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Statistical Analysis of Consumer Perceived Value Deviation

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Abstract

The lack of integration of customer requirements throughout the product development process can lead to over-engineering or performance gaps, which may result in the failure of a product or innovation. From the company's point of view, the lack of integration can lead to instabilities during ramp-up. However, a high level of product maturity in early stages is of very great importance for the ramp-up. Consumers perceive the value of durable goods in the consumption process at two different points of time. The perceived value based on first impressions influences their buying behavior. In the subsequent usage phase consumers form a new value judgment that affects the repurchase behavior. Conversely, the survey methods to represent the pre-purchase and post-purchase value judgment are not sufficiently discussed in the literature. In this sense, a survey instrument was developed that can be used at both time points to assess the deviation of pre-purchase and post-purchase value judgments. This paper represents the results of the statistical analysis, whether the pre-purchase-value differs significantly from the post-purchase-value. Furthermore, it is examined whether a statement about the consumer's willingness to pay can be made on the basis of the perceived value. The knowledge about the deviation of perceived value have implications for the product maturity and thus during ramp-up.

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1. Introduction

Consumers perceive the product value of durable goods at two different points of time in the consumer process. [1–3] First, the consumer forms an opinion about the product value immediately before buying, which determines the choice of a particular product from a set of similar products. [4] In the subsequent usage phase the consumer forms a renewed product value that affects the re-purchase behavior. This formed value is called **Consumer Perceived Value (CPV)**. The CPV is determined as a cognitive, subjective comparison process in which the consumer weighs up the benefits to the costs. [5] Both the expected value before buying, as well as the perceived value during the usage are affected by the perceived quality, which has a significant impact on the CPV. The CPV is not an objectively measurable quantity, rather the perception and attribution of value occurs differently from individual to individual and from situation to situation: “not only does each of us value the same things differently, we individually value different things, and at different times in

different ways.” [1] Particularly, the deviation between value judgments before and after the purchase of durable goods is relevant, because they unfold their benefits in different usage situations during their lifetime. Therefore, for companies the questions arise: How does the CPV change over the usage phase and which quality features are the drivers for a positive CPV? How can the knowledge of the deviation of the CPV be made available in the ramp-up phase for new products? A high degree of product maturity in the early phases of the product development can lead to an effective ramp-up phase for companies. Therefore, the leading research question of this paper is: Does the post-purchase-CPV deviate significantly from the pre-purchase-CPV?

1.1. Definition of CPV

The CPV is a theoretical construct that is not defined consistently in the literature. In his research, WOODALL found 18 different product value terms with a similar semantic content in 90 different publications. [1] Apart from the

different terminology, the CPV is defined differently. MONROE defines the CPV as “trade-off between the quality or benefits they perceive in the product relative to the sacrifice they perceive by paying the price.” [6] GALE defines this as “market perceived quality adjusted for the relative price of your product.” [7] The authors describe the CPV in a similar manner as a ratio between benefits and the cost of a product. WOODRUFF defines the CPV as “a customer's perceived preferences for, and evaluation of, those products attributes, attribute performances, and consequences arising from use that facilitates (or blocks) achieving the customer's goals and purposes in use situations” [8] and extends the trade-off-definition. [9] His definition includes the consideration of different times (pre-purchase and post-purchase-CPV), several cognitive tasks and evaluation criteria. Moreover WOODRUFF detects three common characteristics: [8]

- CPV is connected to the usage of a product.
- CPV is subjectively perceived by customers rather than objectively determined by the manufacturer. [10]
- These perceptions include a trade-off between costs and benefits.

EGGERT and ULAGA developed common definitions: [5]

- CPV consists of several different value components.
- CPV is related to the competition.

HOLBROOK describes the CPV as “interactive, relativistic preference and experience”. [11] This relatively abstract definition includes other important features of the CPV:

- CPV is perceived differently by different consumers.
- CPV is context-dependent or conditional.
- CPV is relative. [10]
- CPV is dynamic. [12]

WOODALL describes the CPV as follows: “Value for the customer is any demand-side, personal perception of advantage arising out of a customer's association with an organization's offering, and can occur as reduction in sacrifice; presence of benefit (perceived as either attributes or outcomes); the resultant of any weighted combination of sacrifice and benefit (determined and expressed either rationally or intuitively); or an aggregation, over time, of any or all of these.” [1] With this definition WOODALL combines the findings of previous authors and manages to concretize the concept of the CPV. In summary, it is stated that the CPV is determined by a cognitive, subjective comparison process in which the consumer weighs up the benefits to the cost. The result of this process is the value of a product, which can be compared with the value of other products. [4, 5]

1.2. Benefits for product planning and ramp-up

Customers are an important factor influencing the product planning process. The lack of inclusion of customer requirements throughout the product development process can lead to over-engineering or performance gaps, which may result in the failure of a product or innovation. A high failure rate of product developments can be an existential risk for companies. [13] One cause of a non-accepted product may be the wrong product specifications, which emerge from the detected discrepancy of assessed customer requirements and

actually required solutions. [14] Furthermore, addressed customer's requirements in the product development may be out of date due to high market dynamics. [15, 16] However, a high level of product maturity in early stages is of very great importance for the ramp-up. Another cause for the failure of products can be a lack of communication when product developers and consumers “speak different languages”. [17] KALLWEIT stated, that customers think in requirements and applications, for developer the components, specifications and functions are of high importance. [17] Furthermore, SCHULTE notes that customers claim a total solution for an individual problem while product developers often rate the innovation success based on their own reached technical objectives. [13] GUDEM ET AL. allocate the CPV a subjective, temporal dimension: “Customer Value [...] develops over time, and it relates to attributes that go beyond the physical product, being influenced by [...] personal experience.” [18] WOODRUFF stated: “Purchase means choosing, and that requires customers to distinguish between product [...] alternatives and evaluate which is preferred. In contrast, during or after use, customers are more concerned with performance [...] in specific use situations.” [8] Therefore, the CPV is a dynamic, situational and contextual construct. With regard to the design of the product development process and the ramp-up, this means that manufacturers need to explore or anticipate usage situations [13]: “Product or service providers must realize that Value is often less a “snapshot” than it is a moving picture.” [19] MITCHELL [20], REDSTRÖM [21], HOONHOUT [22] and VERGANTI [23] observed, that companies need to develop the product not only as a technical artifact. The design of the product associated with the use of the gained experience is important. [18] According to GUDEM ET AL. the definition of the product development process has to be extended to the aspect of usage situations. The CPV allows the assessment of a product both from the pre-purchase and post-purchase perspective. [18] SWEENEY ET AL. stated: “value perceptions can be generated without the product [...] being bought or used, while satisfaction depends on experience of having used the product.” [24] The evaluation of the CPV over several time points allows capturing such changes in the consumer preferences over time. It is possible to determine the reasons for the assessment and thus derive recommendations for future product development in order to have a high level of maturity for the ramp-up in the early phases. The CPV is an aggregation of elements. These different perspectives allow a differentiated analysis of the deviation of the CPV over time at various levels of abstraction. [4] Thus it is possible to determine the elements which perception changes during the use phase by comparing the results of pre-purchase and post-purchase-CPV. To make a specific statement about changes in the CPV, a survey instrument is required, which measures the perceived value at different levels of abstraction. Furthermore, companies need to know how occurring changes in the CPV can be acquired, interpreted, and then be used as a source of information in the product development process. [25] After assessing the pre-purchase and post-purchase-CPV by comparing the two points of time it can be identified, whether and in what respect deviations exist. This information can be processed by the product planning in order to be used in the

next generation product development, and thus to make the ramp-up more effectively (see Figure 1). The knowledge of the judgment deviation allows product developers to identify the time-varying customer requirements and integrate them in the product planning process. An indicator of the ramp-up compared to the period of stable production is often a lower product maturity. The aim of the ramp-up is to ensure the availability of all components for the start of production, to shorten the time-to-market, to make the level of product maturity more transparent and to reduce the ramp-up costs to a minimum. The integration of the knowledge about the reasons for deviation is a valuable driver for the mentioned objectives and thus has an impact on the efficiency of the ramp-up.

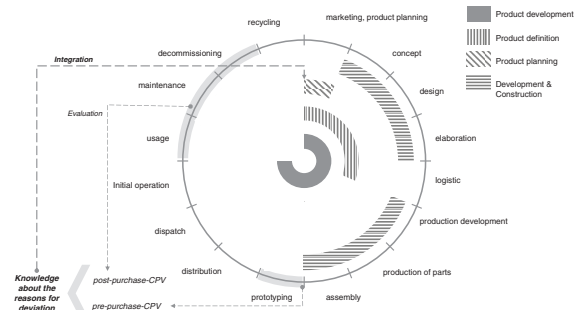


Figure 1: Integration of pre-purchase and post-purchase-CPV in the product development

2. Conceptual approach

This paper aims to answer the main research question, whether the pre-purchase-CPV differs significantly from the post-purchase-CPV. First, it is necessary to examine how the CPV can be measured to determine a deviation of the elements in the course of time (see Figure 2). In previous papers, the CPV construct has already been developed in the first phase and validated in a pre-test. [4, 26] To determine the deviation of the CPV over time, a determination of the data at two separate points in time is necessary. The deviation of the pre-purchase and post-purchase-CPV is of particular interest. At the beginning of the second phase subjects are identified. An example of a product will be presented to the subjects and they are given time to try it. Subsequently, the subjects fill out a questionnaire to determine the pre-purchase-CPV. After a certain time, they fill out the CPV questionnaire a second time. This survey corresponds to the determination of the post-purchase-CPV. Phase 2 provides data about the pre-purchase and post-purchase-CPV through the questionnaire, which can be converted into evaluable records.

Based on the created data in Phase 2, the statistical analysis is carried out in phase 3 to identify the deviations between pre-purchase and post-purchase-CPV. The design of the questionnaire allows representing the CPV for each subject using a quantified value, both for the pre-purchase and post-purchase-CPV. A quantified value enables detailed statements about the CPV. Furthermore, a measurable value of CPV allows a direct comparison of the two points of time of the

investigation, which carries the answer to the research question of this paper. Furthermore, it is examined whether a statement about the consumer's willingness to pay can be made on the basis of the CPV.

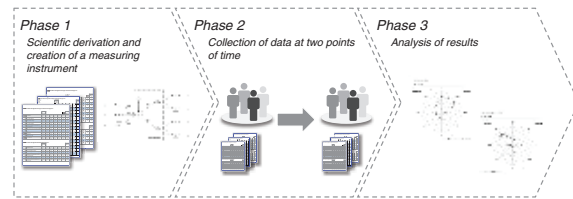


Figure 2: Conceptual approach of empirical study

3. Statistical evaluation and analysis of the results

Overall, more than 30 subjects are needed with completed questionnaires in both point of time, since for applying statistical methods a sample size greater than 30 is required.

Accordingly, 37 subjects were acquired to compensate for failures. The sample product is introduced to the subjects and they are given time to try it. If they participate in the study, the subjects complete the CPV questionnaire to collect the pre-purchase-CPV. Then they use it during a predetermined period in their everyday lives. After a certain time, they fill out the CPV questionnaire a second time to raise the post-purchase-CPV. To avoid any bias by using only one product, a second product from the product category was given to the subjects. Due to the second product, further data could be collected. First, two products have been identified that meet all the suitable criteria of the correspond study. Tablet PCs were the chosen products. Thus, the Odys Xelio 7 Pro and Acer Iconia B1 have been provided as sample products for the study.

3.1. Established research hypotheses

The main research question of this paper is whether the post-purchase-CPV is significantly different from the pre-purchase-CPV. There are numerous indications that suggest that there are not the same elements influencing the CPV before buying and during the use phase. [30] Thus, situations may occur over the product lifetime that has not been anticipated during the purchasing decision of the consumer. Furthermore, the CPV construct will be investigated in terms of its prediction to the willingness to pay. It is expected that a high CPV creates an incentive for consumers to pay a higher price. In summary, for the statistical analysis and interpretation of the study, the following research hypotheses arise:

H1: The pre-purchase-CPV differs significantly from post-purchase-CPV

H2: There is a positive relationship between the CPV and the willingness to pay

3.2. Application of analysis of variance

Through two independent variables (IV) (time and product) with two stages (pre-purchase/post-purchase and Acer/Odys), a total of four experimental conditions arise in this study (see Table 1). For each test condition the same subjects were examined. The CPV value was used as the target dependent variable (DV). Consequently, an univariate, two factor analysis of variance (ANOVA) is performed. The focus of the investigation is on the temporal variation of the DV CPV. Therefore, it is necessary to measure this target variable several times at different time points and with different products within the same subjects. By doing this, an ANOVA is performed with repeated measures. [27] Repeated measures mean that the same sample is examined under various conditions. It is frequently used in medical research to investigate the effects of a treatment in a therapy. [28] Since each subject did not only evaluate the CPV of the product at two different times, but for each of the two times they also handled two different products, both factors must be considered as repeated measure factors, so that a total of four monitoring groups of 30 valid observations arise.

Table 1: Schematic structure of the collected data set

Product	Time	
	Pre-purchase	Post-purchase
Acer tablet	n=30	n=30
Odys tablet	n=30	n=30

Unlike the ANOVA without repeated measures, the differences between the subjects are not important for this analysis. [29] However, in this analysis the question how the measured value changes within the individual subjects is of importance. In this regard, the treatment effects are relevant, that means the change of the measured CPV due to the different time points.

3.2.1. Significance test

Following, the ANOVA is applied to the collected data of the study. Thus, the main research question of this work is to be answered whether the post-purchase-CPV is significantly different from the pre-purchase-CPV. It will be examined whether the means of the IV time differ significantly from each other, which means whether a difference is not caused randomly. [28] The corresponding null and alternative hypotheses are:

$$H_0: \mu_{\text{pre-purchase}} = \mu_{\text{post-purchase}}$$

$$H_1: \mu_{\text{pre-purchase}} \neq \mu_{\text{post-purchase}}$$

The null hypothesis states that there is no difference between the mean values of the factor, that means no effect of treatments exist. The alternative hypothesis assumes that there is a difference between the means. The null hypothesis can be

rejected, if the calculated p-value is less than the specified significance level of $\alpha=0.05$. [31]

The investigation of the collected data for the relevant IV time results in $p=0.037$. Since the p-value is smaller than the level of significance, the null hypothesis may be rejected. Thus, the mean values of pre-purchase and post-purchase differ significantly with respect to the IV time. There is no significant difference of the CPV between the products Acer and Odys, the associated p-value is 0.085. The interaction effects between time and product have also no significant effect on the results ($p=0.479$). In summary, it should be noted that a significant difference between pre-purchase-CPV and post-purchase-CPV exists. The average value of the CPV of subjects, who assessed the products before buying, is statistically significant different from the mean of the subjects who judged the products after purchase.

3.2.2. Evaluation of effect size

An important component for the implementation of a statistical significance test is the effect size. Since a significant result does not necessarily mean that a large mean difference exists, the effect size can be estimated, how strong the effect is marked. [28] If a sample size planning is not performed, this parameter should be examined for a significant result to make a statement about the importance of the effect. [27] When performing an ANOVA the eta-statistic indicates the explanatory power of individual IV with respect to the DV. [31] The partial eta squared (η_p^2) indicates what percentage of the variance of the DV can be attributed to one of the main effects or interaction effect. [28] Regarding the collected data eta squared measures the proportion of the total variance of the CPV-value, which goes back to the differences between the relevant IV time.

The investigation of the ANOVA yielded an effect size value of $\eta_p^2=0.142$. Thus, it can be concluded that the proportion of the total variance of the CPV, which dates back to the differences between the IV time (pre-purchase/post-purchase), is 14.2%. In dependence on COHEN this value corresponds to a major effect. [32, 33]

3.3. Relationship between pre-purchase- CPV and willingness to pay

In regards to SMITH ET AL. the willingness to pay is defined as “the maximum price a buyer is willing to pay for a given quantity of a good or service”. [12] HOMBURG ET AL. stated: “The perceived Value determines the customer’s willingness to pay and thus the price a company can charge for its product.” [34] Therefore, there is a direct correlation between the willingness to pay and the pre-purchase-CPV.

The representation of the collected data of the subjects can be observed in the scatterplot (see Figure 3) Different mathematical models are adapted to the empirical data. It is to be investigated, which model describing the relationship between the CPV and the willingness to pay has the best goodness of fit.

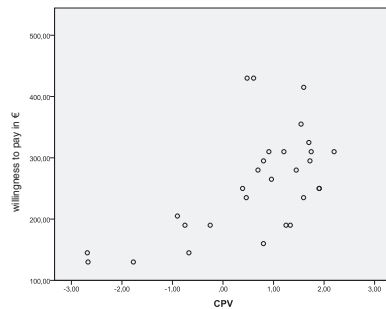


Figure 3: scatterplot of CPV and willingness to pay

To analyze the relationship between CPV and willingness to pay, a regression analysis is carried out. **Regression analysis is one of the most flexible and widely used statistical analysis methods for investigating relationships between an DV (predictor) and one or more IV (criterion variables).** [31] The following Table 2 summarizes the determined coefficients of determination of the regression analyzes of the subjects. The values of the corrected coefficient of determination R^2_{corr} suggest that the highest goodness of fit is achieved with an exponential model. It is striking that all corrected coefficient of determination of the models comprise over 41% and thus have an almost moderate goodness of fit. [35] This implies that in general there is a relation between the two considered variables.

Table 2: Evaluation of different coefficients of determination

Applied Regression Model	R^2_{corr}
quadratic	41%
linear	43%
exponential	50%

3.3.1. Significance test

In order to check the observed relation for significance, a statistical significance test is used. The tested hypothesis is that the average purchase price is greater for a positive CPV value as for a negative CPV value. For this purpose, the data set is divided into 2 groups (positive CPV/negative CPV), which are unconnected and not normally distributed in accordance to the Shapiro-Wilk test ($p_{\text{group1}}=0.8$ and $p_{\text{group2}}=0.2$). Accordingly, the Mann-Whitney-U test is used to verify the significance, based on the comparison of the central tendency of two samples. The null hypothesis states that the average rank of the subjects in both samples is not different. This means, that there is no tendency of the ranks of a sample to deviate systematically from the rank values of the other sample. The alternative hypothesis states that the ranks of a sample are systematically lower or higher than the rank values of the second sample.

$$H_0: E_{R1} = E_{R2} \quad H_1: E_{R1} \neq E_{R2}$$

The arithmetic mean of the subjects with positive CPV value is 290 Euro and 162 Euro with a negative CPV value.

The p-value of the significance test is calculated as 0.0004. Therefore, the result is statistically significant at a significance level of $\alpha=0.01$. The null hypothesis, that both samples are derived from the same population, can be rejected and the alternative hypothesis can be accepted.

4. Conclusion and outlook on further research work

4.1. Conclusion and discussion

Starting point of this paper is the realization that consumers perceive the product value of durable goods in the consumer process at two different points of time. First, the consumer forms an opinion on the product value immediately before buying, which decides on the choice of a particular product from a set of similar products. In the subsequent usage phase the consumer forms a renewed product value that affects the re-purchase behavior. This formed value is called Consumer Perceived Value. It is determined by a cognitive, subjective comparison process in which the consumer weighs the perceived product benefits with the perceived costs. The CPV is no objectively measurable quantity, rather the perception and attribution of value occurs differently from individual to individual and from situation to situation. Particularly relevant is the distinction between the CPV before and after the purchase of durable goods, since these unfold their benefits in different usage situations during their lifetime.

In this paper, the data of the study were collected, analyzed and interpreted. It provides the answers to the formulated research questions. First, the description of the statistical method was performed. This was followed by the analysis of the data with regard to the established research hypotheses.

In chapter 3.2, the main research question of this study was investigated whether a significant difference between pre-purchase and post-purchase-CPV of durable goods exists. The ANOVA was identified as a suitable method for analyzing this question. This method could prove a significant main effect of the IV time, so the research question could be answered affirmatively. This implies that there are not the same features that condition the pre-purchase and post-purchase-CPV. Thus, companies cannot limit their market research activities only to the purchase situation. It is not sufficient to integrate the voice of the customer only at this point of time to develop customer-oriented products and to build satisfaction and loyalty to the company.

The relation between the pre-purchase-CPV and willingness to pay was outlined in chapter 3.3. The willingness to pay is shown as a function of the CPV to make a qualitative statement about the relationship between these two variables. The results of the regression analyzes reveal that the willingness to pay depends exponentially on the CPV. Further investigations should be made in order to do more accurate predictions based on the CPV for the willingness to pay. These predictions can support companies to design their marketing activities more efficient and customer oriented.

The developed CPV-construct was specially designed for durable goods. It could be shown, that the developed CPV-construct is suitable for the product category of tablet PCs.



Further research should be conducted to evaluate, whether this construct can be transferred to other product categories e.g. digital cameras, robot vacuum etc.

4.2. Outlook on further research work

To derive recommendations for the product development based on the findings of this study a qualitative research approach should be adopted, which enables to identify the reasons for the different value judgment of the elements of the pre-purchase and post-purchase-CPV. Subjects, for whom differences in the relevant abstraction levels have occurred, can be asked about the reasons for the change. Methodically, the implementation of semi-structured interviews can be applied. The result can be a list of possible reasons for a deviation of the importance of benefit and cost elements, which can be included as a source of information in the product planning process and thus enables an effective ramp-up.

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