research and Development
RFQ	Request For Quotation