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# Flexibility and revenue management in the automotive industry

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## Abstract

**Purpose** – This research aims to analyze the potential of revenue management in the German car industry. The concept offers the chance for original equipment manufacturers (OEMs) to be more customer-oriented to reduce costs and increase earnings. To implement revenue management, criteria are required to segment the customers. The car configuration changes and the delivery time look suitable in this context and this paper aims to analyze these.

**Design/methodology/approach** – Survey analysis was conducted with 2974 German buyers of new cars. The respondents recently bought a car or were in the planning process of doing so. A total of 803 data sets could be evaluated statistically using SPSS software. Descriptive statistics and mean test were utilized to test several hypotheses and find out distinctions between the respondents.

**Findings** – The results show that German car buyers could be segmented in to different groups according to the criteria: delivery time and configuration changes. This enables manufacturers to introduce revenue management and realize benefits in better customer orientation and improved supply chain planning.

**Originality/value** – This research shows that German OEMs, especially the premium OEMs overestimate the value of change flexibility and short delivery times for their customers. The implementation of revenue management could help to reduce complexity and offer each customer the appropriate degree of change flexibility and the optimal delivery time combined with a process- and effort-adequate pricing.

**Keywords** Income, Demand management, Financial flexibility, Automotive industry, Germany

**Paper type** Research paper

## Introduction

A change concerning the production philosophy can be observed in the automotive industry. Different interconnected changes in model-policy and production-system led to a new situation in the industry. The modified customer behavior demands these changes as it relates to time (delivery time, model-lifecycle) and product (model-range) (Fredriksson and Gadde, 2005). This triggers a modified model-policy by the original equipment manufacturers (OEMs) (model-segments) and a new production-structure (build-to-order). Actually, the build-to-order-approach is regarded as a promising strategy to understand the idea of “mass customization” (Alford *et al.*, 2000; Coronado *et al.*, 2004). The consequences of these changes can be separated into positive and negative aspects. Advantages of the build-to-order-strategy include lower current assets, reduced materials, smaller discounts, better model-mix, higher customer orientation, and higher customer satisfaction (Reithofer, 2005). A negative impact is the increase in the complexity of the overall supply chain. This could be ascribed to the high diversity of versions (Putzlocher, 2002) and the missing possibilities of balancing in the production level (Fisher and Ittner, 1999). This problem is reinforced by very



short delivery times (five-day-car) and increased changes of demand (Bretzke, 2005). The ability to modify the car configuration almost until shipment also increases the problem. All these aspects interfere with the planning and design of the automotive supply chain. New planning tools need to be developed to meet these new aspects.

After customers are identified as triggers of these changes, the question arises, whether demand management could reduce the impact. For current German research on the topic “automotive customer” the studies of Bauer (1983), Gaus (2000) and Unger (1998) have to be considered. Their studies focus on personal attitude characteristics of automobile buyers. With regard to the build-to-order-strategy the work of Holweg and Pil (2004) has to be mentioned. Both authors research the build-to-order-principle but do not focus solely on the customer. Therefore, two research questions were developed:

- (1) How can German automotive customers be segmented by their demand behavior to improve planning of the supply chain?
- (2) Which methods are needed to manage the different segments in an economic way?

The procedure for these both questions is as follows: first, based on theoretical findings of the build-to-order-strategy, different hypotheses are compiled, focusing on the customer. These hypotheses are later tested by an empirical study of automobile buyers. This allows the basis of the survey to be presented first. Then the most important results are shown including the testing of the hypothesis. The next step is a discussion of the conclusions. Finally a potential concept will be introduced making demand oriented supply chain planning and design possible.

### **The build-to-order-strategy**

Contrary to the build-to-stock-strategy, the build-to-order-strategy focuses on customer oriented production (Reeve and Srinivasan, 2005). According to the arguments of leading investment companies, this strategy has the potential to redefine the automotive industry (Reithofer, 2005). This strategy is supported by the fact that build-to-order-production in the automotive industry is increasing in Europe. In addition, with this strategy the requirement is needed “for making the entire supply chain flexible” (Fredriksson and Gadde, 2005; Holweg and Miemczyk, 2003). Flexibility costs rise in the build-to-order strategy enormously and increase manufacturing costs in the long run (Holweg and Miemczyk, 2003). Therefore, the reduction of flexibility costs can be seen as a key-factor in the competition of the automotive industry that has to be managed. This leads to the basic hypothesis of the whole article: the flexibility costs, which depend on the customers’ behavior, are a main driver of the whole supply chain and must be coordinated. The approach to this topic takes place via representation of the current conditions to the field automobile industry – automobile buyers. The continuous trend of build-to-order-production in the automotive industry points to the high importance of the individual customer-oriented car production (Holweg and Pil, 2004). The BMW Group handles strategy with its “KOVp-approach” (customer-oriented production and sales process) which is thus far the most consistently under the OEMs. An advantage, often mentioned, is the high degree of change flexibility, which is offered to the customers out of marketing and sales considerations. This leads to 120,000 changes by BMW-customers per month. The changes actually affect approximately 50 percent of the vehicle orders (Reithofer, 2005).

Likewise, changes to dealer vehicles (i.e. demonstration cars, obligation orders) are also included in these numbers and therefore falsify the real need for change. On the basis of these considerations the first hypothesis can be derived:

*H1.* The customers differ according to their need of change flexibility.

After the automobile is an individualizable product, the customer can select from different versions offered by the manufacturer. It must thereby be differentiated between premium manufactures, like Mercedes, BMW, Audi or Jaguar and mass manufactures, like Toyota, Volkswagen, Mazda or Nissan. The Premium manufacturers offer a large number of configuration options, while the mass manufacturers only offer a limited selection. For example, a customer of an Audi A6 can choose between 18,800 different door trims. This uncontrolled growth is not wished, respectively honored, however, by the customers. Of all the versions, 30 percent are designed without customer demand. These versions are not perceived or ordered (Schlott, 2005). Therefore it can be expected, that the process of configuration and ordering can be limited to certain versions. If the customer changes his order, the changes focus on a small range of parts. This means, that customers change certain parts more often than other parts. Therefore the second hypothesis is:

*H2.* The changes concentrate only on certain parts/modules.

One target of the OEMs is to reduce the lead time. While BMW aspires to reduce the lead time to eight to ten days (Reithofer, 2005), research projects like Intelligent Logistics for Innovative Product Technologies (ILIPT) call even for a “five-day-car” (Nayabi *et al.*, 2006). The “five-day-car” raises a new question: Is this vision a way to realize customer demands or is it finger exercise of very enthusiastic logisticians? Bretzke (2005), a leading German scientist and consultant in supply chain management, points at the questionableness of the “five-day-car”.

*H3a.* The “five-day-car” is a vision, which provides no added value to the customer and therefore is refused.

*H3a* can be formulated more generally. Various studies from the years 1999 and 2001 prove that the delivery time for German premium customers is not an important factor in the decision process (Audi, 2006). Comparing this result with the strategy of the OEMs concerning lead/delivery time, *H3b* is:

*H3b.* The delivery time is actually not purchase-crucial criterion for (premium-) customer.

At the beginning of the 1980s when air traffic in North America was liberalized, the airlines needed an instrument to handle the growing market dynamic. One answer was the “revenue management-approach”. The philosophy of this concept is the segmentation of the total capacity. A given overall capacity is divided in partial capacities. Then a price class is made for each partial capacity, so that an integrated price-/capacity-controlling-concept is reached. Neither the extent nor the structure of the demand is influenced; the actual demand will be controlled (Corsten and Gössinger, 2005). The customer commits itself with booking a certain seat in a certain category, to accept a service that is described before the effective service is provided. The later the booking/ordering takes place, the more expensive becomes usually the service. If you

transfer this idea of capacity-planning to a build-to-order organized automotive manufacturer the fourth hypothesis can be formulated:

- H4.* The automotive customers accept the commitment to fix their order and configuration early.

This hypothesis is furthermore supported by the consideration, that a car is a relatively expensive investment, which normally is researched and planned intensively. Analyzing the purchase-process of German automobile buyers, the average preparation time for the purchase is 37 hours (NN, 2006). In order to make an “optimal” decision, this time is also necessary due to the large number of models and versions. However car manufacturers give customers the possibility of changing the configuration. The question arises, whether or not this possibility must exist when the decision is researched and planned well. The argument of the OEMs is that the buyers often do not know exactly how the configuration should be. Especially the premium-customers do not want to miss the out on change flexibility (Audi, 2006; Reithofer, 2005). From this area of conflict thesis *H5* is derived:

- H5.* The customers know their final configuration when closing their contract.

Analyzing the change opportunities of the German premium-manufactures like BMW show that the customer can change the configuration of his individual car up to four days before production begins (Reithofer, 2005). Audi offers actual this opportunity until five days before producing the chassis/body. In the future, they want to bring it to three days before starting the car production (Audi, 2006). If one compares these facts with the time (37 hours) which the customers concern themselves with an automobile purchase, the question arises, whether the change offer matches the needs of the customers. Therefore the last hypothesis can be set up:

- H6.* The present offer of change flexibility clearly exceeds the need of the customers.

### **Empirical survey**

On the basis of these hypotheses an empirical survey was conducted. First, an adequate target group had to be defined. Results of the selection process focused on German automobile buyers, who understand the purchase process. The suitability of this target group can be supported by the fact that people, who are presently concerned with buying a car, can better answer the questions. It is also suitable because the German market, regarding customer-oriented production, plays a pioneer role. Therefore, the German market is a suitable base for the empirical study, focusing on “configuration changes from automotive buyers”. Additionally, the very large German automobile market is comparable to the remaining European markets, and the results could, in principle, be transferred to other markets. An exception in Europe is the British market, which is similar to the American market. In both markets the customers want to pick up their vehicle right away from the dealer’s stock, so the build-to-order strategy is unpopular (Holweg and Pil, 2004). Hence, the target group of the study does not fit for these two markets and the results presented should not be transferred.

Defining the type of data collection represented the next step. An online-based questionnaire was selected because of numerous advantages. First, a large number of

persons can easily be reached. Second, the survey's ratio of costs/participants is more efficient than i.e. interviews. Finally, the acceptance of online questionnaires is higher than written questionnaires (Stier, 1999).

After defining the data collection method, the questionnaire itself was compiled. Three aspects were important during the design process. The questionnaire was designed in a manner to fulfill necessary requirements regarding clarity, clearness and simplicity of the questions. Furthermore the questions were as neutral as possible so all participants understood the questions in the same way.

The second aspect was the arrangement of the questions. The structure of the questions was orientated on a procedure suggest by Zikmund (1982) and Procter (2000) which uses general and easy questions at the beginning and sensible or rather difficult questions at end of the questionnaire. Thereby, the reply will be eased as the respondent gets a general idea of the questionnaire's content (Churchill, 1991). Moreover this structure enables the participants to gain a better overview of the questionnaire during the completion. Therefore, as more questions are answered by the respondents the probability rises for completing the sensitive questions.

The third aspect was the layout design. The design was arranged in such a way, that the previous mentioned aspects were adequately observed. Additionally, Mayer and Piper argue that the layout of the questionnaire substantially affects the answers to the questions, thus the design was done in an accurate way. The development of the questionnaire was accomplished according to the presented requirements by the authors. Altogether 26 questions to the topic "automotive buy" and seven questions to socio-demographic characteristics were formulated. The section "automotive buy" was structured according to the hypothesis. First paragraph contains questions to demand of change flexibility, second to delivery/lead time and last paragraph to process of car configuration. Multiple correction loops during the pre-test completed the development process.

The data collection was started in January 2006. The execution was done in cooperation with the market research institute "Puls-The Navigation Company". The company, specializing in automotive market research, invited 2.974 potential German automobile buyers to the survey. A total of 816 people took part, which represents a return ratio of 27 percent. In the end 803 analyzable questionnaires were statistical evaluated by SPSS-Software.

### Sample

In Table I the sample structure is described on the basis of the socio-demographic data.

Analyzing the socio-demographic data, it is noticeable that the male automotive buyers in the survey are over-represented. The results of other studies also show the male domination in the purchase process of new cars, therefore the results of the sample are not seen as disadvantageous (AOL, 2004). Also persons with a higher income are over-represented in the sample. However, this segment is especially relevant for premium OEMs, which already implement the build-to-order strategy. Hence, information about this segment is especially of value because better conclusions of the acceptance from the build-to-order strategy of this group can be derived. An important differentiation in the stage of the purchase process must be done. In this context the sample could be divided into two groups. Persons who plan to buy a new car and persons who recently bought a new car. The statistical evaluation of the sample



			Flexibility and revenue management
Variable	Value	Percent	
Sex	Male	90.0	429
	Female	10.0	
Age (years)	18 to 30	20.0	
	30 to 40	26.4	
	40 to 50	26.7	
	50 to 60	19.2	
	60 to 70	4.9	
	70 to 80	0.7	
	No statement	2.1	
Family status	Single	22.9	
	Married	69.4	
	Divorced/live apart	5.2	
	Widowed	1.0	
	No statement	1.5	
Monthly income (€)	Under 500	2.0	
	500 to 1,000	3.2	
	1,000 to 1,500	6.5	
	1,500 to 2,000	10.7	
	2,000 to 2,500	13.0	
	2,500 to 3,000	12.3	
	3,000 to 3,500	9.8	
	3,500 and more	27.0	
	No statement	15.4	

**Table I.**  
Socio-demographic data  
of the conducted survey

asserted a proportion of 36.7 percent, who recently purchased a new car, to 63.3 percent who were in the planning process. Manufacturer brand is a just as important distinction criterion. Altogether the respondents were interested in 41 brands. The allocation of the brands is shown in Figure 1. The result represents the current status of the population (German market) because the market shares of the brands are almost similar.

The (planned) purchased price class for the car is charted in Figure 2. In analogy to the socio-demographic data “income”, the persons are interested in more expensive (> 30.000€) vehicles. Like mentioned before the upscale classes are especially relevant, therefore the unrepresentative distribution is not seen as a disadvantage (KBA, 2006).

Also the utilization of the new car by the persons was an aspect in the survey. In the sample 77.1 percent responded they use/will use the car privately and 22.9 percent use/will use the car for business purposes. Thus the business customers are also included in the sample.

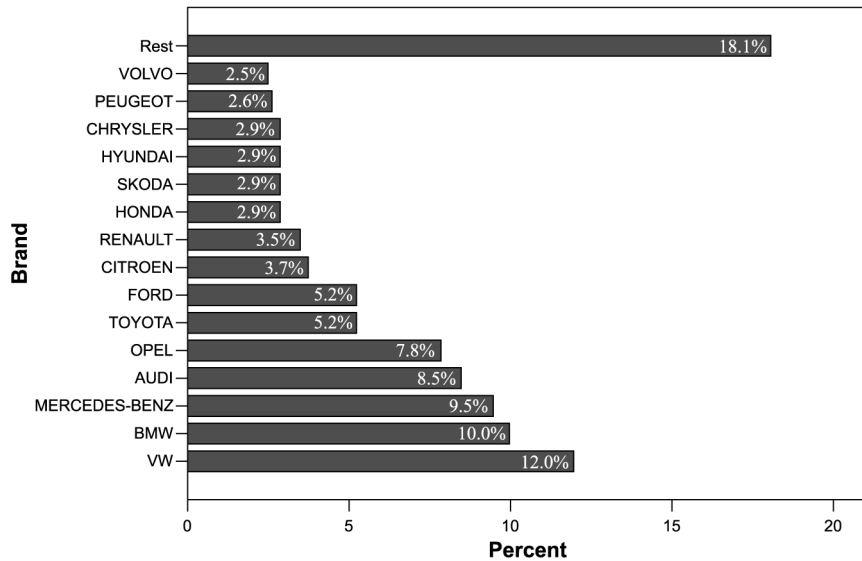
After presenting the key facts of the sample including the restrictions concerning the representativeness, the next chapter of the survey describes the results. The six hypotheses from the previous section will be examined.

## Results of the empirical study

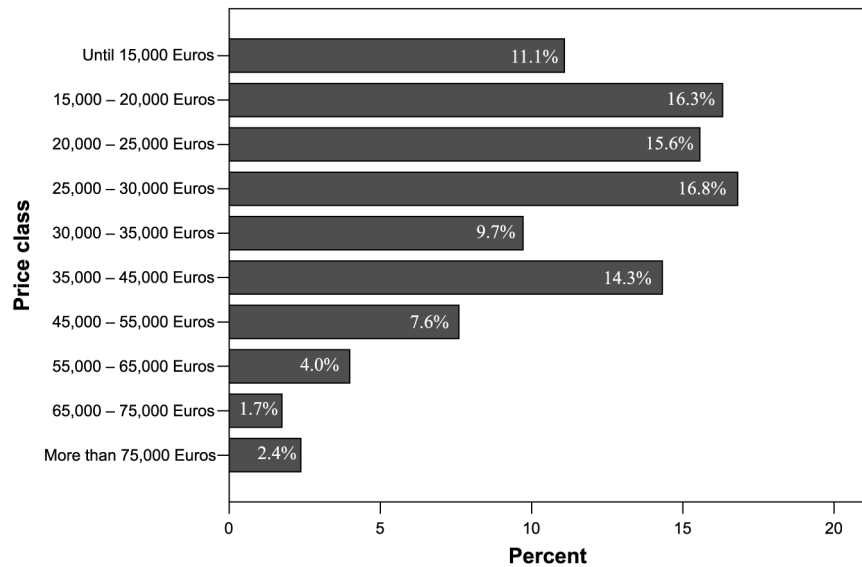
### H1. *The customers differ according to their need of change flexibility*

To test the hypothesis the costumer must be segregated on the basis of criteria. Because of the substantial influence of the OEM-brand in the purchase process, the differentiation criterion “brand” is adequate (Kuder, 2005). Nevertheless due to few entries ( $n < 3$ ) of certain brands in the survey, the results are weak for a statistical

**Figure 1.**  
Brands covered in the survey



**Figure 2.**  
Price classes of  
bought/potential car



evaluation (Brosius, 2002). Therefore, it is difficult to make a profound statement. To overcome this weakness the brands were aggregated into three categories. The created categories are “premium”, “volume” and “budget”. Hence, the mentioned weakness ( $n < 3$  per brand) of the previous criterion can be negated and statistical test like the ANOVA test can be made (Brosius, 2002). The combination follows thereby the image positioning of the automobile brands in Europe (Becker, 2005).



The brands, for those the image and driving pleasure are crucial, are assigned to the premium segment. Brands, reflect those buyers who are unemotional/rational as well as easily price-oriented, reflect the volume segment. The last segment “budget” tries to differentiate exclusively over a favorable price. With this segregating it is now possible to evaluate the differences between the groups in an acceptable statistical way. The assumption, that premium brands offer their costumers the possibility to change their configuration, causing the customers to wish for more change flexibility, must be considered. The general evaluation of the question, “How important is it for you to have the chance to change your car configuration after closing the contract?” show the following results: of the respondents, 12 percent stated the chance is very important for them, for 29.7 percent it is important, the largest portion, 45.6 percent, consider the chance less important, and for 12.7 percent unimportant. It can be argued that the change flexibility is less relevant for the majority. Significant distinctions between these groups can be identified concerning the criteria “market segment”. The one-factor ANOVA mean difference test was chosen as the procedure to execute a one factor-related variance analysis for a quantitative dependent variable with a single independent factor variable. It is now possible to test the first hypothesis. The results are illustrated in Table II.

The ANOVA test shows, that between the groups a significant difference is present. Using the *post-hoc* test “Duncan”, which determines homogenous subgroups of means, the difference between the groups can be measured. This means that for buyers of a premium brand change flexibility is more important than for customers of the volumes segment. The hypothesis “the customers differ according to their need of changing flexibility” can be supported. The results contain a reference that a differentiation of changing flexibility between different customer segments is necessary.

## H2. *The changes concentrate only on certain parts/modules*

The procedure for this thesis was as follows: those customers, who had recently bought a new vehicle, were filtered from the group. Only this group was asked which configuration changes they made after closing their contract. Because of to the wide range of possibilities to change the configuration, a complete inquiry could not be accomplished. For example the customer of a Mercedes C-class can choose between 80 different extra options, which must be detailed in a complete survey. However, a too long questionnaire reduces the willingness to participate in the survey (Stier, 1999). Because of this eight categories of extra options were created. The classifications are as follows: interior (i.e. upholstery, interior trim), interior electronic equipment (i.e. navigation system), paintwork/body color, power of engine, type of model (i.e. sedan or estate car), type of engine (i.e. diesel or petrol), exterior (i.e. wheels) and exterior electronic equipment (i.e. xenon headlights). These eight categories are based on the consideration that a distinction between elementary configuration changes (i.e. type

	Importance changing flexibility after closing contract				
	Square sum	df	Middle of the squares	<i>F</i>	Significance
Between the groups	9.445	2	4.722	6.469	0.002
Within the groups	576.714	790	0.730		
Total	586.159	792			

**Table II.**  
ANOVA test – market  
segments – importance  
of changing flexibility

and power of engine, type of model) and more specific changes in exterior and interior equipment are necessary. Since the amount of electrical components in vehicles continues to rise (VDA, 2003) and widely influences vehicle production, this fact was also considered. In this context the selected buyers of a new car were asked which category/categories they changed after closing the contract. From 295 new car buyers, 38 buyers effectively changed their configuration. In Table III the entries on the categories are shown.

The most frequently changed category is the interior, rarely are changes in type of model and type of engine made. Analyzing the means pairwise of the different configuration categories (Brosius, 2002), significant distinction between the categories interior, interior electronic equipment, exterior and exterior electronic equipment and rest can be concluded. The results show that the means of the individual categories distinguish significantly and therefore the hypothesis can be accepted. The intermediate result after testing the first two hypotheses is that the configuration changes are concentrated on specific costumer segments and on specific configuration categories:

*H3a. The “five-day-car” is a vision, which provides no added value to the customer and therefore is refused*

For this hypothesis the respondents were asked to specify the ideal period between placing the order and the shipment of their new car. A total of 790 persons responded to the question. The ideal period for those surveyed was an average of 45.6 days. The portion of the respondents who regarded a period of less than or equal to five days was 0.8 percent. This result underlines the thesis that the automotive industry is pushing a target (“five-day-car”) which currently represents a vision. Rather it is clear that in the German automobile market such a short delivery time is wished by a very small number of buyers. Even the meantime formulated target “ten-day-car” is not based on the customer need. Only 4.7 percent of the respondents regarded a period of less than or equal to ten days as ideal. Finally the results show that the vision of a five/ten-day-car is demanded by only a few buyers and should not be an aim of the build-to-order strategy.

*H3b*, related to the previous topic: “The delivery time is actually not purchase-crucial criterion for (premium-) customer”. The test of the hypothesis was made in the context of the question “How strong is the influence of your demands matching delivery time in the purchase process”. 13.5 percent of the total 798

Configuration categories	Entries
Interior (i.e. upholstery, interior trim, etc.)	14
Interior electronic equipment (i.e. navigation system, etc.)	12
Paintwork/body color	5
Power of engine (kW/hp)	4
Type of model (i.e. sedan or estate car, etc.)	1
Type of engine (i.e. diesel or petrol.)	2
Exterior (i.e. wheels, etc.)	7
Exterior electronic equipment (i.e. xenon headlights, etc.)	5

**Table III.**  
Changed configuration  
categories after closing  
the contract (multiple  
entries allowed)

responding persons answered that the influence of an appropriate delivery time is very strong, for 39.7 percent it is strong, for 37.5 percent it is less strong, and for 9.3 percent there is no influence. These descriptive statistics illustrate, that the delivery time can be quite a purchase-crucial criterion. For the majority of the respondents, 53.3 percent, the influence is very strong or strong.

To differentiate statements from buyers where the delivery time is crucial, the Mantel-Haensel Test was used. The variable analyzed within this test was the utilization of the new car. The testing of linear association between delivery time and utilization points out that there can be a weak association ( $\chi^2 = 2.87$ ,  $p = 0.09$ ) between the variables (Brosius). A relationship between the segments (especially premium segment) could not be determined as with the previous hypotheses. The consequence of the evaluation is that the hypothesis must be rejected. For selected customers the delivery time can be very important and thus crucial to the purchase. It is not possible to derive from this result, that a short delivery time is important for business costumers. Because there exists more factors (i.e. useful life, financing package, etc.) influencing the process, which were not collected in this study, this conclusion is risky.

#### *H4. The automotive customers accept the commitment to fix their order and configuration early*

The hypothesis contains two aspects. On the one hand the early commitment to a configuration choice and on the other hand the fixing of the configuration. Hence, the test of the hypothesis is split in two parts. The ideal period between order and delivery is an average 45.6 days (see *H3a*). The respondents were asked, whether they accept a still longer order-delivery period, or not. Similar to the early bird rebate in the airline/tourism industry the (potential) buyers have to specify their maximum delivery time combined with a financial discount. Results of the 803 responses concluded that 13.4 percent do not accept an additional waiting period. For the remaining respondents the maximum acceptable delivery time increases on the average to 91.3 days. For this additional time the respondents demanded; however, an average discount of 12.7 percent from the purchase price. In this context a low correlation ( $r = 0.34$ ,  $p = 0.00$ ) between the demanded discount and the maximally accepted delivery time can be detected. Costumers who demand a higher discount tend to accept a longer delivery time. Hence, the analysis shows that the first part of the hypothesis can be confirmed. The majority accepts a longer delivery time, but it must be combined with a discount.

Whether the respondents also abandon the option to change the configuration after closing the contract, is the second part of the hypothesis to examine. To this aspect 12.6 percent responded that they will not abandon the option; 41.4 percent answered they would accept a configuration fixing without any compensation; and 46.0 percent responded they would abandon configuration flexibility, but they demand an average discount of 10.6 percent from the purchase price. From this, three groups can be composed. The smallest group, 10.6 percent, demands a changing flexibility and therefore, the OEMs must offer the option for them. The second group, 41.6 percent, accepts a configuration fixing; therefore, the manufactures do not need to offer them a changing option. The largest group, 46.0 percent, demanded a rebate. Here the OEMs must decide whether or not to offer them the option. Fixing the configuration is appropriate for 87.4 percent, and the second part of the hypothesis can be accepted. At

the moment the optimal determination of the ratio maximum delivery time/discount, a detailed characterization of the group rejecting the hypothesis as well as a decision model for the OEMs in which cases they should offer the changing flexibility for the second segment, is missing. These tasks are elements of future research work.

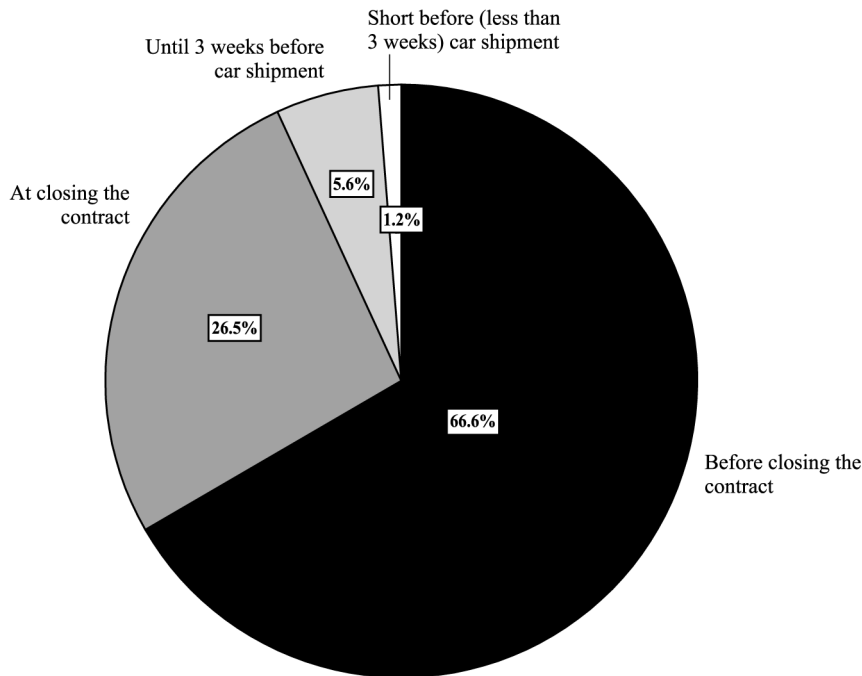
*H5. The customers know their final configuration when finalizing their contract*

As previously mentioned, German car buyers invest 37 hours in the decision process "car purchase". What do the buyers do during this period? The 803 persons surveyed were asked how they rate their level of information concerning the configuration variations for their bought/potential car. A total of 50.8 percent rate their level as very good, 40.9 percent good, 6.5 percent less than good, and 1.7 percent responded that they are not at all informed. That is, 91.7 percent have a good or very good level of knowledge regarding their individual configuration. Distinctions between different groups (i.e. brands, brand segments, utilization) could not be found. The fact that the costumers are interested in change flexibility due to a poor level of information is not conclusive based on the survey results. An argument which could reject the intermediate result is that the costumers know their exact configuration just shortly before car shipment. Therefore, the persons were asked at which time they actually have/had the knowledge about their individual configuration. The results are shown in Figure 3.

The results clearly show that 93.1 percent of the respondents decide their specific configuration at contract closing. The remaining 7.8 percent can be characterized as undecided. Finally, the portion of customers, who know their configuration shortly before car shipment, is very small, 1.2 percent. In this context a difference between potential customers and buyers cannot be determined. It can be concluded that the costumers are very well and timely informed about their configuration. The results support the formulated hypothesis. The build-to-order production strategy has not to be focus on short delivery times and late configuration changes due to lack of customer's level/status of information.

*H6. The present offer of change flexibility clearly exceeds the need of the customers*

The testing of the hypothesis will be made by analyzing the effective use of the configuration change flexibility. Nearly all car manufacturers offer their customers the chance to reconfigure their car until a certain point of time. That means 100 percent of the customers can change, with some restrictions, their configuration. Compared to the data collected in the survey, there is a large gap between offering the change and using it. Only 12.9 percent of recent buyers changed their configuration after closing the contract. Therefore, an oversupply of change flexibility can be observed. In addition, the configuration changes were not only done by favored premium customers, but also by customers belonging to the volume segment. The distribution is as follows: 63.1 percent premium, 31.6 percent volume and 5.3 percent budget segment customers changed their configuration. Consequently the volume manufactures have to offer a changing flexibility for a selected group although in the run-up the volume customers regard the option as less important. Because of the low entries in this context the results must be rechecked. For an optimal statement more configuration changes must be recorded and analyzed. Owing to the complexity and the high integration of IT



**Figure 3.**  
Point of time concerning  
the exact knowledge about  
the individual  
configuration

systems not all the manufacturers are able to track the data. Also the customer's data are often sensitive and not accessible to the authors.

### Interpretation of the results – an approach to coordinate the flexibility demand

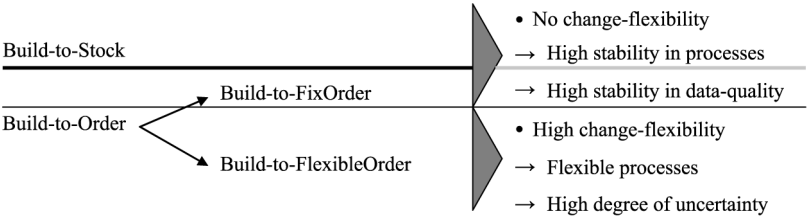
It was shown that the customers in the automotive industry differ according their need, usage and demand (*H1*, *H2*, *H4* and *H6*) of change flexibility. Also aspects in relation to delivery time (*H3a*, *H3b*) and motives (*H5*) were discussed in the context “build-to-order” and emphasize the importance of the criterion flexibility. The main thesis formulated at the beginning, that the coordination of the demand in the context of a build-to-order-strategy could save flexibility costs, receives a boost. Now the question arises of how to define a process which provides an adequate degree of change flexibility to each customer in order to optimize flexibility costs and fulfill the wishes of the customers.

The “FMNA approach” (flexibility-cost oriented management of new car orders in the automotive industry) offers a solution to this problem. The customer orientation (KOV), high and stable data quality, and economical process organization possibilities are united in this approach. The main idea of the FMNA approach is based on the revenue management concept. Probably the most important difference between the two concepts lies in their goal. While revenue management tries to maximize the profit (Corsten and Stuhlmann, 2000), the FMNA approach tries to optimize the degree and costs of change flexibility. To achieve this goal, the total and limited capacity has to be separated into partial capacities. For each of these partial

capacities a price class has to be defined. This leads to an integrated price capacity management. The crucial starting point for the realization of such an integrative approach is the adding up of the pure capacity management around an active price management (Corsten and Gössinger, 2005). The most important element of this approach is the segmentation of the customers according to their individual demand of change flexibility. The typical build-to-order becomes either a build-to-fix order without change flexibility and a long delivery time or a build-to-flexible order with a short delivery time and/or high change flexibility (see Figure 4).

After the segmentation of the customers' orders (according to the suggested groups in *H4*), the orders must be distributed to the particular production lines (partial capacity). The build-to-fix order can be manufactured on a line together with the build-to-stock cars. This production line can be characterized by rigid processes. Since production program planning is very stable (long periods without changes) the appropriate delivery calls can be conveyed promptly to the suppliers. The supplier can then decide whether or not to produce in one lot size or bundling the order. In principle the supplier can stabilize its production over a longer period. This produces potential cost reductions. More savings can be realized by a reduced complexity in planning and controlling. For example due to accurate call data, as is typically done in the automotive industry, rough planning is not necessarily needed. Forecast estimations become redundant, too. The expense in scheduling of material and resources can be reduced. Finally the cost advantages realized from this can be passed on to customers and improve the competitiveness of the OEMs.

The build-to-flexible orders are manufactured on a second line. This line is characterized by flexible processes, resources and structures oriented toward the popular changing categories. The costs which result from this flexibility are covered by the price premium; those customers desiring change flexibility have to pay for it. The additional costs of this flexibility-oriented organization can be derived in direct comparison with the production line aligned to stability. The FMNA approach makes it possible to combine a high number of versions simultaneously with a reduction of complexity. In comparison to Asian OEMs, which guarantee a high degree of process stability by a low number of versions, the process stability is achieved over the temporal dimension. Besides the FMNA approach enables the OEM, to deal more individually with the demand for flexibility of the customers. Each customer can choose between a long-term and obligatory order variant or a short-term and flexible one. The "moral hazard effect", well known in economical theory, can be likewise illustrated by this study. Customers change their configuration as there are no disadvantages for doing so. As soon as they have to pay for any changes, selected persons would do without the change flexibility. By introducing a financial incentive (discount or alternatively premium) it can be measured which customers are interested



**Figure 4.**  
The FMNA approach in  
the overview



in a change flexibility and how much value the customers attach to the change flexibility.

A justified point of criticism at the shown model is perhaps customers abandon the chance of reconfiguration, which speaks against the economic aim of turnover maximization. This aspect should be regarded somewhat different.

If a customer of the category “build-to-fix order” nevertheless is interested in changing his configuration, it has to be examined by criterion previous defined which change fee the customer has to pay or whether the OEM can waive/reduce the fee. Customers of the “luxury class” expect non-restrictive change flexibility. Therefore the FMNA approach is particularly convenient for the “lower and upper middle class”. In these segments high volumes meet innumerable variations.

### Conclusion

In conclusion it can be determined that an unreflected change from the classical build-to-stock strategy to a build-to-order strategy leads to various disadvantages. On the one hand the flexibility costs increase by providing (higher) change flexibility. On the other hand it is not measured if the degree of change flexibility is actually noticed and desired by the customer. Therefore, it is necessary to integrate a controlling and management tool. The presented FMNA approach offers the chance to fulfill design this tool. The discussed approach as well as the database is subject to some considerations. The study was accomplished exclusively on the German passenger market. Thus, studies in other markets have to prove the accuracy of the survey. A second consideration is seen in the different car classes. While it is acceptable to reduce change flexibility in the budget/volume segment, it is expected in the premium segment. Thus, the OEMs must differentiate exactly for which models the FMNA approach can be used.

Indeed the entire study shows that implementing the build-to-order approach can help increase efficiency and benefits to the customer. Further research is needed to answer the question, how a controlling and management tool can be defined to prevent negative effects and reactions in the order-process by the customers. Also future research to determine the optimal ratio of maximum delivery time/discount and a detailed characterization of the groups who want to change or who changed their configuration is needed. Nevertheless increased change flexibility has the chance to influence the customer configuration shortly before start of production and possibly increase the profit of the car. This leads to a conflict of interests between logistics/production and marketing/sales. Consequently the balance of logistics and marketing activities is the challenge for implementation.

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