Making the Most of Customer Product Reviews

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***Abstract*—Online product reviews are a twofold user-centric instrument: reviews are written by users and, furthermore, aid other users with their purchase decisions. Moreover, detailed product reviews that rate product parts help retailers in improving products by identifying reasons for defects. In this paper, we report, analyse, and discuss the results and findings of two user studies (160 and 229 participants respectively). We contribute findings on customer reviewing behaviour and on improving reviews to include ratings for product parts. Furthermore, we analyse reviewing incentives and evaluate an alternative review system that presents its users with a list of known problems that they can select from.**

Keywords–Online Product Reviews; Product Rating; Rating Decomposition; Customer-centric; Review Systems.

I. INTRODUCTION

Online product reviews are a remarkable user-centric component of e-business. The duality of reviews involves customers at two times during their online shopping experience: at first, potential customers of a product read reviews to evaluate product suitability and therefore, base their purchase decision on reviews. After a purchase, the second aspect of reviews becomes relevant when customers may write their own product reviews in an altruistic action to help others with their purchase decisions. In general, product reviews report the experience with the product alongside with an indication of the product's merits (called *rating* from now on).

Even though customer product reviews suffer from conceptual problems, for example, authors lying about their experience with a product or reviews written by paid authors who never bought the product, reviews are considered such important for online business that they are implemented in almost every online shopping platform. Besides aiding potential customers, reviews also provide benefits for online retailers. Highly-rated products reach higher prices compared with low-rated products [1][2]. Moreover, potential customers will usually choose the highest-rated product from a set of functionally identical ones.

The impact of product reviews on customers is in the focus of research since some time. Our interest in customer reviews differs. In order to improve the benefit for both customers and retailers, we are interested in splitting a review into sub-ratings for individual parts of a product. Most products sold today are composed of parts contributed by different, potentially independent suppliers. However, customers receive assembled products and thus, reviews address products as a whole. While this is helpful for customers, having ratings for product parts would enable retailers to improve the assembled product by identifying weak parts and consequently replacing their suppliers with other suppliers that deliver higher quality. Eventually, this will have impact on the overall product quality and thus, on customer satisfaction, as well as on the reviews written for the product. Beyond the scope of this paper, such knowledge on individual ratings would also have impact on pricing strategies of retailers and similar.

Therefore, we are interested in ways to *decompose* product reviews into detailed reviews for sub-components. It would be a strong assumption to expect the general customer to be able to write individual reviews for product parts or even to identify such ones. In order explore reviewer capabilities, as well as to understand how and why reviews are written, we conducted a preliminary survey (160 participants) on the attitudes of customers towards reviewing followed by a second study (229 participants) that further investigates the results of the preliminary study. By the term *customer capabilities*, we summarize both the ability and the willingness to produce detailed reviews. For the second study, the following assumption was made: customers are generally unable to identify and rate parts of products individually. Thus, we focused on the capabilities to identify defects and the reasons for the defects. Defect identification is close to (negative) ratings for individual parts, because it delivers the information needed to identify and replace suppliers of weak product parts. This aids both retailers in improving product quality and customers in buying better products.

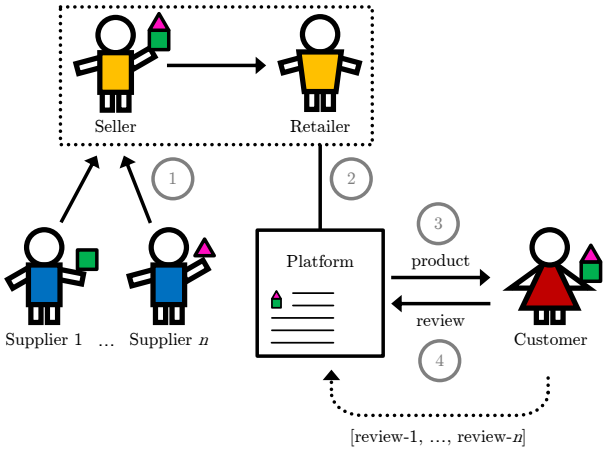

Figure 1. The e-business reviews scenario: the retailer sells a product made from components of different suppliers to customers. Each customer may write a review about the product as whole. Nevertheless, our interest is to obtain reviews for individual parts of the product.

Our studies assume the scenario depicted in Figure 1. A *seller* assembles a product from parts contributed by several *suppliers*. The finally assembled product is given to the *re-*

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tailer, which uses an *e-business platform* to offer the product to potential *customers*. The seller and retailer may as well be the same entity without influence on the results of our studies. Products that are offered on the platform consist of a description and a set of product reviews written by customers. When a customer makes a purchase decision, the product is given to the customer, who may write a *product review*, which will be available on the platform to other potential customers. Our intention is to determine the possibility of obtaining decomposed reviews from customers.

A. Structure

This paper is organised as follows: we survey work related to customer product reviews in Section II. Afterwards, in Section III, we present the setup and demographics of the two studies we conducted. In Section IV, we report our findings on customer review behaviour, while Section V focuses on the results on how customers can be incentivised to write more useful reviews. Based on the results of the first study, we presented the participants of the second study with an alternative review system. The reactions to the proposed review system are analysed in Section VI. We conclude in Section VII.

II. Related Work

Online customer product reviews are of interest in several fields of research, especially in psychology, economics, and computer science. In the latter field, most research targets the extraction of features and ratings from textual reviews by text mining. This section reviews a selection of the scientific work most relevant to our approach of decomposing customer product reviews.

A. General Aspects of Customer Product Reviews

In 2004, Resnick et al. conducted an experiment to research the effects of positive and negative reputation in eBay [1]. Thereby, eBay users can rate a transaction, that means, a purchase, as either *positive*, *negative* or *neutral*. Based on these ratings, a reputation is built up for every eBay user. Resnick et al. found that sellers with good ratings—and thus, good reputation—were able to achieve significantly higher prices for the same products compared to sellers with less good ratings. According to the authors, eBay's reputation system is flawed but works anyway because buyers pay insufficient attention to bad reviews.

In [3], Li, Zhang, and Martin present an alternative review system for e-marketplaces. To overcome the flaws of current systems (e.g., no information is available on new market entities; delayed effects of negative reviews), they propose a system in which reviews are kept private between the buyers and the marketplace operator, which needs to be a trusted third party. The operator then applies punishments to misbehaving retailers. Related approaches to improve review systems have been made, for example, by Miller, Resnick, and Zeckhauser in [4]. Such improved systems usually apply financial measures to prevent misbehaviour; either by punishing misbehaving entities [3] or by rewarding good behaviour [4].

Our research is targeted towards making better use of reviews, not towards replacing the review systems themselves.

B. Effects and Motivations behind Customer Product Reviews

With the example of online movie reviews, Dellarocas and Narayan investigated the motivations of customers to write product reviews [5]. They found that exceptionally good or bad movies, high marketing effort, public disagreement on quality, and the number of already available reviews lead to an increased number of reviews. Dellarocas and Narayan could reject their hypothesis that customers write reviews out of altruism. Their results fit with ours from Section IV-B where applicable.

Research on the impact of reviews on the number of sales has been made by Chevalier and Mayzlin [2]. The authors investigated the effects of customer reviews for books on two large online shops. Besides a general tendency towards positive reviews, they found that better reviews correlate with higher sales numbers. Moreover, the impact of bad reviews is higher than that of good ones. The most interesting finding for our work, especially regarding consequences drawn from tests with our alternative review system, is that customers prefer written reviews over ratings only.

C. Text Mining Customer Product Reviews

There are many approaches in computer science that apply text mining on written customer product reviews. All these approaches use text mining to identify product features and the sentiments of customers towards these features. Thereby, features are detected in different ways and assigned with a rating.

Aciar et al. apply text mining with a product-specific ontology [6]. The authors define the ontology upfront and match the results of their text mining afterwards. Moreover, they calculate an overall product rating from all identified features. We believe that the customers should have the option to rate a product independently from their written review as it is possible that relevant influence factors are missing from the set of identified features.

Striving towards assisting manufacturers in increasing product quality, Archak, Ghose, and Ipeirotis apply text mining to customer product reviews [7]. In contrast to Aciar et al. [6], their approach includes learning the features from the reviews without the use of a predefined ontology.

The text mining approach by Yu et al. distinguishes between reviews that contain so-called *Pros&Cons lists* and pure textual reviews [8]. Besides this differentiation, the authors also identify product features (which they call "aspects") and sentiments towards these features.

In terms of decomposed ratings, product features are similar to product parts. While our approach in this paper aims at receiving reviews that are already decomposed from customers, applying text mining to reviews seems promising to aid review decomposition for situations in which the customers are unable to write decomposed ratings by themselves.

III. Study Setup

To explore customer reviewing behaviour and their capabilities to write detailed reviews, we conducted two studies.

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The results of the first *preliminary study* helped in designing the second *full study*.

Both studies were conducted by means of structured online questionnaires. Invitations were sent to our extended network of family and international friends with the plea to redistribute to their friends and family. Both questionnaires were available in English and German language. For each question, the participants could choose from a list of predefined answers that ranged from specific answer like *yes* or *no* to an indication of tendency, e.g., *totally agree*, *agree*, *do not agree*, *do not agree at all*. When applicable, participants could concurrently select multiple answers.

The preliminary study was designed to gather data on the general attitude of customers towards online reviews. The full study was focused on the participants' capabilities in writing detailed ratings that may reveal faulty parts of a product. Additionally, the study was intended to reveal incentives that increase the probability of customers to write reviews. At the end, we presented the participants with a fictitious alternative review system designed on the results from the preliminary study. Details on the alternative system are explained in Section VI.

During both studies, all participants were asked for their gender, their employment status, and if they consider their job being in the field of technology or not. The participants were not asked for their age. Of course, all data was collected anonymously.

Overall, 160 people participated in the preliminary study. For the full study, we were able to recruit 229 people. Figure 2 shows the distribution of genders and of participants that see their job in the technological field. In both studies, almost 30% of the participants are female. The amount of participants with a technological job and those without increased from 60% to about 66%.

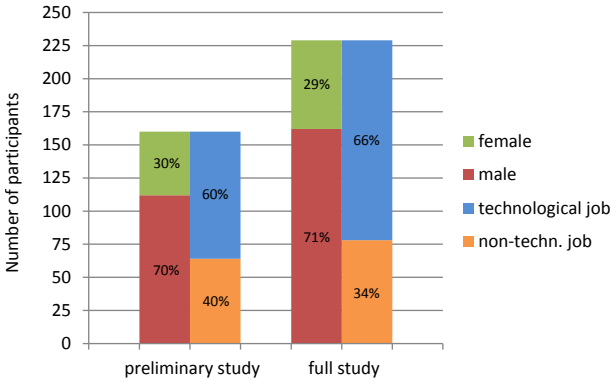

Figure 2. The distribution of genders and participants who consider their job being in a technological field for both studies.

The distribution among the different states of employment was similar in both studies. As Figure 3 shows, the vast majority of participants consisted of (university) students and employees. Due to the high percentage of German-speaking participants (around 80% of the participants chose to answer the questionnaire in German), it is to assume that undergrad students mostly chose "student", while Ph.D. students chose "employed" as a Ph.D. position usually is a full time position at a German university.

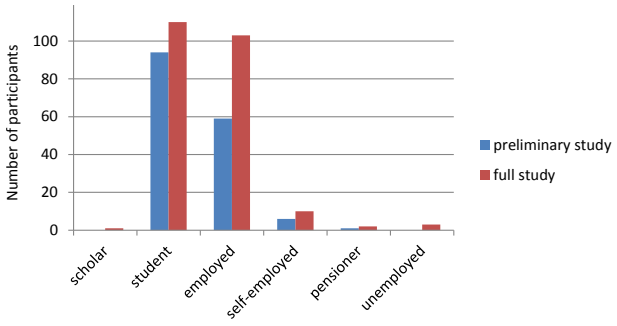

Figure 3. The distribution of participants among distinct types of employment for both studies.

In the preliminary questionnaire, all 160 participants answered the question if they ever bought products online with *yes*. Therefore, this demographic question was removed from the full study. However, we received an e-mail from one person stating she didn't complete our questionnaire because she never used online shopping before.

IV. Customer Reviewing Behaviour

The preliminary study targeted general customer reviewing behaviour. This sections discusses the main findings.

As expected, a high percentage of potential customers base their purchase decisions on product reviews from other customers. When asked if they are influenced by product reviews, 50% of the participants answered with *agree* and further 26.25% answered with *totally agree*. Therein, we see a reason to believe that customer reviews have an important effect on e-business in general. However, there appears to be a contradiction as only 75% of the participants ever wrote a review (in text form, on a point scale or in a mixed setting). Moreover, 79.2% of those who write reviews, only write reviews rarely.

A. Why Customers don't write Reviews

In order to investigate why customers don't write reviews, those 25% participants who claimed not to write reviews were asked for their reasons. Multiple answers were possible. The two most chosen answers were *missing motivation to do so* (75%) and *unwillingness to perform a registration which is required to write reviews* (67.5%). The same answers were given by the participants who write reviews only rarely. An overview on all answers is given in Table I.

TABLE I. Reasons not to write reviews as given by those who write reviews only rarely. Multiple answers allowed.

Reason	Participants	Fraction
I lack motivation	71	74.74%
I don't want to register	65	68.42%
I forget to write reviews	42	44.21%
I don't mind writing reviews	36	37.89%
Other customers already write reviews	30	31.58%
I'm aware that it's bad not to write reviews	21	22.11%
I consider reviews dispensable	12	12.63%
Reviews don't represent the reality	11	11.58%
I regret to write reviews rarely	7	7.37%
I don't know how to write a review	5	5.26%
other	8	8.42%

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B. Why Customers write Reviews

All participants that claimed to write reviews were asked for their reasons to do so. For every potential reason, the participants could state their consent on a five point Likert scale ranging from *totally agree*, *agree*, *neutral*, *do not agree*, *do not agree at all*. In Table II, the first two options are summarized under *positive tendency*, the last two ones under *negative tendency*. A sixth option *no opinion* could be selected in case none of the above applied. We asked for the eight reasons to write reviews as given in Table II.

TABLE II. REASONS TO WRITE PRODUCT REVIEWS. PARTICIPANTS WHO CHOSE *no opinion* ARE NOT LISTED.

I write reviews…	Positive Tendency	Neutral Tendency	Negative Tendency
to share my firm conviction for the product	80.83%	9.17%	8.33%
to warn other potential customers	76.67%	10.83%	9.17%
to share my experience with others	73.34%	11.67%	11.66%
because I want others to follow suit	38.33%	28.83%	35.00%
to express my frustrations	36.66%	12.50%	47.50&
without deeper reason	30.84%	25.83%	32.50%
to receive discounts or other benefits	22.50%	15.00%	58.33%
to receive assistance	20.00%	15.83%	55.83%

Participants could list additional reasons for writing reviews in a text field. Most notable reasons were *boredom* and *doing the retailer a favour*.

Many customers implicitly assume that the majority of reviews is written by unsatisfied customers. The assumption herein is that customers invest more time when they are dissatisfied with a product, for example, to "let off steam". Our findings do not back this assumption. In contrast, we found that there is no general correlation between writing a review and the tendency of the review.

In order to identify a general tendency towards positive or negative reviews, the participants had to indicate their level of agreement to the following two statements: *if I write a review, the review is always negative* and *if I write a review, the review is always positive*.

As can be seen in Figure 4, there is no tendency towards writing only negative reviews. However, a slight trend towards writing positive reviews is visible.

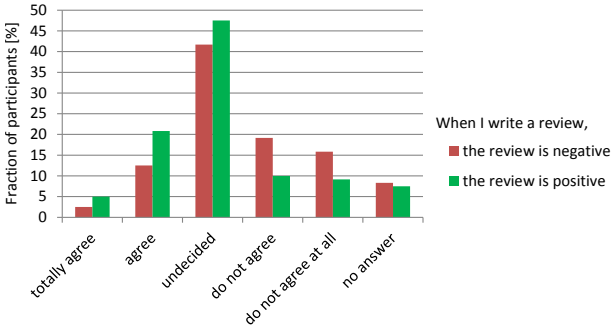

Figure 4. Tendencies towards generally writing positive or negative reviews respectively.

In conclusion, the best way for retailers to gather product reviews is to have convinced customers. Reviews are as often written to warn about potential defects as to share product experiences. This finding reconfirms that there is no tendency towards writing negative reviews.

C. The Influence of Warranty

The reaction of customers to a defect depends mostly on the state of warranty. If delivered with a defect, customers will send the product back to the retailer, regardless of the price. Moreover, searching the reason for the defect only plays a minor role. Nevertheless, 51.53% of the participants stated that they are usually capable of identifying the reason for a defect. Additionally, only 13.97% of the participants write reviews a long time after a purchase.

We conclude that it is especially difficult to obtain decomposed product reviews during the warranty period as customers are more prone to sending the product back than to find the defect. Getting information on product wearing is also difficult.

V. REVIEWING INCENTIVES

One part of the full study investigated how customers can be motivated to write more product reviews. We explored three potential incentives: receiving an explanation how a review helps the retailer to improve the product, receiving feedback to a review from the retailer, and rewards for writing a review. Figure 5 lists the participants' answers when asked for their level of consent towards each of the potential incentives.

Figure 5. Potential incentives for customers to write more product reviews.

Interestingly, there is no significant difference between the participants that claim to have a technological job and those who don't (Fisher-Freeman-Halton test [9]).

In summary, only rewarding the customers would increase the amount of reviews. However, rewards may distort the balance between positive and negative reviews. On one hand, customers might write more positive reviews as a form of positive reciprocity towards the retailer. On the other hand, those customers that are not satisfied with a product might not be interested in the reward. Consider the following example: when buying a video game, the retailer offers free access to a bonus level as reward for customers that write a review. Especially customers who dislike the video game profit less from a bonus level than satisfied customers. Therefore, a tendency towards positive reviews is created by the reward. That is, rewards need to be designed carefully not to influence the reviews. In fact, most retailers would be interested in manipulating customers towards writing positive reviews; but, this is not the intention of our research.

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VI. Alternative Review System

The next part of the full study explored which features customers like most in review systems. Additionally to classifying the importance of specific features, the participants were presented with an alternative review system. The given task was to compare the proposed system with one that has the features of common review systems: rating a product from five stars (best) to one star (worst) and writing a textual review. This section first discusses the features of review systems, then presents the alternative review system and closes with the evaluation of the proposed system.

A. Features of Review Systems

For several features of review systems, the participants of the full study could state their level of agreement. Table III presents an overview of features that we could identify to be relevant.

TABLE III. Relevance of the features of a review system.

Feature	Agreement
Overview over all products	94.32%
Detailed reviews from other customers	85.15%
Short reviews from other customers	80.79%
Ability to write reviews instead of ratings	61.57%

Interestingly, 68.5% of the participants who want access to detailed reviews anyhow prefer short and compact reviews over detailed ones. We believe that this type of potential customer uses short reviews to get an overview over available products and their features, but exploits detailed reviews for the final purchase decision.

Other features we tested are of minor relevance, for example, the possibility to leave reviews fast or allowing only reviews from authors who previously purchased the product. 4.5% of all participants are not interested in reading reviews (or ratings) from other customers at all.

Based on the results of this part of the full study, we deduce that a customer-centric review system should assist potential customers with a good overview over the ratings for all available products with the option to get detailed information for specific products. Moreover, after a purchase, a relevant set of customers expects a review system to accept textual reviews instead of just a product rating.

B. The Alternative Review System

In common review systems, customers who bought a product can leave a rating (e.g., one to five stars) for the product and additionally, they can write an arbitrarily long textual review. As motivated in the introductory section of this paper, reviews left using such systems are focused on the product as a whole. It would be an improvement for both customers and retailers when product reviews included ratings for product parts. The participants of the full study were presented with an alternative review system that leads to such a type of product reviews.

As shown in Figure 6(a), a customer is asked to leave a star rating (part 1) and to select all problems with the product the customer had (part 2). Therefore, the customer is given a list of all known problems with the product. The alternative review system does not include the option to write textual reviews.

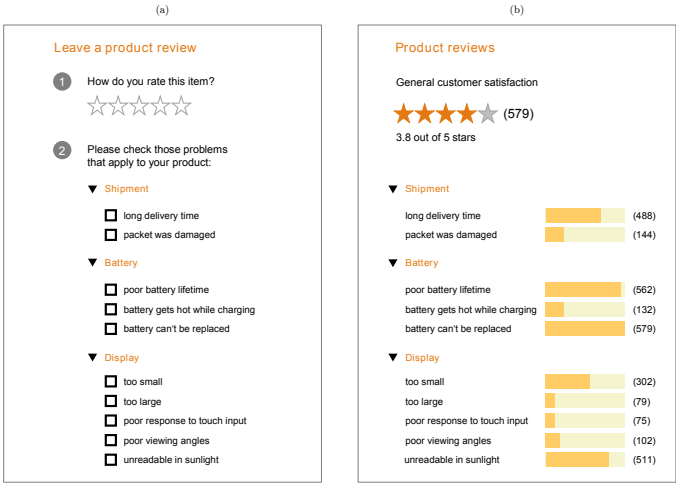

Figure 6. A mockup of the alternative review system with a smartphone as example product: (a) interface for authors of product reviews, (b) interface for potential customers. (The figure was edited for print.)

When a potential customer accesses reviews for a product, a form similar to Figure 6(b) is shown. On top, the average rating of all reviewers is shown. Below the average rating, all known problems are listed with a numeric indicator how many reviewers reported to have this problem.

C. Evaluation of the Proposed System

When asked if they perceived the alternative review system to be more intuitive than the common ones, 68.12% of the participants agreed (either *totally agree* or *agree*). 46.67% of the participants would like to see the alternative system to replace the common ones. However, the largest fraction of participants prefers not to replace the common systems. When asked if they want to see the alternative system as an addition to common ones, 89.52% agreed. In total, 93.91% of the participants said that they would like the alternative system to be used (either as a replacement or as an addition to common ones). Details can be found in Figure 7.

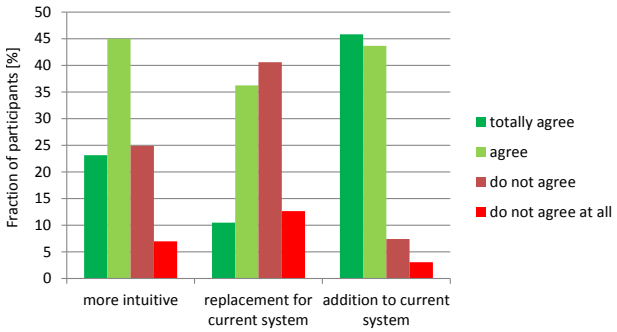

Figure 7. Reactions to the proposed alternative review system.

Afterwards, the participants could agree or disagree with reasons for using the proposed system. 59.72% of those who would like the alternative system to be used (replacement or addition) stated that the newer system would be faster and easier to use. However, 69.86% of all participants assume that a predefined list of problems is not representative enough for individual reviews. This is backed by the fact that 89.52%

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of all participants would want to leave additional textual reviews when using the proposed system. Even in the group of those who wanted to replace the common systems with the alternative review system, 41.48% would want to leave additional textual reviews.

We therefore conclude that our proposed system needs further refinement to be accepted by a majority of customers. However, when customers are provided with an option to additionally leave text reviews, the alternative review system is able to assist customers in writing better product reviews. Such better reviews help other customers to identify potential problems with a product faster and more reliable because the overview over problems is accompanied with a numeric indicator how often the problem occured. For the same reasons, the reviews help retailers to improve product quality, which, eventually, also helps customers. Moreover, retailers can extract previously unknown problems with a product from the written reviews and add those to the list of known problems in the review form.

While we do not encourage forcing customers to write reviews in any way, 89.08% of all participants stated that they would fill a mandatory questionnaire when returning products. A questionnaire like this could be designed similar to our proposed review system, but should include a free text field.

VII. Conclusions and Future Work

Online product reviews assist users in two ways: first, customers can base their purchase decisions on reviews to identify the best product to buy. Second, retailers can use product reviews to identify problems with a product and thus, improve the product quality.

In this paper, we report the results of two studies on online customer product reviewing behaviour. Furthermore, we analyse and discuss the results and findings. We identify reasons for customers not to write product reviews (top reason: lack of motivation), as well as reasons why customers write product reviews (top reason: firm conviction for the product). Subsequently, we explore potential incentives for customers to write more or better reviews.

When using product reviews, retailers should be especially aware of three aspects:

- Only few customers write reviews a long time after the purchase. Thus, reviews mention only problems that occur early in the product lifetime or already exist when delivered, but not those that are caused by wearout.
- Customers will return products during the warranty period without trying to identify or fix problems. Thus, it is difficult to obtain decomposed product reviews during this period.
- When incentivising customers with rewards to write reviews, the design of the reward might distort the representativeness of the reviews.

We also evaluate a mockup of an alternative review system that strives towards producing detailed ratings for parts of products instead of reviews that target a product as a whole. Ratings for parts of a product enable directed improvements to products from the retailers, e.g., by replacing the suppliers of those product parts that cause defects. A major finding is that a list of known problems from which customers can select those problems that apply to them is insufficient. Customers prefer to have the option to leave textual reviews.

For future research, a prototypical implementation of the alternative review system with textual reviews is needed for in-depth evaluation of the system. Thus, a comparison of reviews created with the new system and reviews created with current review systems should reveal if the new system leads to improved reviews.

A second future research direction is the use of mandatory feedback forms when returning products. Our study reveals a high customer acceptance for such feedback forms. Open questions are how useful the information from such feedback forms is and how to transform the results back into reviews that can be used by other customers.

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