



Master's degree thesis

LOG950 Logistics

**Product Variety in the Automotive Industry:
A Case Study of the European Passenger Car Market**

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Preface

When commencing a Master of Science program in a foreign country, one knows in advance that it will be a life-changing experience both on a private and professional level. This could not be applied less for the MSc in Logistics program at Molde University college. The college was a second home and always created the perfect environment for reading, studying and doing research.

The logistics program never failed to lose our interest and motivation and challenged us accordingly. This master thesis is the icing on the cake of the two year program. During the seminars prior to the thesis, we were both very interested and attracted by the topic of Product variety which was lectured by Taylor Randall, Dean at the University of Utah, David Eccles School of business. After the seminar, we decided to see Berit Irene Helgheim, associate professor at Molde University College to talk about several possibilities for a topic for our master thesis.

The topic of product variety in the automotive industry came up soon enough and we both almost immediately started reviewing the literature and looking for relevant data. The main foundation of the thesis was laid and numerous ideas, brainstorming sessions and discussions were yet to follow. We are proud to present the final result in the course of this document.

Our first and greatest thanks go to our supervisor Berit Irene Helgheim, for guiding and supporting us through the process of this master thesis. Berit was always available for us and always made time as much and as soon as possible when needed. Her critical reflection and feedback regarding the research design and structure of the thesis have been very valuable for us.

Second we would like to thank Øyvind Halskau, coordinator of the MSc in Logistics program, for his critical feedback on our master thesis proposal which lays at the basis of this thesis. Great thanks also to Ottar Ohren, dean and head of the department for economy, informatics and social science at Molde University College for having confidence in our supervisor and making the resources available to get data which was needed for the analysis.

Next we would like to thank Sarah Graham from IHS Automotive for supplying the data and her availability whenever we had data-related questions and her always immediate response. Finally, thanks to all other master students which were present in the meetings and presentations we had during the course of writing this thesis for their interest, critical questions, feedback and mental support.

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Abstract

“Variety is the spice of life (William Cowper)”. Based on this statement from William Cowper it might be questioned if the product variety is the spice for the consumers’ choice and if it influences sales. This possible interaction between product variety and sales in the European passenger car market was examined in this paper in subsequent to execution of analyses regarding the development and current situation of product variety in this market. The analyses were executed from two different perspectives, the consumers’ and suppliers’ perspective.

Four main research questions were formulated. The questions concern the above mentioned topics and in addition the general situation of the automotive industry is taken into account in order to get a complete picture. The questions were answered on the basis of available literature dealing with these issues, three datasets and by applying the SWOT analysis as a tool and simple statistics. The analyses were done for 16 brands representing around 80% of the market. These 16 brands were assorted based on their average selling price per car into four different market segments which were analyzed separately.

As a result for the consumers’ perspective it was found that the level of product variety decreased in the observation period from 2001 to 2011 and that the companies try to differentiate by the design of their cars and the car model series offered. Furthermore, the analyses show that the variation from the suppliers’ perspective was lowest in the premium segment and even lower for manufacturers belonging to the same group. In addition the results indicate that there is no significant difference regarding the supply structure of the different component areas. Finally, no evidence was found for a relationship between product variety and sales.

Key words: automotive industry, product variety, European passenger car market, perspectives, supplier, consumer

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1 Introduction

1.1 General introduction

Today, the automotive industry is one of the most important industries in terms of revenue and generates globally around 60 million jobs (IMAP 2010). This means that the industry often has been subject to research in many different fields such as supplier management (Aláez-Aller and Longás-García 2010) and product variety (Scavarda et al. 2009). The last mentioned, i.e. product variety, will form the scope for the research in this thesis. In several previous researches such as Randall and Ulrich (2001), Hüttenrauch and Baum (2008) and Scavarda et al. (2010), defining product variety has often been an issue because of different interpretations and the option of having different levels or categories of product variety. In this research, we want to contribute to this for the automotive industry and come up with our own definition based on previous literature.

The importance of product variety for the supply chain and production processes has often been neglected. Over the last years, product variety in the industry increased significantly due to fiercer competition and the higher demand of the customers. As a consequence of this, the market has become highly fragmented and the average product life cycle declines. This means that less volume of a particular model is sold and manufacturers benefit less from economies of scale. The amount of sales per model influences the revenue and the extent of which development costs can be recovered (Holweg 2008).

The central theme throughout this thesis will be if there still is product variety or not. From an explorative point of view, we will look at product variety from both a consumer's and supplier's perspective. It is interesting as well as important to look at product variety from both sides because consumers and suppliers may have their own definition of product variety. For consumers, product variety can be perceived as external characteristics and technical specifications of the car to be built. Even between different consumers, product variety can have a different meaning e.g. the different colours of a car for both interior and exterior while for other consumers product variety is about different engines, fuel types or performance like top speed and fuel consumption.

On the other hand, suppliers may see variety in supplying different components for different car manufacturers and different end products. One part of the analysis of this thesis will be to find out which suppliers are supplying which car manufacturers in the market. By doing this, we can see if there are common suppliers between two or more brands and if competitors are using the same suppliers for their components. If car manufacturers are using the

same suppliers and same components, it would mean that, up to a certain level, the finalized products would be the same as well as which would indicate a decreased product variety in the industry.

Depending on the perception and definition of product variety, the analysis or results may differ. In this thesis we seek to give an answer to some of the questions mentioned above.

1.2 Aims and objectives

The aim of this thesis is to create a more clear understanding of the current situation of the European car market and industry by doing explorative empirical research. Furthermore, we want to give more insight in the functioning and importance of product variety and the influence on sales. By giving a new approach to product variety in the automotive industry, this thesis intends to form the basis for new research in this topic. Furthermore, this approach of product variety could also be taken over into other topics such as purchasing- and supply theory or resource dependence theory.

The objective is to find out how product variety in the European automobile market changed over the years. We want to bring the discussion to about the difficulties of approaching and defining product variety to the forefront because different actors in the supply chain can have a different perception and interpretation of product variety. By doing this, we want to create a new possibility on how to look at product variety. More specific, we hope to contribute to the current research regarding the automotive industry by pointing out certain factors like who supplies whom, i.e. which suppliers supply which car manufacturers. Finally, we hope that this thesis can give an incentive and possibility for further researches depending on the results of the analysis. This will be discussed in detail at the end of the thesis.

1.3 Structure of the thesis

In this part, we will explain the structure of this thesis and how the analysis is built up. We start with the research questions which form the basis for the analysis later in the case study. Every research problem is represented by a specific research question. Moreover, we have the literature review where we present and discuss some of the main research articles about the topic and the theory of the automotive industry. The first part of the review focuses on product variety and the automotive industry in general. Subsequently, we look more specific at research concerning product variety in the automotive industry. Finally, we introduce the results of former research regarding product variety and sales.

In the next chapter, the methodology delivers further insights into the research design and type of research applied in this thesis. In the course of this chapter we also describe the kind of analyses executed, the tools used for these analyses such as the SWOT tool and the statistics applied. The chapter will be finalized with the description of the type of data used, including the description of the different data sources, the structure and the measurements. Furthermore, the criteria related to the reliability and validity of data will be introduced.

Subsequent to the methodology the case study of this thesis is presented. In the case study we analyze the data and answer the research questions formulated and explained in the second chapter. The structuring of this case study is similar to the structure of the research questions. All questions are analyzed and answered in the same order and are summarized at the end. In addition, our definition of product variety in the automotive industry will be given.

The case study is followed by the discussion part where we reflect the results of the analysis and compare these results with our expectations and link it to relevant theory. In this part, we can also see if our findings match or contradict the literature. Afterwards, we briefly summarize and make a conclusion for all research questions. In addition, we give our own critical insights about the topic of this thesis and the current situation of the industry. Finally, we end the thesis by describing some of the limitations we faced during this process and present some possible topics for further research.

2 Research questions

Research questions are central to the overall research process and they have a substantial impact on a lot of decisions which have to be made during the research process. They can be considered as the basis of any research executed and present the guideline how a research problem is studied and solved in the respective scientific work (Bryman and Bell 2011, 82-83). Due to their importance, research questions should fulfill certain criteria. The criteria defined by Bryman and Bell (2011, 82) are summarized in the following paragraphs.

The research questions should be formulated in an understandable and clear way, so that there is no room for doubts about the meaning. They “should be researchable”, that means that they should not be too abstract and should be convertible into an adequate research design. Furthermore, the question should have some kind of connection to established theory and formerly executed research. It is very unlikely that there has been no research at all related to a certain topic. This connection allows also to show the contribution to knowledge and understanding of the research (Bryman and Bell 2011, 82).

Beside the connection to former research, the questions should have a connection between each other. If the questions are not linked, a good basis for the final discussion and argumentation might be missing. Another criterion is that the questions should give a reasonable input to the topic and potentially broaden the knowledge related to the scientific field. The last point to consider is that the questions should be answerable. They should not be too broad and not too narrow. In other words, they should leave some room for discussion, but on the other hand they should not require ages of research in order to find appropriate answers (Bryman and Bell 2011, 82-83).

Subsequently, the research questions formulated for this paper will be introduced. They are based on the research problem and on the criteria already mentioned. In order to make the research questions more understandable at this stage of the thesis and to clarify the underlying structure, some short explanations and additional information are added in the forerun of the questions when necessary. There are four main research questions. The first question looks at the situation of the European car market. Then we look at product variety from two perspectives i.e. consumers’ and supplier’s perspective. And finally, in the last research question we look at the interaction between product variety and sales.

As stated before the first research question examines the European car market in general. The answer to this question is supposed to obtain information about the current situation of the industry considering internal and external factors. The level of analysis for this research question is the market level. More detailed information about the level of analysis will be given in the course of the methodology.

1. What is the current situation of the European car market in terms of strengths, weaknesses, opportunities and threats?

The different car manufacturers present their own portfolios as comprehensive as possible and with a high level of variety. According to their grandstanding, the variety is high and increased constantly over the last years. Based on the way how the market presents itself, the approach of the following part is to give an indication if this variety really exists and how it changed over time. In accordance to that, the aim of the research questions of this part is to find out what the current situation and the development of product variety in the European passenger car market actually is. In this case, the level of analysis is the car brand level.

2. Is there still product variety in the European passenger car market and had it developed in the last years considering the three perspectives of product variety, design, technical specifications and performance?
 - a. From a design perspective, is there a development in product variety over the last years?
 - b. From a technical perspective, is there a development in product variety over the last years?
 - c. From a performance perspective, is there a development in product variety over the last years?

For the purpose of being able to answer the second research question and to put the arguments on a solid base, we formulated three sub-questions. These sub-questions are based on the three perspectives, also called levels or categories, of product variety which are mentioned in the main research question. These categories will be defined and explained later in the thesis, prior to the analyses. For these analyses, we apply several variables for each perspective of product variety. These variables will also be discussed later in the thesis when relevant.

The third research question considers the so called internal variety or the variety from a supplier's perspective. This kind of variety cannot necessarily be experienced or seen by the consumers. In this paper, the focus for this part is on the differentiation between the different car brands and not between the cars of a certain brand which means that the level of analysis is also in this case the brand level. One aspect influencing this perspective of variety is the selection and allocation of suppliers of car components to each manufacturer. The higher the percentage of common suppliers of the companies in the market, the lower is the level of variety. The low level in this case results from the similarity of car components supplied by the same suppliers.

3. What is the current situation towards internal product variety in the European passenger car market based on the allocation of suppliers to the different manufacturers?

In the literature, no clear answer can be found if product variety influences sales or not. Some researchers found evidence for this relationship while others argue that there is no significant correlation between the overall variety offered and the sales volume. The fourth approach of the thesis deals with this topic and links the results of the product variety part to sales. The final answer to the second research question, whether there still is product variety or not, will be compared with the development of the sales volume in the European passenger car market. Thereby, the aim is to find out which result is valid for this specific market. As in the two previous parts, the level of analysis for this research questions will also be the brand level.

4. Is there a relationship between product variety and sales in the European passenger car market?

3 Literature review

In this chapter the relevant theory applied in this research will be presented and discussed. Due to the fact that the amount of literature about product variety and related topics is enormous the theory had to be narrowed down. Only important sections and issues of the theory will be explained and used as framework for this thesis. The same applies for the automotive industry. Studies about the industry as a whole and every single part of it have been conducted and observed from different angles in previous research. Also in this case it was necessary to reduce the considered theory to the relevant parts for this thesis.

The first part of this chapter will describe the relevant theory related to product variety. This theory includes the general definition of product variety found in the literature, elements of creating and managing product variety, considerations about the optimal level of product variety as well as the advantages and disadvantages accompanying product variety. Secondly, the aspects concerning the automotive industry will be introduced. The theory about the automotive industry comprises a short definition, a brief overview of the history as well as a presentation of its present appearance and expectations for the future. Furthermore, the current market situation will be analyzed and the buyer-supplier relationships in the industry will be examined. Subsequently, product variety in the automotive industry will be considered and discussed on basis of the available theory in order to draw a line between the two previously mentioned parts. The chapter will be finalized presenting the consideration regarding the interaction between product variety and sales in previous research.

3.1 Product Variety

Product variety was subject to several researches in the last years in different management disciplines such as marketing and operations management and in combination with diverse related topics and industries. The general statement presented in most of the papers about product variety is that product variety has steadily increased over the last years (Fisher, Jain, and Macduffie 1995, Fisher, Ramdas, and Ulrich 1999, Swaminathan and Nitsch 2007, Scavarda et al. 2009).

This increase of variety was and still is driven by several forces such as the growing global competition, evolving technologies, increasing consumer sophistication and changes in trade structures and energy prices (Ramdas 2003, Swaminathan and Nitsch 2007). Fisher, Jain, and Macduffie (1995) explain this increase of variety in a slightly different way by using the “pull” of the market and the “push” of the companies as driving forces. While the “pull” of the market is a result of consumers rewarding the higher level of variety, new technologies and automation “push” the companies’ capabilities to produce more variety. Due to this devel-

opment differentiation becomes an even more important factor and so does tailoring niche products (Fisher, Jain, and Macduffie 1995).

Before the different aspects of product variety such as advantages and disadvantages, impacts on businesses and industries and developed strategies to use product variety as a differentiator or competitive advantage can be discussed further, it is necessary to define product variety first.

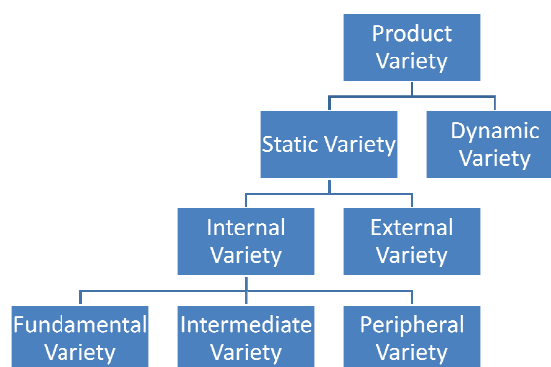
3.1.1 Definition

The basic definition of product variety is similar in most literature and can be summarized as the number of products or options of a product that a single company or brand offers to the customers (Hüttenrauch and Baum 2008, Randall and Ulrich 2001, Scavarda et al. 2010).

Even though the basic view on product variety is the same or similar, some researchers give more detailed specification of variety and take additional aspects and options into account. Variety can for example be divided into static and dynamic and furthermore static can then be differentiated into internal and external variety (Scavarda et al. 2010, MacDuffie, Sethuraman, and Fischer 1996, Pil and Holweg 2004, Fisher, Ramdas, and Ulrich 1999). MacDuffie, Sethuraman, and Fischer (1996) and Pil and Holweg (2004) apply an even further grouping of internal variety into fundamental, intermediate and peripheral variety as a final step of deviation.

The different tiers of variety are visualized in the following figure and will be explained more detailed afterwards.

Figure 1: Tiers of variety



Source: own illustration base on Pil and Holweg (2004), MacDuffie, Sethuraman, and Fischer (1996) and Scavarda et al. (2010)

Static and dynamic variety

Dynamic variety adds the frequency in which existing products in the market are replaced by new ones to the basic definition of product variety (Fisher, Ramdas, and Ulrich 1999). In other words, dynamic variety also considers the time interval which is chosen by the company to introduce new or modified products to the market as a source for variety while the static variety is defined as the variety that does not change over time and “exists at any point in time” (Scavarda et al. 2010).

Internal and external variety

Static variety can then further be divided into internal and external variety. External variety can be expressed as the total number of different variants of a product which can be bought by the end-customer. In other words, external variety is the variety which is presented to the customer. Internal variety concerns the variety that is necessary to enable the delivery of the external variety. It is involved in the creating and production process of the products and is responsible for the level of manufacturing complexity (Pil and Holweg 2004, Scavarda et al. 2010, Child et al. 1991).

Fundamental, intermediate and peripheral variety

In order to distinguish between the impacts different kinds of internal variety can have on the production process and its complexity, MacDuffie, Sethuraman, and Fischer (1996) grouped the different types into fundamental, intermediate and peripheral variety. This grouping was especially adapted for the automotive industry where the three categories are related to different aspects of the products and the product mix within this industry.

Fundamental variety is seen as the category for the so called Model Mix Complexity which “is based on the number of different platforms, body styles, and models, scaled by the number of different body shops and assembly lines in each plant” (MacDuffie, Sethuraman, and Fischer 1996). Intermediate variety represents the impact that an increasing amount of variety has on functions such as product design and on the whole supply chain. The peripheral variety is related to the overall sum of different parts per offered product and furthermore the single options per part (Pil and Holweg 2004, MacDuffie, Sethuraman, and Fischer 1996).

3.1.2 *Creating variety*

The previous part introduced and explained what product variety is and which different tiers and categories exist. Furthermore, it is necessary to clarify how product variety can be created and what its basis is. Randall and Ulrich (2001) stated in their research that “variety within a product line arises by varying the values of attributes from one product to another”.

This approach refers to the idea that one product consists of a multitude of attributes or dimensions (Ulrich et al. 1998, Green and Krieger 1996). The attributes or dimensions respectively depend on the certain product and are not necessarily the same or similar.

Ramdas (2003) extended the variety creation process and expressed that it is based on four decision themes which concern the design of the product line, the target market and time horizons for the products. She applied the approach that a product consists of a multitude of dimensions and added product architecture, degree of customization and timing as themes that need to be considered while creating variety. This will be explained in the following paragraph.

Dimensions of variety

Variety can be based on the physical form of a product or the product function. Though, aspects such as brand and packaging can also be a source for variety. In other words and referring to the approach of product attributes, the variety of products occurs due to different characteristics and appearances of certain product attributes. No matter which source for variety is chosen it should offer a competitive advantage for the company and, furthermore, should increase the perceived value of the product for end-customers (Ulrich et al. 1998, Ramdas 2003).

Product architecture

Product architecture is the mapping of the relationship either between the functions of a product and the physical components in case of assembled products or between the functions and the process steps for the process and service industry. In literature, product architecture is divided into modular and integral architecture. In a modular architecture every single function of a product is allocated with its physical components and facilitates the possibility to base the variegation of certain components. Integral architecture on the other hand includes coupled interfaces between components and applies so called complex mapping of functional elements and physical components (Ulrich 1995, Ramdas 2003, Ulrich et al. 1998).

Degree of customization

A company can offer different levels of customization to its customers. It would be possible that the company offers a set of ready-made options a customer can choose from at the lowest level of customization. The extreme would be that the product is completely customized and a customer can get completely individualized products. In addition to these two lower and upper limits, several intermediate steps exist. Consequently a company should

base the decision which level it needs to apply on the market situation and its own capabilities (Ramdas 2003).

Timing

The unfolding of a company's product line over time, when and in which frequency new or modernized products are introduced to the market, has an impact on the customers' perception of variety and should therefore be included into the considerations about variety creation (Fisher, Ramdas, and Ulrich 1999, Ramdas 2003).

These four decision themes influence the way how variety is created and are supposed to form the basis for the variety strategy (Ramdas 2003). The different management and strategy approaches dealing with product variety which can be found in literature will be introduced in the following part of this chapter.

3.1.3 Product variety management and strategies

According to literature, managing variety has become a crucial factor for the success of a business amongst others due to the fact that product variety and its management can be a source of competitive advantage. Nevertheless, it is not sufficient to just increase variety. To implement variety without a predefined strategy and management plan can even lead to a loss of competitiveness. Furthermore, increased variety is often closely related to an increase in cost and higher operational efforts which makes an effective management and a well-defined strategy even more important (Ramdas 2003, Kekre and Srinivasan 1990).

Based on these aspects, managing product variety can be described as balancing the trade-off between additional costs and revenue. Consequently, the management of product variety needs to ensure that the variety strategy is compatible with the firm's long-term objectives and the approach of maximizing the long-term profits (Ramdas 2003). As already outlined in the previous part, companies managing variety do not only need to decide which degree of variety to offer in the market but also which attributes of the product to use for the variation. They also have to decide which frequency to apply for introducing new products to the market and taking old products off the market.

In addition to the management decisions of variety creation, the implementation also needs to be considered. This includes decisions concerning the stage of the production process at which the customization takes place and how the additional costs are allocated. Ramdas (2003) defined three decision themes for this part of the management process.

The first theme deals with the process and the organizational capabilities of a company. It is assumed that the flexibility of a process is a key capability that determines the ability to ac-

commodate changes related to variety implementation. The second aspect to consider is the location of the points of variegation. The underlying theory of the point of variegation, also named decoupling point, will be explained in the course of management strategies for dealing with product variety. The third theme includes the day-to-day decisions that accompany variety. A higher level of variety requires a lot of daily decisions in several different areas. Taking these decisions in an effective way enables a company to differentiate its products based on low cost, high quality and responsiveness (Ramdas 2003).

The decisions made within the themes of variety creation and implementation influence the differentiation and variegation in the product line and the possibilities to realize synergies and to respond to demand uncertainties. While the differentiation and variegation has an impact on the consumers' perception of the brand/product and therefore on the revenue, the other two product line characteristics are crucial for the degree of mismatch between supply and demand and the realization of economies of scale finally influencing the costs. These interdependences and the success or failure of managing the aspects of variety creation and implementation lead to the final resulting long-term profit (Ramdas 2003).

It can be expected that, the better the management is able to apply to the decision themes and the more thorough they weigh the options and their results, the better and more successful the business will be in the market. Due to research executed by Mather (1992) it can be expected that the cost allocation and the deletions of product from the market are the main problem areas within managing product variety. In addition to these decisions the management should always be aware that product variety has a positive and a negative side. These sides will be discussed in detailed on a later stage in this chapter.

In order to be successful while managing product variety and its increasing levels, different strategies have been developed and applied. In the following, the strategies of component sharing, the integration of a decoupling point and its location in the supply chain and the implementation of sequencing points in the supply chain will be shortly explained (Ulrich et al. 1998, Fisher, Ramdas, and Ulrich 1999, Swaminathan and Nitsch 2007). These three examples are used in the thesis because they were or still are, among others, used in the automotive industry.

“Component sharing is a product-based strategy that depends on the fact that families of similar products have similar components” (Fisher, Ramdas, and Ulrich 1999). This strategy mainly focuses on parts which are not “visible” for the consumer or not that relevant for the consumer's choice and offer, at the same time the possibility for the producer to reduce the variety in operations. The research executed by Fisher, Ramdas, and Ulrich (1999) uses the

example of automotive braking systems. The braking system is on the one hand a part of the product where variety is not important and only quality and reliability matter. On the other hand, it is a component which has a high potential for cost savings due to its development and engineering costs (Ramdas, Fisher, and Ulrich 2003).

The decoupling point or point of variegation is the point in the supply chain where the product designation changes from make-to-stock into make-to-order and was already mentioned as a part of the decision themes of managing product variety above. The decision about the position of the decoupling point can be used for strategic purposes due to its impact on the whole supply chain. The later the decoupling point is positioned in the production process or/and supply chain the longer it is possible to gain advantages from economies of scale and to save costs which are caused by higher levels of variety. Therefore, the decoupling point should be located as close as possible to the end-customer (Ulrich et al. 1998, Ramdas 2003).

The third strategy is the introduction of a sequencing point within the production process. The sequencing point is the beginning of the parts pipeline. The parts pipeline is the order of components which is identical with the order of products they will be installed in. In order to improve the production process and to make it more effective this management tool is applied. It has to be located before the point where variety is introduced into the supply chain. This means before the decoupling point. Due to that it might be useful to combine the two latter strategies (Swaminathan and Nitsch 2007).

To find the optimal strategy to deal with a high level of product variety and to allocate the point where the variety should be introduced into the supply chain, a company has to fulfill these two main tasks while broadening the product line. Another task is the estimation of the optimal level of variety. This task considering the amount of variety a company should offer will be presented in the following part of this thesis.

3.1.4 Optimal level of product variety

It seems that customers are convinced that a high level of product variety also implies good quality and give priority to the brand that offers more variety. Nevertheless, there is also a limit of product variety while unlimited product variety is not necessarily the way to success. The companies need to find an optimal level of variety for their customers and to balance between not enough and too much variety. The optimum lies somewhere between the two extremes of no variety and complete customization (Lancaster 1990, Mather 1992).

If product variety is exaggerated it is likely to confuse the customers more than it satisfies them. Furthermore, a too high level of variety can have a negative impact on operations as well as on sales. In addition to the level of variety offered the selection of options needs to

fulfill some characteristics for reaching the optimum and having a positive effect on the company's profit. The products should have clear boundaries and distinctions between each other and too many similarities are not good (Wan, Evers, and Dresner 2012, Powers and Steward 2010). These characteristics are extended by the research of Berger, Draganska, and Simonson (2007) who found that the variety also should be focused and organized. This means the variety is related to one product category like chocolate bars with different flavors and not to a broad portfolio of different sweets and that the different variations available should be displayed in a way that is easy to overview for a customer.

Beside these characteristics of variety and the factors market and product, the optimal level of product variety for satisfying the customers' expectation is also influenced by the present culture and wealth. In other words, the demanded product variety depends on the wealth of the people in a certain country. It is possible to say that the richer the potential customers, the higher the product variety they expect (Wan, Evers, and Dresner 2012, Funke and Ruhwedel 2001). Furthermore, general customer preferences, scale properties in production and distribution and social welfare in a certain market are factors that have an impact on the optimal level of variety (Lancaster 1990).

Like already stated a company will not be competitive if they offer less variety than their competitors, the variety at a too high price or too much variety which confuses the customers. Fisher, Jain, and Macduffie (1995) compared the situation of product variety with the decision about the offered product quality. They argue that the costs for producing a defective product and an operative and reliable product are the same. This argument assigned to product variety means that the cost for the production of an item that no one is willing to buy are the same than for the production of a customized product which satisfies the customers' needs.

Even though it is the task of the management to find this optimal level, it is important that also other departments like marketing and production are involved in the decision making process. In case the decision is made by one single department it could happen that it is not possible to realize and implement the planned variety. For example if the marketing department decides which degree of variety would suit best for the given market it does not mean that the production department of the company is able to implement the variety level suggested by the marketing department.

If the involved parties decide on an amount of variety which does not suit the market, it is very likely to have the already mentioned negative effect on the competitiveness of the company, no matter if it is too high or too low. Subsequently the negative effects product

variety in general can cause will be analyzed in the following in accordance with the positive effects and the advantages and disadvantages variety is accompanied by.

3.1.5 Positive and negative aspects and effects of product variety

Finally, the section about product variety will be summed up in the following with the positive and negative aspects and effects of product variety which includes the relationship between product variety and forecasting and demand. In addition, the impact of product variety on the company's performance will be mentioned shortly. The influence of product variety on sales will only be examined under the approach of possible negative and positive interactions in this part. The controversy about this topic and if the relationship between product variety and sales does really exist will be discussed in detail at a later stage of the thesis.

Kekre and Srinivasan (1990) stated that companies face a so called dilemma when they deal with product variety. On the one hand, a higher level of variety increases unit, direct labor and material costs. Furthermore, it leads to higher complexity in the production processes, an increase in the number of activities, like for example greater material handling and higher supervision requirements, to the additional need of resources and reductions of quality and reliability of the processes. All these aspects together might reduce the performance of the company and hinder the application of economies of scales (Wan, Evers, and Dresner 2012).

Randall and Ulrich (2001) also point out the negative impact of product variety on costs. They divide these additional costs into two cost categories, production cost and market mediation cost. They state that the relative impact of the variety on the two cost categories depends on the attributes which are used to create the differentiation. Furthermore, in their research Randall and Ulrich (2001) introduce the aspect of integration. This means the way the product variety is integrated into the supply chain. The better the coordination of product variety and the supply chain, the higher are the benefits for the company.

On the other hand, it seems to be impossible for companies to survive in the market without a varying product line. Standardized products and product lines do not satisfy customers anymore and, in order to be and stay competitive, companies need to offer a certain level of variety. Furthermore, profitability and market share should also be taken into account. Product variety has a positive impact on these two characters and in literature it is expected that this positive impact would be able to overcome the negative implications related to costs and complexity (Kekre and Srinivasan 1990, Swaminathan and Nitsch 2007, MacDuffie, Sethuraman, and Fischer 1996).

One additional positive aspect of product variety beside an increased profitability and a higher market share is the opportunity to reach heterogeneous consumers and to satisfy a broader customer base. On the counterpart, a high level of product variety makes it difficult to forecast the demand and it could lead to mismatches of demand and supply. Supplementary product variety also raises the difficulty of managing inventory (Wan, Evers, and Dresner 2012).

Gaining additional market share due to a higher level of product variety is a positive effect, but Wan, Evers, and Dresner (2012) state, based on the research of Schwartz (2000) and Osnos (1997), that a higher level of product variety does not automatically lead to higher sales while Ton and Raman (2010) found evidence for the presence of this relationship in their research. At this stage, the optimal level of product variety and the distinction come into focus again.

In general, a clear distinction and differentiation between the different variations is necessary. If these aspects are missing, consumers might be confused and overwhelmed and decide not to buy a product of a certain product line at all. It is even predicted in former research that serious problems can arise and the product variety possibly does not show the expected and anticipated positive effect on the long-term profit. It is very likely that a product line with blurring design and no clear distinction even reduces sales (Powers and Steward 2010, Ton and Raman 2010, Wan, Evers, and Dresner 2012).

3.2 Automotive industry

3.2.1 Definition

In order to avoid any confusion or misunderstanding throughout this research, first a clear and simple definition of the automotive industry is given. According to Rae and Binder (2013), the automotive industry involves all activities concerning the manufacturing of motor vehicles, components, engines and bodies. This includes passenger cars and light trucks such as vans, pickup trucks and SUVs (Sports Utility Vehicle). In this research, the definition is narrowed down to car- and light truck manufacturers only. In other words, this analysis does only include non-commercial vehicles. Throughout the literature and the rest of this thesis, several synonyms are used such as auto industry, automobile industry, car industry and car manufacturing industry, but all different terms used have the same definition and meaning as automotive industry. Furthermore, in chapter 5 the automotive industry will be narrowed down further to the European industry as the European passenger car market will be used as a base for the analysis.

3.2.2 History

Many authors like Holweg (2008) always start with Henry Ford and the Model T as an introduction to their literature. It is often said to be the beginning of the automobile industry or that the roots of the present industry can be found there. This is partially true, but the real foundation of today's motorized automobiles can be found a couple of decades before. Ashamalla, Camp, and Abel (2011) define two eras prior to the initiation of the assembly lines for the Ford Model T which they define as the 'establishment era' (1904-1929). First of all, they describe the 'initiation era' (pre-1888) when the Austrian Siegfried Marcus designed the first automobile in 1870 which ran on internal liquid fuel. This car was the basis for the world's first automobile powered by a gasoline-driven engine with internal combustion, designed by Karl Benz in 1885 (Ashamalla, Camp, and Abel 2011).

However, there were several predecessors in France, Italy and Austria which were constructing and testing vehicles based on a four-stroke gasoline engines. Karl Benz was the first to claim to have driven a road vehicle propelled by a four-stroke gasoline engine moved under its own power. Therefore, Benz is seen as the inventor of the automobile powered by an internal-combustion engine (Eckerman 2001, 31-32).

Two years later, Karl Benz started the commercial production of these cars which is the beginning of the 'veteran era' (1888-1903) where there was a lot of competition between steam, electrical and gas engine vehicles (Ashamalla, Camp, and Abel 2011). At that time, it was even the electric automobile which was given greater acceptance because it was quiet and easy to operate. The major disadvantage was the limited battery capacity which turned out to be the fatal factor for the electric vehicle to lose its competitiveness (Rae and Binder 2013). Gasoline engines appeared to be more durable and were cheaper to produce than steam engines. Thanks to the contributions of Benz and Ford for improving the engine and for taking it into the assembly lines, the gasoline engine started to dominate around 1910 (Eckerman 2001, 31, Ashamalla, Camp, and Abel 2011).

A major milestone in the history of the automobile industry is what Ashamalla, Camp, and Abel (2011) refer to as the 'establishment era' (1904-1929). In this era, Henry Ford introduced the assembly line which marks the beginning of the mass production of motorized vehicles. In 1913, the production time for the Ford Model T was not more than one-and-a-half hours and at a low unit cost. The success of the Model T and the assembly line was enabled by a number of revolutionary processes. First of all, a moving assembly line based on a conveyor system was installed to assure continuity. Secondly, a combination of precision, standardization, inter-changeability of components and synchronization of all processes made the production line a well-oiled machine. Productivity was high because of the break-

down of labour to single repetitive tasks (Rae and Binder 2013). It was also in this era that two other big car producers were established. The General Motors Corporation (1908) and the Chrysler Motor Corporation (1925), together with the Ford Motor Company are still often recalled as 'The Big Three'. In the meantime in Europe, other major car firms emerged: Peugeot, Renault and Citroën in France and Daimler, Benz, Opel and Volkswagen in Germany (Ashamalla, Camp, and Abel 2011, Fisher, Jain, and Macduffie 1995, Rae and Binder 2013).

As a response to Ford's dominance with the Ford Model T, Alfred P. Sloan implemented a repositioning strategy in the General Motors Corporation by establishing a product policy committee in 1921. This committee developed a range of products with corresponding price levels in order to differentiate between the GM automobile divisions (Powers and Steward 2010). Ford's most famous quote "*my customers can have any colour they want as long as it is black*" was not applicable anymore for the expanding car market and lost a lot of market share to GM. In 1923, Sloan became president of GM, took over Ford's market dominance and was the unchallenged market leader for the decades to come (Powers and Steward 2010, Rae and Binder 2013). Sloan's most famous quote "*a car for every purse and purpose*" (Maynard 1995, 23) summarizes his strategy: higher product differentiation for higher market share.

In the eras to come, the 'pre-war' (1930-1948), 'post-war' (1949-1970) and the 'modern era' (1970-present), the car industry further emerged globally. All brands kept introducing new variety into the market. American producers focused on technology and low unit costs, European producers focused on quality and durability and Toyota (Japan) became competitive by their innovative just-in-time and quality management system or the so-called Toyota Production System (Ashamalla, Camp, and Abel 2011, Ohno 1988, Rae and Binder 2013).

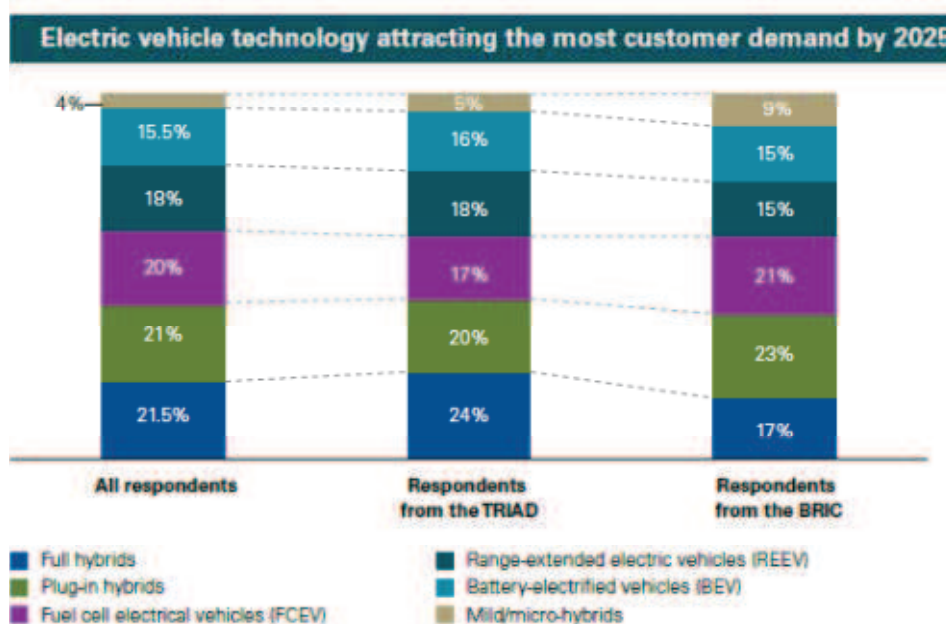
There is a very extensive body of literature regarding the history of the automobile industry (Eckerman 2001, Shimokawa 1994, Johnson 2005) and related aspects and topics. The history has been reviewed and discussed briefly with keeping relevance to the subject of this thesis. Therefore, there are three milestones in history we would like to summarize. First of all is the initiation of industrialization by Karl Benz in 1888. Secondly, there was the mass production and assembly line by Henry Ford in 1913, of which many concepts are still used in the car industry today. Third of all, related to this thesis, the repositioning strategy by Alfred Sloan in 1921 was the beginning of product differentiation and market segmentation. This multi-product strategy and portfolio management laid the foundation for the concept of product variety in the automotive industry which we know today.

3.2.3 Present and future

Having a look at some global automotive survey and outlook reports from IMAP (2010), Ralf Kalmbach et al. (2011), KPMG (2013) and Power (2011), we notice some interesting trends, facts and evolutions about today's automotive industry. First of all, despite the financial crisis in 2008, the industry knew two consecutive years of sales records in 2010 and 2011. This was mainly possible due to overall growth in world economy and the fast growing BRIC-countries (Brazil, Russia, India and China) which took more than 50% of the overall sales growth for their account. In the other markets, the U.S. recovered from the drop in sales in 2007-2008 while Europe remained flat and is expected to remain flat and even slightly decrease. The BRIC-countries will further expand their markets and there will be a shift in dominance from the U.S. market to the Asia-Pacific market both in sales and production.

A second important factor for the future of the industry will be technology. IMAP (2010) and KPMG (2013) both report that, in the future, the main focus will lie on hybrid vehicles and that this market segment is expected to experience strong growth in the years to come. However, according to the report of KPMG (2013), it is not clear which electric technology is going to satisfy the customer demand most by 2025. Different preferences can be found on a more regional level e.g. in China, they expect battery-powered vehicles to come out on top whereas other BRIC-countries more believe fuel cell-powered vehicles will attract most customer demand. However in general we can say that there is no specific technology which will attract most customer demand, all technologies or more or less on a same level.

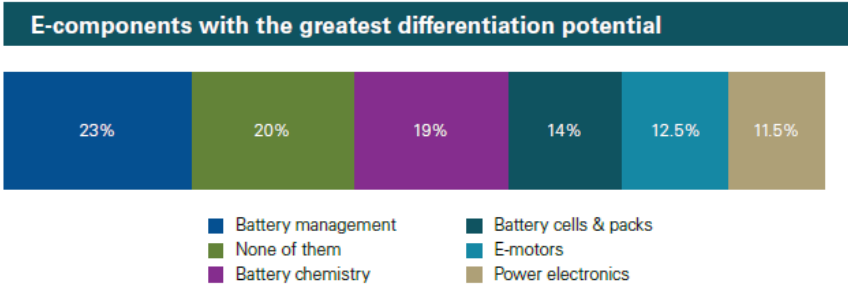
Figure 2: Attraction of customer demand by electric vehicle technology



Source: KPMG (2013)

Related to product variety, it is more interesting to see that the respondents of KPMG’s survey don’t see any potential in any of these hybrid technologies for product differentiation. Because they are not ought to give any competitive advantage, manufacturers are given the possibility to develop them in joint ventures and share R&D expenditure KPMG (2013). In the figure below the distribution of differentiation potential for the different components used in different hybrid technologies are displayed.

Figure 3: Differentiation potential of e-components



Source: KPMG (2013)

Although the car industry seems mature and saturated, there are still enough opportunities for growth and further development. Ralf Kalmbach et al. (2011, 3) even say that “over the next 15 years, the automotive sector will remain one of the most exciting places to be”. The reasons for that are five so-called ‘megatrends’: geopolitical change, demographics change, changing technology, sustainability and the evolution of mobility.

The first of these five trends is the geopolitical change where Asia will continue to grow stronger, production and sales will shift to the Asian markets and, as a result, 300.000 jobs in Europe will be at risk. The second trend is the demographic change which means that the world population is expanding; people are getting older and more and more are living in urban areas. The third trend is changing technology. Car manufacturers will be offering a wider range of different engine and drivetrain technologies because there will be a change in the consumer’s mobility behaviour. This also comes out of the results from KPMG (2013) where the most important trends in the market are expected to be battery and fuel cell electric mobility and innovative urban vehicle design concepts. By 2025, electric vehicles will account for 10% of car sales and hybrid vehicles for 40% (Ralf Kalmbach et al. 2011).

As a fourth trend, Ralf Kalmbach et al. (2011) say that environmental awareness is on the rise in the global society. This means manufacturers are forced to look for fuel consumption and technologies reducing emissions. Also in the production processes and the entire supply chain, the industry will have to learn how to work with closed loops and recycling. The fifth and last trend is the evolution of mobility. Small and low cost cars will gain more and more

importance and will meet the demand for basic transportation. Younger people in urban areas might lose their interest in cars and only see it as a mean of transportation. They no longer have emotional ties with cars or see it as a status symbol.

Besides these five mega-trends, there are also other interesting changes worth mentioning. Ralf Kalmbach et al. (2011) say that new business models will rise in the industry and successful organizations will undergo structural changes and open up to partnerships. They conclude their report with a strong quote which goes as following:

“Over the coming 15 years, the automotive industry will undergo the greatest transformation it has experienced in its history.”

3.2.4 Market situation analysis

In the introduction we already pointed out the importance of the automotive industry. To better understand the industry and the market in which it is operating, we will give a brief discussion of its market form and its characteristics. We will first look into some microeconomic theory where different market forms are described and then link it to the topic. In order to keep relevance, only the market form related to this industry will be discussed.

The most well-known market forms in microeconomic theory are without doubt perfect competition and the monopoly situation. Perfect competition requires a high amount of consumers and producers, a given market price, homogeneous products, no entry barriers etc. Monopoly on the other hand, is the market situation with only one or few players in the market; the market price is set by the monopolist and there are significant barriers to enter the industry. It is clear that the automobile manufacturing industry does not fit any of these two market forms. Therefore, a closer look at forms of imperfect competition such as monopolistic competition and oligopoly is necessary (Wonnacott and Wonnacott 1986).

In many micro-economic theory literature such as Wonnacott and Wonnacott (1986) and Glahe and Lee (1989), the car industry is given as an example for the oligopoly market situation. Oligopoly can be defined as a market form dominated by a few large players which means that these companies each have a considerable market share and they determine the prices for the rest of the market. If we look at the auto industry, it is indeed mainly dominated by big players such as Ford, GM, Chrysler, and Toyota but there are also smaller players like for example Rolls-Royce, Bentley, and Bugatti. The reason that these smaller companies can exist in this market is because they fill certain segments which are not profitable or too small for the larger companies. Car manufacturers like Rolls-Royce and Bugatti focus on high luxury limousines and extreme sport cars. These niches only represent a small percentage of the total market and are not seen as a threat or competition for the big players.

An oligopoly is characterized by two unique features, namely mutual interdependence and repeated interaction. Mutual interdependence means that the big players in the oligopolistic market are dependent on each other and that one's actions immediately affect the other. If for example GM would decrease its selling price or launch a special promotion campaign for its product line, this would immediately affect Ford and Chrysler because all three have a significant market share. This means that GM's action can lead to an increase of its own market share, but Ford on the other hand will directly lose market share and will also lower its prices or take some other action to regain the market share it lost.

The second feature of this market form is the repeated interaction where the big players on the market anticipate each other's moves. Companies like Pepsi and Coca-Cola or in this case, GM, Ford and Chrysler are already competing against each other for almost 100 years. This means that these companies already have some experience with each other and can anticipate quite well how the other will react when one company changes its strategy or lowers its prices. Moreover, in oligopoly, companies will never compete on prices but look for other ways to gain market share. This is mainly found in terms of advertising but there are also other ways like hiring larger sales staff or innovation through larger budgets for research and development (Wonnacott and Wonnacott 1986).

Plenty of these examples can be found in the auto industry. Commercials on television and billboards in traffic promoting cars are omnipresent. Car manufacturers also have always a competition of bringing newer models on the market with the latest and most modern electronic components or fuel saving technology. When it comes to R&D, every manufacturer tries to come with a new futuristic prototype to every car exposition around the world to show their latest technologies and innovations.

According to Glahe and Lee (1989), oligopolies can be divided into pure oligopolies which produce homogeneous products and differentiated oligopolies which produce differentiated products. Examples are copper, steel and aluminium production for the pure oligopolies and automobiles and electrical appliances are examples for differentiated oligopolies. It is obvious that e.g. a car from Rolls-Royce and Toyota are differentiated and not homogeneous products.

A final characteristic for this market are the high entry barriers. It was mentioned earlier that players in an oligopolistic market will compete on other factors than prices. This non-price competition often creates barriers to deter entry for new player who want to enter the market. For example, Ford and GM spend huge amounts on advertising and, because their brand is already established on the market for many years, they profit from brand recognition and

the associations like quality, safety and economy with this brand. In addition, there are also other entry barriers which are not related to the non-price competition aspect. First of all, there is the huge amount of investment in fixed assets like production plants and machinery. Second, there is the large-scale production which is needed to cover these investments and to achieve scale economies. Furthermore, brands like Ford and GM already have their distribution networks set up and numerous dealerships to sell and promote their cars. In addition to this, these big players have long-term contracts and very good relationships with their suppliers which both gain from each other's success. The last mentioned aspect is not a real entry barrier, but it is an aspect which gives the already established companies a significant competitive advantage (Wonnacott and Wonnacott 1986).

Lancaster (1990) states that product variety in a market economy can only persist if at least one of the following criteria is fulfilled; each consumer seeks variety in his own consumption, consumers have a need for variety because of different tastes, firms can increase profits by producing a variety of models or firms can increase profits by differentiating from their competitors. In the differentiated oligopoly, the individual firms can only increase market share and profit by producing a variety of models and by differentiating their products from those of their competitors. This is why the concept of product variety is so important in the automotive industry. We will discuss the literature about product variety in the automotive industry later on in section 3.3 'Product variety in the automotive industry'.

3.2.5 Buyer-supplier relationships in the European automotive industry

In the case study in chapter 5 of this thesis, product variety will be approached from both a consumer's and supplier's perspective. Therefore we will review some literature regarding buyer-supplier relationships in the European automotive industry; in particular, we look at examples from the U.K., Spanish and Italian industry. Many authors like Dyer (1996), Aláez-Aller and Longás-García (2010), Zirpoli and Caputo (2002) and Turnbull, Oliver, and Wilkinson (1992) confirm that Japan always has been a role model and leading example when it comes to supplier relationships and manufacturing performance with long-term supplier relationships or partnerships and sole-sourcing strategies. The US and European industry were always lagging behind and both these industries tried to adopt or implement Japanese manufacturing techniques like just-in-time and total quality control (Turnbull, Oliver, and Wilkinson 1992). However, according to Fujimoto (2001) western manufacturers fail to reduce the performance gap because they have a fundamental misunderstanding of the Japanese practices and therefore do not manage to implement them correctly and successfully.

Turnbull, Oliver, and Wilkinson (1992) documented that in the U.K. motor industry, buyer-supplier relationships are very important as more than 50% of a vehicle's components are purchased from a supplier instead of being produced in-house. In the Japanese automotive industry, this is even up to 70-75%. This means that buyer-supplier relations can have a high impact on the efficiency and competitiveness of car manufacturers. The traditional supplier model in the U.K. industry was based on high volume production with low product variety. Competition between the suppliers was high and price was the only criterion which was important for the manufacturer. There was no cooperation between the manufacturer and supplier relating product design and the information flow was limited.

The increasing oil prices and high quality low cost cars from Japan (Toyota, Nissan, and Honda) caused some major changes and shifts in the automotive supply industry. Because competition was higher and raw materials and energy costs were increasing, car manufacturers started to stress their suppliers by demanding lower prices and using multi-sourcing strategies. This resulted in lower volumes produced by the suppliers, less scale economies and eventually many suppliers faced bankruptcy. As a consequence of the manufacturer's dominance over their suppliers, competitiveness did not improve and supply chain performance in terms of delivery, quality and competitive prices deteriorated. The industry knew a turning point when it started to implement the Japanese model with just-in-time supply and long term collaborative contracts. In other words, relationships became partnerships, cooperation regarding scheduling processes increased and suppliers got involved in product design and research and development (Turnbull, Oliver, and Wilkinson 1992).

Perez and Sanchez (2001) studied the supplier relations in the Spanish automotive industry and confirm the traditional model of the U.K. automotive industry and its radical changes in the 1980's towards lean production and just-in-time delivery. Because of these changes, the percentage of deliveries from the suppliers to the car manufacturer's final assembly line is high and inventory and delivery costs are pushed to the supplier's side. As a response to this, many suppliers re-locate closer or next to the assembly plants of the manufacturers. Some suppliers even had storage facilities by the assembly line of their customers.

Perez and Sanchez (2001) also discuss that there are differences between the buyer-supplier relationships as some components require more collaboration in production and design or asset specific investments than other depending on the complexity of the component. Strategic partnerships can therefore be classified in four different groups varying from very low to high intensity of the partnership. In the first group of very low intensity, suppliers are selected by price, quality and delivery and there is little or no involvement in design or other cooperating activities. Car manufacturers have alternative suppliers available and product

complexity is low. On the other side of the spectrum, the strategic partnership can be high which means that products are designed jointly by the supplier and customer. In these situations, investment in research and development is high, deliveries are just-in-time and the customer does not have any alternative suppliers in the market. There is a high integration of communication technology and information flow by using intranet and EDI. Asset specific investments are made and components are often complex (Perez and Sanchez 2001).

Aláez-Aller and Longás-García (2010) also studied the Spanish automotive industry but more focused their research on buyer-supplier relationships at supplier plant level. They say that significant cost savings can be made and that supply strategies evolve at this level. One of their findings was that when comparing the same plants in two periods, the supplier evolved from a single sourcing strategy in 1996 to a dynamic multi sourcing strategy in 2003 to improve the process of reducing costs. Remarkably, car manufacturers changed from multiple sourcing strategies to more sole-sourcing strategies and setting up strategic partnerships while first-tier suppliers tend to do the opposite with the second-tier suppliers (Aláez-Aller and Longás-García 2010).

Three shifts in the industry forced car manufacturers to change their supply strategies. First of all there was increased complexity of components because of technological innovation. Second, automakers started to realize the presence of mutual dependence with their suppliers and how the traditional supply strategies had negative effects on competitiveness in the long run, something which was already mentioned by Turnbull, Oliver, and Wilkinson (1992). The third change was what we know as modularization, sub-assemblies either produced by suppliers or in-house which are then put into the final assembly line. The literature always sees the Japanese model as the best practice of how to organize buyer-supplier relationships. However, empirical evidence shows that car manufacturers often apply different supply strategies according to the type of supplier, specifications of the components and the conditions of production or market power between the buyer and the supplier (Aláez-Aller and Longás-García 2010).

There is a high amount of literature which describes the Japanese model as superior for buyer-suppliers relationship management. However, we mentioned earlier that many western manufacturers face a lot of difficulties and challenges to successfully implement this model (Fujimoto 2001). Zirpoli and Caputo (2002) argue that because of these difficulties, a complete and successful implementation is impossible due to sociologic and cultural factors and a superior model for buyer-supplier relationship management might not even exist. In this research, the authors focus on design activities and supplier involvement in the Italian automotive industry and look at the strategy and supplier relation management of Fiat Auto in

a case study. Zirpoli and Caputo (2002) conclude that Fiat's new organization for product development is different than the dominant Japanese model. First of all, Fiat outsourced a high amount of its activities, including component design to a selective group of suppliers. Second, they shifted their supply from component to module supply and outsourced the assembly of modules to their suppliers. Then Fiat globalized their supply base by engaging a purchasing joint venture with GM. This joint venture gives Fiat short term benefits in terms of scale economies in purchasing. In the medium and long term they want to further develop this joint venture by sharing major components and development of components and platforms.

3.3 Product variety in the automotive industry

In this section, the basic literature about product variety within the automotive industry will be discussed and the way product variety has been researched in this industry will be examined.

First of all, we recall the repositioning strategy by Alfred P. Sloan at the General Motors Corporation in 1921. Earlier in the literature review, we pointed out that this strategy was the beginning of product variety, differentiation and market segmentation in the car industry. This strategy and its implementation is reviewed by Powers and Steward (2010) in order to point out the brilliance of this strategy over several decades when GM achieved its greatest success. They also discuss that the company's deviation to their original strategy is responsible for GM's decline in the marketplace and their eventual bankruptcy in 2009.

The reason for this strategy to be implemented can be found in the structure of GM at that time. The General Motors Corporation was actually more a group of individual car manufacturers which were bought and merged by William Crapo Durant. As a result of this, many of GM's products and prices were overlapping. This means that these products were too similar to each other and were 'stealing' market share and revenue from one another, something which Ramdas (2003) refers to as product cannibalization. It was Sloan's intention to create distinct target markets and eliminate these overlapping (Powers and Steward 2010).

The repositioning strategy consisted of two objectives. First of all, GM had to produce car models in each car segment of the entire market range which were still able to be mass-produced. This means that one division (e.g. Chevrolet) would produce cars in the low price segment, another division (e.g. Cadillac) in the high price segment and all other segments in between so that GM is present in all target markets. Then the second objective was to not overlap prices between different car brands in order to avoid product cannibalization (Powers and Steward 2010).

In the years to come, GM was very successful and became the world's largest and most profitable corporation. However, as decades passed, GM started to deviate from the original strategy because of the economic downturn in the 1930s and World War II. Also component sharing between car brands and changing price levels over time due to a maturing market made the differences between the product lines of GM blurry again. By comparing relative price levels, Powers and Steward (2010) argue that GM was responding to the changing market situation and different divisions of GM were competing with each other for the same customers.

We think that the value of this review by Powers and Steward (2010) lays within the fact that it can learn us some valuable lessons for the rest of the industry. They compare one of GM's main competitors, Toyota, and their present strategy with the original strategy of Sloan in 1921. It appears that Toyota is using the same strategy today as Sloan in 1921 but made some modifications to the modern market situation. Toyota uses three divisions or car brands (Scion, Toyota and Lexus) where GM used five (Chevrolet, Pontiac, Saturn, Buick and Cadillac). Second, Toyota also has no or minimum overlap between divisions except for Scion and the Toyota Yaris as a market response to high fuel prices and the demand for fuel efficient cars. This strategy appeared to be successful for Toyota when they overtook GM as world's largest car manufacturer in 2008 (Powers and Steward 2010). Another valuable lesson for the industry is that the increased component sharing between divisions and the decreased distinction between car brands (and as a result of that, overlapping price levels), or what you also could call 'over-differentiation', are at the basis of GM's downfall in the market and bankruptcy in 2009.

Holweg (2008) discusses that product variety and Sloan's repositioning strategy is one of the important shifts in the evolution of the competition in the automobile industry. Today, the industry is marked by four trends i.e. regionalization, segmentation, saturation and overcapacity. Holweg (2008) speaks of an implosion of the traditional vehicle segments with many cross-overs between segments and niche vehicles. Product variety increased significantly over the last years because of two reasons. The first one is the appearance of new segments which are created by cross-over models. The second reason is that car model lines are expanding in traditional segments as well. This increase in product variety together with shorter product life cycles has some severe consequences on the economy of the industry. There is less volume sold of one particular model which reduces economies of scale.

Moreover, the shorter life cycles give the manufacturer less time to recover from substantial costs and investments in research and development. As a response to this, car manufacturers increase component and platform sharing and try to utilize this as much as possible.

However, this trend imposes a major threat to the future if we recall the history of GM and Sloan where differences between divisions became blurry because of overlapping price levels and component sharing which finally resulted GM's downturn and bankruptcy (Powers and Steward 2010, Holweg 2008).

Scavarda et al. (2009) conducted a product variety multi-market study and a benchmarking analysis between practical and theoretical findings of a research project of the European Commission. These findings point out that the product variety in the European automotive industry exceeds the appropriate level of variety. In this study, product variety is divided into 4 different categories.

The first category of variety is platforms. The number of platforms used by car manufacturers decreased over the last years but the number of car models sharing the same platform increased. The second product variety category is the model range. New models and a broader model range are used to enter new market segments and are part of a company's positioning strategy. In this category there appear to be some regional differences. Europe has a higher concentration in the mid-size segment, the USA is more concentrating on higher segment levels such as SUVs and South-America is more focused on the sub-compact segment. The third variety category is the variants of a car model. This means that one car model can have different body types (e.g. sedan, convertible, station wagon) or one model can have different variants with different engines or cylinder sizes. Finally, the last category is the factory-fitted options. This category consists of options which are installed at the factory like ABS, climate control and additional options which are installed at the dealer's location. However, the latter does not influence manufacturing operations.

The study concludes that the automotive industry has several challenges in order to cope with product variety. Product variety can be different between regions as these markets have other requirements and consumer preferences. Also there can be another focus on certain market segments between markets which increases product variety. Another important conclusion is that product variety can differ according to the perspective or definition of product variety in the auto industry. For example, according to the variant category, Europe has the highest level of product variety globally. However, from a platform perspective, the product variety is much more similar to the variety of other markets (Scavarda et al. 2009).

MacDuffie, Sethuraman, and Fischer (1996) researched product variety in the automotive industry from a manufacturing and operations management's perspective. They examined the effect of product variety on the manufacturing performance in terms of productivity and

product quality in the assembly line. One of the goals of their research was to look at the impact of increased product variety on manufacturing performance because an increased variety results in a more complex production scheduling. Together with other challenges along the assembly line, a higher product variety should have some negative effects on the manufacturing performance. However, the results of the research pointed out that these negative effects are limited or even non-existing. The authors state that the assembly line of car manufacturers can handle the increased variety because of new technology and lean manufacturing techniques. This would imply that there is a much lower trade-off point between costs and product variety and car manufacturers will have higher benefits from an increase in variety as long as there is enough demand in the market.

Finally, Swaminathan and Nitsch (2007) looked at the sequencing point in automotive assembly. We already mentioned this in 3.1 'Product variety' earlier in this thesis. The automotive industry has to deal with a higher product variety and has to respond quicker to changes in the market demand. MacDuffie, Sethuraman, and Fischer (1996) said that JIT-systems can handle the variety but this research shows that when the sequencing point is located at the supplier, there is minimum flexibility to quickly respond to changes but maximum degree of variety possible. On the other hand, if the sequencing point is at the final assembly line, there is high flexibility in the supply chain but it minimizes the variety.

3.4 Relationship between product variety and sales

Like already notified in the part about positive and negative effects and aspects of product variety, this chapter will focus on the influence that product variety might have on sales. The literature and previous studies related to this topic can be allocated to two different management disciplines, marketing and operations management (Wan, Evers, and Dresner 2012). The findings and results of the researches are as two-minded as the management disciplines the topic refers to. Two extremes are supported by these researchers. On the one side, the researchers are stating that there is no direct relationship between product variety and sales and that a high level of variety does not influence sales neither in a positive nor in a negative way. On the other side, researchers found evidence that sales is actually influenced by the amount of variety offered (Ton and Raman 2010, Wan, Evers, and Dresner 2012, Xia and Rajagopalan 2009, Lancaster 1990, Pil and Holweg 2004, Scavarda, Barbosa, and Hamacher 2005).

The line between product variety and sales can be drawn in a direct and in an indirect manner. The indirect approach considers the fact that an enhanced level of product variety is supposed to increase market share, profit and the quality perception (Fisher, Jain, and Macduffie 1995, Wan, Evers, and Dresner 2012, Scavarda et al. 2010, Ramdas 2003). Ramdas

(2003) for example related the decisions about creation and implementation of product variety to the long term profit of a company and the better and more careful these decisions are made, the better the overall outcome for the company. This overall outcome is influenced by revenues and costs. One of the factors impacting the revenue is the sales volume. In accordance to this interaction, it can be assumed that there is a relationship between product variety and sales depending on how anticipatory and strategic the decisions related to product variety are made. Therefore, product variety influences sales as well as the long term profit either in a positive or negative way.

The same can be deployed for the market share. In this case, it is possible to link the two aspects indirectly. In literature, it is stated that a broader product selection can raise a company's market share (Tang 2006, Wan, Evers, and Dresner 2012) and it can be assumed that a higher market share also leads to increasing sales. One argument mentioned in marketing literature that also supports the theory of more variety raising the number of sales is the expectation that more variety increases the probability that the customer finds what he or she is looking for and that it enables the company to satisfy a broader and more heterogeneous range of customers. Furthermore, it is supposed to attract especially the customers seeking for variety (Ton and Raman 2010, Wan, Evers, and Dresner 2012, Xia and Rajagopalan 2009).

Beside the positive aspect and like already stated and explained previously, increasing product variety and too much variety also can have a negative influence in general, but also on sales. Nevertheless, a negative impact is still an impact and would underline the assumption that these two features are correlated. The aspect of variety confusing the customer was already stated earlier as well as the effect of blurring design and missing distinctions between the different options. These three features of variety are expected to have a direct negative impact on sales and due to that support the assumptions about the presence of the tie among the two elements (Powers and Steward 2010, Ton and Raman 2010, Wan, Evers, and Dresner 2012).

Ton and Raman (2010) on the other hand explain from an operations management perspective how product variety hampers operations in a store and how this hampered operations indirectly influence and impact sales. The requirements of in-store logistics increase with rising variety levels and so does the probability of human failure. It is more likely that so called phantom products appear. Phantom products are products which are present in areas of the store which are not accessible by the customers (Ton and Raman 2010) and due to that elusiveness undermine sales.

In contrast to the possible connections between product variety and sales stated in previous parts and to their original expectations, Pil and Holweg (2004) as well as Scavarda, Barbosa, and Hamacher (2005) did not find any evidence for a relationship between product variety and sales in their research. While Pil and Holweg (2004) examined the European automotive market Scavarda, Barbosa, and Hamacher (2005) concentrated on the Brazilian market. Both calculated the correlation between the total number of variations of certain car models offered to the customer and sales per unit for these models in the respective market. Scavarda, Barbosa, and Hamacher (2005) in addition also measured the correlation for GM, Ford, VW and Fiat separately. Neither in the Brazilian (0.43) nor in the European market (-0.23) a correlation between the total variety offered and the sales volume was found. Same results are valid for the different car brands. They range from -0.13 to 0.73. The only exception was Ford whose variations offered correlated with the company's sales in the Brazilian market with a coefficient of 0.94 (Scavarda, Barbosa, and Hamacher 2005, Pil and Holweg 2004).

4 Methodology

This chapter comprises the theory about research methods applied in this thesis. It includes the research design and the framework of the used analytical techniques and tools as well as all aspects related to the data classification. Furthermore, it will be shortly explained which criteria have been considered while deciding on the car brands for the analysis.

4.1 Research design

Three key decisions have to be made when starting a research. It needs to be decided on the research design, the method and the strategy. Even though research design and method seem to be the same, they are not. In order to clarify the difference between these two terms they will be shortly defined.

Research design on the one hand is the framework that needs to be provided for collecting and analyzing the data. The research design chosen gives an indication of the prioritization of certain dimensions within the research process (Bryman and Bell 2011, 40). The research method on the other hand is the technique that is applied for the data collection (Bryman and Bell 2011, 41).

The research strategy is stated to be the “general orientation to the conduct of business research (Bryman and Bell 2011, 26)”. The research strategy can either be quantitative or qualitative. While the quantitative research strategy focuses on the quantification of data in the working process and on testing the theory, the qualitative strategy emphasizes words. That means it is mainly based on the generation of theory and on the individual interpretation of circumstances (Bryman and Bell 2011, 26-27). This research includes characteristics of both strategies, whereby it is not possible to make a clear distinction and to state which strategy is more suitable for the purposes of this research. Elements of both strategies will be applied.

The options of choosing the appropriate research design form are broader than those for the strategy. Several different types of research design are introduced and explained in literature (Bryman and Bell 2011, 45 ff.). In this thesis the case study will be applied as research design. “The basic case study entails the detailed and intensive analysis of a single case (Bryman and Bell 2011, 59)” and it focuses “on a bounded situation or system, an entity with a purpose and functioning part (Bryman and Bell 2011, 60)”. The so called system which this paper will focus on is presented by the European passenger car market.

The European passenger car market as well as product variety are topics which can be characterized by a high level of complexity and always have to be analyzed in their current environment and situation. According to literature, a case study is able to fulfill these require-

ments on basis of its possibilities to analyze complex and present phenomena in detail and in their real-life context (Baxter and Jack 2008, Yin 2009, 18). This fact of fulfilling the requirements is one reason why the case study is the appropriate research design method for this paper.

Yin (2009, 4) stated that the case study is suitable if the research questions are formulated to explain current situations. This underlines the appropriateness of a case study for this research process due to the approaches to examine the current situation of product variety in the European passenger car market from the two different perspectives and to investigate the relationship between product variety and sales within the market.

Furthermore, this research design is supposed to cope with situations in which not only data points are of interest, but also other, not necessarily measurable, variables (i.e. customer perception) (Yin 2009, 18). Of course elements such as and sales volume of the European passenger car market can be measured, but other aspects related to the market and to product variety are not expressible with numbers. These arguments likewise emphasize the usage of this type of research design.

Besides the above cited arguments for using this research design, also two additional characteristics of a case study can be related to the purposes of this research. One of these characteristics is the fact that a case study relies on multiple sources of evidence (Yin 2009, 42). Secondly, in the course of a case study it is possible to use qualitative as well as quantitative data (Gillham 2010, 80). Both of the just mentioned characteristics will be deployed in the course of this research. Multiple sources will be applied and the used data will be of both kinds, qualitative and quantitative.

The research design needs to be further differentiated by the kind of the case study that will be taken as the basis for the research process. In literature, several variations of case studies are presented while different authors have developed different terms and definitions of case study types (Baxter and Jack 2008). Appropriate for this thesis is the so called explorative case study. The explorative case study is supposed to be used for the exploration of "situations in which the intervention being evaluated has no clear, single set of outcomes (Baxter and Jack 2008)." Yin (2009, 20) further explains that an explorative case study is supposed to enlighten this kind of situations.

4.2 Analysis: strategy, tools and levels

“Analysis is a matter of giving meaning to first impressions as well as to final compilations. Analysis essentially means taking something apart (Stake 1995, 71).” The analysis forms the second part of the methodology and covers the theory about what kind of analyzing techniques and tools will be used for the research process. First, the analyzing strategy based on the research design will be introduced and explained. The second part contains the tools which will be used for analyzing the situation, system and the data. A main element within these tools will be the SWOT analysis. In addition, simple statistics will be applied as analyzing tools. Subsequently, the two levels of analysis which are appropriate for this paper will be presented.

4.2.1 Analyzing strategy

The definition of a clear and purposeful analyzing strategy for this research basing upon the literature is not easy due to the fact that parts of both quantitative and qualitative strategies will be deployed. It will be necessary to combine and modify the strategies introduced in literature and to adjust them to the requirements of this thesis.

Stake (1995, 74) stated that for the qualitative approach the two analyzing strategies “direct interpretation” and “categorical aggregation” are appropriate. These strategies are similar to those introduced by Bryman and Bell (2011, 574), “analytic induction” and “grounded theory” whereby one partial result of the strategy “grounded theory” is a categorization structure which can be used for sorting the data in any kind or manner depending on the certain case (Bryman and Bell 2011, 578, Hartley 2004, 329). While the previous mentioned authors cite that categorization is a strategic element which can be applied for analyzing qualitative data, Gillham (2010, 85) suggests that it also can be used for quantitative data.

In this thesis, the strategy of categorization will play a key role and will not be handled as a part of the grounded theory. Based on the explanation of Hartley (2004, 329) that “the data maybe organized around certain topics, key themes or central questions”, the approach of categorization will be used for more than one occasion. In the course of this paper, the categories will be called perspectives and these perspectives will form the basis for the analyses which will be executed with the help of the analyzing tools described in the next part. In addition to the categorization, also the strategy of direct interpretation will be applied. This strategy will be used for the qualitative part of the data and the tool for the execution of this strategy will be the SWOT analysis.

4.2.2 *Analyzing tools*

The choice of the appropriate analyzing tool is highly dependent on the kind of data that is supposed to be analyzed. Tools for qualitative data often differ from tools for quantitative data. In this case, the SWOT analysis will be applied in order to examine the automotive industry and especially the European automotive industry to get a better overview of the abilities of this industry and to clarify the picture of the European passenger car market. The theoretical background for a SWOT analysis will be presented in the following and, subsequently, the remaining tools will be shortly introduced.

SWOT analysis

SWOT analysis is first described by Learned et al. (1965) but Helms and Nixon (2010) discuss that the origin of the term 'SWOT' is unknown and that several other references in the literature credit different authors for the SWOT concept. For more information about the history of SWOT, we refer to Helms and Nixon (2010) and their suggested literature.

The objective of a SWOT analysis is to identify strengths and weaknesses of an organization together with threats and opportunities in its environment. Strength and weaknesses are internal aspects such as personnel, facilities, location and production. On the other hand, threats and opportunities are more seen as external factors such as political, economic, social, technological and competitive environment (Dyson 2004). A SWOT analysis is used by many practitioners and researchers in the field of marketing and strategic management. It is a very simple tool which can quickly give an overview of an organization's situation from different points of view. The analysis can be the starting point for strategic planning and it facilitates complex decision making problems (Helms and Nixon 2010). Referring to multiple authors in the literature, Dyson (2004) and Helms and Nixon (2010) confirm that the SWOT tool is well-established and respected in strategic planning.

Helms and Nixon (2010) reviewed the SWOT analysis by analyzing all literature from the ABIInform Global database which had SWOT as a key index and search word. They found out that SWOT analysis is applied to organizations but it is extended to individuals, countries and industries. However, the authors state that, as a result of the popularity of SWOT, the framework became vague, oversimplified and limited. One of these limitations is that the SWOT analysis does not give a context for strategy optimization. This means that the result of the analysis does not give any strategy to implement but just gives a simplification of a complex business situation. Despite the downsides and limitations, most analysts still prefer the SWOT analysis as a start for the strategy planning process. One of the reasons for the weaknesses of the SWOT analysis is that it only gives an overview of one moment in time

while most business environments are constantly changing (Helms and Nixon 2010). For the case study in our thesis, it is the intention to give a snapshot or overview of the current industry so therefore the SWOT analysis is sufficient.

Method for car brands segmentation

The selection of the car brands which will be used for the analyses in chapter 5 will be based on the brands included in the European car market statistics (2001-2011). This is done in order to ensure the availability of data for the selected brands. Due to this availability all brands with incomplete data need to be excluded right from the beginning. This means that some information is left out for these brands and/or not recorded for the whole time period of 2001-2011.

The remaining brands which fulfill the requirement of complete data will then be sorted by the average price in 2011. Based on this result, they will be sorted into the four segments premium, middle class, economy, and low price segment. This segmentation is considered due to the expectation that the levels of variety and developments over time are different between the different price segments of passenger cars. It is for example assumed that the variety in the low price segment is on a lower level, because the production process in the lower price segment needs to benefit more from economies of scale in order to be cost-covering than cars which are more expensive.

It is necessary to use this new kind of segmentation because the existing segmentation of cars is mainly based on the size or the kind of a car model (series) and does not include the complete brand. For example, car rental companies divide their cars by size, number of doors and technical aspects. This kind of deviation is for the purposes on a too detailed level and not executable and manageable on basis of the available data.

In the end of the segmentation process, the market share of the brands in each segment will be cumulated. This is necessary in order to see if the selected brands represent a large share of the market and for the evaluation of the analyses, the result of a segment with a higher market share also needs to be weighted higher.

Simple statistics

Yin (2009, 144) introduces time series analysis as a possible analyzing technique and differentiates between simple and complex time series. In this thesis, the basic idea and design of a simple time series analysis will be used as an analyzing tool. Quantitative data series will be examined and compared over time and displayed in timeline graphs. This tool enables

among others the comparison of the development of a certain factor, characteristic or data within a certain category over time and between different car brands.

Gillham (2010, 80) divides statistics into two kinds, descriptive and inferential statistics, and argues that both of them can be used for analyzing quantitative data within a case study. The choice depends on the desired outcome. Descriptive statistics offer the possibility of summarizing quantitative data, like for example by displaying averages, totals or ranges of a certain dataset. Inferential statistics on the other hand enable to draw conclusions about correlations, evolutions or trends within the dataset and to compare different datasets based on these conclusions. Both statistics will be deployed in this research.

Due to the appearance of the available data and the structure of the datasets, it is not possible to apply more advanced analyzing techniques or tools. The number of observations and amount of data is not sufficient for running regression analysis or to use the demand function for any of the three parts concerning the analysis of product variety in the European automotive industry. Furthermore, the data concerning the third part of quantitative analysis does not enable analyses comprising the factor time. The data will be described in part 1.3.1 and this description will clarify why only the described simple statistics can be used for the analyses in this paper.

4.2.3 Level of analysis

In literature, four different types of possible level of analysis are presented which are individuals, groups, organizations and societies (Bryman and Bell 2011, 67). In this thesis two different levels of analysis will be applied. For the first described analyzing tool, the SWOT analysis, the automotive industry or the market respectively will be used as the basis for the analysis. This level suits best into the category “societies” due to the description of the category given by Bryman and Bell (2011, 67) that this analysis considers aspects such as politics, environment and economy.

The three remaining parts of the case study will be analyzed by using simple statistics and the appropriate level of analysis is the brand level. This means the different car brands are the basis for the executed analyses. The brands can be related to the category “groups” which considers research based on certain types of grouping (Bryman and Bell 2011, 67)

This section explained how the data will be analyzed and which strategies, methods, tools and levels of analysis are the most appropriate ones for this process. Subsequently, it will be described in detail what kind of data will be examined. Furthermore the data sources will be shortly presented and some general characteristics of the data will be given.

4.3 Data

In general, the data is divided into two categories, namely primary and secondary data. Primary data is gathered and compiled by the authors themselves, they are actively involved while secondary data already exists before the actual study starts and the authors were not in the collection process. Beside this distinction into primary and secondary data which is valid for quantitative and qualitative data, the data can be further differentiated by its source. The data source can either be external or internal (Bryman and Bell 2011). Within this thesis mainly external secondary data will be used. More information about the data and the sources will be given in the following parts.

4.3.1 *Collection, description and sources*

The first part of the data is mainly qualitative data and is designated to the SWOT analysis. The necessary information can be found in outlooks and reports about the automotive industry and are provided by several different institutions and companies. The most important documents and sources will be briefly introduced in the following.

- European Competitiveness Report 2004: This report gives a comprehensive overview of the impact of governmental decisions on different areas. In addition, an analysis of the competitiveness, challenges and future strategies of the European automotive industry is given. It is published and provided by the European Commission.
- Trends and drivers of change in the European automotive industry: Mapping report 2004: This report published by the European Monitoring Center of Change (EMCC) presents strengths, weaknesses, drivers of change and trends in the European automotive industry.
- Automotive and Components Global Report 2010: This report considers different topics of the industry but focuses mainly on the aspects related to mergers and acquisition due to the business field the publishing company, IMAP, is situated in.

Further data is provided amongst others by the European automobile manufacturers' association (ACEA) and the American auto council (AAPC).

Collecting quantitative data about the automotive industry and single brands within the industry appeared more difficult than expected. The brands within the industry do not use the same reporting system and it was often not possible to find the same information for several brands. Furthermore, the data and information were often consolidated on a group level and not available for each brand separately. In addition, the information was mainly given on a global basis and not for single markets or regions. Besides the missing information, it was not manageable to count the car models manually on the desired level due to differ-

ences in model presentation by the company and ambiguity about the definition of a model and its level of detail. Especially for the previous, the sources for model counting were rare or not existing. In theory it would be possible to collect this data if one would contact all the car manufacturers to get internal company information, however this was not possible in the setting of this thesis in terms of time and resources. Due to these difficulties it was decided to use car model series as the basis for variety in the automotive industry.

Three different datasets will be used for the analyses in this thesis. These datasets are listed and described in the following.

Teotalida car database

Teotalida is an independent business offering several services such as designing and architecture services and also provides customized data about the automotive industry. The car database provides a comprehensive overview of the global development of car model series for all important brands. It is based on the German magazine “Autokatalog (Car Catalogue)” which is published once a year by Motor Presse Stuttgart. The characteristics of the overview are mentioned in the following:

- sorted by region and brand in alphabetical order,
- gives information about when a certain brand introduced a new series (model),
- provides knowledge about how long this series was available in the market (not including second hand market),
- states to which segment each series belongs,
- the expirations regarding the models shortly after World War II, the confusion within the data for the North American market regarding model, production and launching years and the fact that for the Japanese brands only the models offered in Europe are displayed do not impact the purposes the data will be used for in this paper (Teotalida 2013).

European vehicle market statistics

The European vehicle market statistics is published by the International Council on Clean Transportation (ICCT). The ICCT is a nonprofit organization which does research and analyses in the field of environmental regulators (ICCT 2013). The ICCT publishes the European vehicle market statistics already for a couple of years. The latest release published in 2012 will be used for the analyses in this paper. The statistics is structured as described in the following and provides the listed information:

- market data about passenger cars and light vehicles in the European market in the period from 2001 to 2011,
- measurements for the biggest countries within the EU27 according to the number of car sales/registrations as well as for the car brands based on their market share in the market of the EU27 countries,
- data related to issues such as sales/ registrations, car configurations, different kinds of emissions, and fuel consumption for the mentioned countries and brands on average,
- not all measures are complete for all brands and not all brands are present in each year (ICCT 2012).

European supplier database

The European supplier database is provided by IHS SupplierBusiness. IHS SupplierBusiness is a practice within IHS Automotive which itself is a part of IHS. IHS is a company located in the US collecting, providing and selling information about market and economic developments, structures and situations to its customers. IHS SupplierBusiness deals with information about the global automotive supplier base (IHS 2013b, a). More information about the database is given in the following overview:

- the dataset contains information about which suppliers deliver which components to which car manufacturers in the European automotive industry,
- the file consists of over 98,000 rows of data,
- in total 48 brands with cars launched between 1989 and 2013 are considered,
- information provided within one row are the component, the related component group and area, the supplied car manufacturer as well as the car model and the launching year just to mention the most important,
- the data is not complete for all of the brands and also not for all models.

All these datasets have in common that they need to meet certain criteria. The most important criteria that these data should fulfill in order to be suitable for research purposes will be introduced and explained in the subsequent and last part of this chapter.

4.3.2 Reliability and validity

Reliability and validity of data is important in the same manner for quantitative as it is for qualitative research, even though it is sometimes just stated in coherence with quantitative research. Both research strategies require the reassurance of a certain quality level of data in order to get reliable and consistent results (Bryman and Bell 2011, 394). Furthermore reli-

ability and validity are supposed to judge about the objectivity and credibility of the research (Peräkylä 2004, 283).

Validity

Bryman and Bell (2011, 159) state that “validity refers to the issue of whether or not an indicator (or set of indicators) that is devised to gauge the concept really measures that concept.” In literature, validity is divided into the three sub-groups, internal, construct, and external validity (Gibbert, Ruigrok, and Wicki 2008, Yin 2009).

Internal validity concerns the causal relationship between variables and the solidity of the relationship. It needs to be assured that the research conclusion regarding this relationship is powerful and compelling. Construct validity is also called measurement validity and deals with the quality of the measurements executed. The validity refers to the degree to which the measures are able to accurately observe reality and whether the “study investigates what it claims to investigate (Gibbert, Ruigrok, and Wicki 2008)”. The third sub-group, external validity, relates to the aspect if it is possible to generalize the results of a certain research study and if the results can be applied for explaining for example similar markets, behaviors or developments (Bryman and Bell 2011, 42-43, Gibbert, Ruigrok, and Wicki 2008).

Reliability

Reliability refers to the circumstance that if the research would be conducted in exactly the same way it would give the same result. This is especially a concern for the data collection process. It needs to be clear and transparent where the data comes from and which steps were taken to get the data, respectively (Gibbert, Ruigrok, and Wicki 2008, Yin 2009).

5 Results: Product variety in the European passenger car market

In this case study we will perform the different analyses and answer the research questions presented in chapter 2 earlier in this thesis. First, research question 1 will be answered by executing a SWOT analysis of the automotive industry. Then we present our own adjusted definition of product variety based on theory which we discussed in the literature review. After this, we explain how we segmented the market to facilitate the analyses. This is important because the definition as well as the segmentation will be applied for three of the four parts of the case study.

The first of these three parts considers product variety in the European automotive industry from a consumer's perspective and is supposed to answer research question 2. Afterwards we look at product variety from a supplier's perspective with supplier data and answer research question 3. The last part will then examine the interaction of product variety and sales according to research question 4. The case study will be finalized by a summary of all findings and results which will be discussed in the following chapter.

5.1 SWOT analysis: Automotive industry

The SWOT analysis consists of two parts. For each of the factors strengths, weaknesses, opportunities and threats, we briefly discuss the car industry on a global level and then we specify it down to the European automotive industry as this is the focal level of analysis in this case study.

Strengths: One of the main strengths of the automotive industry is that it is already over 100 years old and thus a long-lasting industry. More particular, this means that the industry has a rich history and knowledge base and that the biggest players like Ford, GM, and Toyota are very well established companies already for several decades. Because of this establishment, the industry was able to gather capital over the years to invest in research and development which enabled them to use cutting-edge technology in their products and in their manufacturing processes. This resulted in a high product variety and scale economies achieved by mass production (ACEA 2012, AAPC 2012).

One of the main strengths of the European automotive industry is its home market. It is the largest single market for passenger cars and the second largest for commercial vehicles. Next to that, consumers are very demanding and loyal which pushes the industry for innovation and their feedback has positive effects on product quality. Expenditures in research and development are very high and as a result of this, the European car industry has a strong lead for innovation, well-engineered products and future automotive technologies (EuropeanCommision 2004, EMCC 2004).

Furthermore, European car brands like BMW, Mercedes and Audi are global leader in the premium and high performance car segments which are highly profitable. Two additional strengths from the European industry are the presence of a modular value chain and qualified labour. This value chain enables flexibility and risk sharing because of system standardization and quality control. A qualified labour force in a labour intensive industry is necessary to produce highly complex quality products and requires a lot of know-how and flexibility. As a part of the value chain, Europe also has its infrastructure and road transportation as a strong component for all industries, thus also the automotive industry. Another strength is that the European automotive industry is present in all world markets and with strong presence in all the emerging markets like the BRIC-countries. For example, in China, the automotive industry is expected to become the largest and most powerful industry in the next two decades. All European car manufacturers, such as the Volkswagen Group already established different assembly and production plants there. Finally, the industry in Europe can rely on a strong and independent supply base which forms the foundation of the industry (European Commission 2004, EMCC 2004).

Weaknesses: The main weakness of the auto industry is its financial strength. Especially due to the financial crisis in 2007-2008, the car industry suffered and lost huge amounts of capital. Even two out of three of the biggest players in the industry applied for bankruptcy but got support from the American government. Five years later, many car manufacturers are still in the recovering process and try to overcome it by a lot of restructuring and cost-cutting. This mainly takes place at the cost of the personnel which also affects the personnel and the operations of the suppliers. As one result of the cost-cutting, thousands and thousands of people have lost their jobs in the car industry. This is not well accepted by the unions and in the society in general and as a consequence these car manufacturers faced a huge loss of brand image and negative bad reputation (Bailey et al. 2012).

The highly qualified personnel in Europe is seen as a strength but it also knows a downside. Labour costs are high and the labour market is strictly regulated which results in low flexibility. Other production locations in the world are training and educating their work forces which makes that Europe is losing its competitive position. When it comes to productivity, the European industry is still lagging behind the US and Japanese market. Despite its technological advantages, Europe was never leading in areas such as new manufacturing methods and lean manufacturing compared to e.g. Japan. Although the European automotive market is said to be strong, growth in this market is almost zero for several years especially compared to markets such as Asia and South America which are emerging. Also compared to the US market, the EU markets show less positive sales trends. One of the problems is also that

the European market is fragmented because of different taxation and regulations between the member states of the European Union. Another weakness of the industry is that there is a certain political influence on decisions regarding the value chain. For example, the European Union has many famous production sites which are difficult to give up for more modern and efficient facilities because of social anxiety and uproar (EuropeanCommision 2004, EMCC 2004).

Opportunities: Despite of the financial crisis, which affected many of the major car manufacturers, there are still some opportunities globally and also towards the future of the industry. First of all, markets in regions such as Asia (especially China, India, and Thailand), Latin-America, Eastern-Europe and other developing countries experienced consecutive growth for several years in a row. This means that the selling market is still not saturated and these regions also give opportunities for car manufacturing as the wages are still very low but knowledge and expertise are increasing. If we look at the future of the industry, car manufacturers expect significant growth in the segment of hybrid vehicles. This means there is a big opportunity in research and development to further improve/optimize the production and performance of hybrid cars (IMAP 2010).

The opportunities for the European automotive industry are similar to those of the global industry. European manufacturers have a strong position in the world markets and a strong presence in the emerging markets. They have the know-how in entering and servicing new markets which gives them a competitive advantage. Not only car manufacturers, but also its supply industry is attracted by the emerging markets like China. Europe also has other opportunities when it comes to know-how. In the future, they can export high value services like design, engineering and re-cycling expertise. They also have the potential in being a market leader in new vehicle and traffic management technologies. This may be driven by new cooperative ventures for innovation and economies of scale. Furthermore, the European automotive industry can create opportunities by more working closely together with the supply industry and the retail sector by developing a customer-oriented retail system linked to the upstream component supply (EuropeanCommision 2004, EMCC 2004).

Threats: The biggest threat of the auto industry today is that it is still highly dependent on fossil fuels to service their products. A vast majority of the cars produced are still driven by diesel or petrol engines which make them useless if the fuel would become unavailable or too expensive for the customers. Oil prices set several new records in the last years but it is very unclear if or how fast crude oil reserves or running empty. This threat can at the same time be seen as an opportunity to invest more in alternative engine technologies like bio-

fuels, electro-engines and hybrid technologies (Porter 2005, Campbell and Laherrère 1998, Rushton 2012).

One of the threats for automotive industry in Europe is that some companies are financially weakened and are losing market share. This makes them vulnerable for take-overs which could threaten the technology lead the European industry currently has. We already mentioned this as one of the weaknesses but also the regulation and political influence can both be seen as a weakness and a threat for the future because both factors affect the flexibility in the supply chain. Also innovation, which is seen as Europe's strength is threatened by severe competition from Japanese automotive manufacturers. Another threat can be found on a macroeconomic level. Economic growth in Europe is on a downturn at the moment which also affects the demand for automotive products. If this downturn would be prolonged, it could threaten the global competitiveness of the industry. As a result of lower demand in saturated markets and emerging markets rapidly increasing their capacity, over-capacity is being created worldwide which will stimulate price competition. This would be positive for consumers because they will get lower prices but European manufacturers are not well equipped for a price competition in segments like the middle class car segment. It also will be more difficult to recover the high labour and research and development costs (European Commission 2004, EMCC 2004).

A SWOT analysis for the global and European automotive industry could endlessly be elaborated but in the course of this paper we will not go further into detail. We pointed out and discussed the most important strengths, weaknesses, opportunities and threats and for a more detailed analysis we refer to the European competitiveness report from the European Commission (2004) and the mapping report of the trends and drivers of change in the European automotive industry of the EMCC or European Monitoring Centre on Change (2004).

Summary

In the table below we summarize the most important factors of the above executed SWOT analysis according to internal and external factors.

Table 1: Overview SWOT analysis automotive industry

Internal	External
Strengths	Opportunities
Strong, well-established brands	Emerging markets (Asia, East-Europe, Latin-America)
Use of cutting edge technology	Export of know-how and expertise in design and engineering
Large home market	Traffic management technologies
Global market leaders in high profitable segments	Closer cooperation between supply industry and retail sector
Strong presence in emerging markets (BRIC)	
Modular value chain	
High qualified labour	
Weaknesses	Threats
Financial strength	Dependence on fossil fuels
High labour cost	Oil price
Strictly regulated market	Vulnerable for take-overs
Productivity is lagging behind	Impact political influence on competitiveness
Flat sales trends	Other markets improved innovation
Different tax regulations in different countries	Low economic growth
Political influence	Overcapacity

5.2 Definition and perspectives of product variety in the automotive industry

In this segment the definition of product variety will be adjusted to the purposes of this paper. That means that the definition and specifications of product variety introduced in the literature review will build the main frame for this definition. This frame will be extended by the requirements of the later coming analyses. These requirements result from the special characteristics and features of the automotive industry and the passenger car market.

One of these special features of the automotive industry is the relatively high level of variety especially in the European market in accordance with a high level of customization. Often customers cannot only choose a model in addition they have several model variants and options, like for example color, engine size, and interior design, to decide about. Two other aspects are how the brands define their variety themselves and how they try to differentiate themselves from their competitors.

Like just stated there is no common rule which is applied by the manufacturers to define variety and furthermore several tiers of variety can be found in the industry. Tiers of variety mean in this case the depth and the level of detail used. Referring to the definition of variety stated in the literature that variety is the number of products or options of a product that a single company or brand offers to the customers and combining this definition with the tiers of variety several options and interpretations are possible. In this case the number of products or options is dependent on the certain tier of variety chosen. In the car industry that can either be the number of series, models or variations offered whereby the variations have the highest level of detail.

In this paper the number of car model series offered by each brand will be taken as the tier of variety. The other two options would be too detailed and partly not countable or measurable without internal company information. In order to avoid any misunderstanding of the term and the use of the expression car model series will be shortly explained. A car model series is also called vehicle line and consists of one car model which is offered in different variations of body work (Hüttenrauch and Baum 2008, 119). One example is the A4 line of Audi. This line is available as standard A4 Limousine, Avant, all-road Quattro, A4L (only in China), S4 Limousine, S4 Avant and RS4 Avant (VW 2012). A car model series can often be allocated to a certain segment like for example the Audi A4 to the segment of medium size cars.

After this short explanation of car model series the considerations regarding product variety in the automotive industry will be continued. For the analyses and purposes of this thesis the static variety will be used. That means according to the explanations given in the literature review that the frequency of introducing new or modified products to the market is not taken into consideration. The variety will simply be based on the static number of car model series per brand per year.

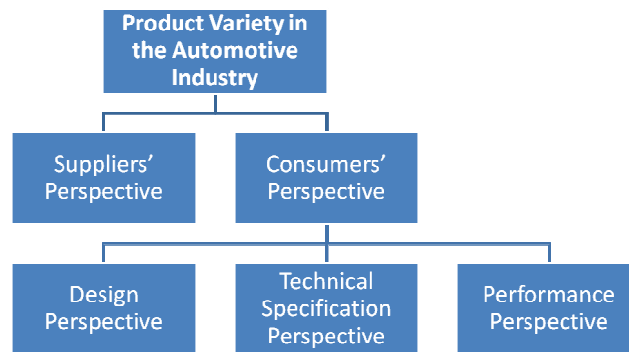
Following these just mentioned explanations static variety consists of two parts, internal and external variety. In this paper these two parts are represented by the suppliers' and the consumers' perspective. While the suppliers' perspective represents the internal view on variety the consumers' perspective embodies the variety that is perceivable, visible or experiential by the customers.

In this paper the consumers' perspective is further divided into three sub-categories which refer to the approach of Ramdas (2003) regarding dimensions of variety in the context of variety creation. There it was stated that variety can be based on the physical form of a product or the product function and that variety of products occurs due to different characteristics and appearances of certain product attributes. For the automotive industry these attributes will be grouped in this paper into three categories or more precisely in the following three perspectives which were already shortly mentioned and explained in the course of the presentation of the research questions:

- Design: comprises everything related to the outer appearance of a car, attributes which are recognizable without driving the car, for example size, shape, and color.
- Technical specifications: like already indicated by the term itself this perspective deals with all technical attributes and measures which are present in a modern passenger car. Components belonging to this perspective are for example engine type and gearing system.
- Performance: refers to attributes which are related to the actual performance of the car while it is running and includes factors like top speed, consumption and emission rates, and frequency of repair.

The compound of perspectives of product variety in the automotive industry which were explained in the segments above is graphically summarized and displayed in the following figure:

Figure 4: Product variety in the automotive industry



Source: own illustration

Based on this summarizing figure and the above mentioned facts, figures and characteristics of product variety in the automotive industry the following definition has been developed for this thesis:

The overall product variety in the automotive industry is the sum of the variety of the two perspectives of suppliers and consumers. The suppliers' perspective includes the variety resulting from the allocation of suppliers to brands and the share of common suppliers between the brands. The consumers' perspective on the other hand is based on the design, technical specification and performance perspective which comprise and group the variety of the different attributes and components of a car.

5.3 Car brand segmentation

In this part it will be shortly explained how the brands taken for the subsequently following analyses were chosen and which brands were assorted to which market segment. As described in the methodology, the brands were sorted by their average price in 2011 and divided into the four segments, premium, middle class, economy, and low price. These prices were taken from the European car market statistics. In total 21 brands are included in the statistics.

Chevrolet, Dacia, Suzuki, and Vauxhall had to be excluded right away due to incomplete data. The remaining 17 brands could be assorted to the four segments. The grouping of the single brands on basis of the price was quite obvious only two difficulties appeared. The first one was related to Volkswagen (VW) and the question into which group the brand should be put either the premium or the middle class segment. It was clear that this brand could not be left out of the analyses due to its position as market leader in Europe with a market share of 12%. It was decided to put VW into the middle class segment based on the gap in average price between VW and the average price of all brands in the two possible segments. In this

case the gap between VW and the middle class segment (4,462 €) was smaller compared with the one to the premium segment (13,643 €).

The second problem was related to the middle class segment. After assorting VW into this segment it included a total of five brands, VW, Nissan, Opel, Peugeot, and Ford, while all other segment consisted of four brands. Here the decision was made on basis of the market share. Nissan was excluded due to the lowest market share within the segment of 3%.

The following table gives an overview of the chosen brands including their average price in 2011 and market share of the same year. Also visible in the table is the cumulated market share of each segment which will be needed for the evaluation of the results of the analyses later on. The brands in the table account in total for 83% of the whole market.

Table 2: Car brand segmentation

	Car Brand	Average Price 2011	Market Share
Premium Segment (16 %)	Mercedes-Benz	41,923 €	4 %
	BMW	41,195 €	5 %
	Volvo	37,379 €	2 %
	Audi	36,899 €	5 %
Middle Class Segment (33 %)	VW	25,706 €	12 %
	Opel	21,361 €	6 %
	Peugeot	21,145 €	7 %
	Ford	21,061 €	8 %
Economy Segment (22 %)	Citroën	20,695 €	6 %
	Toyota	20,370 €	4 %
	Škoda	20,313 €	4 %
	Renault	20,041 €	8 %
Low Price Segment (12 %)	Seat	19,690 €	2 %
	Kia	18,900 €	2 %
	Hyundai	17,848 €	3 %
	Fiat	15,145 €	5 %

Source: own illustration based on ICCT (2012)

5.4 Product variety from the consumers' perspective

In this part the research questions related to the consumer's perspective of variety will be answered. This will be done by answering the sub-questions first in order to enable a final conclusion for question 2. The structure of the sub-questions is in accordance to the three perspectives of product variety, design, technical and performance perspective, which were defined in chapter 5.2. Furthermore, the segmentation of the car brands will be used as a guideline for the answering structure. The goal is to be able to make statements about the product variety in each perspective and each segment as well as for the consumers' perspective in general.

Before we can start with the analysis of the consumers' perspective, one assumption needs to be made. The data concerning the European car market statistics provided by the ICCT comprises information about what is being sold in Europe between 2001 and 2011. It does not display what has been offered by the car manufacturers. However, it is rather evident to assume that the sales on the market represent the products offered by the producers. We can make a very simple reasoning which says that a producer will not offer what he cannot or did not sell. If a car model would not get sold, or sales numbers are very bad, the producer will take that product off the market and will stop offering it. So the general trend is the same, if the variety sold and demanded decreases manufacturers would react and also reduce the variety offered. Only a small shift in time between the two trends might be possible. Furthermore, manufacturers rely on market trend reports and surveys. These reports and surveys may already indicate the change in consumer preferences and enable manufacturers to adapt to the changing situations earlier and to offer what is demanded.

In order to answer the main as well as the sub-questions, several variables are chosen from the European car market statistics to measure the development of product variety in each perspective. This approach of using variables for answering the questions refers to the assumption described in chapter 5.3 that the variety of a product occurs due to different characteristics and appearances of certain product attributes. That means that the variables are used as a synonym for the attributes.

Like described in the part concerning the data used, the statistics includes data for the years 2001 until 2011. In addition to the European car market statistics, the car model timeline in the period between 1991 and 2011 will be applied for the analyses. The variables used for the analyses will be introduced and explained in the following part.

5.4.1 *Variables consumers' perspective*

The first perspective considered for the analyses is the design perspective and according to the definition it refers to the appearance of the car. This means the elements which are visual without running the engine. The subsequent variables are chosen for answering the research question related to the design perspective.

- a. The first variable measures the number of car model series of each brand. Interesting for these analyses is if there is any evolution of product variety in the period from 2001 to 2011 regarding the number of car model series per brand and between the different car brands.
- b. The second variable concerns the dimensions of passenger cars. The analyses for this variable should explore the change of the car dimensions over time and detect probable developments in the variations between the car brands.

The second perspectives includes the technical specifications of a car and in order to compare the different brands and the development over time in this field of product variety the following variables are taken and examined more detailed.

- a. The engine types available on the market should be explored considering the development within the observation period and the differences between the car brands.
- b. Secondly, a look will be taken at the two factors engine size (cc) and engine power (kW). Interesting for the analyses in this case would be if there are changes over time and variations between the manufacturers.

The performance of a car is the basis for the third perspective of product variety. This perspective is mainly related to the performance of the engine under certain working conditions and due to that the subsequent variables are supposed to be suitable measures for the variety within this perspective.

- a. The first variable of the performance perspective deals with the average top speed of different car brands. Matter of interest is here also the possible change over time and potential differences between the car brands. For this variable measures are only available for the time period 2001-2010.
- b. The average fuel consumption in a combined environment (rural and urban environment) is used as second variable for the analyses within this perspective. Also in this case the variable will be analyzed in order to find changes over time and to compare the car brands.
- c. The last variable compares the average emission rates per brand from to 2001 until 2011 and tries to find out if rates increased or decreased over time. Furthermore, the

analyses should explore if there is a general trend concerning the development of the gaps among the brands of a segment?

The results of the analyses will be presented in the next part. The answers will be based on the just explained variables and structured in accordance to the three perspectives and to the four car brand segments. How these analyses have been executed and which tools were used exactly will be described in the next part.

5.4.2 Results consumers' perspective

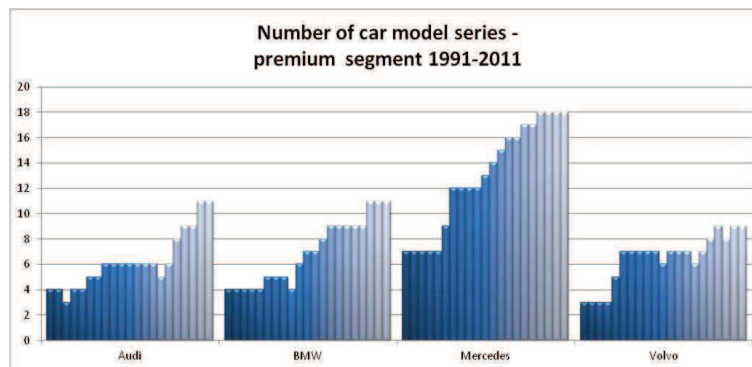
The analyses will mainly be executed by using line charts based on time and the median of the evolution of all brands for each segment separately. The resulting graphs can be interpreted as followed. If the lines of the different brands move closer together or the differences between them shrink respectively it is an indication that variety decreases and in the opposite case it increases. This visual estimate is supposed to be underlined or corrected by the calculation of the median of the differences. That means the absolute differences between all possible brand combinations in the segment are calculated and then the median of these absolute differences is calculated and used as the measure of variety. If the median decreases so does variety and the other way round. The median was chosen instead of the average in order to reduce the effect of outliers on the results.

The premium segment will be the first segment which will be analyzed regarding the variety within the three perspectives, followed by the middle class and economy segment and as last the low price segment.

Premium segment

The first level of product variety is like described above the design perspective where we look at the external factors of a car. These external factors consider aspects like the look, shape and size of a car and can be quantified in different ways and also on different levels. First of all, we look at the evolution of the number of car model series from 1991-2001. If we take Mercedes, the A-, B- and C-class cars would be described as model series and each series includes different variants like for example sedan, coupe and convertible.

Figure 5: Number of car model series - premium segment

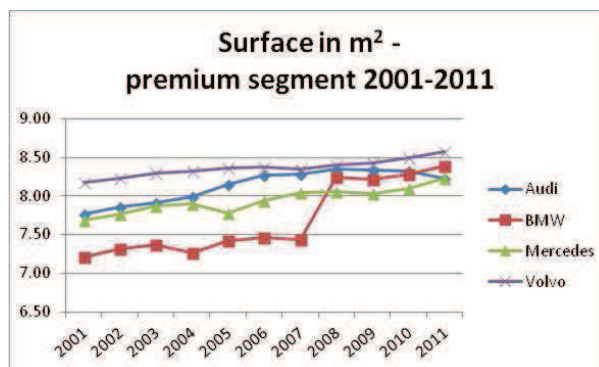


Source: own illustration based on Tealida (2013)

Looking at the graph, it is obvious to see that the trend for all four brands points upwards which means that the number of models is increasing. Especially in the last ten years, which is shown by the grey area on the graph, a significant increase is displayed. This is already a first sign of an increased product variety on the European market. Also, it is notable that Mercedes has a much higher number of car model series than Audi, BMW and Volvo.

Second, we examine the evolution of the dimensions of the cars or in other words the change of the car size of the different brands over time. To analyze this, we take three different measures regarding the size of the car into consideration. First of all, we take the surface of the car i.e. length multiplied by width expressed in square meters (m^2).

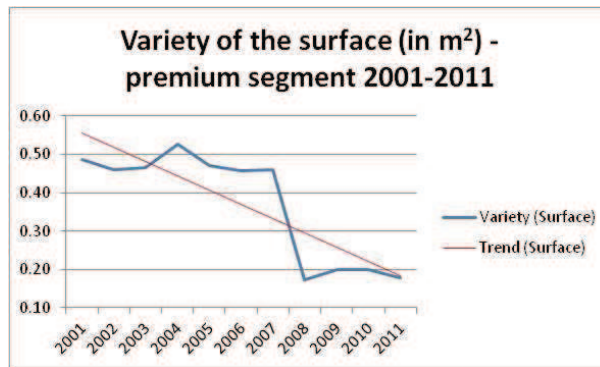
Figure 6: Surface in m^2 - premium segment



Source: own illustration based on ICCT (2012)

In general, it is possible to say that the surface slightly increased over the last ten years. Furthermore, it is visible that BMW made a significant increase in 2008 and came much closer to the size of its competitors' cars. In order to see the evolution of the variety in the premium segment, we calculated, like described in the beginning, the differences between each car brands and then took the median of these results.

Figure 7: Variety of the surface - premium segment

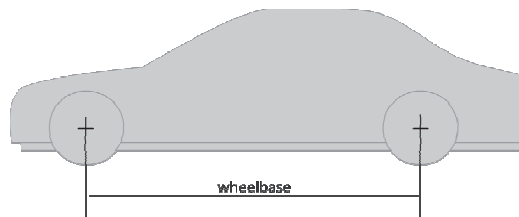


Source: own illustration based on (ICCT 2012)

The trend line on the graph shows a decreasing median which means that the differences between Audi, BMW, Mercedes and Volvo are getting smaller. In other words product variety, in terms of surface size, is decreasing.

The other two measures to analyze the dimensions are the wheelbase and the height of the cars. The wheelbase of a car is the distance between the center of the front- and back wheel of a car as shown in the illustration below.

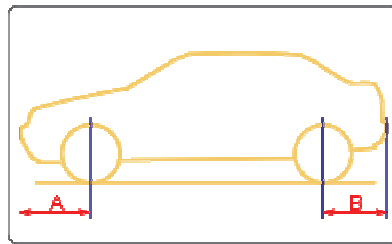
Figure 8: Graphical illustration of the wheelbase of a passenger car



Source: Adhoc (2011)

If you look at the graph representing the development of the wheelbase measurements from 2001-2011 (figure 10), it is obvious that the development is very similar to the previous one representing the surface of the cars. This similarity can be explained by the involvement of the car length in both measures. The surface is calculated by multiplying the length and the width, the wheelbase is calculated by subtracting the overhang of a car of the total length. This overhang is graphically illustrated in the following picture.

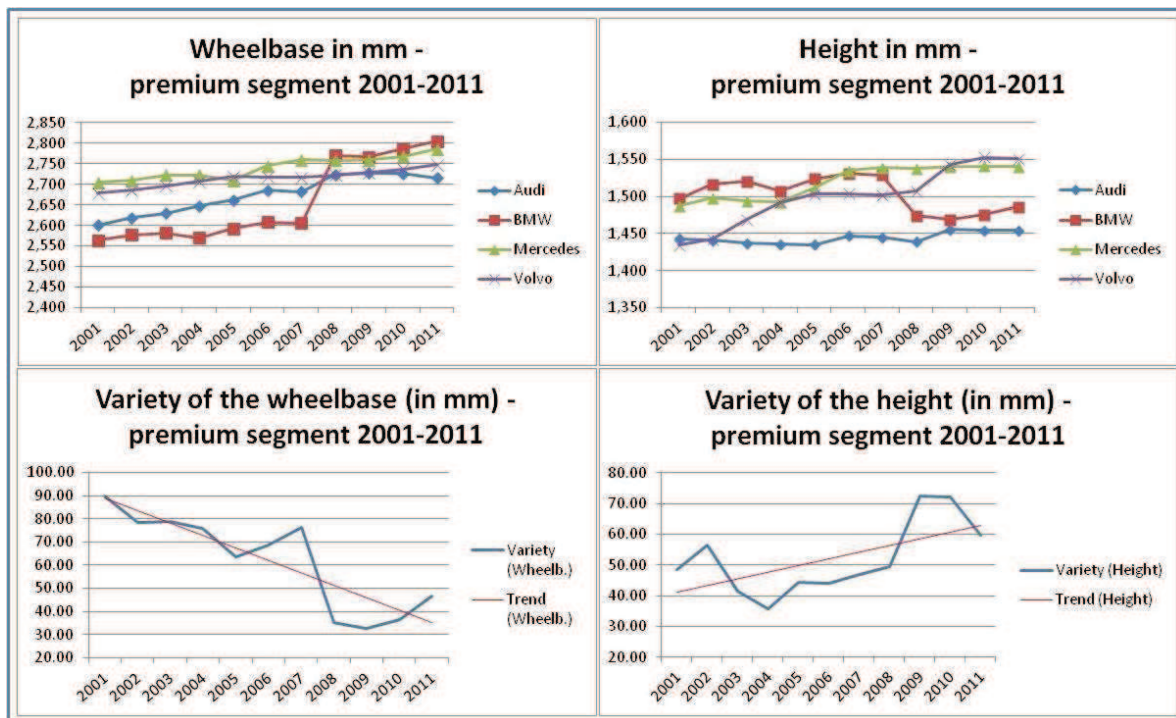
Figure 9: Graphical illustration of the overhang of a passenger car



Source: Adhoc (2011)

However, it is still important to include the wheelbase as a measure because it can say something about the size of the platform on which the car is built. If the length of the wheelbase is the same between two cars, it is most likely that these cars share a common platform. Also the difference in the overhang of the car can say something about the design of the car in terms of shape and other external characteristics.

Figure 10: Wheelbase and height - premium segment



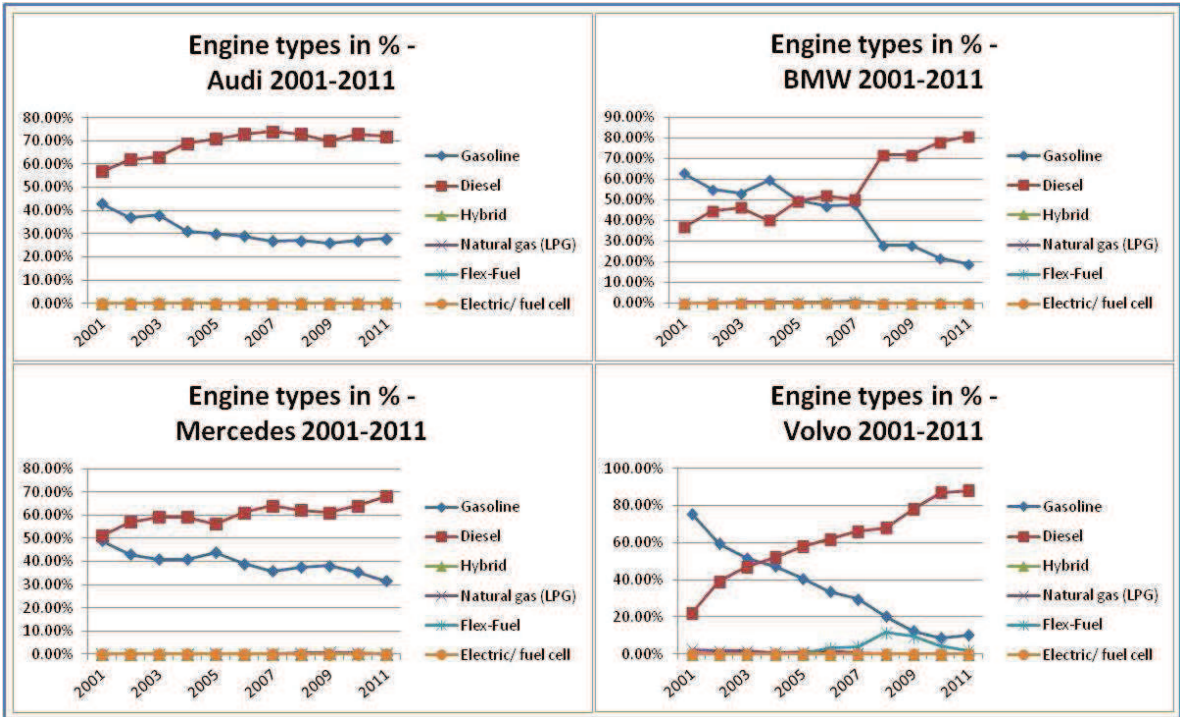
Source: own illustrations based on ICCT (2012)

The third measure, height, shows another evolution compared to surface and wheelbase. Mercedes and Volvo increased the height of their cars, Audi stayed more or less the same and BMW had several fluctuations between 2001 and 2011. The height of the premium brands diversified and if we look at the median of the differences, we see that differences between the brands got larger.

The variables surface and wheelbase of cars in the premium segment indicate less product variety and the variation in height points out an increased product variety. However, these factors have to be seen in a certain perspective. If we look at the maximum and minimum differences between the brands, we see that this ranges between 2-9cm for the height and the wheelbase, and 0.16-0.35m² for the surface. These differences are negligible and can barely be seen by the customers when looking at a car. Therefore we take the number of series as a more decisive factor for the design level of product variety. Due to this evaluation of the variables we can conclude that product variety increased in the premium segment.

For the second level of product variety, we will look at some technical specifications which were listed as variables previously and consider the engine type, size and power. First of all, we look at the percentage of different engine types (diesel, petrol, hybrid, etc.) of cars which are sold/registered on the European car market. By doing this we can see if there is a dominant engine type which benefits most preference from the consumers.

Figure 11: Engine types - premium segment

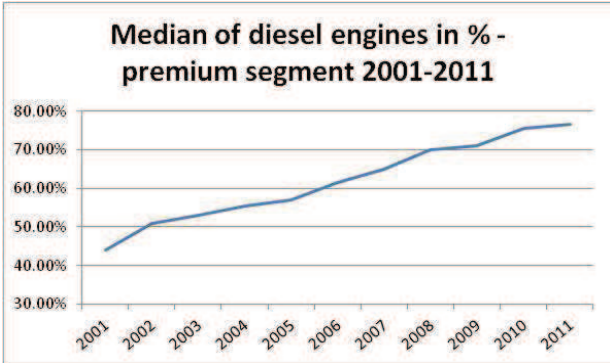


Source: own illustrations based on ICCT (2012)

According to the above displayed results, it is most obvious that consumers in the premium segment prefer diesel engines. Alternative engine technologies like Hybrid, LPG and electric engines represent less than 1% of the total registrations for these four premium brands. Only Volvo had a significant percentage of registrations for cars driven on Flex-Fuel technology of approximately 10% but which is reduced to around 2% again in 2011. The drop in sales is

clear evidence that the technology was not successful in this segment. Looking at the graph below, the percentage of diesel engines in the premium segment rose from 44% in 2001 to a little over 75% in 2011. This would mean that three out of four cars in the market are driven by diesel engines. We can say that product variety is low and reduced from 2001 to 2011.

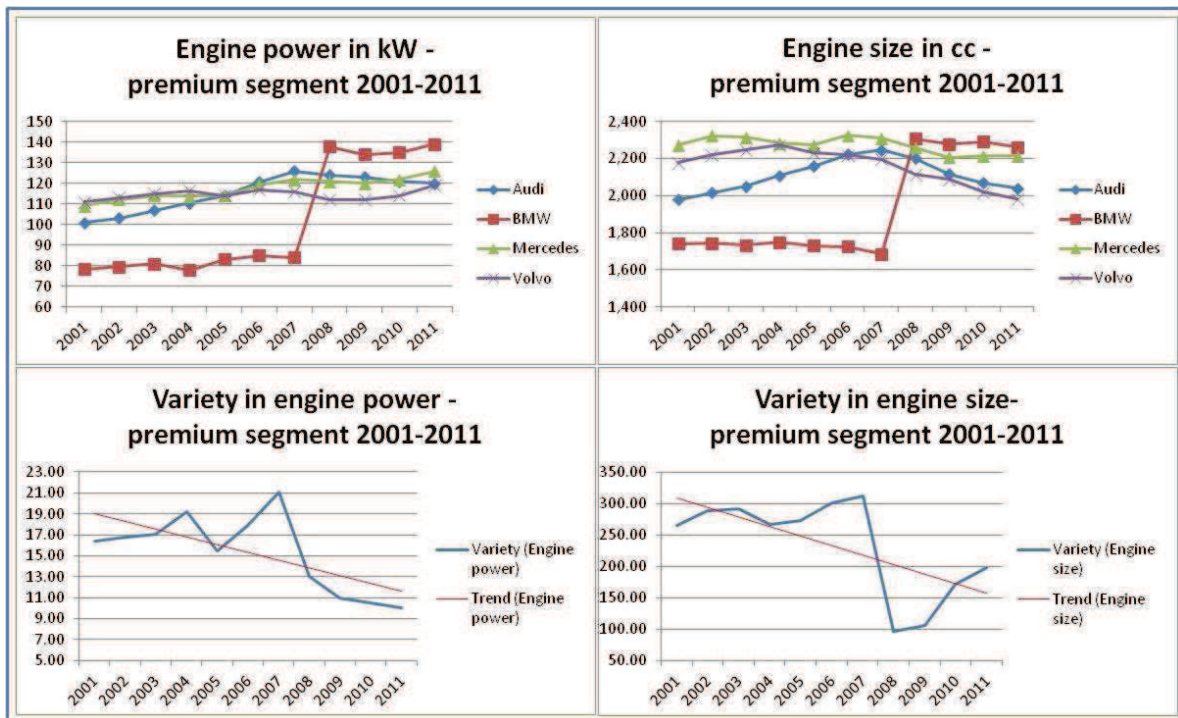
Figure 12: Median of diesel engines - premium segment



Source: own illustration based on ICCT (2012)

The other technical specifications are the engine size (expressed in cubic centimeters) and engine power (expressed in kilowatts). If we first look at the evolution of the engine power, we see that it generally slightly increased, no big changes or shifts happened. Only BMW cars experienced a significant increase in engine power from 2007 to 2008. A similar evolution was measured for the engine size although there is more variation between the brands compared to the engine power. The graph 'Engine size in cc – premium segment 2001-2011' visualizes that in the last five years of the observation period the engine sizes from Audi and Volvo cars start to decrease while Mercedes and BMW stay approximately on a the same level. This could be explained by a 'downsizing' strategy of Audi and Volvo in order to meet the demand of the consumer which merely bases its decision to buy a car on price and fuel economy (Aral 2011). Often tax regulations regarding automobiles are based on the size of the engine which means that smaller engines would result in lower purchasing prices for the consumer. Secondly, smaller engines have a lower fuel consumption which would also be a cost-saving factor.

Figure 13: Engine power and size - premium segment



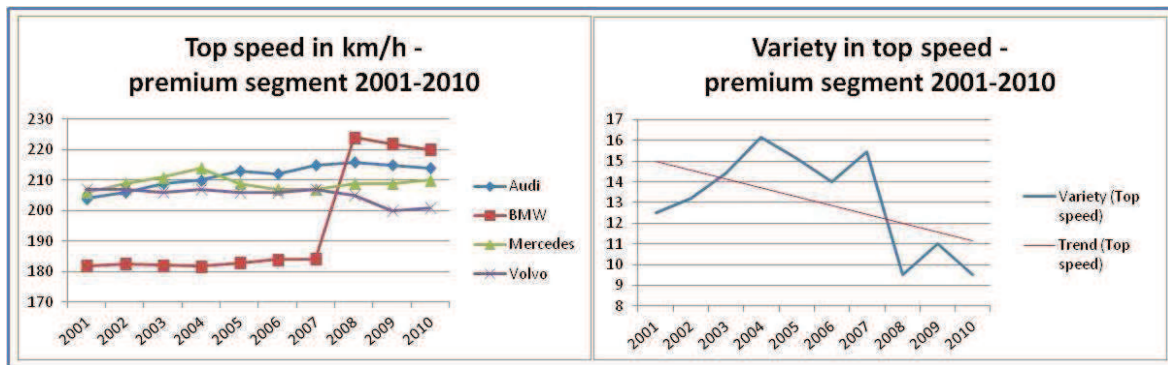
Source: own illustrations based on ICCT (2012)

Regardless of both graphs looking similar and showing similar trends, this does not necessarily mean that engine power and engine size go hand in hand. It is perfectly possible that the engine size decreases or stays the same while the engine power increases. This is due to the technological progress and the increased use of turbos and compressors which increase the oxygen in the engine for a better combustion and more efficient fuel management.

The medians of the differences of both variables, engine size and power, decreased during the observation period which means that there is less variety between the brands of the premium segment. However, we remark that the differences between brands relating engine power continued to decrease in the last year while the differences of the engine size increased again. On a technical level, we can conclude that product variety decreased in the premium segment.

The third and last level of product variety for this analysis is the performance level. The performance level looks, like already stated, at variables that measure characteristics of the car concerning its operation and driving. Therefore, we take the three variables top speed, fuel consumption and CO₂ emission in order to answer the sub-question dealing with the performance perspective. First, the average top speed of cars in the premium segment and its development from 2001 to 2010 is analyzed.

Figure 14: Top speed - premium segment

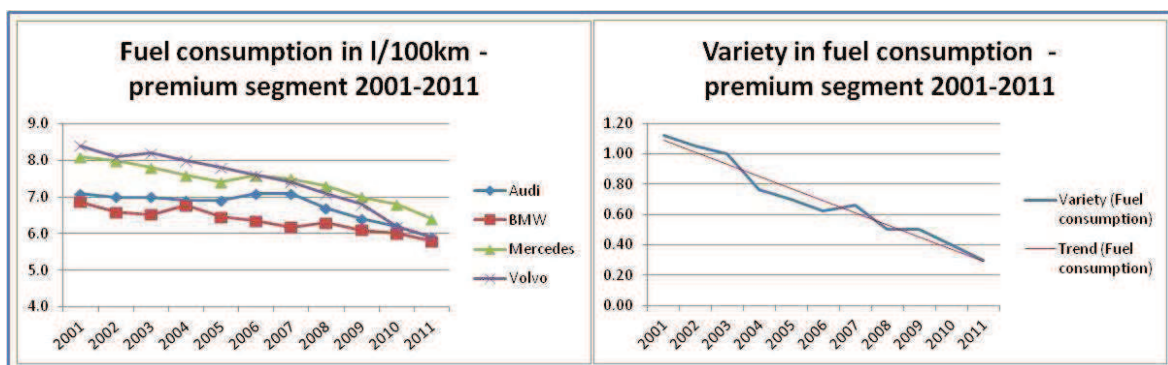


Source: own illustrations based on ICCT (2012)

Also in this case the measures for Audi, Mercedes and Volvo are very close to each other and BMW shifts up in 2008. In general, the top speeds of the four brands displayed in the graph above stay more or less stable but if we look at the median of differences you can see a decreasing trend. This means that the differences in terms of top speed between brands got smaller which indicates a decreased product variety on the performance level.

In order to confirm this first impression, we also look at two other variables of the performance perspective. In the last decade, environmental awareness and climate change became more and more present in the society so we find it important to include variables such as fuel consumption and CO₂ emission. Furthermore, the fuel consumption is one of the main factors consumers base their decision on when buying a new car (Aral 2011). The following graphs represent the average combined fuel consumption in liter per 100 kilometers and the CO₂ levels which are expressed in gram per kilometer.

Figure 15: Fuel consumption - premium segment



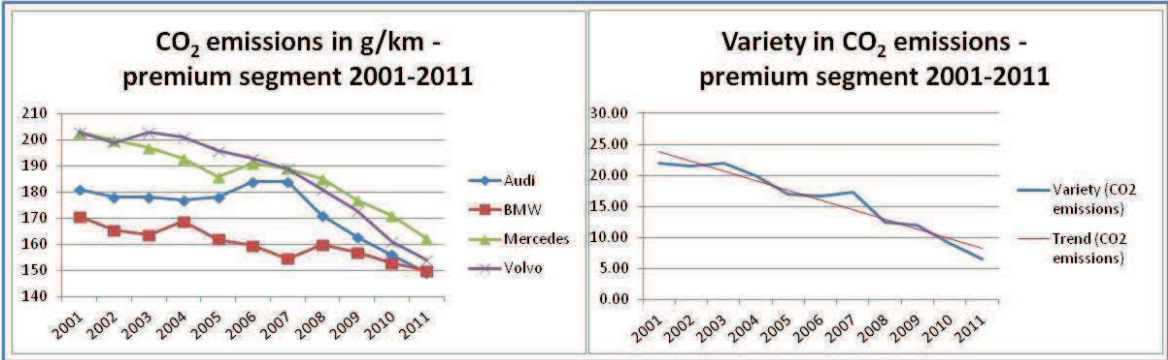
Source: own illustrations based on ICCT (2012)

The average fuel consumption in the premium segment shows a decreasing trend for all four brands between 2001 and 2011. On the left of the two graphs above it looks like all four brands are converging to each other. This interpretation is confirmed by the right graph

which shows a decreasing trend of differences between the brands. In terms of product variety, this would mean that there is less differentiation between the fuel consumption of, for example, Audi and Mercedes. This is a second indication for a decreased product variety in the premium segment on a performance level.

Now we will analyze the measures of the CO₂ emission as a final indicator for the third perspective of product variety. The evolution of the CO₂ emissions looks very similar to the evolution of the fuel consumption. When we calculate the correlation coefficient between these two datasets we get a result of 0.99 which means that these two variables are almost perfectly correlated. This can logically be explained by the following reasoning that when you have lower fuel consumption or when the engine burns less fuel, it will also have a lower emission level. The decreasing median of differences confirms a decreased product variety. In other words, there is almost no difference in CO₂ emissions per kilometer when driving a BMW or a Mercedes.

Figure 16: CO₂ emissions - premium segment



Source: own illustrations based on ICCT (2012)

All three variables of product variety on a performance level show decreasing trends. Therefore, we can conclude that, in the premium segment, there is less product variety on a performance level in the European passenger car market.

Looking at the results of all three perspectives, design, technical specifications and performance, two of them indicate decreasing variety while one indicates an increased level of product variety. At this stage of analysis, it can therefore be concluded that product variety decreased in the premium segment of the European passenger car market.

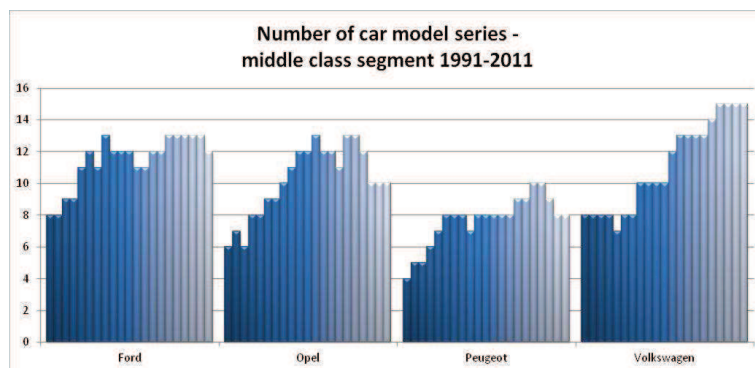
Middle class segment

In this part the sub-questions will be answered for the middle class segment and the approach of product variety will be examined while using the already mentioned brands of this segment, Ford, Opel, Peugeot, and VW. The first variable to look at concerns the evolution of number of car model series in the segment and between the four brands.

The analysis of the number of car model series in this segment shows an overall increase of product variety within the period of 1991 to 2011. The number of series nearly doubled in these 20 years. While in 1991 26 different series were produced by the manufacturers 2011 45 different series were counted. It had its peak 2007 and 2008 where the total number of car model series in the segment reached 50. After this peak the following years the variety decreased slightly.

Taking a closer look at the single brands VW constantly increased its number of series up to 15. The other brands had much more ups and downs between the years. In general, all of them had a higher number of series in 2011 than in 2001, but compared to VW which reached the peak in 2008 and stayed on this level the years after the other brands had their peak 2007/2008 and reduced their level of variety afterwards again slightly. This described development is visible in the graph below.

Figure 17: Number of car model series - middle class segment



Source: own illustration based on Tealida (2013)

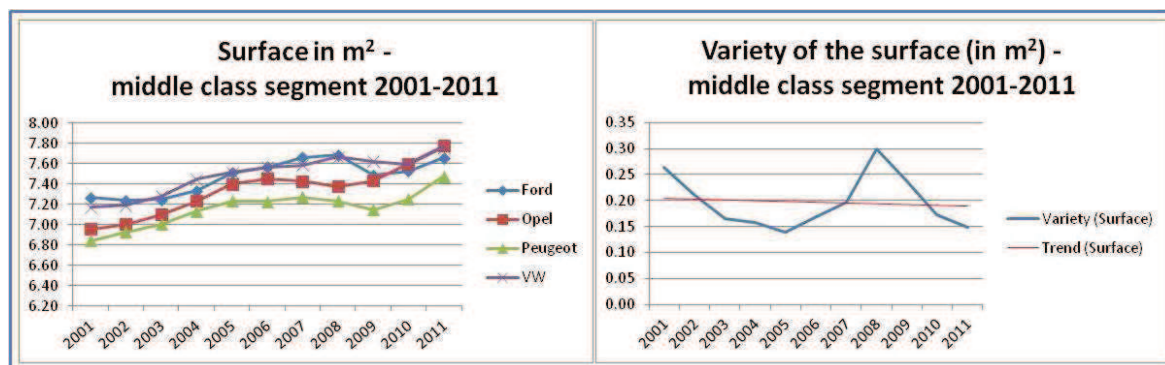
In order to give a clear picture regarding the dimensions of passenger cars and their development length, width, height, and wheelbase measures are taken into account while the focus lies on the surface (length x width) of the cars.

In general, the cars get bigger. All measures grew over the observation period for all four brands. The differences between the brands are highest for the length and the wheelbase. The development of the width and especially of the height was quite similar and variety decrease to a very low level in 2010. Even though speaking about higher variation between the

brands for the length and the wheelbase these differences stay within an area of around 20cm over all the years. The brand that is more different than the rest is Peugeot. Peugeot has the smallest measures regarding length and wheelbase and the gap between Peugeot and the three other brands started to get obvious in 2004/ 2005.

Looking at the surfaces underlines the trend just mentioned that car sizes increased. Nevertheless, product variety decreased. Like displayed in the graph below the variety got less, comparing 2001 and 2011. It had its peak in 2008. The level of 2011 is close to the lowest level of variety in 2005. Based on the fact that for the calculation of the surface the length is multiplied by the width logically Peugeot is again the smallest and a remarkable gap between Peugeot and the other three brands exists. This gap is probably one of the reasons why the level variety is not even smaller than it already is.

Figure 18: Surface - middle class segment



Source: own illustrations based on ICCT (2012)

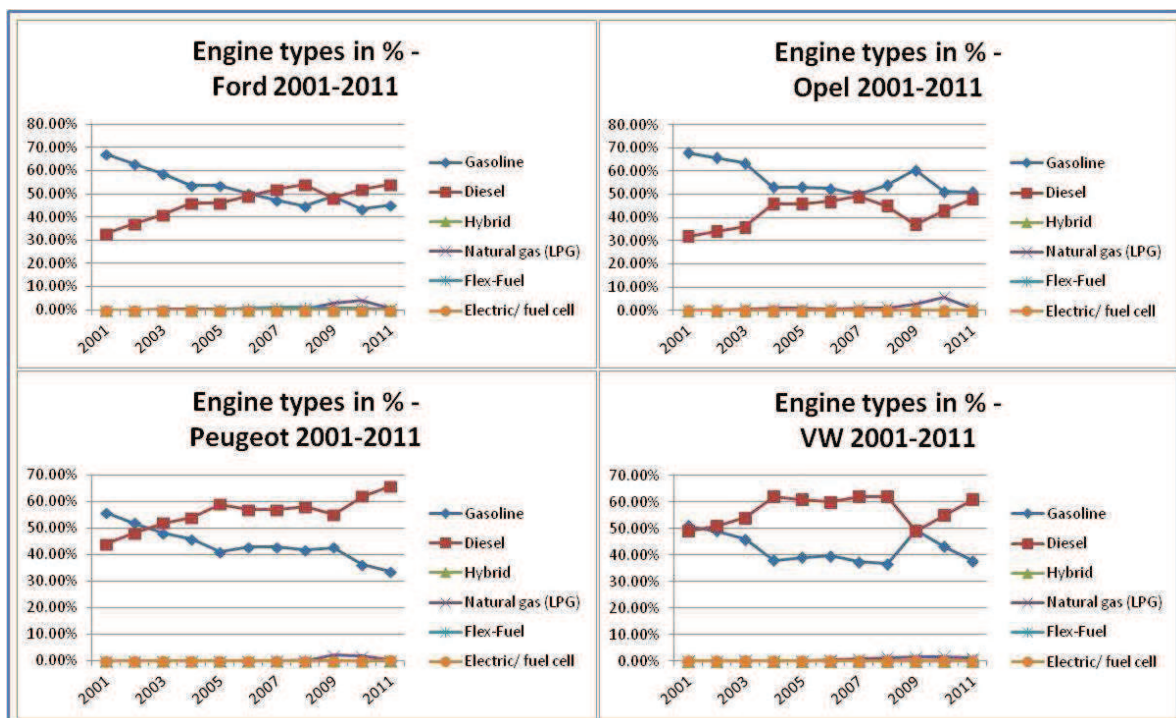
Based on the two analyses about the number of car model series and car dimensions it is possible to conclude on the variety of the design perspective and to answer the first sub-question. Like already explained in the part of the premium segment the variable concerning the number of car model series is weighted higher than the dimensions. The different car model series are easy to identify and even an inexperienced customer is able to recognize differences between certain series. The dimensional component on the other hand is varying in a range of a few centimeters and differences are not so obvious. Also in this segment the variety level of the design perspective increased due to the evaluation of the variables.

The first variable chosen for supporting the answering of the sub-question of the technical perspective deals with the consumers' preferences regarding the engine types. While the demand for new or alternative engine types, like for example hybrid and natural gas, remained on a very low level the traditional engine types, gasoline and diesel, cover the highest percentage of engines sold. The development of the percentage of sold engine types is different for the four brands within the middle class. Ford cars were mainly powered by gas-

oline engines until 2006. After that point the majority of Ford cars were equipped with diesel engines. The share of the four remaining engine types is equal or close to zero. The only exception within the demand for alternative engine types is natural gas engine after 2008.

Opel customer stayed over the whole period with gasoline as main engine type. The range between gasoline and diesel engines reduced, but the diesel share was at no time higher as gasoline even though in 2007 they were only separate by 0.9%. Regarding the alternative drive systems again only natural gas needs to be mentioned which reached 5.7% in 2010, but then fell back to previous levels of around 1% in 2011. Peugeot and VW have a similar development of the percentage share of engine types whereby the one of VW is more extreme. In 2002 respectively 2003 the share of diesel engine exceeded the one of gasoline for both brands, the gap grew and stayed approximately the same from 2005 to 2008. In 2009, the trend changed again especially for VW engines. While for Peugeot engines the gap just got a little smaller the two engines type reached the same level in case of VW. Afterwards, the two engine types of both brands developed apart again. Like for the previous brands the percentage of alternative engine types is very small and only natural gas was able to gain some noticeable amount between 1% and 2% in 2009 and 2010 in case of Peugeot and from 2008 to 2011 respectively for VW. All the described developments and evolutions are displayed in the graphs included in figure 19.

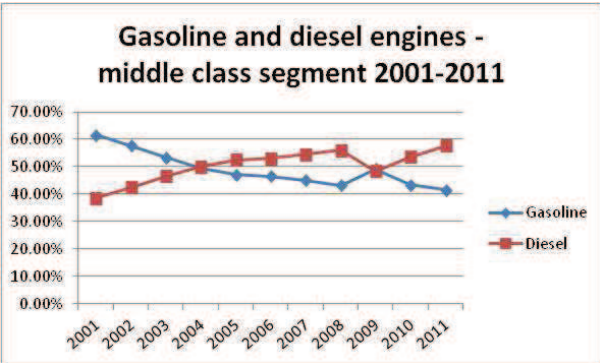
Figure 19: Engine types - middle class segment



Source: own illustration based on ICCT (2012)

A comparison of gasoline and diesel engines within the segment and the development over time shows that gasoline lost its dominant position which it possessed in 2001. In 2004, the two engine types were on the same level. In the following years diesel engines took over and it seems that diesel engines will become as dominant as gasoline was in the beginning of the observation. The values of the other engine types are so low that they are not really able to influence the general variety of engine types in the middle class segment and after a period of higher variety around 2004 it decreased again and reached a similar low level as in 2001.

Figure 20: Median gasoline and diesel engines - middle class segment



Source: own illustration based on ICCT (2012)

The development of engine size and engine power in the timeframe of observation as well as the evolution of the variety levels of these two technical car components are different. In the middle class segment the engine power of all four brands increased slightly. Opel enlarged its engine power on average by 16 kW, the other brands a little less with 9 and 15 kW respectively. In 2011 VW cars had on average the strongest engines within the segment with an average power of 86 kW while Peugeot was ranked fourth with 75 kW.

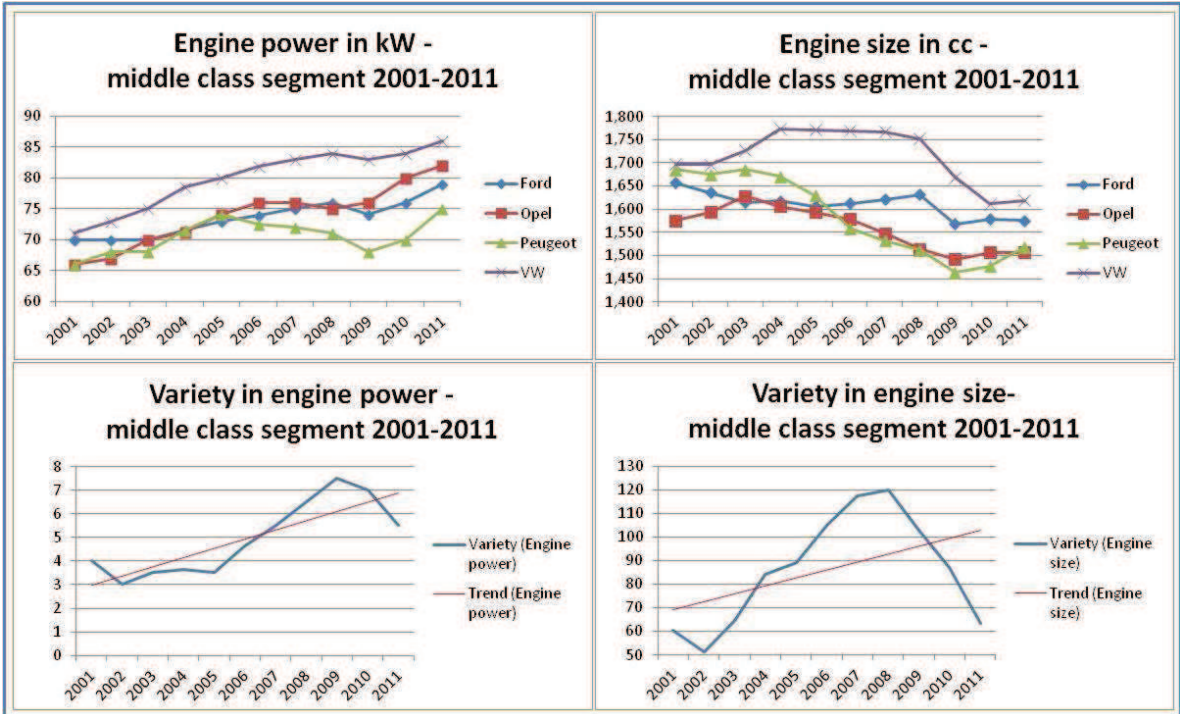
Due to the fact that all four brands stayed in a range of not more than 15 kW and had an average difference of not more than 8 kW the variety settled on a low stage. The small disparity is underlined by the graph 'Engine power in kW – middle class segment 2001-2011' below. Even though it is on a low level it still can be said that the variety rose over time and that the trend points upwards. Nevertheless, the graph 'Variety in engine power – middle class segment 2001-2011' could be miss leading and suggests a much higher increase than there actually was.

The engine size on the other hand got smaller for all brands. The current position in the development of engine sizes was approach by the brands on different ways. While Peugeot constantly reduced the engine size VW engine first became bigger before it changed the path and started to produce on average smaller engines. Beside, VW still has on average the biggest engine within the segment. Opel and Ford over the whole period reduced their en-

gine size as well and in 2011 Opel had the smallest engines with an average size of 1,507 cc. The difference between the four brands varied over time between 11 and 240 cc.

The diversification between the brands within the variable ‘engine size’ changed several times and its level moved up and down. It had its peak in 2008 after having a trough in 2002. The value of 2002 was never undercut so far and the figure of 2011 is little higher than in the beginning of the period of consideration. The general trend of variety of engine sizes in the middle class segment is going up mainly pushed by the accumulations in the years 2003 to 2008. After 2008 the differentiation level between the car engines of the four manufacturers diminished.

Figure 21: Engine power and size - middle class segment



Source: own illustrations based on ICCT (2012)

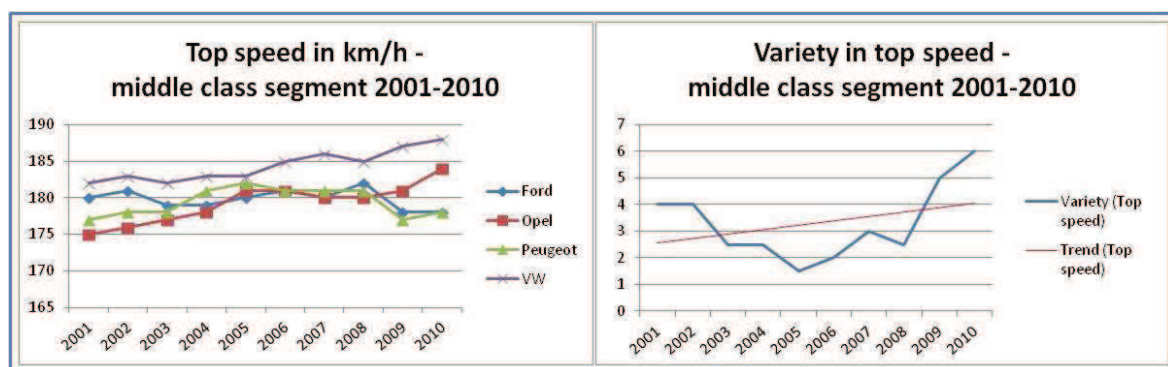
Like for the design perspective also the variety of the technical perspective increased over time. The variety of engine types as well as engine size and power increased in general over the given time period even though the differences were just marginal. This means for the sub-question concerning the technical specification of a car that there actually is a development of product variety over the last years. This development indicates a slight increase of product variety within this segment and perspective.

In order to answer the sub-question concerning the performance perspective of product variety the three variables top speed, fuel consumption and CO₂ emission will be analyzed. The variety between the brands concerning top speed is shown in the graph ‘Variety in top

speed – middle class segment 2001-2010' below and it is evident that the variety was on a down turn until 2005. The years after the level of variety rose again and reached its highest point within the observation period in 2010. The general trend is going upwards and so does the variety in this area. Despite, it needs to be remarked that this variation lies in a range of just 10 km/h.

While VW follows a strategy of stable enlarging the top speed, Peugeot and Ford have a more inconsistent course within the development of their top speed within the timeframe. The evolution of top speed of Opel cars is similar to the one of VW but on a lower level, on average around 5 km/h less.

Figure 22: Top speed - middle class segment

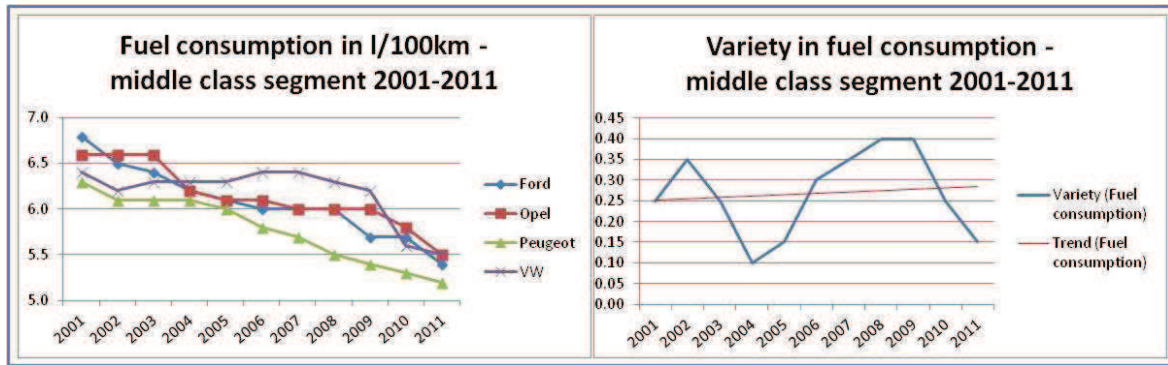


Source: own illustrations based on ICCT (2012)

The second approach of the performance perspective concerns like stated above the fuel consumption in liter per 100 km. The average fuel consumption per 100km went down to under 6.0 for all of the brands in the middle class segment and all of them reached a quite similar level in 2011. The average difference between the four brands in this year was down to 0.17 l per 100 km.

The median as a representative of the variety (see graph 'Variety in fuel consumption – middle class segment 2001-2011') indicates that there have been changes within the range of variety, but on a very low level. The median stayed between 0.15 and 0.4 liter. The median as well as the average difference of the middle class segment were 0.1 liter per 100 km in 2004. Even though the variety in 2011 was lower than in 2001, the general trend of variety within the average fuel consumption is pointing upwards due to the years 2008 and 2009. In these years the difference between VW and Peugeot got bigger than all other years. While the fuel consumption of VW cars got higher Peugeot engines consumed on average less than the previous engines and less than the ones of its competitors in the segment.

Figure 23: Fuel consumption - middle class segment

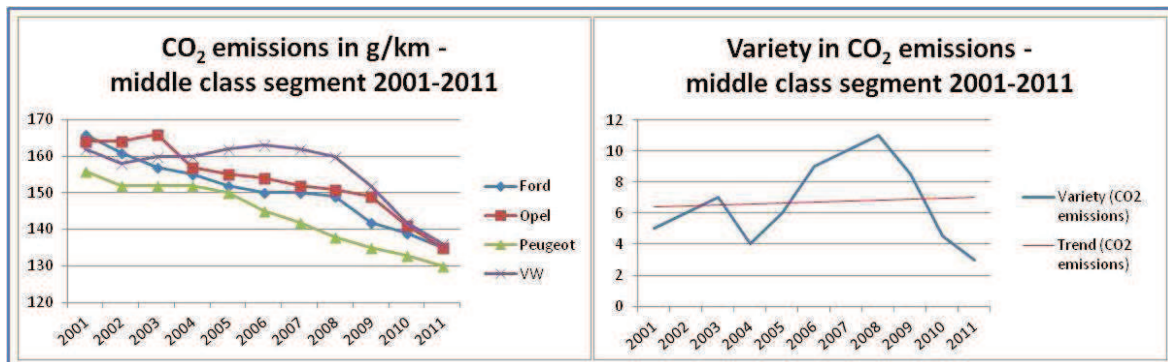


Source: own illustrations based on ICCT (2012)

The CO₂ emissions per km declined like expected in the last years. Nevertheless, the development of the average emission rates of VW cars is striking. Before the average emission rate of VW cars started to go down in 2008 it rose up to a level which was much higher than the measures of the other brands. In 2011, the VW engines had similar measures as Ford and Opel. Peugeot as a contrast to VW reduced its emissions constantly over the whole observation period and also by the end of the period Peugeot engines produced on average less CO₂ emissions than the other three brands in the segment, around 5g/km.

Mainly resulting from the difference between VW and Peugeot variety related to the environmental friendliness of the engines still exists and leads to a quite significant increase in variety between 2004 and 2008 where it had its high. After this point the variety between the brands shrank constantly and reached its lowest point so far in 2011. So overall the variety regarding the CO₂ emission rates decreased from 2001 to 2011. This development is also visible in the following graph. Furthermore, the development of the single brands within the middle class segment is displayed.

Figure 24: CO₂ emissions - middle class segment



Source: own illustrations based on ICCT (2012)

For the performance perspective it can be concluded that there was a development and that the overall variety increased. The two components top speed and fuel consumption differentiated more during the observation period. Surprisingly and against expectations the variety of the variable CO₂ emissions decreased. It was expected that the development of the CO₂ emissions and the fuel consumption would have a similar progression.

The situation within the middle class segment is quite clear and so the summary can be kept short. The variety increased in all three parts. For five components the diversification level between the brands got bigger. Only in case of the dimensions and the CO₂ emissions the trend pointed into the opposite way.

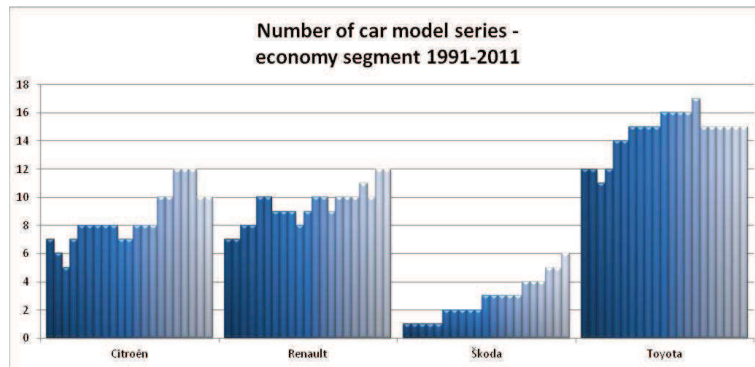
Economy segment

In this part the three sub-questions will be answered based on the analyzing results of the different variables for the economy segment consisting of the four brands Citroën, Renault, Škoda, and Toyota. For the first variable dealing with the evolution of the number of car model series the results are displayed in the graph 'Number of car model series – economy segment 1991-2011' below.

In this segment Toyota and Škoda are outstanding, one far above the others, the other one beyond. While Toyota had an average of 14.5 different series within the observation period Škoda had 2.7 respectively. The two French brands in the segment stayed close to each other with around 8-9 series on average. Citroën, Renault and Toyota had some fluctuations over time. Škoda on the other hand increased its variety steadily even though on a low level. The number of series for Toyota was stable for the last six years (2006-2011) and it was the only brand within the segment that reduced its variety within the last ten years.

In general, the variety in the segment increased from 27 different series in 1991 up to 43 in 2011. In the course of the years there were some fluctuations like in 2000 or 2004. Especially from 2000 to 2011 the number of series increased. The following graph shows this evolution of car model series per brand in the segment between 1991 and 2011.

Figure 25: Number of car model series - economy segment



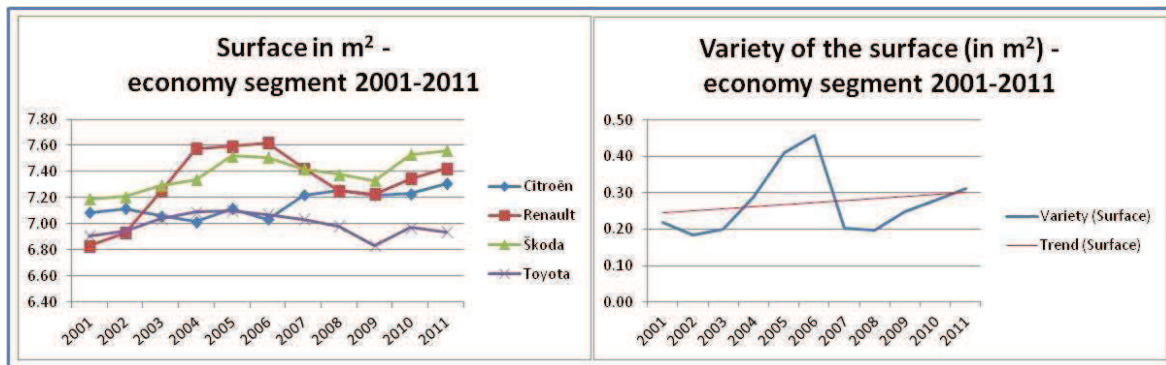
Source: own illustration based on Tealida (2013)

It is not possible to make a clear and general statement about the development of the dimension of cars within the economy segment. No equal development is discernible for the brands in the segment.

The difference between the brands is highest for the length and the wheelbase. The height measures got more and more the same over time and the smallest difference between the brands was reached by the end of the observation period. The length as well as the height of Škoda cars obviously was chosen differently than from the other brands. While the measures of the length always lay above the ones of its competitors the height measures stayed beyond them. The width stayed nearly constant, the range between the brands only changed from around 2cm to 4cm and with one exception. In the years 2003 to 2007 Citroën exceed its competitors' width significantly before it returned to the same stage.

This extreme is logically also visible in the evolution of the surface. At the point this extreme appeared the surface of Citroën exceeded the surfaces of all others. Otherwise it was Škoda which had the largest surface. Škoda, Citroën and Renault increased the size of their surface and the gap between them got smaller. Toyota's development is a little isolated from the rest. The average size of the surface of Toyota cars was nearly equal at the start and the end of the observation the measures were much smaller than of the three remaining brands. The differences to the other brands increased significantly after 2007. These evolutions of the four brands led to some fluctuations within the development of variety and to a general increase of it within this variable of the design level. The variety peaked in 2006 and had its trough in 2002. The variety in 2011 was higher than in 2001. The development of variety as well as the one of the surface per brand is displayed in the following two graphs.

Figure 26: Surface - economy segment



Source: own illustrations based on ICCT (2012)

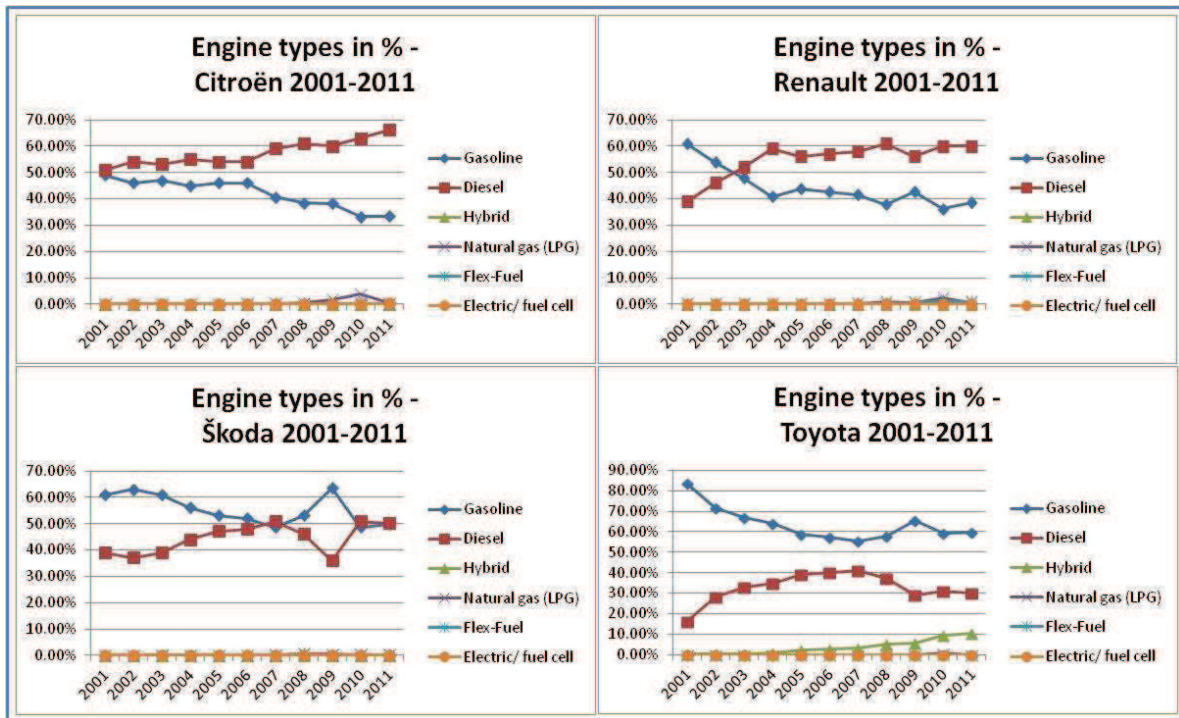
The product variety increased regarding the number of car model series as well as car dimensions. So it can be concluded that the differentiation between the brands within the design perspective of the economy segment increased and that a development took place over the last years. This development was mainly pushed by the number of car model series which enlarged the variety significantly over the observation period.

The different engine types used in the automotive industry are subject of the first variable of the technical perspective. The consumers' preferences regarding the engine types varied significantly between the four brands of the economy segment. Nevertheless, they all have in common that the highest share of engine types is covered by the traditional engine types, gasoline and diesel engines. The new or alternative engine types, hybrid, natural gas, flex fuel, and electric, remain on an even lower level than in the middle class segment. The only exception is Toyota. The share of its hybrid engines increased constantly and counted for 10% in 2011. The highest percentage of all new Toyota cars in the market is powered with gasoline even though the tendency is shrinking just as the difference between gasoline and diesel engines.

In case of Citroën the main engine type is diesel which actually increased up to 66% in 2011. The development of the shares of diesel and gasoline look like mirrored on the 50% line (see graph 'Engine types in % - Citroën 2001-2011'). The losses of one of them were taken as gains by the other whereby diesel gained more of the gasoline share than the other way round. The same can be said about the shares of Renault and Škoda. Only difference in the evolution of Citroën engines is that in 2001 and 2002 gasoline still was the main engine type. The development of Škoda engines bought includes much more fluctuations of the two shares and these shares are also much closer together. In 2011, they are separated by just 0.2%. Two additional points need to be mentioned. Firstly, natural gas engines took a noticeable share of Citroën engines in the period of 2008 until 2011 where they accounted for

up to 3.7% of the used power systems. The second point effects the same time period but this time with a lower share and referring to Renault engines. Flex fuel and natural gas engines had a share of up to 1%.

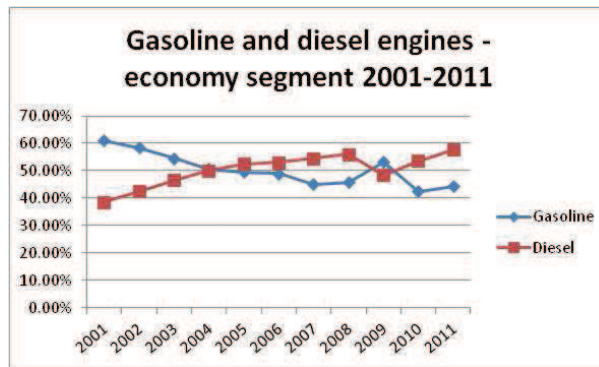
Figure 27: Engine types - economy segment



Source: own illustrations based on ICCT (2012)

A detailed comparison of the development of gasoline and diesel engines in the economy segment gives the result shown in the graph 'Diesel and gasoline engines – economy segment 2001-2011'. Gasoline was dominant from 2001 to 2003 and covered up to 60%. Afterwards the dominance of gasoline was reduced and diesel gained a higher share. Combining these observations with the constantly growing share of Toyota hybrid engines and the small increases of natural gas and flex fuel it is possible to say that the variety of engine types slightly increased.

Figure 28: Median gasoline and diesel engines - economy segment



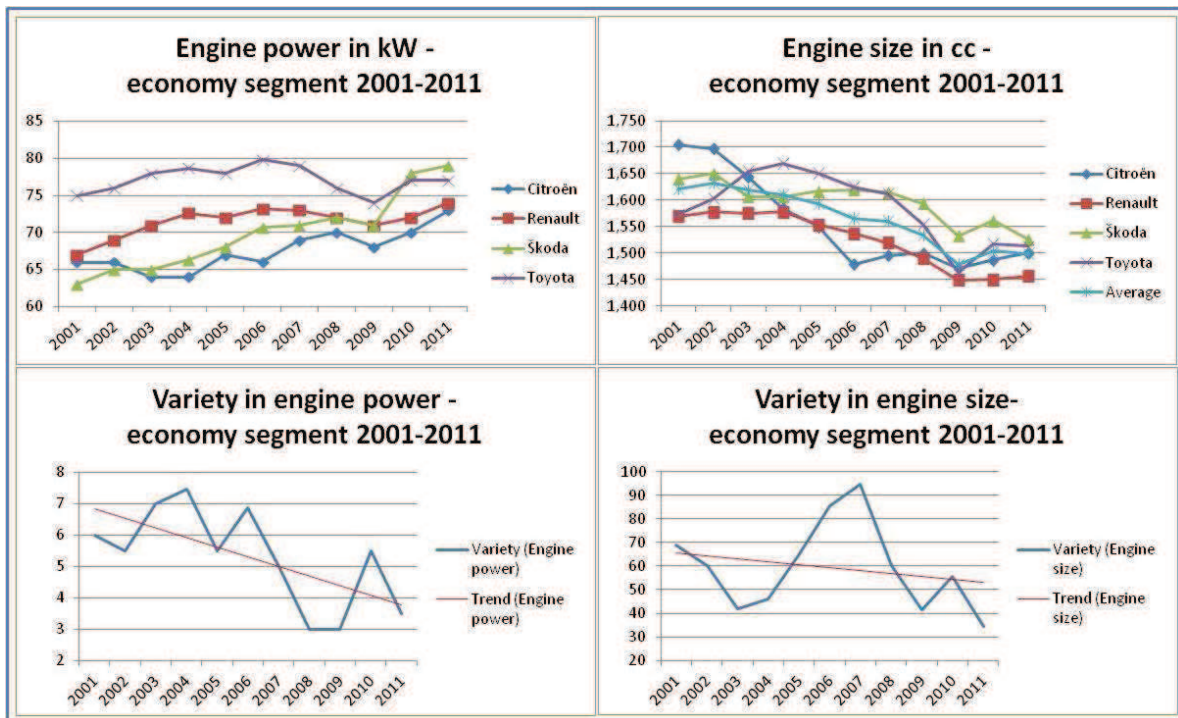
Source: own illustration based on ICCT (2012)

The second part of the technical perspective considers engine power and size. The difference between the brands regarding engine power is not very striking. In 2011 they all lay in a range of 10 kW. Within this component group it is not necessary to highlight one of the brands or to describe a certain development separately. All four brands increased their engine power slightly and reduced the difference between each other. This automatically leads to the result that the product variety related to the engine size decreased over time. It had some fluctuations in the course of the timeline and the highest level of variety was reached in 2004 and the lowest in 2008/2009. The range these fluctuations take place in never exceeded an average of 7.5 kW.

The evolution of the engine size for the single brands within the economy segment differs a little more than the one of the engine power. All brands have in common that their engine size is smaller in 2011 compared to 2001. Renault engines were on average the smallest engines from 2008 onwards in the economy segment. Citroën had the biggest decrease in engine size of 205 cc comparing the measures at the start and the end of the observation period.

The diversification between the brands changed several times and its level moved up and down. These ups and downs are displayed in the graph 'Variety in engine size – economy segment 2001-2011'. The product variety peaked in 2007 and reached its lowest point so far in 2011. The general trend in the years of observation is pointing downwards.

Figure 29: Engine power and size - economy segment



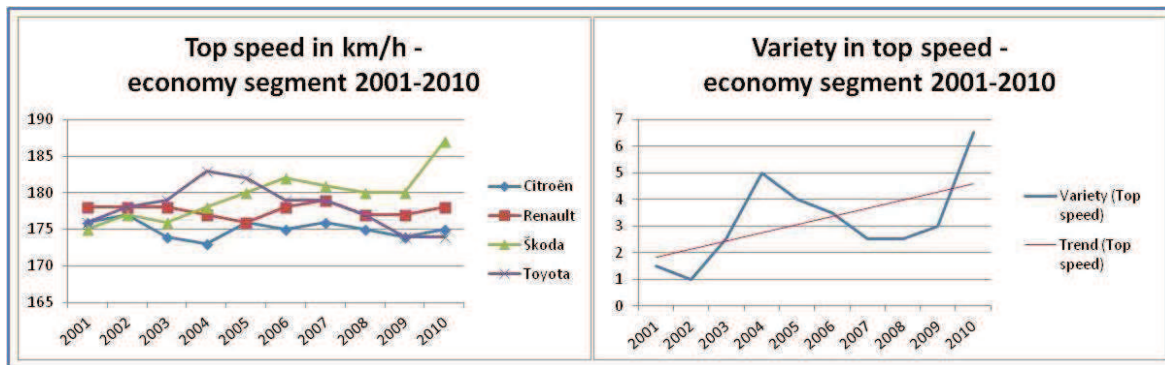
Source: own illustrations based on ICCT (2012)

While the variety level concerning engine types increased the diversification level between the brands related to engine size and power got smaller. It is possible to say that the result is 2 to 1 and due to that we can conclude that a declining development of variety took place within the technical perspective.

The results of the analysis of the first variable in the performance perspective dealing with the top speed of the different brands cannot be summed up with one sentence due to the fact that the development of the four brands does not seem to follow a certain strategy. The peaks of the different brands are located at various stages in the observation period and also the courses of the lines are mostly not parallel. Škoda was ranked fourth in 2001, took over the lead in this area in 2006 and until 2010 it even increased the gap to the remaining brands in the segment up to 14 km/h. Toyota reduced its top speed constantly after 2004 and had the lowest top speed in 2010. The top speed of Renault and Citroën had some ups and down but stayed approximately the same. This diffuse development is visible in graph 'Top speed in km/h – economy segment 2001-2010'.

The variety of this variable of the performance perspective in the economy segment reached its peak so far in the last year of observation (2010) and had its trough in 2002 with a median of the difference between the brands of just 1 km/h. The overall trend of variety is going upwards and displayed in the following graph.

Figure 30: Top speed - economy segment

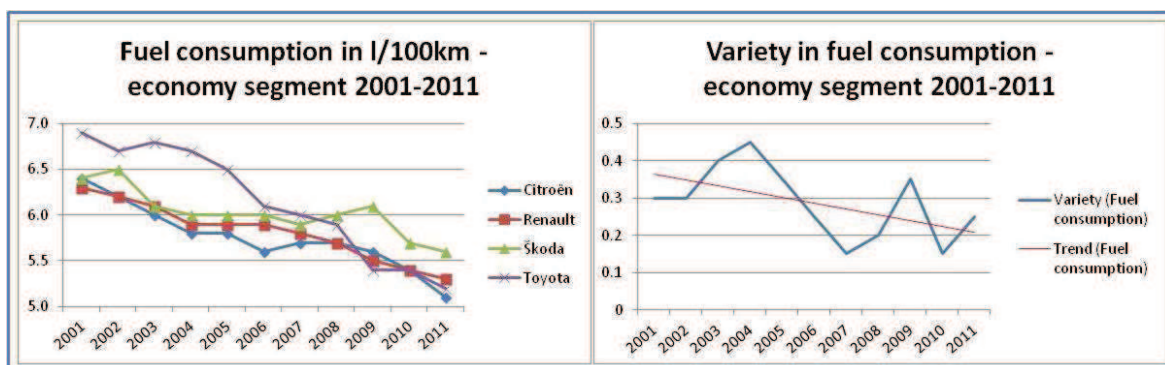


Source: own illustrations based on ICCT (2012)

The average fuel consumption per 100 km per brand as well as the variety of this variable went down. The largest average reduction was achieved by Toyota of around 2 liter per 100 km and handed over the position of the brand with the highest average fuel consumption to Škoda in 2008 which it kept until 2011. Still, the average fuel consumption of Škoda cars also decreased during the observed years. The same statement is valid for Citroën and Renault. Both brands reduced the average fuel consumption of their engines and Citroën is the one with the lowest consumption of all four brands in the economy segment.

The variety in this field had several ups and downs and these fluctuations are visible in the graph 'Variety in fuel consumption – economy segment 2001-2011' as well as the just stated general trend of decreasing of variation. The highest level of diversification was measured in 2003 and the lowest in 2007 and 2010.

Figure 31: Fuel consumption - economy segment



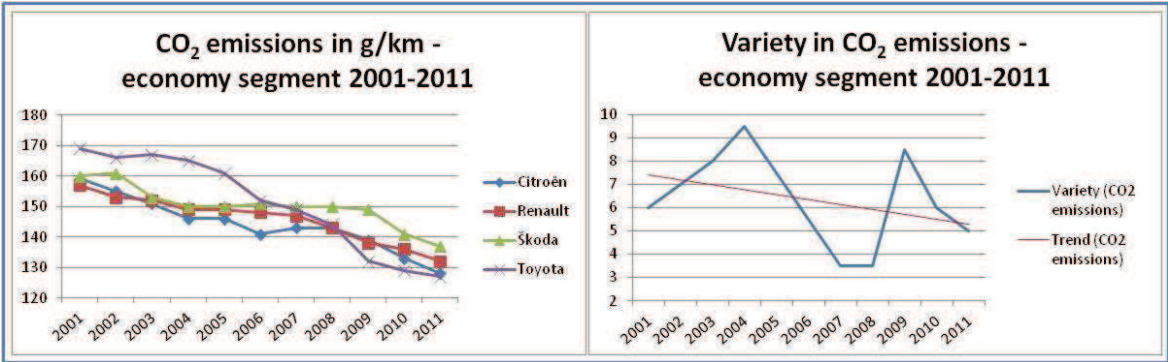
Source: own illustrations based on ICCT (2012)

The development of the average CO₂ emissions within the economy segment presents logically and as already described in the course of the premium segment a similar picture as the fuel consumption. Also in this case the average emission rates per brand and the variety level decreased. Furthermore, Toyota is again the brand with the highest reduction from 169

down to 127g per km and while Toyota had in 2001 the engines with the highest average emission rates in the segment it had the lowest in 2011. For a second time Škoda took over Toyotas position. From 2007 on the measures of Škoda were higher than the ones of its competitors. Citroën and Renault followed the trend and their emissions decreased by around 30g per km over the whole period.

The highest level of diversification was this time notified in 2004 and the lowest 2007/2008. One more time it is best to have a look at the graph ‘Variety in CO₂ emissions – economy segment 2001-2011’ to get a clearer picture of the evolution of variety. In 2011 it reached a level under the one of 2001.

Figure 32: CO₂ emissions - economy segment



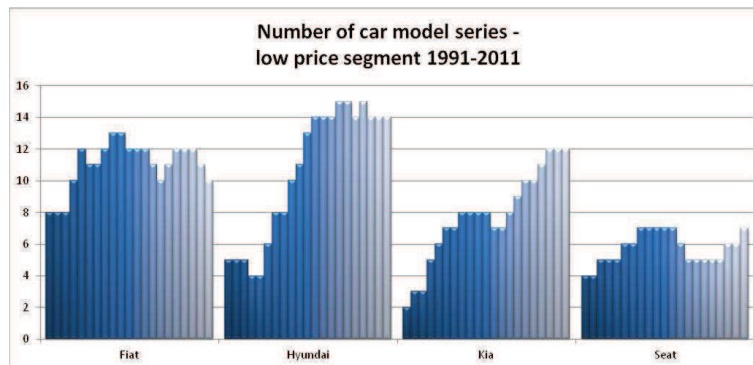
Source: own illustrations based on ICCT (2012)

The result is the same for the performance perspective as for the whole economy segment. The variety decreased over time. While the brands diversified more based on top speed the variety related to fuel consumption and CO₂ emissions reduced from 2001 to 2011. So the variety of two components decreased while the third one increased its variety which leads to an overall reduction of diversification within the performance perspective. This ratio is also valid for the economy segment as a whole. The level of diversification only increased for the design perspective for the other two perspectives it developed contrary which occasions to the conclusion that the overall product variety within the economy segment is on a down-swing.

Low-price segment

As last, we have a more detailed look at the low price segment in the European car industry. Also in this case we will look at the same three levels of product variety, design, technical and performance like we did for the previous segments and answer the same three sub-questions based on the results of the analyzed variables. For the design level, we first analyze the development of the number of car model series between 1991 and 2011.

Figure 33: Number of car model series - low price segment

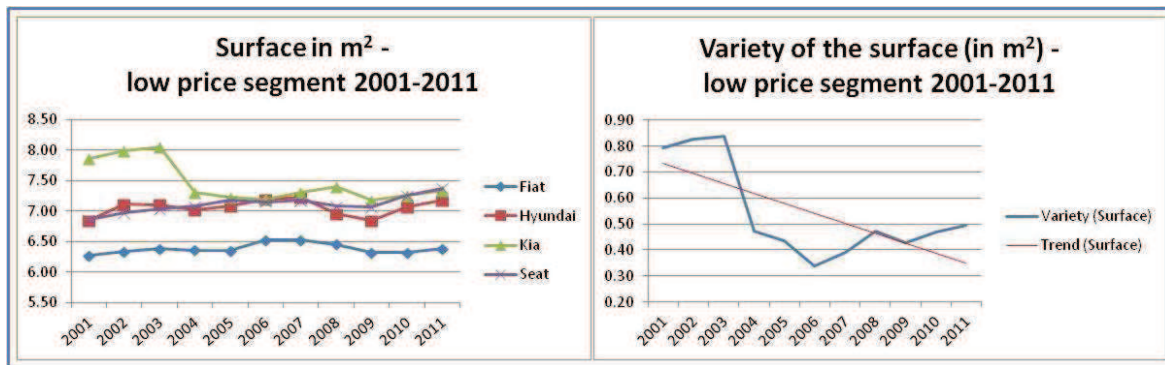


Source: own illustration based on Tealida (2013)

Several differences are noticeable concerning the level as well as the evolution of variety of the brands in this segment. Seat and Fiat experienced a small increase in model series of approximately two more series in their product range. However, the difference between these two brands is that Fiat has on average ten car series while Seat only has around six. Then looking at Hyundai and Kia, it was found that both brands significantly increased their variety over the period between 1991 and 2011 and almost tripled their number of car model series. This means Hyundai and Kia are emerging brands and largely expanded their product range. They are now at the same level of product variety as Fiat; Hyundai even surpassed the level of Fiat.

As a next step we will focus on the variable dealing with the dimensions of the cars in the low price segment. One more time we start with the measurements of surfaces. From 2001 to 2003 we see that Kia cars had the largest surface in the segment but significantly decreased in 2004 and were since then on the same level as Hyundai and Seat. Only Fiat stayed distinguished from the other brands in the segment and had a considerable lower average surface. In general, the surface of the car brands stayed more or less the same but the differences between them are getting smaller which means that variety decreased.

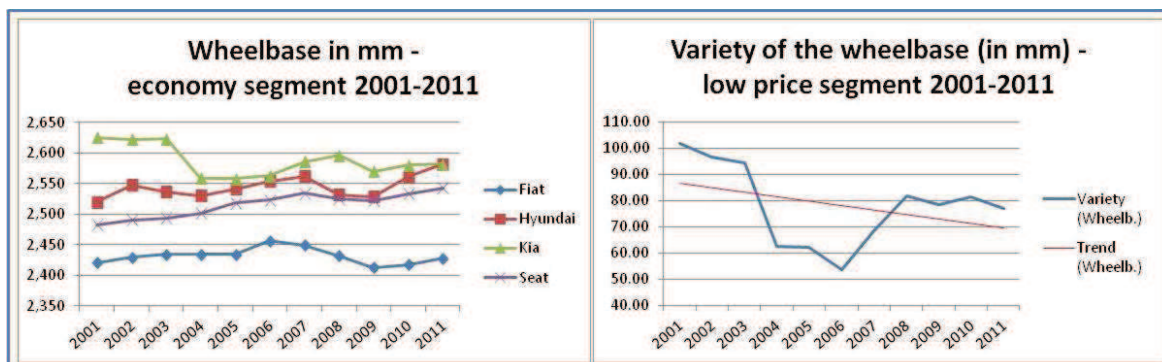
Figure 34: Surface – low price segment



Source: own illustrations based on ICCT (2012)

For the wheelbase we see similar trends while Kia decreased its wheelbase Hyundai and Seat slightly increased the wheelbase of their products which causes the brands to converge to each other. Again Fiat has a significant lower wheelbase than its competitors and the level stays the same. If we look at the differences, the trend line slightly goes downward which would indicate a decreasing variety. However, if we look at the value from 2001 (10.2 cm) compared to the value of 2011 (7.7 cm), the difference is just 2.5 cm. The average wheelbase in this segment is around 2.5 m. Taking these two characteristics into perspective the result of a decreasing product variety appears in a different light. Therefore we conclude that the differences between the brands is very low (5-10 cm on average) and the variety remains unchanged.

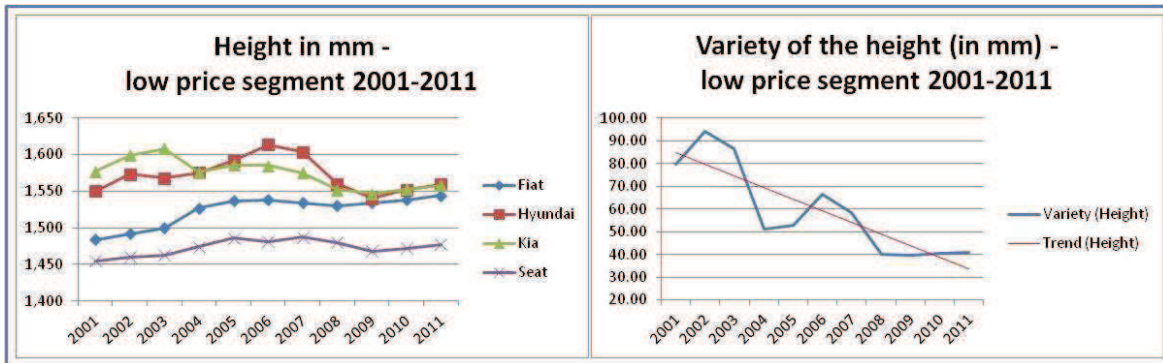
Figure 35: Wheelbase - low price segment



Source: own illustrations based on ICCT (2012)

Finally, we look at the evolution of the height of the cars in the low price segment. This time we see Fiat, Hyundai and Kia converging close to each other and Seat staying significantly under the measures of its competitors. We can say that the average car height slightly increased but again this increase is limited to a couple of centimeter. The median of the differences concerning the height decreased from approximately 8 cm in 2001 to 4 cm in 2011.

Figure 36: Height - low price segment

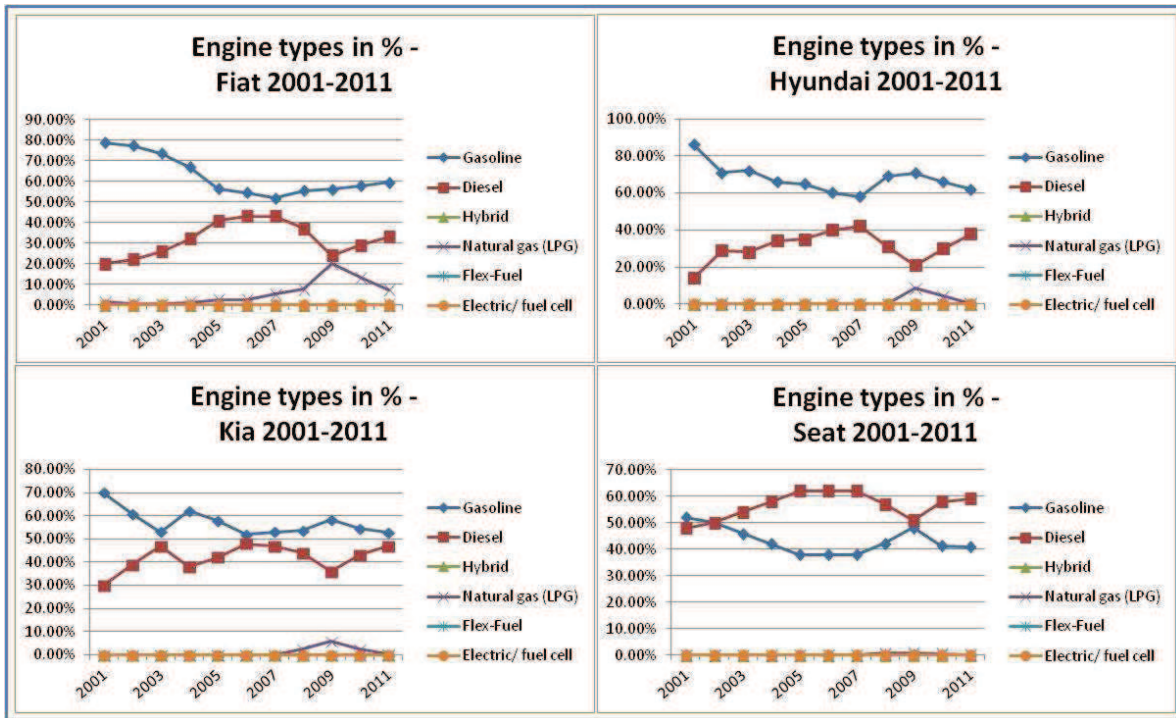


Source: own illustrations based on ICCT (2012)

All variables related to the dimensions of the car point into the direction of a decreased product variety. On the other hand, the number of car model series for the different brands indicates increased variety. As in the previous segments, the product variety for the dimensions is very limited as the differences are relatively small. Therefore, we can say that also in this case a development over time took place and that product variety of the design perspective increased in the low price segment.

The second level of product variety will again be analyzed by looking at the engine type, power and size. We start with the percentage of the different types of engines which are registered in the European passenger car market between 2001 and 2011 for low price brands.

Figure 37: Engine types - low price segment

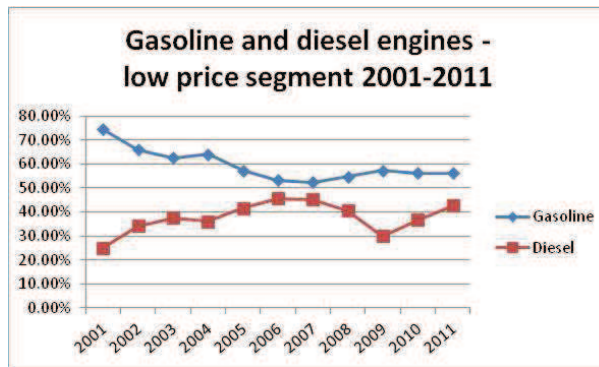


Source: own illustrations based on ICCT (2012)

When looking at the graphs above, we can see that three out of four brands have a majority of gasoline or petroleum engines on the market. Only Seat has a majority of diesel engines of approximately 60%. Regarding alternative engine types, Fiat clearly is the market leader in this segment with a peak of almost 20% for engines which run on natural gas like LPG (Liquefied Petroleum Gas) in 2009. Hyundai and Kia had an increasing share of engines running on this technology between 2007 and 2009 but it went down to less than 1% again in 2011.

Comparing the percentage of diesel and gasoline cars in this segment, we see an increase of percentage of diesel engines and a decrease of gasoline engines. Both engine types lay around 50% in 2011 which means that there is not a dominant engine type in the low price segment at that point of the observation. In the first years of the observations period gasoline engines had a much higher share than diesel engines but the gap between the two types reduced over time. The variety in the segment based on the variable 'engine type' stayed approximately the same. It might be possible to argue that it slightly increased because of the reduction of the dominance of gasoline engines.

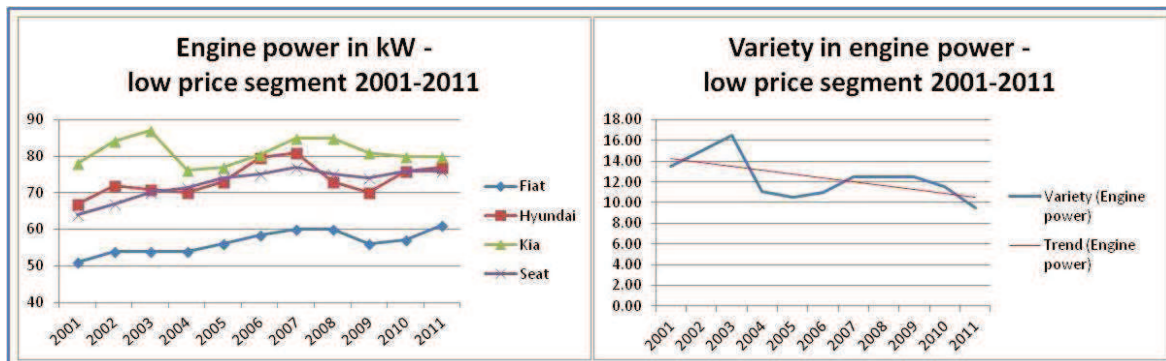
Figure 38: Median gasoline and diesel engines - low price segment



Source: own illustration based on ICCT (2012)

Our next variables for the technical level are engine size and engine power. When we first look at the evolution of the engine power we observe that Kia has the most powerful engines and Fiat has the lowest number of kilowatts in the segment. Also in this case Kia, Hyundai and Seat come closer to each other while Fiat stays on a considerably lower level. This development is also visible in the graph displaying the median of the differences where the trend line has a downward slope (right graph in figure 39). This means that the differences between brands are decreasing which would imply less variety between these brands.

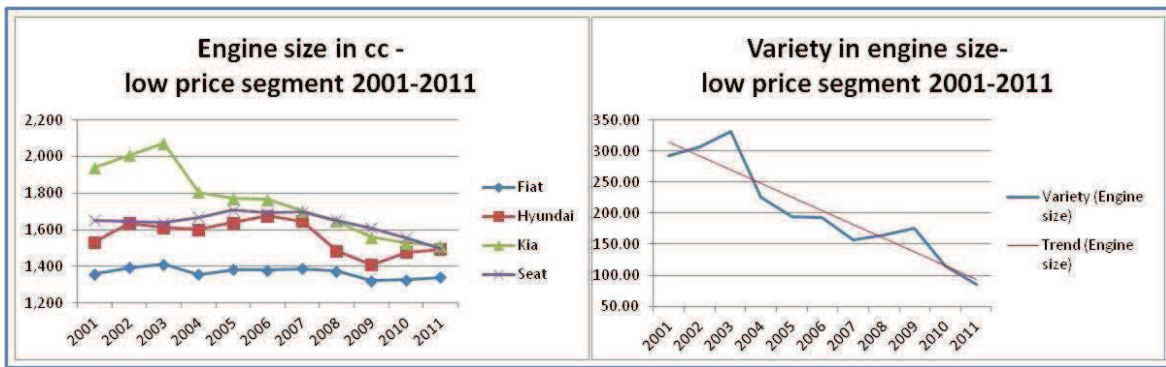
Figure 39: Engine power - low price segment



Source: own illustrations based on ICCT (2012)

While analyzing the development of the engine size, we would expect to see a lot of similarities with one of the engine power. This is only partially correct. Kia for example continually decreased, in contrast to the development of the engine power, its engine size to a point where it is as good as exactly the same as the engine size of Hyundai and Seat. However, all three brands always had more powerful engines over the years than Fiat. Once more Fiat is at the bottom of the graph with the lowest engine sizes and no big changes over time.

Figure 40: Engine size - low price segment

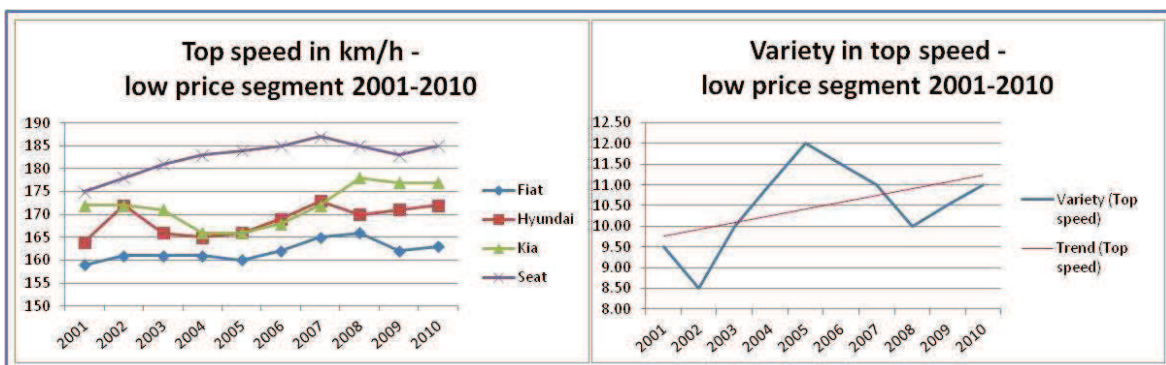


Source: own illustrations based on ICCT (2012)

The median of the differences shows a decreasing trend which again implies reduced variety. The engine size of Hyundai, Kia and Seat only varies within a couple of cubic centimeters from 1500 cc. This would mean that their engine sizes are basically equal. Together with the results from the variables engine type and power we can conclude that, on a technical level, product variety reduced comparing 2001 and 2011 because the results of engine size and power overweight engine type by two to one. The general level of product variety in the low price segment for passenger cars in the European market is quite low.

Finally, we examine the performance perspective where we consider the average top speed of the different brands. Seat clearly has the fastest cars in this market segment which is quite surprisingly because they did not have the most powerful or the biggest engines. This could be explained by better aerodynamics because they had the lowest height of all brands or just by the use of lighter materials. In general, all brands increased their average top speed over the years and all are quite diversified in 2010. We observe that the differences increased and that the performance of the brands in the low price segment diversified.

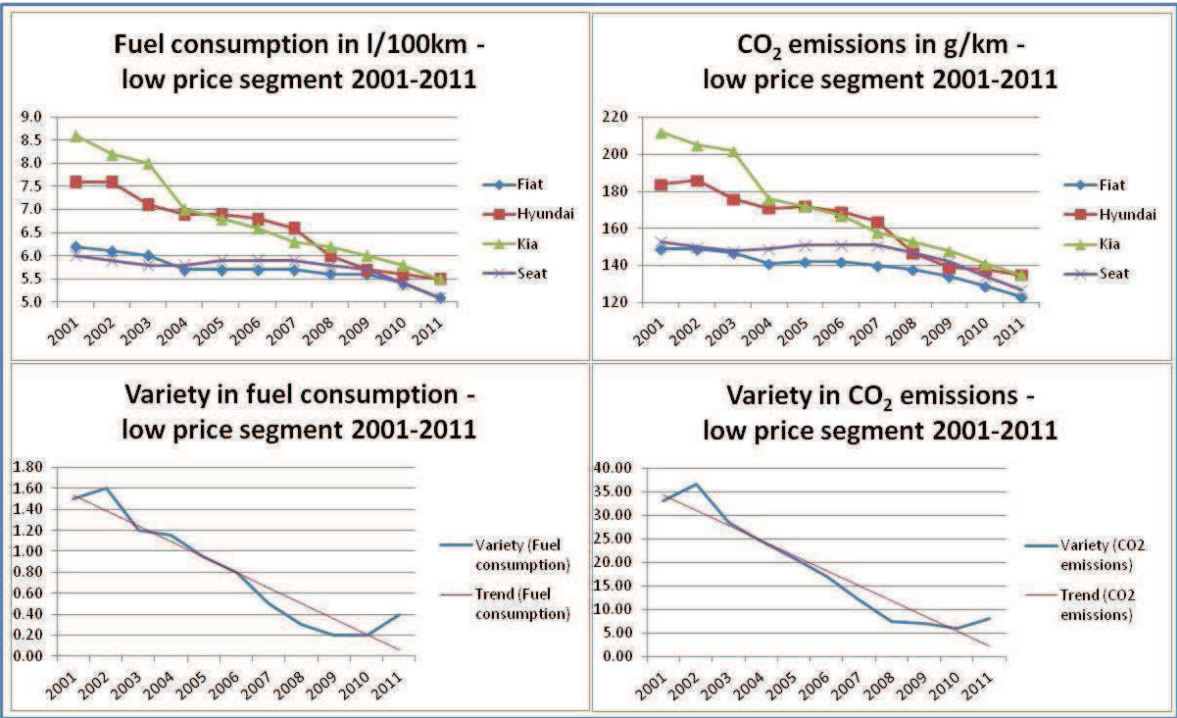
Figure 41: Top speed - low price segment



Source: own illustrations based on ICCT (2012)

If we then look at the fuel consumption and CO₂-emissions we see for both measures that all brands have decreasing measures from 2001 to 2011 albeit at a different decreasing rate. The brands are converging to each other in both graphs and also the medians show a decreasing trend. This means that car brands are consuming less fuel and therefore also have lower emissions. Furthermore, the differences between the brands are on a lower level and decreased in the 21st century. These results suggest a low and decreased product variety in the performance perspective.

Figure 42: Fuel consumption and CO₂ emissions - low price segment



Source: own illustrations based on ICCT (2012)

Two out of three perspectives indicate that product variety decreased and we therefore conclude that there is less product variety in 2011 than 2001 in the low price segment of the European car market.

Summary of the answers to the sub-questions and final conclusions for question 2

The just mentioned and described results for each perspective and segment are again summarized in the table below. This overview highlights the result that only the middle class segment increased its variety in all three categories. The other three segments only increased their variety in the design perspective while the other two perspectives experienced a decline of diversification between the different brands.

Table 3: Summary of the results regarding each segment and perspective

	Premium Segment	Middle Class Segment	Economy Segment	Low Price Segment
Design Perspective	increased	increased	increased	increased
Technical Perspective	decreased	increased	decreased	decreased
Performance Perspective	decreased	increased	decreased	decreased

Evaluating these results by the market share leads to the following:

- the product variety decreased for 50% of the market
- the product variety increased for 33% of the market

On basis of these results and the evaluation of the answers for the different variables and the three sub-questions it is possible to give a general answer for the consumers' perspective or more precise for the second main research question. This research question concerns the circumstance if there is still product variety in the European car passenger market and if the variety developed considering the three perspectives, design, technical specifications, and performance.

The answer to this question is, yes, there still is variety in the market and a development over the observation period took place. Main drivers of this still existing variety are the design level and the middle class segment. It seems as if the companies focus on the design level as a possibility to differentiate from its competitors or to present themselves in an as broad picture as possible. Like already stated in the beginning the middle class segment is the only segment which increased also variety in the other two levels of variety, technical specifications and performance. Even though the variety is on a much lower level in 2011 compared to 2001 due to the described development within the segments and of the different variables which were analyzed the variety is not zero and some differentiation and variation between the brands exists further on.

5.5 Product variety from the suppliers' perspective

In this part the focus will be on the internal variety resulting from the allocation of suppliers to the different brands. The basis for the analyses will be the database from SupplierBusiness. Like already mentioned in the introduction part to research question 3 it is assumed that, the higher the share of common suppliers, the lower the variety of the product and in the market in general. This assumption is built on the expectation that the quality of a component and the related services delivered to different manufacturers by the same supplier does not vary significantly or not at all.

Further assumptions have to be made due to the structure and appearance of the data before starting to work with it. While scanning the data it appeared that only the years when the single models were launched are considered in the database. That means that the supplier relationship is only linked to one year and not to all years of production when the relationship still needs to exist. In order to get the information it would be necessary to check the production period for every single model separately. In this case that would be far more than 100 models. Presuming that supplier relationships are based on long-term contracts and that models often have several generations, no separation of supply per year will be considered and all suppliers will be treated as still active. Possible bankruptcies, takeovers and mergers of suppliers are not taken into account. Finally, we also assume that every supplier has an equal level of importance to the manufacturers and that each supplier supplies equal amounts of resources.

In addition to the assumptions, the years before 1993 and after 2012 are excluded from the dataset due to incompleteness. This is reasonable because the data of the excluded years has a percentage of less than 1% of the whole data used. Also the analysis is narrowed down to the 16 brands of the four segments presented in chapter '5.3 Car brand segmentation'. Considering all brands for this analysis is due to the size of the database not executable in a reasonable time. These 16 brands only represent 1/3 of all brands, but they are considered as a representative share, because they count for around 78% of all data in the set.

The analysis for the suppliers' perspective is executed in the following way. First, the data will be analyzed from a general point of view. One objective in this case is to find out how many sole suppliers there are in the market i.e. how many suppliers exclusively supply only one brand. The other objective concerns the other side of the spectrum and tries to investigate how many suppliers supply all car manufacturers in the market and what percentage they represent out of all suppliers.

Second, we again consider the four different segments and analyze the number of common suppliers between two brands within a segment in relation to their total number of suppliers. For example, if we look at the premium segment, BMW shares 62% of its suppliers with Audi but for Audi this share accounts for only 58% of its suppliers. Then the average of these ratios for each segment is calculated in order to see if there are any differences between the segments. As a next step, we compare these results from the segments with results for the brands belonging to the same manufacturing group. The calculations are executed the same way and in this case the Volkswagen Group with the brands Audi, Seat, Skoda and VW is chosen as analyzing basis. Each segment is represented by one of the four car brand of the Volkswagen Group.

For the final step, we divide the supplier data into the different component areas. Then the calculations are done the same way as described above. The results are supposed to enable a comparison of the different component areas and to detect possible differences between the areas. The level of analysis is like also for this part the car brand level.

5.5.1 General figures and overview of the supplying structure

We start with the supplier structure in general and see how many suppliers supply all brands or just one brand in the European passenger car market. In total, the 16 brands are supplied by 596 exclusive suppliers. These account for around 40% of all suppliers. VW has with 85 exclusive suppliers the highest number of all 16 brands. These 85 represent 14% of all exclusive suppliers and 15% of all VW's suppliers. Renault and Fiat with 14% each are both ranked second regarding the share of exclusive suppliers on the total number of their suppliers. Looking at all 16 brands, the percentages vary from 2% up to the just mentioned 15%.

The opposite approach considers suppliers which supply all brands in the industry. That means that all of them have certain parts in common. In case of the 16 selected brands 16 suppliers deliver components and services to all of them. This is equivalent to approximately 1% of all suppliers having contracts with all the brands considered. Nevertheless, it needs to be stated that none of the suppliers delivers products to all 48 manufacturers in the complete database. There are only ten producers supplying 40 brands or more. These ten account for less than 1%. The supplier delivering its products to the largest number of manufacturers (44) is Continental.

These numbers are indicators for product variety because of the already mentioned interaction that more exclusive suppliers lead to more variation between the manufactured cars of the different brands and a high level of suppliers supplying all brands leads in the opposite direction. In this case, the overall results of 40% exclusive suppliers and 1% of suppliers sup-

plying all brands indicate that the product variety is on a relatively high stage. In contrast, the figures of exclusive suppliers per single brand give a slightly different picture with much lower percentages regarding the exclusiveness of their suppliers. The variation between the brands and within the different segments will be examined more in detail in the following part in order to get a clearer picture and to draw more precise conclusions about the variety.

5.5.2 Analyses on segment and group level

The second step for the analysis of the suppliers' perspective considers the average percentage of common suppliers within a segment and if there is any difference between the four segments. Common supplier in this case means that a certain supplier delivers its components to both of the compared manufacturers. The average percentage per segment is a result of comparing all four brands with each other. The number of common supplier is then divided by the total number of suppliers of the certain brand. These percentages are summed up and divided by the number of results to get the average. The tables with the brand by brand comparison of all four segments can be found in the appendix (Appendix A).

The highest percentage of common suppliers in a segment can be found in the premium segment where the brands share on average 56% of the suppliers. The middle class is ranked second in this comparison with an average of 54%. The economy and the low price segment reached an average of 49% and 43% respectively. An overview of these results is displayed in table 4 beyond. Conspicuous is that the highest average percentage of common suppliers was accounted for the premium segment and the lowest for the low price segment. Relating these outcomes to product variety leads to the assumptions that the variety in the low price segment is more distinctive than in all other segments and that the variation of the cars of the premium segment is comparatively low. These assumptions are not consistent with the expected results based on the structure, composition and appearance of the segments. These expectations would have assorted the levels of variety the opposite way.

Table 4: Average share of common suppliers within each segment

Segment	Average
Premium	56%
Middle class	54%
Economy	49%
Low price	43%

Source: own calculations based on IHS (2013c)

After comparing the different segments with each other, we will compare the segments with one car manufacturing group. When comparing the segments, the number of common suppliers is taken into relation to the total number of suppliers between competing brands in a specific segment, for example, Audi versus BMW in the premium segment, Ford and Opel in the middle class segment and so on. Like just described the results of these analyses say something about the level of product variety between these competing brands in the same segment. However, it is also possible that there is a lower level of variety between car manufacturers which are in different segments but belong to the same group. If we take the Volkswagen Group as an example, we see that this group is represented in each of the four segments. In the premium segment there is Audi, in the middle class segment VW, Škoda in the economy segment and Seat in the low price segment. We expect that the number of common suppliers between these brands is higher because they belong to the same group and might try to gain advantages through sharing suppliers.

The shares of common suppliers between the brands within the Volkswagen Group are displayed in the table below. Škoda is the brand sharing most of its suppliers with Audi and VW with 77% of its total suppliers. For Audi and VW this is respectively 44% and 39% of their total number of suppliers. For all four brands of the Volkswagen Group, the average ratio of common suppliers to the total number of suppliers is around 60%. In other words it is possible to say that six out of ten of the total number of suppliers of these brands, supplies components to several manufacturer of the group. This means that there is a high level of component sharing between these brands which indicates a low product variety. In addition, we can say that there is not only a low level of product variety between brands in the same segment, but the product variety is even lower between brands belonging to the same group such as the Volkswagen Group. The average of common suppliers in the segments is roughly around 50% for each segment. We can conclude that there is a significant difference between the number of common suppliers of brands within different segments and car brands belonging to the same group.

Table 5: Share of common suppliers within the Volkswagen Group

VW Group	Audi	Seat	Škoda	VW
Audi		70%	77%	60%
Seat	47%		69%	44%
Škoda	44%	59%		39%
VW	68%	75%	77%	

Source: own calculations based on IHS (2013c)

5.5.3 Supplier allocation on component area level

Finally, we try to explore if there are any differences in the number of common suppliers between the different areas of which a car is built up. It is most reasonable to expect to find differences between these areas as it gives the possibility to the car manufacturers to differentiate from their competitors and to create variety in one of these areas. It would be perfectly possible for two or more brands in the market to have substantially more common suppliers in, for example, the powertrain area. This area includes, among others, the transmission and engine of a car. These parts are typically very capital intensive to develop and produce so it often happens in the industry that some car manufacturers set up a joint venture to develop and produce some of these parts together both to share the investments for research and development and to lower the unit price by achieving scale economies. However, this has negative effects on the product variety if both of their products will run on the same engines. Therefore, it is possible for the car manufacturers to seek for variety in other areas like interior or exterior and try to differentiate from its competitors in this way.

In order to analyze the supply structure within the different component areas we divide the data according to the seven different areas and calculated also in this case the ratio of the number of common suppliers to the total number of suppliers for each of the 16 brands. Then we take the average of each area. The results of these calculations are shown in the table below.

Table 6: Share of common suppliers within the different areas

Area	Average
Chassis	58%
Electronic	62%
Exterior	58%
Interior	58%
Miscellaneous	62%
Powertrain	55%
Tooling	62%

Source: own calculations based on IHS (2013c)

Remarkably, the averages of ratios of common suppliers for all areas vary between 55% and 62%. In other words, for each area, all 16 brands have on average six out of ten of their suppliers in common with another brand in the market. There are no distinct differences between areas when it comes to the rate of common suppliers between brands. Out of this we can conclude that there is no variety-seeking or differentiation in one of the areas. In all component areas a car has, all car manufacturers share approximately the same amount of suppliers in relation to their total supply base.

In this section we looked at the supplier data from two different angles. First we compared the number of shared suppliers between brands at segment level, and then we also looked at the data for all brands but divided according to the component area of the car. Both approaches give ratios, on average, mostly between 50% and 60% which means that half of one manufacturer's supply base is shared with other manufacturers on the segment level as well as group and component area level. With this overall high percentage of supplier and component sharing we can conclude that product variety in the industry, from a supplier's perspective, is quite low.

Summary of the answers to the sub-questions and conclusions for question 3

This part of the analyses dealt with the internal product variety in the European passenger car market based on the supplier allocation and supplying structure in the industry. First, we looked at some general results such as the number of exclusive suppliers and suppliers having all manufacturers as customer. 40% of the suppliers operate as sole supplier which is rather high and would indicate high variety. However, this also means that 60% of the suppliers have at least two or more car manufacturers in the industry as their customer. This is a first indication for a low level of diversification between the brands. Looking at the different segments, we found out that the segment with the highest ratio of supplier sharing is the segment with the highest average price (premium segment) and that the low price segment has the lowest average ratio of common suppliers. Possible arguments and explanations for this will be discussed in the next chapter of the thesis.

Another approach to the research question concerning the suppliers' perspective is that we take one manufacturing group as an example, in this case the Volkswagen Group, and look at the common suppliers of the brands belonging to this group. We expected that the average share of common suppliers of the Volkswagen Group would be higher than the one of the four segments. The results confirmed this expectation. The Volkswagen Group has a ratio of 61% common suppliers compared to an average of 50% in the segments. This means that there is less product variety between car manufacturers belonging to the same group. In

order to definitely confirm this hypothesis, it would be necessary to test this with all or several groups but this is not taken into this thesis. This and further limitations and further research will be discussed at the end in chapter 7.

As a last approach, we split up the suppliers according to seven component areas of a car. If we would find some significant differences between the areas, we would be able to point out in which areas car manufacturers try to seek for more differentiation. However, the average range of ratios ranks from 55% to 62% which means that there is no area which is significantly different from the others. In other words, in all areas there is a high level of supplier sharing with an average of 59% and the level of product variety in the different component areas is similar.

Table 7: Comparison of the results of average percentage of common suppliers

Level	Average
Segment	50%
VW Group	61%
Area	59%

Source: own calculations based on IHS (2013c)

5.6 Product variety and sales

In this section research question 4 will be answered. This question concerns the interaction between product variety and sales in the European passenger car market. The goal is to find out if there is a relationship between the two mentioned characters. In case the results indicated that this relationship exists it is also of interest if product variety has a negative or positive impact on sales. As basis for answering this research question the car model series timeline and the European car market statistics will be used. In addition and as in the analyzing part of the consumers' perspective variables have been chosen to enable the answering of this question. These variables will be explained in the following part.

5.6.1 Variables product variety and sales

The measures chosen for the analyses executed in this part of the thesis refer to the consumers' perspective due to the suitability of the available data. As measures for testing and analyzing the existence of an interaction between product variety and sales the evolution of sales over time as well as new launches, the number of car model series and the market share of the 16 brands are considered. These measures are linked and form the basis for the following two variables:

- a. The first variable explores the effect of entering new market segments on sales. That means it is supposed to examine if car manufacturers are able to increase their overall sales when entering new market segments such as, for example, the SUV-segment.
- b. The number of car model series and its relationship to the market share and sales is the basis for the second variable. The matter of interest in this case is if manufacturers with the largest offered variety, based on the number of series, also have the highest market share and sales per year in the European passenger car market. In other words if these two measures are correlated.

5.6.2 Results product variety and sales

The analyses in this part of the paper are again executed for the 16 car brands chosen previously and structured in accordance to the four defined market segments. Like in the consumers' perspective each segment will be analyzed separately, starting with the premium segment and finalizing with the low price segment.

Premium segment

In order to find out if there is a relationship between product variety and sales, we will first look at the evolution of sales data when car manufacturers launch a new series in a segment which were not included in their previous portfolios. After that, we will compare the level of

product variety with the market share and see if the manufacturers offering the highest variety also have the highest market share.

We expect that launching a new car series is launched or in other words increasing the product variety has positive effects on sales. Therefore we calculate the development of sales compared to the previous year in percent. The results for the brands of the premium segment are displayed in the table below. The year after the actual launching is also taken into consideration due to the possibility that the new car series was launched late in the year and did not impact the sales of that year significantly. The fields which are marked red represent the years when the particular brand launched a new car model series or entered a new market segments.

Table 8: Development sales volume - premium segment

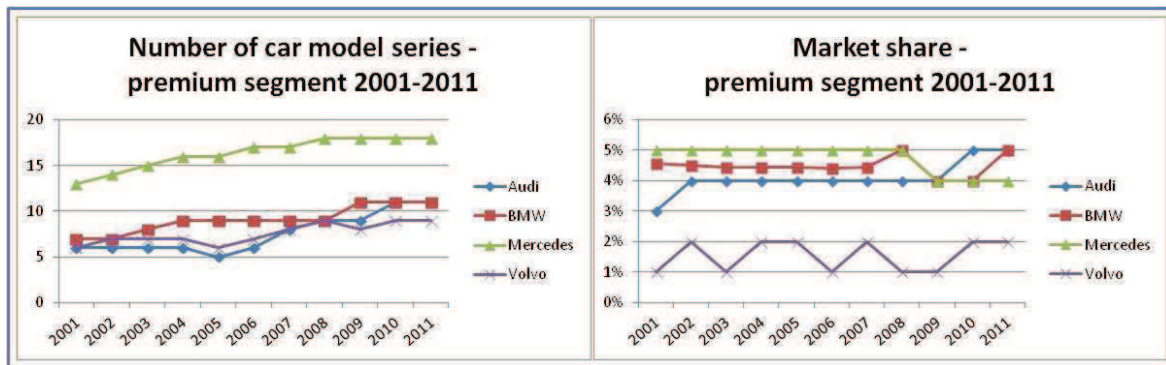
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Audi	2.00%	-0.28%	2.39%	9.57%	3.67%	2.90%	0.19%	-7.56%	1.74%	8.81%
BMW	0.09%	0.52%	-1.67%	2.82%	0.60%	-7.41%	3.95%	-15.57%	6.44%	4.79%
Mercedes	0.36%	-2.39%	-3.92%	0.26%	3.15%	0.23%	-6.16%	-15.49%	0.84%	1.25%
Volvo	4.03%	-6.36%	14.49%	-0.46%	-4.67%	8.17%	-16.21%	-8.49%	12.13%	9.81%

Source: own calculations based on ICCT (2012)

If we first look at Audi, we can see that sales increased every time the manufacturer launched a new product although the increase in 2008 is just below 0.2%. BMW has mixed results and shows that sales increased for some years, but also decreased in others when launching new cars. Also Mercedes and Volvo show both negative and positive sales changes. This means that the brands of the premium segment did not increase their sales every time they launch a new series in the European car market.

As a second part to answer the research question, we will now look at the market share and the level of product variety in terms of number of car model series. Again we assume a positive relation between the number of series and the market share i.e. the more variety a car manufacturer offers, the higher its market share should be. If we compare the graphs below we see that Mercedes has the highest product variety and also the highest market share which would confirm our assumption. However, in 2009 Mercedes lost market share to BMW and Audi and still offered the highest variety. Also Volvo offered a higher product variety from 2001 to 2007 compared to Audi but Audi always had a higher market share in those years. Therefore, the results of the explorations related to the second variable indicate that a high level of variety not necessarily leads to a high market share and this expectation formulated in course of the second variable can be denied.

Figure 43: Number of car model series and market share - premium segment



Source: own illustrations based on Tealida (2013) and ICCT (2012)

In order to have more evidence that there is no relation between the level of product variety offered and the market share the correlation is calculated. If we analyze the coefficients from each brand separately we can see that Audi has a significant positive correlation while Mercedes has a negative correlation. BMW as well as Volvo show similar results but these coefficients are much less significant. These results underline the statements made on basis of the visual interpretation of the graphs above and enable a final conclusion regarding the question if there is a relationship between product variety and sales in the European passenger car market. The results for the premium segment were quite inconsistent between the different brands and pointed in a negative as well as in a positive direction. Based on these inconsistencies we conclude that there is no clear relationship between these factors in this segment.

Table 9: Correlation coefficients premium segment

	r
Audi	0.73
BMW	-0.22
Mercedes	-0.60
Volvo	0.12

Source: own calculations based on Tealida (2013) and ICCT (2012)

Middle class segment

Like already described the first variable is supposed to check if manufacturers were able to increase their overall sales when entering new market segments. The definite answer for the middle class segment is 'no'. The manufacturers were not able to increase their sales, nor in the year of entering the new segment nor the year after. In the year a brand entered a new segment the development of sales compared to the previous year was always negative for this certain brand. The same characteristic is observable for the year after entering the new

segment. The only exception is VW in 2009. In 2009, VW sales grew by around 5%. It needs to be added that the overall development of sales in this segment was negative and only very randomly the brands were able to increase their sales compared to the previous year. In the table an overview of the percentage development of sales compared to the previous year for each brand is given. The fields which are marked red represent this case the years when a new segment was entered by the certain brand. Not included in this table are launches in the segments the brands have already been present before and modifications or new generations of already existing car model series.

Table 10: Development sales volume - middle class segment

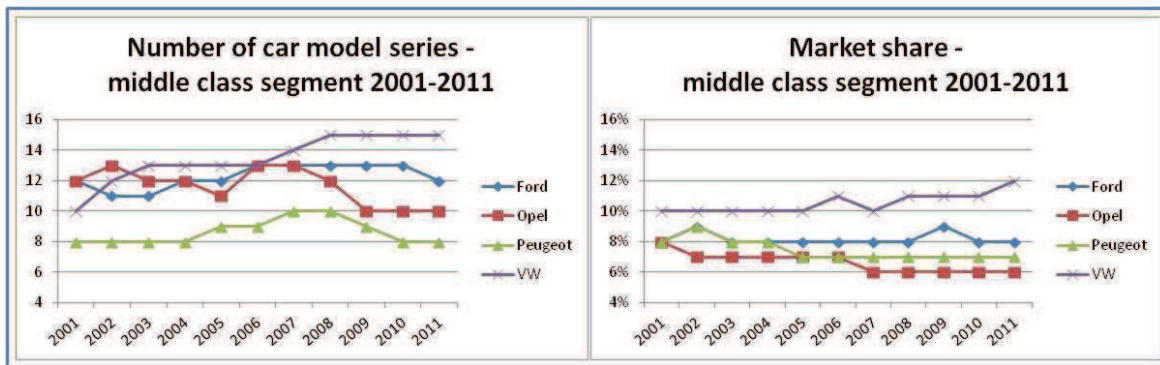
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Ford	-0.79%	-2.77%	2.22%	-2.68%	0.91%	1.76%	-5.90%	5.01%	-13.70%	-3.32%
Opel	-13.05%	-3.65%	-0.14%	-0.36%	-2.19%	-2.19%	-15.50%	-3.04%	-8.56%	-0.68%
Peugeot	0.75%	-5.66%	-4.45%	-5.46%	-1.79%	-1.46%	-8.99%	-1.53%	-0.55%	-9.52%
VW	-6.65%	-4.42%	1.63%	3.97%	7.87%	-3.61%	-3.67%	5.24%	-8.66%	10.89%

Source: own calculations based on ICCT (2012)

The two graphs in figure 44 display the development of both, the number of car model series and the market share of the brands within the middle class segment. Both are characteristics of the second variable which explores, like described in the previous part, the relationship between product variety on the design level and the market share. The goal is to find out if the brand with the highest variety also has the highest market share.

The brand with the highest variety does not necessarily have the highest market share like visible in the beginning of the observation period (2001 and 2002). Opel had the highest variety in these two years, but the highest market share was gained by VW and even Peugeot with the lowest variety of all four brands had a higher market share than Opel at that time. Starting in 2003 VW had the highest level of variety and highest market share, but the distribution of variety and market share of the remaining three does not support assumptions about the existence of this relationship. Opel always stayed last in the middle class segment regarding the market share no matter which number of car model series the company offered on the market.

Figure 44: Number of car model series and market share - middle class segment



Source: own illustrations based on Tealida (2013) and ICCT (2012)

Again we calculate the correlation between these two factors in order to confirm our evidence for this non-relationship. The results are displayed in the following table and underline the previously stated result that no relationship exists. The correlation coefficients are wide spread over the range between 1 and -1. Two of the results are negative. The coefficient of Ford, one of these two negative results, is not only negative, but also close to 0.

Table 11: Correlation coefficients middle class segment

	r
Ford	-0.17
Opel	0.44
Peugeot	-0.57
VW	0.67

Source: own calculations based on Tealida (2013) and ICCT (2012)

The conclusion for the middle class segment can be summarized quickly. It was not possible to find any evidence for the fact that increasing product variety could lead to higher sales. Furthermore, a high level of product variety in the design perspective does not necessarily mean that a high market share can be gained. Even the best result in this segment only gave a correlation coefficient of 0.67.

Economy segment

The development of the economy segment is in general much more positive than the one of the middle class segment. The brands were able to keep their sales around the same level over the observed time period even though with significant fluctuations. Also the connection of entering new segment and sales gives a more positive picture in this case. Eight out of ten times sales increased in the year of entries into new market segments. On the other hand the balance for the years after entries is less promising. Here only three are positive and six negative while one is not known so far. In this case it is not possible to give a clear answer

due to the fact that the increase in sales compared to the previous year could also be a result of the general positive development and is not necessarily attributable to the entry into new market segments. The percentage development of sales compared to the previous year for all four brands is displayed in the following table. Highlighted in red are only the years when a certain brand entered a new market segment.

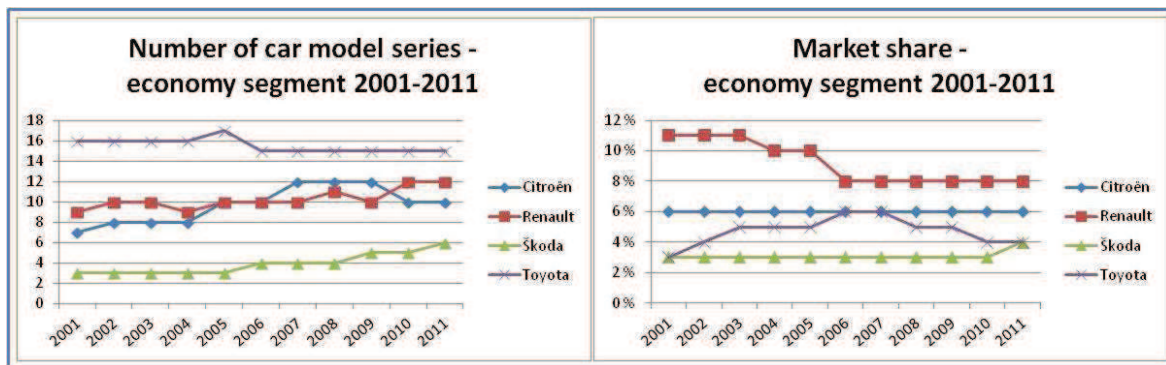
Table 12: Development sales volume - economy segment

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Citroën	3.51%	2.82%	-3.04%	1.67%	-2.07%	2.84%	-9.15%	1.44%	-4.90%	-8.37%
Renault	-1.28%	-1.76%	-1.26%	-5.78%	-12.39%	-7.35%	-9.13%	-1.97%	4.11%	-8.60%
Škoda	-4.53%	2.77%	-1.60%	4.52%	6.70%	3.01%	-4.04%	7.29%	-4.20%	5.28%
Toyota	16.92%	11.20%	6.81%	4.26%	9.21%	2.30%	-16.48%	-5.92%	-18.04%	-9.90%

Source: own calculations based on ICCT (2012)

The answer for the considerations of the second variable concerning the relationship between variety and market share can be given more clearly. Based on the two graphs shown below it is possible to say that there is no relationship between the variety of the design level and the market share of a car brand within the economy segment. While Toyota constantly had the highest number of car model series Renault kept the highest market share over the whole period of observation. Another example is Citroën which had exactly the same market share all the time no matter how its variety developed.

Figure 45: Number of car model series and market share - economy segment



Source: own illustrations based on Tealida (2013) and ICCT (2012)

The calculation of the correlation coefficients for the four brands underline the conclusions made above. They are quite diffuse. The correlation coefficient of Citroën is 0 and indicates that there is no linear relationship at all. Two other extremes are that there is one result indicating a slightly positive correlation (Škoda 0.66) and on the other hand one suggestion a slightly negative relationship (Renault -0.60).

Table 13: Correlation coefficients economy segment

	r
Citroën	0.00
Renault	-0.60
Škoda	0.66
Toyota	-0.22

Source: own calculations based on Tealida (2013) and ICCT (2012)

The final conclusion for the economy segment is not unambiguous. While the result for the first part can be interpreted in different ways the answer for the second part is clear. Based on the structure and development over the whole period for all brands it is assumed that the development is not significantly influence by the entrance of brands into new market segments. Especially looking at the measures for the year after entry and the figures presented by Toyota underlines this assumption. Toyota onetime gains sales volume of 4.26% (2005) and the next time it loses around 6% (2009). In addition, in 2010, the year after entry, this loss tripled up to 18% which is very unlikely just a result of the entry to new segments. So based the assumption made it can be concluded that entering new market segments does not automatically lead to increasing sales. The second part on the other hand gave an unequivocal picture. A high level of product variety in the design perspective does not automatically result in a high market share.

Low-price segment

As last, we will look at the data for the low price segment and see if there is a relationship between product variety and sales. Our approach is the same as for the previous segments, first we try to find out if there is a relationship between an increase in variety and car sales compared to the previous year and after that we look at the market share and product variety in terms of the number of car model series.

Table 14: Development sales volume - low price segment

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fiat	-16.77%	-9.97%	-2.05%	-11.77%	19.54%	8.06%	-2.47%	6.47%	-18.61%	-17.07%
Hyundai	7.63%	11.11%	23.14%	3.82%	-3.57%	-5.38%	-11.97%	27.00%	2.79%	10.54%
Kia	8.41%	45.76%	52.41%	43.48%	-6.21%	4.86%	-7.46%	10.92%	0.59%	10.08%
Seat	-5.94%	1.70%	-2.34%	-4.90%	2.83%	-0.86%	-13.35%	-5.82%	-5.15%	0.94%

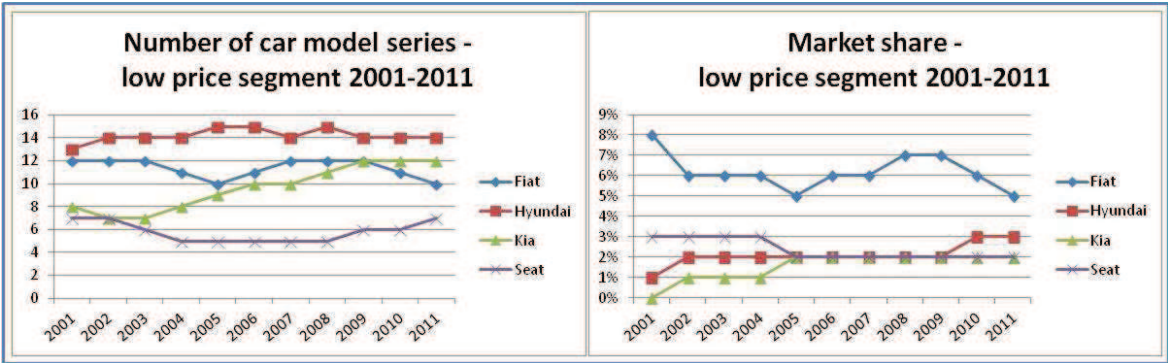
Source: own calculations based on ICCT (2012)

The red fields in the table above are again the years where the car manufacturers launched a new car series or entered new segments. In total for the period between 2002 and 2011, there were 16 launches of new low price car model series. If we look at the sales data for these years, nine turned out to have increased their sales compared to the year before and

seven times sales decreased in the year the car was launched. If we look at the following year, sales increased in nine out of 16 and decreased in six out of 16 times. One following year is missing because of missing sales data for 2012. The results point out that manufacturers do not necessarily increase their sales when entering new market segments or modifying their product portfolio.

Now we will look at the number of car model series and market share and see if the manufacturers in the low price segment with the highest product variety also have the highest market share. Hyundai is clearly the car brand providing most variety in this segment but has the same market share as Seat and Kia of around 2%. Fiat is clearly the market leader in this segment but does not have the highest product variety and started to decrease its number of models since 2009. This indicates that the car producer with the highest variety does not have the highest market share.

Figure 46: Number of car model series and market share - low price segment



Source: own illustrations based on Tealida (2013) and ICCT (2012)

In order to see if there is any relation between the market share and the number of car series, we correlate the data for each brand and get the following results.

Table 15: Correlation coefficients low price segment

	r
Fiat	0.75
Hyundai	0.25
Kia	0.75
Seat	0.39

Source: own calculations based on Tealida (2013) and ICCT (2012)

All four brands show a positive correlation but only Fiat and Kia show a clear and significant correlation of 0.75. Due to the fact that only two out of four brands show a significant correlation between the two characteristics it is not possible to conclude that the relationship between variety and market share exists for the entire segment. Finally, the results of the low price segment can be shortly summed up. Both variables indicate that no relationship between product variety and sales is present in the low price segment, neither positive nor negative.

Summary of the analyzing results for the variables and final conclusions for question 4

The results for all four segments in the European car market indicate that there is no relationship between product variety and sales. Some results gave some positive indications for a positive relationship but are outbalanced by other factors which showed mixed results so that no clear line could be drawn. This non-relationship was already discussed by some authors in the literature review and is in our analysis confirmed. However, these results have to be nuanced in a way that we approached product variety on a high level and mainly from the design perspective. This means that the results could be different if we would change the level of analysis and/ or the perspective. This will be further discussed in the conclusion at the end of this thesis where we describe some of our limitations and ideas for future research.

5.7 Summary of the results of the analyses

In this part the results of the executed analyses will be shortly summed up in order to get the whole picture and overview of the results before they will be discussed. The order for this summary will be based on the order of the previous analyzing parts of the chapter. The first step was the SWOT analysis, followed by the development of a definition of product variety suitable for the purposes of this thesis and the introduction of the different perspectives of variety. Furthermore, the brands used for the subsequent analyses were selected based on data completeness and divided into four segments according to their average price in 2011. The perspectives as well as the segmentation formed the basis for the structure of the three analyzing parts concerning the consumers' and suppliers' perspective as well as the part dealing with the relationship between product variety and sales.

Starting with the SWOT analysis, just a few points will be highlighted due to the overview already given subsequent to the SWOT analysis (Table 1 – 'Overview SWOT analysis automotive industry'). The strengths and weaknesses are often directly related. While the industry profits from high qualified labor, the labor cost weakens the competitiveness. Furthermore, the European brands have a large home market, but in this market the sales trends are very

flat. Two opportunities of the industry refer to the intensification of the buyer-supplier-relationships and to sharing of knowledge and expertise. Examples for external threats that could affect the industry negatively are low economic growth in the European market and the current dependency on fossil fuels in combination with the hardly predictable development of the oil price.

For the summary of the results of the analyses concerning the consumers' perspective it can be said that 50% of the market decreased its variety while 33% increased it. This 33% are represented by the middle class segment which is the only segment with a higher level of variety in 2011 than in 2001. The other three segments represent the 50% that reduced their level of diversification. Taking a look at the three perspectives, design, technical specifications and performance, the first mentioned raised the level of variety in all four segments while the remaining two decreased it in three out of four times. In both cases it was the middle class segment where the trend was opposite to the rest.

In the suppliers' perspective the results show that around 40% of all suppliers are exclusive suppliers while 1% supplies all 16 brands. The average share of common suppliers within all four segments is around 50% while the premium segment is the one with the highest average percentage of common suppliers and the low price segment the lowest. The findings indicate that the percentage of common suppliers is even higher between brands of one group such as the Volkswagen Group. No evidence was found that there is a significant difference between the different component areas, the share of common suppliers ranges within 7%.

The results of the analysis regarding the interaction between product variety and sales volume in the European passenger car industry underline and confirm the outcome of previous researches about this interaction in the automotive industry that there is no relationship and that the level of variety does not influence the sales figures.

6 Discussion

Now that we finished the case study about the European passenger car market, we can discuss the results from the analyses which are summarized in the previous section 5.7. We compare the answers to the research questions to what we expected and see if we can link these results to the literature about product variety and the automotive industry which was introduced in chapter 3. In section 3.4 we already discussed that there is some contradiction in the literature regarding product variety and its possible relation with sales. Here we will also discuss if our results match the theory or if it is contradictory.

The results of the executed analyses show that both perspectives do not support the statements in literature regarding the increasing variety. Especially the consumers' perspective shows the opposite trend in the period from 2001 to 2011. For the suppliers' perspective it is not possible to make a statement of the development due to the fact that the analysis just considers the current situation. Nevertheless, the fact that the brands have on average a share of around 50% of common suppliers also indicates a lower level of variety than expected. The discussion of the results of these two perspectives will be split up. Firstly, the part regarding the consumers' perspective will be examined and the results will be linked to the theory. Subsequently, the results of the last part concerning the interaction between product variety and sales will be discussed.

The reasons for these results can be multitude and can for example be found in the way the analyses were executed, the characteristics of the industry as well as in the economic situation of the industry and the European market. It might be that the product variety would have increased if other angles and tiers of variety would have been considered. In this paper the consumers' perspective observed the product variety between brands and not within brands. So it is possible that the variety one single brand offered within the observation period increased while the variety between the brands declined. Furthermore, the product variety of a more detailed tier of variety such as the variety concerning the variants and options of car models could also lead to other results than the level of car model series.

Nevertheless, it is reasonable that the variety in the European car market declined in the observed period. According to former research the variety in the European car market is extremely high and exceeds most likely the optimal and necessary level of variety. It is more important for the consumer that the variety is clearly distinguishable. Assuming that the manufacturers base their decisions about their strategies partly on the results of market observations and studies and that these are the same for all brands of a certain segment, it does not surprise that the actions taken are similar. If the companies base their decision on the same information, the resulting strategic steps are most likely the same or at least similar.

In the theory it was mentioned that due to high levels of variety and an increasing frequency of introducing new or modified products to the market the life cycles of the products are getting shorter and so the chance of gaining back the investments for research and development and all other costs related to the introduction of the product to the market. Moreover, it is more difficult to realize scale properties in a production process with high variety. All these factors make it interesting for brands to form joint-ventures, to share platforms or to even merge which also could be an explanation for the reduction of variation between the brands.

The only two exceptions which increased their variety within the consumers' perspective are the design level and the middle class segment. The first mentioned deals with the development within one of the three sub-groups of the consumers' perspective concerning the design of the car, the other one takes the segments as basis for the analysis. It seems that the car manufacturers have chosen the design of a car as one of the basis for their strategy of diversification. The number of car model series grew for nearly all of the observed brands in the period from 1991 to 2011. A reason for this strategy could be that the variation of car models or series is the easiest to identify even by not so experienced and skilled consumers. It seems as the focus of differentiation would be put on the visible parts of a car. This impression is underlined by the fact that the number of car models in the European market increased in the last years while the number of platforms used for these models declined.

Other options for diversification within the design level which were not examined in this paper are the offered options related to the design of a car. The level of customization which is offered by the manufacturers possibly varies between the different brands but also between the different segments and the strategy applied by the single brand could have an impact on the amount of variety offered.

It is not possible to definitely argue why the analyses of the middle class segment came to different results than for the other segments. It might be that the manufacturers in the middle class segment chose a different strategy than the others. Their focus of differentiation may not only be on the number of car model series, to gain more market share or to be able to compete with the premium segment for example by entering new market segments. Another possibility is that the sales volumes in this category are high enough to cover the costs resulting from variety. Furthermore, some researchers are convinced that the trade-off point related to variety is lower in the automotive industry than in other industries due to the new technologies and techniques applied and therefore the manufacturers are able to gain higher benefits out of a high level of variation.

The results of the two remaining perspectives, technical specifications and performance, were already anticipated by stating that the design perspective represents an exception with its raising variety in the observed time period. The perspective of technical specifications probably includes the aspects most of the consumers do not know a lot about or even are not so important for the consumers' choice. Here, the engine power could be an exception at least for some buyers. Other factors like the engine type seem not to be a source for gaining competitive advantage and the alternative fueling systems and technologies are not very popular. It is very likely that this will and has to change in the future. The dependence on fossil fuels and the development of the oil price were mentioned as major weaknesses of the industry in the SWOT analysis. In order to be successful, companies may have to reconsider their strategy related to engine type which also could influence the variety. The product variety could either be reduced or increased by the introduction of other/ new engine types depending on how fast the different brands change their strategy.

According to studies about consumer preferences, the characteristics of the performance perspective are very important for the consumers' choice. Fuel consumption reducing technologies are getting more and more important especially in relation to the previously mentioned development of the oil price. In addition, the environmental awareness is growing. These two trends force the manufacturers to invest in these areas of the car. Concerning variety these two areas do not contain much potential for differentiation so the variety level declined in accordance with the fuel consumption and emission rates. Furthermore, the flexibility of the features of the performance perspective or the flexibility of changing and varying them is not very high, so that the companies probably focus on other components and areas of a car to differentiate from their competitors.

For the suppliers' perspective the explanations and basis for the results are as multitude as for the consumers' perspective. Also for this perspective the differences between the brands

were considered. Not taken into account for the analyses of this case study, but possible influencing factors for the variety related to the supplying structure in the industry, are the general trend of merger and acquisition in the last years and the appearing bankruptcies.

According to theory, four characteristics have an impact on the supply structure of an industry, the type of supplier, the specification of the components delivered, the conditions of production and the allocation of power in the market respectively the interdependencies between the different players in the market. This theory can be related to the results of the analyses of the suppliers' perspective.

We assumed that the level of variety decreases if the percentage of common suppliers between brands increases. However, the results of the analyses concerning the percentage of shared suppliers within the segments are opposite to the preceding expectations. In accordance to these expectations the variety and diversification would be highest in the premium segment and lowest within the low price segment. A possible way of arguing is that the quality demanded by the brands is declining from segment to segment and that the brands of the premium segment demand the highest quality of all four segments which can only be provided by a small number of suppliers. If this is the case, the chance of sharing suppliers between the brands is higher as in the opposite case when the components can be delivered by several different or even local suppliers.

The second part of the results concerns the high share of common suppliers on the group level. In this case it was the Volkswagen Group which brands share on average 60% of the suppliers. This result can be approached in two different ways. The first one considers the option that the members of the Volkswagen Group are able to bundle their buying power. If they buy their components jointly, the amount purchased is significantly higher especially for parts which are not very valuable but are needed in large quantities. This purchasing strategy can achieve scale economies. The dependency of the supplier on the group is most likely very high due to the purchasing value of the group and so the group has more power in the course of negotiations. This trade-off for the members of the group leads to a reduction of variation between the cars of the different brands due to the higher share of similar or equal components. It can be expected that the variety in the market will decline further because the trend of joint ventures and mergers of popular brands in the automotive industry is supposed to continue. The latest examples for this trend are the already mentioned joint venture between GM and Fiat and the integration of Porsche into the Volkswagen Group.

The second option of explaining the result concerns the importance of strategic partnerships. Strategic partnerships are mentioned in theory as a possibility to gain competitive advantage and to improve the quality of the delivered components. This approach could be supported by the fact that the brand VW has the highest share of exclusive suppliers and might have chosen the strategy of forming partnership with its suppliers. If these partnerships are expanded to the other members of the group it would increase the share of common suppliers between these brands. This argumentation indicates that strategic partnerships could be seen as a strategic decision for quality instead of variety.

The idea of strategic partnerships comes from the Japanese industry, with Toyota as a leading example, where they have much more single source suppliers than in the European automotive industry. In the post World War II era, car manufacturers in Europe chose to have multiple suppliers in order to spread the risk of becoming dependent on suppliers. Having multiple suppliers also made it possible to create competition between these suppliers so the manufacturers could have a cost advantage. However, this caused negative effects on quality and compatibility of the components. Despite that European manufacturers tried to take over the Japanese model of strategic partnerships, they have not been completely successful. Asset specific investments for the strategic suppliers are high and manufacturers put a lot of pressure on the suppliers in terms of costs. This means that the suppliers became highly dependent on the manufacturers which have a dominant position in the relationship. Many smaller suppliers went into bankruptcy because of this trend or were taken over by other suppliers or even manufacturers. As a response to this, the existing suppliers apply a multi-sourcing strategy to lower the risk and try to lower costs. This is necessary for the suppliers to remain a healthy and balanced position in the supply chain. However, this will again have the same negative effects in the second tier relationships in the supply chain as it had in the first tier supplier relationships in the first place. Instead of shifting the problem further down the supply chain, the car manufacturers should try to integrate the entire supply chain and make sure that also second-tier suppliers have a healthy and stable relationship with the first-tier suppliers. The goal of the industry should be to create a durable supply chain which gives the best results for all actors in the long term.

Based on the previous mentioned theory that the supply structure is influenced by, amongst others, the specification of the components, it could be assumed that the share of common suppliers and the variation diversifies between the different component areas. In other words, the percentage of common suppliers of the manufacturers is lower in the component areas with a higher (technical) complexity of the components. This means at the same time that the level of product variety would be higher in these areas as well. Nevertheless, the

analyses show that there are no significant differences between the areas. One reason could be the already mentioned trend of mergers, in this case of the suppliers, so that there is not much room for choice and the number of suppliers in the market does not leave much opportunities for differentiation.

The answer to the last main research question that there is no relationship between the product variety offered to the consumer and the sales figures in the European automotive industry underlines the part of the theory which states that no evidence could be found for the interaction of these two factors in the automotive industry. It seems as the interaction exists in other businesses such as the retailing business but not related to car sales. Toyota, often taken as a state-of-the-art example for the industry, underlines these results by having the highest sales globally in 2011, but not the highest variety taking the number of car model series as a measurement.

Furthermore, it is stated in the theory that no matter which source for the creation of variety is chosen it should offer competitive advantage for the company and that it is important to make the variation visible and obvious for the customer. The variation needs to have clear distinctions between the different available options. It can be doubted that this is still the case in the European car industry. First of all, like already mentioned, the variety most likely exceeds the demanded variety by the customer. In addition, the brands get more and more similar or respectively the differences between them get smaller, like the two other analyses show. Both aspects lead to confusion for the consumers as mentioned in the theory.

Besides these factors, it can be assumed that there are other factors influencing sales which are not considered in this paper. Factors which are not directly related to the supply chain or affected by the operations of the car manufacturers, or so called external variables, might also influence the sales. Some examples are GDP, unemployment rate in a certain market, interest rates and inflation. In addition, the relationship of European consumers' and car owners might be influenced by factors which are not easy to measure such as the brand loyalty and importance of the car as a status symbol in different cultures. An indication for these results and the fact that obviously sales figures are not influenced by product variety can also be found in the SWOT analysis. Product variety was not considered as an influencing point at any time while other elements mentioned in the SWOT analysis were later on discussed as possible factors influencing sales in this paragraph.

One of the problems of the European car manufacturers is that they still try to gain market share by creating more and more variety. The market segments become highly fragmented with cross over models and new segments and the lines between distinctive models disappear. To handle this excessive variety, car manufacturers increase their component and platform sharing which we could see in the analysis where we looked at the number of common suppliers between brands. This actually means that the product variety decreases, especially between brands belonging to the same group (e.g. Volkswagen Group) which causes that the distinction between products of different brands become even vaguer. The hazard of this situation is that it strongly reminds of the repositioning strategy of Alfred P. Sloan for GM. The downfall of GM was the consequence of over-differentiation. A price response to market changes and the economic climate of that time caused increased component sharing and price overlapping which in its turn resulted in product cannibalization where car brands of GM were stealing each other's revenue and market share.

7 Conclusion and further research

This chapter will finalize this thesis by giving a short summary of the content of the paper. The limitations of the research executed and its results will shortly be mentioned. As a last step some indications for possible further research will be presented.

7.1 Conclusion

In this thesis, we reviewed the literature about product variety and the European automotive industry, formed our own definition of product variety and performed analyses from a consumer's and supplier's perspective. We learned that the concept of product variety is very versatile to define. Variety can be static versus dynamic, internal versus external or fundamental, intermediate and peripheral variety. The most important aspect is to find a good trade-off between additional revenue and costs product variety can generate. However, finding the optimal level of product variety is very difficult and challenging, especially in dynamic markets such as the auto industry.

The analyses taught us that, according to our definition and level of analysis, product variety decreased over the years. Despite the fact that manufacturers want to offer more variety by creating more different models, segments and cross-overs, the opposite happened in terms of suppliers, components and car specifications like dimensions, power, fuel consumption and so on. Also the relationship between product variety and sales was analyzed and has been found non-existing in this research. This matches the results of previous research concerning this relationship in the automotive industry.

Research regarding this topic always looks at product variety from a manufacturing perspective like production, sequencing points in the supply chain and platform sharing. In this research, we tried to look at product variety through the eyes of the consumers and suppliers. Not much literature could be found regarding product variety from a consumer's perspective as it is difficult to define product variety in the automotive industry on an end product level. Many manufacturers use different definitions to define their product line in terms of series, models and variants which makes it difficult to compare and get an overview of the product variety on the car market. We hope to contribute to the research by approaching product variety differently than current traditional research.

The automotive industry will be an exciting industry to follow and faces a lot of challenges regarding demography, mobility and fuel dependence but also knows some opportunities in technology and the emerging markets. In Europe, the market is saturated and is passed its optimal level of product variety. The analyses showed that product variety is decreasing, lines between different car segments and car manufacturers are getting vague but also quality levels, technology and fuel emissions are becoming equal between so-called differentiated products.

7.2 Limitations and future research

During the process of this thesis, we faced several limitations and had to make several assumptions to accomplish our research. One of our first limitations is the high level we chose for product variety in terms of car model series. The analyses would be more precise and accurate if it were possible to have a more detailed level of product variety where different models and variants could be taken into consideration. However, if we would take a more detailed level of product variety, it would not be possible to get this information for all the brands we used and for each year from 2001 to 2011. In this case, the research should be narrowed down to a limited number of brands but then it is not possible to make a generalization for the entire European market because there can be differences between brands. A second limitation for this research is that not all the brands were included in the analyses due to incomplete data. This accounts for both databases used in the consumer's perspective and supplier's perspective. The data we used from the European car market statistics accounts for approximately 80% of the market. The supplier of the supplier data also said that not all components and suppliers could possibly be included in the database. A car usually consists of 12000-15000 components (as delivered by the supplier) and the database has on average 8000-9000 components per car model. If each component was broken down to each part, this number would be even higher. To make the research possible, we decided to take a high level of components and considered the number of suppliers only. Another limitation to this research is that it is only valid for the European market. Results, reasoning and conclusion cannot be generalized to the Asian or American market for several reasons. First, there is the difference in supply chain structure. Second, cultural differences like buying behavior and the meaning of a car as status symbol in the society and brand loyalty must be taken into account as well. The third reason is the difference in economic climate. For example, if similar research was done in an emerging market like Latin-America, results will probably be very different compared to the results of this thesis.

Finally, we want to give some possible indications for further research in this topic. First of all, this research could be performed more in depth. In other words, the level of product

variety could be more detailed or the research can focus on only a limited number of brands. Other interesting topics would be to look at emerging markets like China and Latin-America or other mature markets like the American market. Furthermore, some car brands could be grouped together so that manufacturing groups such as VW Group, Fiat, GM, and Daimler can be compared. Also a comparison of suppliers of these groups could be based on this research and the data used in it. As a final point, supplier data could also tell us something about the current supply industry and the resource dependence between buyer and supplier.

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Appendix

Appendix A: Share of common suppliers within the four segments

PREMIUM	Audi	BMW	Mercedes	Volvo
Audi		62%	59%	61%
BMW	58%		56%	58%
Mercedes	63%	64%		64%
Volvo	44%	45%	43%	

MIDDLE CLASS	Ford	Opel	Peugeot	VW
Ford		56%	52%	48%
Opel	59%		51%	49%
Peugeot	54%	50%		46%
VW	62%	60%	58%	

ECONOMY	Citroën	Renault	Škoda	Toyota
Citroën		56%	60%	61%
Renault	57%		59%	65%
Škoda	37%	36%		48%
Toyota	34%	35%	43%	

LOW PRICE	Fiat	Hyundai	Kia	Seat
Fiat		58%	65%	45%
Hyundai	10%		43%	10%
Kia	17%	68%		16%
Seat	48%	66%	65%	