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# Strategies for Customer Satisfaction and Customer Requirement Fulfillment within the Trend of Individualization

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**Abstract**

Individualization is one of the current megatrends in the product development. The literature offers approaches for customization of which individualization emerged. Nevertheless, it is not emphasized if the approaches are also applicable for focusing each individual customer and his requirements within individualization. Also, the achievable customer's requirements fulfillment compared to the induced internal complexity is disregarded. Therefore, this paper clusters different individualization strategies for fulfilling customer-individual requirements and emphasizes the induced complexity, solution approaches, the resulting customer benefit and limitations for each strategy. Afterwards, decision-making models for finding the right strategy for the own business are reviewed and discussed.


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*Keywords:* Product Individualization, Self-Individualization, Value Adding, Decision-Making in Customization and Indiviudalization, Individualization Strategy

## 1. Introduction

These days, individualization has become one of the megatrends which needs to be considered in product development [1,2,3,4,5]. A customer does not want to be seen as part of a customer group any longer but be noticed and treated as an individual [6]. For the customer, the trend of individualization promises the appreciation of individual requirements and its fulfillment, so that customer satisfaction can be improved. Regarding the trend of individualization from the companies' sight of view, following the trend may lead to an increase of sales and competitive advantages. Nevertheless, to handle individualization, the companies' internal structures need to be made for an individual customer treatment.

Especially in medical device development, the consideration of individual customer requirements may increase customer requirement fulfillment resulting in an increase of customer satisfaction since diagnostics and therapy quality can be improved [7]. Examples for already applied individualization in the medical area are the individual adaption of orthopedic inserts to the customer specific foot anatomy, the individual adjustment of knee joint bandages by Velcro®, individual expert advice in choosing a hearing aid variant of a portfolio, the individual adaption of the shape and color of dental implants or the individual configuration of wheel chairs by combining modules.

Although, all examples pay attention to the individual customer requirements motivated by the individual anatomy, their individualization strategies differ from each other. The few examples already show, that the trend of individualization can be faced differently. However, individualization strategies are not clearly defined in literature. In most cases, individualization is seen as an extreme case of customization, where the size of customer groups for the definition of product variants goes against one. For taking into account each individual customer, a company can face individualization using different strategies and options having different extends and graduations. For analyzing the own potential for the individualization trend, it is necessary to know which strategies for facing individualization exist. This execution is the aim of this paper.

Starting to deal with individualization, it becomes obvious, that it is a widely spread term, which exists in many disciplines like social science, medicine or business and management. This paper concentrates on the engineering understanding of the term. For the paper, a review was conducted including the

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search terms (mass) customization, individualization and personalization in combination with internal variety, external variety, product differentiation or customer benefit. Basic understandings of customization, its challenges and solution strategies regarding the product architecture are reviewed, since individualization can be seen as further development of customization (chapter 2). Strategies, approaches and levels applied within mass customization are studied. Since customization focuses mainly on customer groups, only strategies which also allow a consideration of the individual customer and his requirements are further researched, analyzed and clustered to new individualization strategies to achieve a differentiation between individualization and customization strategies (chapter 3). After a comparison of the strategies (chapter 4), existing decision models are described (chapter 5) to underline the conclusion of a need for a new method of how to face individualization (chapter 6).

## 2. Customization Terminology and Strategies

When customers started to ask for a higher product differentiation for better requirement fulfillment, the serial production of customized product variants replaced the mass production of standardized products as dominate strategy [8]. Companies customized their product portfolio and developed different variants of a product which are summarized within one product family [1]. Product variants fulfill a similar function, but are different in at least one product attribute [2]. The range of product offered to the customer is called external variety [1]. Unfortunately, external variety induces internal variety inside the company causing complexity costs. Internal complexity describes the variety of parts, components, products as well as processes within a company to provide the portfolio [2]. While a huge external variety reflects a high product differentiation, the internal variety should stay as low as possible.

Design for variety (e.g. [1,2,9]) and Modularization (e.g. [1,10,11]) are possible approaches for realizing customization with having a high product differentiation respectively a large external variety with manageable internal variety [1]. The definition of each product variant, whose differentiating property should ideally be mapped to one variant component, is based on general requirements shared within one customer group [12]. Customers of a customer group have similar but not exactly the same requirements. After the definition of components, modularization takes place. Different product variants are created by combining standard, variant and optional modules. Thus, a predefined product portfolio is created, of which an individual customer can choose the product variant, which fulfills his requirements the best [1,13]. To profit from economies of scale, many companies develop product components and modules commonly used in different product variants although they have slightly different purposes to fulfill. In this context, the term of Mass Customization was introduced, initially described in 1989 by Davis [14] who states that trough mass customized markets, each customer can be treated individually like in preindustrial economy but with the efficiency and scale of industrialized mass markets. Fogliatto et. al [15] or da Silveira et. al [16] published overviews of mass customization issues.

But even with a predefined product portfolio, the best fitting product variant may not exactly fulfill the customers' specific needs [1]. For the individual customer, there may remain a discrepancy between what he gets and what he really wants.

## 3. Individualization Strategies

In the following, individualization strategies, which allow an improved requirement fulfillment, are clustered and described. For each strategy, a definition is given using an example of the medical area followed by a description of possibly occurring problems and solution approaches paying attention to internal complexity and customer benefit offered by the literature.

### *3.1. Classification Principle*

To minimize the discrepancy between the individual customer requirement and the final product solution, further product differentiation is requested. This sharpens the already existing challenge for the company to find a compromise between product differentiation (external variety) and complexity costs (internal variety). The consideration of a customer group for the definition of product variants changes more and more to the appreciation of the individual customer. Customization, meaning increasing the number of predefined product variants and shrinking the size of customer groups, gets to a limit at that point. Having customer groups with the size of one customer is focused in the trends individualization and personalization. In this paper, deducted of the sociological and medical definition of the wordings, individualization pays attention to the individual customer need resulting in a customer specific product adaption, while personalization focuses holistically the individual customer himself to co-create a customer specific product. Here, the focus lies on individualization.

The literature offers different customization strategies and customization levels (e.g. [17,18,19]) representing different compromises between internal variety and customer benefit, differentiating also in the optimal size of the external variety. Individualization strategies are rarely distinguished and often summarized within customization strategies. To achieve a differentiation, customization strategies which can be applied for focusing individual customer requirements are extracted and clustered to different individualization strategies. In this paper, the clustering is arranged considering if a product adaption takes place or not and who is executing the product adaption. A product adaption describes the change of product structures or product characteristics due to individual requirements. Thus, a conclusion for the complexity induced in a company can be drawn. Following this definition, three main strategies considering individual customer requirements can be clustered: First, the adaption of the product by the company, second, the adaption of the product by the customer himself and third, no individual product adaption but the adding of value to a predefined product variant.

### *3.2. Customer Specific Product Adaptions Executed by the Company – Product Individualization*

A product individualization [3,4,20] meaning the creation of individual product variants for each customer according to his individual needs is executed by the company and can be done to different extends, e.g. adapting one or several product attribute to individual needs. Also, the range within which the adaption takes place can be limited. Limitation can occur of the manufacturing processes, cost or time issues, law and standards, the material (parameters) or the final use. How extensive individual adaptions can be is also dependent on the time point, when the customer is initially integrated into the product life [21]. Tien [22] calls the time point Customer Order Penetration Point or Customer Order Decoupling Point (CODP). The earlier during the product life the customer is integrated, the more influence he has on the product design and the higher the degree of customization respectively individualization is. A product life includes the product development, the procurement, the production, the assembly, sales and finally the use and recycling [2].

One example for a product individualization affecting a medical device is the orthopedic insert, whose form can be adapted to the anatomical geometries of the customer specific foot. Individual product variants are produced using molds of the customers soles of the foot for the design of the insert. Another example is the design of individual dental implants, which fit exactly in the customers set of teeth having the same color. A unique product is created for each individual customer.

The infinite expansion of the external variety might be desirable for the customer but results in a high internal complexity, since the number of product variants within one product family is expanded infinitely. The product and processes contents have to be changed for every customer.

To manage the induced complexity of product individualization, structural optimizations within the company can be done. The approved strategies of design for variety and modularization effecting products and processes can still be applied for customer specific product adaptions. A modular product architecture and extensive process standardization made it possible to develop customized products in a large scale with a manageable internal complexity and is furthermore the solution for adapting repetitively products for individual customers [3,4,23]. Based on the existing customization approaches, methods and ideas applied for individualizing the product are presented in literature. Gräßler [3] introduces a method for the Development of Mass Customized Products by planning and identifying an appropriate individualization framework. For deciding which components on the product shall be individualizable, Holle [24] developed a Design For Open Innovation Methodology (DfOI). Lindemann et. al [4] and Piller [5] state, that for a repetitive product adaption, a solution space needs to be defined, within which the individual, customer specific adaption can take place. Hu et. al [25] suggest defining the personalized module as solution space in addition to standardized and variant modules. Through the limitation of the location of repetitive individual changes to certain modules, all authors aim a manageable internal complexity. Koren et. al [23] propose an open-architecture-product for realizing mass individualization meaning the adaption of the product to individual customer requirements in a large scale. Together with the customer, companies create personalized modules. Since each company focuses on the design of only one module of the product, the internal complexity for each company is manageable [23]. For creating individualized products, the personalized modules are added to one overall standardized product platform with known interfaces defined by another company. Boer et. al [26] emphasize for the determination of a stable solution space the consideration of the company's policy and strategy, its production options and flexibility and the entirety of all customers [26] to realize product individualization.

Structural optimization for manage product individualization can also affect the processes. A high process flexibility for reacting on individual requirements is necessary. Lindemann et. al [4] suggest a two-parted product development process: In a detailed structural planning, an adequate product structure with a defined solution space and flexible processes are developed based on individualization scenarios. Thus, complexity is manageable when executing the product adaption for every single customer [4]. Another method for managing arising process complexity through repetitive product adaption is the standardized individualization process of Spallek and Krause [20]. The individual design and manufacturing of determined components takes place after the customer order within highly standardized process steps. With a standardized process, product adaptions can be repeated for each customer [20].

### *3.3. Product Adaptions Executed by the Customer – Self-Individualization*

Besides the adaption of the product in the company, Pine [27] states the opportunity to create individually adapted products by the customer himself. Piller and Stotko [19] call the modification of the product by the customer self-customization. Since customization is defined differently in this paper, it is henceforth called self-individualization. A company offers a predefined product variant including the flexibility to be modified by the customer due to his individual requirements [5,28]. Accordingly, the company can offer the same product to every customer. Piller [5] differs products for self-individualization by the frequency the customer can adapt his product (repetitively or uniquely) and by the function the product can fulfill (one fixed one or variable ones).

One example for a self-individualizable product is a medical bandage e.g. for the knee joint. Customers can adjust the diameter with Velcro® stripes so that the product fits the customer specific leg. The company manufactures one or just a few variants of the bandage. Nevertheless, the customer can adapt the standard product easily to his own anatomical requirements. The individual needs being caused by the individual anatomy can be satisfied.

In self-individualization, there is no need for an integration of individual requirements during the production phases [27]. Thus, the internal complexity stays manageable, the product structure and processes can stay how they are for every customer. On the other side, there is a high complexity in the

development of a product variant and the dedicated product family to include all flexible alternatives so that a customer can adapt it to his own needs [5,28]. The company predefines the range of opportunities in which the adaption can take place. All scenarios for use, which are not considered during the product development are not possible to adapt anytime. Besides the preplanning of the product, customers knowledge and skills limit adaption opportunities.

Therefore, a detailed product development with an extensive product planning is necessary. During the product development and the definition of the flexible adaption area, customer skills for adaption has to be considered. Companies need to consider, that for self-individualization, not all products types respectively all product adaptions are appropriate. Piller [5] states, that especially the software of a product is individually adaptable by the customer himself. Choi et. al [29] mention, that self-individualization is especially appropriate for products which have to be adapted again and again.

### *3.4. Individualization Strategies without Product Adaptions – Value-/ Service-Individualization*

The infinite expansion of the external variety does not always have enough benefit for the customer to justify the induced internal complexity. The literature also offers alternative ways to face the individualization trend and comply individual customer needs without adapting the product. For satisfying the individual customer need, Tseng et. al [6] introduce the paradigm of mass personalization and states, that for satisfying the customer, a company has to consider the products in its ecosystem. This includes besides the hard components of the product also the core infrastructure (e.g. the business model) and the achievable customer experience while creating and receiving the product. Pine [27] suggests a customized service around a standardized product. Through individual marketing and the delivery solutions, each individual customer can get the attention he desires [27]. Thus, customer satisfaction can be improved. In this regard, a standardized product refers to the predefinition of variants by the company so that the customer cannot influence the product itself. According to the author of this paper, a customized service around a predefined product variant instead of using standardized product variant might be a better wording at this point. Very close to that, Pine introduced the Point-of-delivery Customization, where a predefined product is adapted to customers individual requirements right at the point of sale, e.g. when an engraving is done or a personalized print is added to the chosen standard product. So not only the product itself is relevant for fulfilling individual customer requirements, but also marketing and customer interaction issues.

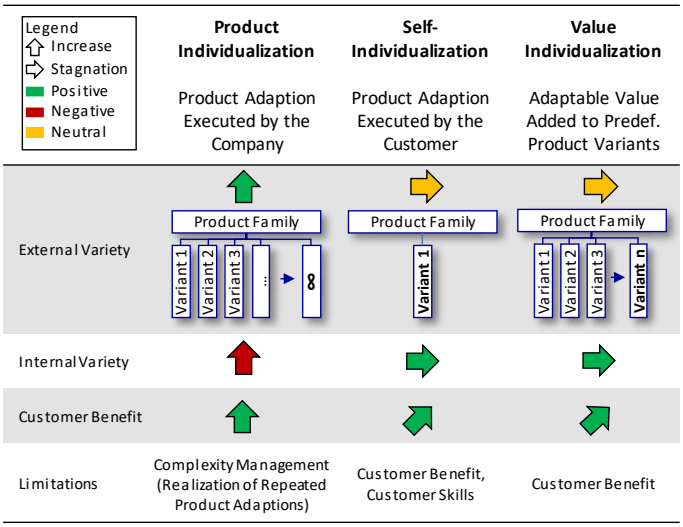
One example for a service around a predefined product is a hearing aid. In a special shop for hearing aids, the customer is advised by a salesperson who knows the differences and advantages of different product variants of the predefined hearing aid portfolio. Thus, the best fitting product variant for the individual customer can be chosen. The predefined product in combination with the attention and service may already fulfill the customer needs. Additional value also occurs during an individual adjustment of the hearing aid settings according to customer specific requirements right at the point of sale.
Offering only the existing predefined product variants induces no further complexity inside the company. Only structures for a customer-service interaction has to be established. Although the additional value might please the customer, there is still the danger that receiving only a predefined product might not suffice for him. It depends on what the customer expects of individualization. If he is satisfied by the company's interest in solving his particular problem, individualized values around the product, e.g. an individual support, are sufficient.

Before implementing the additional value creation, an analysis what the customer expect of the individualization trend is indispensable. Only thus, a company can avoid the risk that no benefit for the customer is created.

## 4. Summarizing the Compromise Between Customer Benefit and Internal Complexity

The previous subchapters cluster customization solutions of the literature into three individualization strategies. It became obvious, that not only the modification and further differentiation of the product is a solution for facing growing individualism, but that marketing and communication strategies also may yield in adequate results. The different individualization strategies have different solution spaces for fulfilling individual customer requirements. The more individual adaptions are possible, the smaller is the discrepancy between the customer requirement and the final solution and the better is the degree of customer requirements fulfillment. On the other hand, a high number of individual adaptions induces a high internal complexity. Not only between the strategies but also within one strategy, different gradations of the individualization degree and the induced internal complexity occurs. Table 1 summarizes the main differences of the strategies including the adaption of the product and the size of the adaptable solution space expressed through the external variety, the induced internal variety, the customer benefit they can reach and the limitations for the individual customer requirement fulfillment.

Table 1. Differences and Limitations of the Individualization Strategies Considering External Variety, Internal Variety Induced and Customer Benefit



## 5. Determination of an Adequate Strategy

The last chapter shows, that a company can react differently on the individualization trend. To find the right strategy for the own business, a deeper analysis of the own structures is needed. In the literature, the determination of an adequate strategy for facing individualization at the own company is rarely supported. Since individualization with the focus on individual customers is closely related to customization, methods for customization decision-making are reviewed.

Daaboul et. al [30] use for the decision-making on Mass customization strategies an extended value network modelling followed by a simulation. For determine which customization level to follow, a company can develop different concepts and check its applicability. Jiao and Tseng [31] developed an analytical customizability analysis using the formulation of the indices to compare technical criteria concerning the product and process design. The Mass Customization Implementation template of Boer et. al [26] deals with the general implementation of a customization strategy and does not only focus the decision-making. Similar to that, the Guidelines for achieving a proper Mass Customisation system of Skjelstad et. al [32] concentrate on what to do for implementing customization and support a decision-making only at the margin. Xu et. al [33] developed a quantitative modeling, which supports the company in finding an appropriate number of product variants considering the increasing costs by increasing variety. Close to that, Rathnow [34] analyzed how to determine right external variety. The optimal point is reached, when the costs respectively internal variety are compensated by the customer benefits the external variety offers [34]. Through the optimization of intern structures (e.g. modularization) or the improvement of the benefit for the customer (e.g. exact customer requirement fulfillment), the size for the optimal variety increases [34].

Most of the introduced methods offer customization decisions related to product changes. But as shown before, not all individualization strategies deal with the adaption of the product by the company. Individualization strategies might have extensive impact on all different life phases of the product. That is why an involvement of all product life phases into the decision-making is necessary to find the right compromise between customer benefit and induced complexity. This fact is neglected by the introduced methods. Analytical solutions often have the disadvantage that they neglect strategic procedures and decisions standing behind the product and process design. A method supporting the decision-making for one individualization strategies followed by its realization and implementation is needed. Adequate visualization tools are essential to support the decision-making. The customer benefit needs to be emphasized adequately to justify a decision for a certain individualization strategy. Strategic positions, technical opinions and expertise of all product life phases need to be considered. To satisfy an unlimited variety, the resulting benefit for the customer has to increase faster than the induced complexity. If the costs increase faster than the benefit for the customer, a defined size of external variety is desirable.

## 6. Research demands and first solution ideas

The research makes clear, that when starting to deal with the individualization trend, a company needs to find and define its compromise between the induced complexity and resulting customer benefit. An adequate method is needed, considering the range of influence factors and conditions of the product life phases to find the optimum. A new approach should support the analysis of the potential for individualization respectively further customization. Doing so, a company can decide whether individualization is an appropriate trend to follow and to what extent. An analysis may include the following issues:

- Determination of the customer benefit of product adaptions
- Determination of the impact of individualization strategies on the internal complexity
- Management and harmonization of internal complexity and customer benefit
- Implementation of the individualization strategy

A method will be developed henceforth on the basis of this paper. Figure 1 is a first draft of a possible visualization tool supporting the determination of how good (existing) product variants fulfill customer requirements. In the center is the exact customer requirement. Axes, pointing from the middle, show different product attributes. For one customer, each product attribute is evaluated. Within the blue circle, the requirement is fulfilled and the customer would buy the product (variant 1 and 2). The better the exact customer requirement is fulfilled, the nearer the product attribute is drawn to the middle and the smaller is the discrepancy. If it is located in the center, the requirement is exactly fulfilled. In addition to the discrepancy, the visualization can also include a weighting of the different product attributes by the angle of the area around the axis. The more the product variant differs from what the customer wants, the more area is colored in red (variant 2 would have more red area than variant 1). To know where to allocate the product variants on the axis, further studies are planned, trying to evaluate the benefit of an individual product attribute adaption.

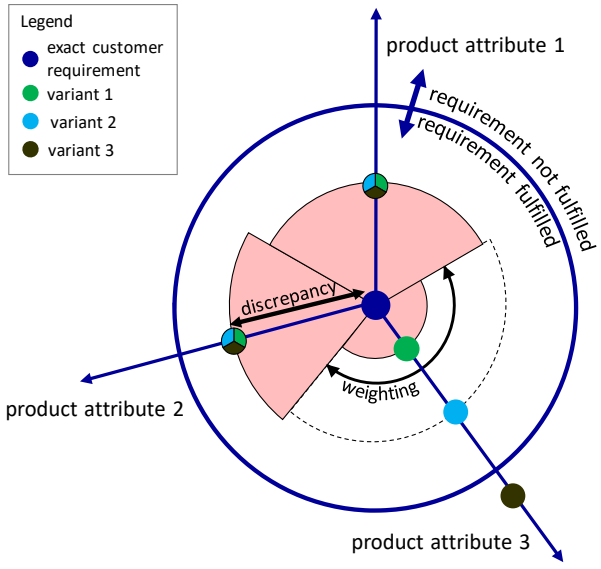



Fig. 1. Draft of a Visualization Tool Supporting the Determination of the Customer Benefit of a Product Adaption

## 7. Conclusion

Individualization is one of the current megatrends, which focuses each individual customer. One of the main challenges for a company is to find the right compromise of achievable customer benefit and the induced internal variety. A high external variety decreases the discrepancy between the exact customer individual requirement and the product solution but induces at the same time internal complexity for the company.

In this paper, different individualization strategies are reviewed and clustered considering if a product adaption occurs and who is executing the adaption. A product individualization executed by the company has the advantage to meet the exact customer requirement regarding certain product attributes. But the induced internal complexity through the repetitive adaptions needs to be managed with adequate methods, whose implementation effort and realization might limit the product individualization possibilities. Concerning the self-individualization, the product and processes are the same for every customer so that no further internal complexity is induced. But the customer benefit which can be reached depends on the predefined adaptable alternatives at the product and the customer skills. Concerning the value-individualization, existing product and process structures can remain how they are, only structures for service or communication have to be implemented. Nevertheless, predefined product variants, which are upgraded by an additional value, has to suffice for the customer.

Depending on the company's product, its processes and internal resources in combination with the required customer benefit, an adequate individualization strategy needs to be chosen by the company. A methodical approach supporting and directing the decision-making is missing. That is why, a method is developed by the author of this paper including a characterization of necessary analysis to evaluate the company's potential for the individualization trend and the different strategies.

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