Does the effect of online customer reviews on sales differ between tangible and non-tangible products in an online marketplace?

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ABSTRACT,

This study examines the different impact of online customer reviews on sales performance between tangible and non-tangible products in an online marketplace. Using Amazon review data, this study looks at different review features - average rating, text length, number of reviews, and inclusion of visuals – that affect sales performance differently for these product categories. Results reveal that average ratings and the number of reviews positively impact sales performance for both product types, with a stronger effect for tangible products. Unexpectedly, longer review texts show a slight negative relationship with sales performance, likely due to non-informative content. Reviews with visuals significantly boost sales performance, especially for tangible products, by providing clear visual verification. These findings highlight the importance of a review management strategy aligned with product category, business can use these insights to optimize the buyer journey and improve sales performance.

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Keywords

Online customer reviews; tangible products; non-tangible products; sales performance; consumer-generated content; online marketplace

1. INTRODUCTION

The online marketplace is a digital platform in the form of a website, that consist of multiple independent sellers who offer products or services to consumers (Akroush & Al-Debei, 2015). This online marketplace has grown over the years due to the introduction of web 2.0, which enabled individuals to create consumer generated content (CGC), therefore sharing opinions and experiences with products, services or companies in the form of reviews (Constantinides & Fountain, 2008). According to Constantinides & Fountain (2008) CGC such as reviews are perceived as much more influential in changing preferences and decisions of potential buyers in the buyer's journey than traditional communication from the company. According to recent research, 93% of people have used online reviews while making their purchase decision (Pan, 2023). This significant reliance on online reviews highlights their importance in the online marketplace, influencing consumer trust, purchase intentions, and overall satisfaction.

Online reviews significantly impact sales by providing social proof and reducing uncertainty for potential buyers, which enhances trust and increases purchase likelihood (Amblee & Bui, 2011; Clemons et al., 2006). Positive reviews can increase consumer confidence and perceived product value, leading to higher conversion rates and sales volumes (Mudambi & Schuff, 2010). Features such as average rating, review text length, inclusion of visuals, and the number of reviews all play critical roles in shaping consumer perceptions and decisions. For example, high average ratings and detailed, lengthy reviews offer comprehensive insights that can reduce perceived risk, while visual content helps buyers better understand product attributes, further encouraging purchases (Liu & Du, 2019; Xu et al., 2015). Therefore, the overall effect of online reviews is multifaceted, influencing consumer trust, perceived value, and ultimately driving higher sales and customer satisfaction (Forman, Ghose, & Wiesenfeld, 2008).

Research has shown that online reviews can significantly impact sales (Park et al., 2019). However, all this research tends to treat products homogeneously, without distinguishing between tangible and non-tangible goods. This approach overlooks potential variances in consumer perception and decision-making processes depending on the tangibility of a product. For instance, the buyer journey of electronics good could differ from those of a software product like Windows. By the extending literature on online consumer behavior and e-commerce by providing an analysis of product reviews based on product tangibility. This differentiation is crucial for developing an understanding of consumer interactions in digital marketplaces between those product categories, which can be used to further highlight the necessity of reviews in these categories.

As the online marketplace landscape will continue to grow, it includes both tangible products, such as electronics and fashion products, but also non-tangible products, like software and subscriptions. Research of reviews in the hotel sector already showed that negative reviews are often linked to tangible products such as the room while non-tangible aspects, such as services, are highlighted positively more often (Berezina et al., 2015). Other studies also indicate that reviews have a different impact between different product categories (Zhu & Zhang, 2010; K. Li et al., 2020; Weisstein et al., 2017). However, this effect is unclear for the difference between tangible and non-tangible products, despite their differing nature and consumer evaluation processes. This study will therefore focus on the different impact online reviews will make between tangible and non-tangible products. Examining this difference is useful because it allows businesses to adjust their review management and marketing strategies to the specific needs and evaluation processes of each product type, enhancing consumer trust and driving more effective sales outcomes (Mudambi & Schuff, 2010; Liu & Du, 2019). Understanding these differences helps in optimizing product presentations and customer engagement approaches, ultimately improving customer satisfaction and sales performance for both tangible and non-tangible products (Dellarocas, 2003; Forman, Ghose, & Wiesenfeld, 2008).

The question guiding this research is: "Does the effect of online customer reviews on sales differ between tangible and non-tangible products in an online marketplace". Given the significant reliance on reviews in the digital buying process, as highlighted by recent findings such as those by Constantinides & Fountain (2008). By examining different aspects of reviews, such as average rating, text length and total amount of reviews, this thesis will explore differences in sales performance between tangible and non-tangible product categories.

2. THEORY

Characteristic of review, such as text length, average star rating and number of reviews have an impact on the sales of a product. The Transaction Cost Economics (TCE) theory, developed by Oliver Williamson (1981), suggests that firms and markets exist to minimize the costs of transactions, which include search and information costs, bargaining costs, and enforcement costs. Reviews can significantly impact sales by reducing information asymmetries and transaction costs for potential buyers. When reviews provide credible and detailed information about a product or service, they can increase consumer confidence and facilitate purchasing decisions, thus potentially increasing sales by lowering the perceived risk and search costs associated with transactions. Uncertainty Reduction Theory, developed by Charles Berger (1975), describes that the primary goal of communication is to reduce uncertainty about others and one's environment. In the context of consumer behavior, this theory suggests that reviews can play a crucial role in reducing uncertainty about products or services. By offering firsthand information and evaluations from previous buyers, reviews help potential buyers gain a clearer understanding of what to expect, thereby reducing uncertainty and influencing their purchasing decisions.

Research consistently shows that online product reviews have a significant impact on sales in online marketplaces. Li (2019) found that the volume and valence of reviews positively influence sales, with a stronger effect for self-operated stores. Huang & Pape (2020) further supported this, identifying both awareness and persuasive effects of reviews on sales, with the persuasive effect being slightly stronger. Hu et al. (2008) emphasized the importance of reviewer characteristics and temporal effects, showing that reviews from reputable and exposed reviewers have a greater impact, but this impact diminishes over time. Hu et al. (2008) analyzed that consumer pay attention to both review scores and contextual information, such as text length, inclusion of images or helpfulness rating. The number of reviews, star ratings, standard deviation of ratings, helpfulness, and sentiment all have significant impacts on product sales, with review length and special shipping having no significant effect (Li, 2020).

2.1 Sales rank

As dependent variable in this study, the sales rank of the product is used. This metric is used by Amazon to place an order of the product in the specific category. Using the Sales Rank of a product as a predictor of sales is commonly accepted in the literature (Touzani & Van Buskirk, 2016; Cui et al., 2012). Since absolute sales numbers are often not released due to various reasons, sales rank is the best option to predict sales. The sales rank of a product on Amazon is an immediate, easily accessible measure that correlates with sales performance, providing an efficient method for estimating sales volume (Sharma et al., 2020)

2.2 Predictors of sales rank

2.2.1 Average review rating

When previous buyers leave a review behind, they have the option to rate the product based on a scale between one and five starts, where one is extremely negative and five is extremely positive. A three-star review could reflect a moderate review or indifference, but it could also be caused by a series of positive and negative comments that cancel each other out (Kaplan 1972; Presser and Schuman 1980). According to a study by Clemons et al. (2006), strongly positive ratings can positively influence the growth of sales and can therefore be one of the factors that influence the sales. The social proof theory suggests that individuals look at the behavior and choices of others to make decisions themselves (Cialdini, 1993). High average ratings serve as social proof, signaling to potential buyers that the product is positively experienced by many previous purchasers, thus encouraging them to buy it too (Amblee & Bui, 2011). Li (2022) added that review ratings, both positively and negatively, are positively linked with both sales and returns. Which suggests that consumers may overestimate product quality based on positive reviews, leading to increased sales.

2.2.2 Average text length of rating

Research has consistently shown a relationship between the length of text reviews and sales. Moon (2014) and Chevalier (2006) both found that longer reviews, particularly those with more detailed content, can enhance the explanatory power of a product sales model and lead to an increase in relative sales. This is further supported by Li (2019), who found that the content of negative reviews, including their length, can impact online sales. Hu (2008) also highlighted the importance of review sentiments, which are often conveyed through the length and detail of the review, in influencing sales.

2.2.3 Number of reviews

High average ratings serve as social proof, signaling to potential buyers that the product is positively experienced by many previous purchasers, thus encouraging them to buy it too (Amblee & Bui, 2011). Li et al. (2022) added that review ratings, both positively and negatively, are positively linked with both sales and returns. Which suggests that consumers may overestimate product quality based on positive reviews, leading to increased sales but also potentially higher return rates.

2.2.4 Number of reviews that include visuals

Studies about visuals in reviews such as images or videos have shown that it has a positive relationship with sales. Li et al. (2022) state that reviews that include photos are more useful and are perceived more useful for potential buyers and it even found a relationship with customer engagement. Another research of Liu & Du (2019) found that image-based reviews significantly enhance customer understanding and perceived helpfulness because images contribute providing richer, visual information, which helps potential buyers better assess product qualities that are not easily conveyed through text, such as style and feel.

Besides images, in the current age users are also able to upload videos to further support claims in their reviews. Studies suggests that videos can significantly influence consumer decision-making in e-commerce by enhancing the perceived credibility and effectiveness of online reviews, since these reviews include motion and sound that make the message more attractive it makes it more attention grabbing (Xu et al., 2015). Another study even suggests retailers to encourage customers to include videos in their reviews since potential buyers are easier attracted (Yin et al., 2021).

2.2.5 Model of current literature

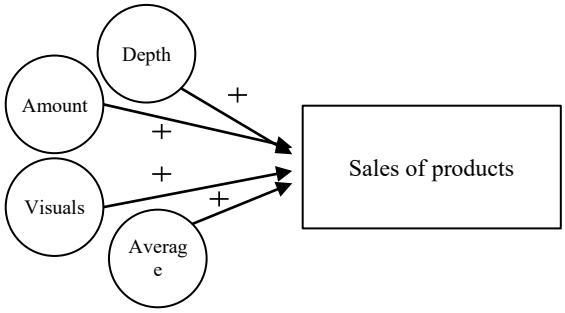

Figure 1. Model of current literature

2.3 Tangible versus non-tangible

Vargo and Lusch (2004) introduced goods dominant logic and service dominant logic, where Goods-Dominant Logic, which emphasizes the transaction of physical, tangible goods, aligns closely with the traditional marketing approach where value is embedded in the product itself. While on the other hand, Service-Dominant Logic suggests that value is co-created through experiences, making it particularly relevant for non-tangible products like services. For tangible products, reviews might focus on attributes such as quality and usability, directly influencing the perceived value pre-purchase, whereas reviews of non-tangible products often reflect on the consumer's interaction with the service provider and the overall experience, impacting the post-purchase perception of value.

Research in the hotel sector already found that tangible elements (such as room quality) and non-tangible elements (such as staff service) influence customer satisfaction differently. For tangible products, consumers are more interested in physical quality or durability while for non-tangible products reviews may focus on satisfaction with product experience (Berezina et al., 2015). This study also highlighted those negative reviews where often linked with tangible products while satisfied/positive reviews were linked with non-tangible aspects such as services. Currently, there are no studies available that delve into the different impact of reviews on tangible versus non-tangible products in an online marketplace, thus presenting a gap in the research. Investigating this area on platforms like Amazon could provide insights into how consumer behavior and purchase decisions are influenced by reviews according to product category. Addressing this gap is crucial because understanding these dynamics on platforms like Amazon can provide valuable insights into consumer behavior

and purchase decisions. By examining how reviews influence sales across different product categories, businesses can develop more effective marketing strategies and improve customer satisfaction.

According to the experiential value theory (Mathwick et al., 2001) experiential value is derived from interactive, realistic preferences shaped by experiences. For non-tangible products, where the product is not a physical object but rather an experience or a service, reviews become an important source of information that can influence the perceived experiential value. Consumers rely heavily on reviews of previous customers to measure the emotional and psychological satisfaction they might derive from the non-tangible product. Therefore, according to this theory, there should be a different impact of reviews on sales between non-tangible and tangible products, since non-tangible products rely more on experience which are captured in reviews.

Tangible products typically emphasize inherent qualities like durability and quality, which can be assessed prior to purchase. While on the other hand, non-tangible products, such as services, derive their value from the consumer's experiences and interactions, which are communicated through post-purchase reviews. The differential impact of reviews on consumer satisfaction and purchase decisions in these two categories highlights an interesting area for research. The research in whether reviews have a different impact on tangible and non-tangible products is interesting because it could explain and give insights into consumer behavior and decision-making processes.

3. HYPOTHESES

As the e-commerce continues to grow, consumer perceptions and purchasing decisions are influenced by more and more elements. One of these elements, that exists for a while now, is online consumer reviews. These reviews can offer a lot of information, from overall satisfaction rating to detailed personal experiences including visual content such as images. All of this helps potential buyers decide, which is therefore also highly relevant to investigate. The impact of these online customer reviews can differ between tangible and non-tangible products. Tangible products (e.g., books, electronics or clothes) which consumers can physically interact with, are often judged based on measurable attributes such as size, quality, materials or appearance. However, non-tangible products (e.g., software, e-books or digital games) are evaluated more on experiential and performance-based attributes.

3.1 Average review rating

As seen in previous studies, scholars have shown a positive relationship between average review rating and sales performance (Clemons et al., 2006; Amblee & Bui, 2011; Li, 2022). This is mainly caused by the social proof theory, whereas more people value the product positively, the higher potential buyers value the product (Cialdini, 1993). There hasn't been research performed that looked at the difference between tangible and non-tangible products and the impact of these review ratings. Tangible products can be physically evaluated by consumers, elements such as product quality, size or colors can be processed in these ratings. Whereas, non-tangible products often do not have physical elements and are purely assessed subjectively, such as a service or software program where specific needs play a larger role and could be explained in the review text.

Expectancy-disconfirmation theory states that consumer satisfaction is composed of the difference between pre-purchase expectations and post-purchase perceptions (Oliver, 1980). For tangible products, consumers have concrete expectations regarding physical attributes such as quality, size, and color. Average review ratings serve as a critical guideline, confirming or disconfirming these expectations and directly influencing satisfaction and purchase decisions. Consequently, a high average review rating can significantly boost the sales rank of tangible products by aligning with or exceeding consumer expectations. In contrast, non-tangible products, such as software or services, lack physical elements and are assessed more subjectively based on personal experiences and specific needs. While review ratings are still important, they may not align as directly with consumer expectations due to the variability and experiential nature of these products, rather review description or images are more effective. Therefore, the impact of average review ratings on sales rank is less straightforward and more moderated by individual user experiences and detailed feedback in the reviews for non-tangible products.

Product reviews significantly influence consumer behavior and sales, with higher ratings generally boosting sales through social proof (Cialdini, 1993). Tangible products benefit more directly from high average ratings as they align with consumer expectations based on physical attributes. In contrast, non-tangible products, such as services and software, are assessed more subjectively, making detailed feedback crucial. Therefore, it is expected that for both tangible and non-tangible products the relationship is positive, however a higher average rating is more influential to the sales of tangible products than for non-tangible products. The weaker positive effect of average review ratings on non-tangible products can be attributed to their characteristics. Potential buyers of non-tangible products may rely more on detailed reviews and specific user experiences to decide. This reliance on comprehensive feedback rather than just average ratings means that while high ratings still positively influence sales, their impact is less pronounced compared to tangible products where the quality and features can be more easily and objectively assessed (Mudambi & Schuff, 2010; Forman, Ghose, & Wiesenfeld, 2008).

H1: The relationship between average review ratings and sales is positive for both tangible and non-tangible products, with a significantly stronger positive effect observed in tangible products.

3.2 Average text length of reviews

Tangible products, such as electronics, clothing, or household items, have physical attributes that can be quickly assessed. Consumers often rely on concise reviews that summarize key features, quality, and performance (Chevalier & Mayzlin, 2006). Shorter reviews are sufficient for tangible products because visual inspection and straightforward criteria can easily confirm their value. On the other hand, non-tangible products, such as software, digital services, or online courses, lack physical form and are assessed based on functionality, user experience, and subjective satisfaction (Zhu & Zhang, 2010). These products often involve complex, multifaceted evaluations where detailed information is crucial. Longer reviews provide comprehensive insights, including in-depth descriptions, personal experiences, and specific use cases, which help potential buyers understand the product's value and relevance to their needs (Zhu & Zhang, 2010). Additionally, the intangibility of these products means consumers face higher perceived risks and uncertainties, making more comprehensive reviews essential for informed decision-

making. Consequently, the average text length of reviews is more impactful for non-tangible products, as it directly addresses the complexity and subjective nature of these evaluations, significantly influencing their sales rank.

The Elaboration Likelihood Model (ELM) explains two possible routes to persuasion: the central route, which involves careful and thoughtful consideration of the content, and the peripheral route, which relies on superficial cues (Petty & Cacioppo, 1984). For tangible products, consumers often utilize the peripheral route due to the straightforward nature of evaluating physical attributes. Shorter reviews with concise information about product quality, size, and performance can efficiently meet consumer needs, making extensive text less impactful. Thus, the average text length of reviews for tangible products might not significantly affect their sales rank, as consumers prioritize quick, clear indicators of quality. In contrast, non-tangible products such as software or services require a more detailed and subjective evaluation, engaging consumers in the central route of persuasion. Here, the average text length of reviews becomes crucial, as longer reviews provide comprehensive insights into functionality, user experience, and specific use cases. This detailed information helps reduce uncertainty and aids in the decision-making process, significantly impacting the sales rank of non-tangible products. Therefore, ELM explains why the effect of review text length on sales rank differs markedly between these two product categories.

Information processing theory states that the type and amount of information required vary with the nature of the product, impacting consumer decisions differently for tangible and non-tangible products (Atkinson & Shiffrin, 1977). Moon (2014) and Li (2020) both highlight the significant impact of text length in reviews on product sales, with Moon focusing on experience products and Li on the moderating role of product category. Ren (2018) further explores the influence of review characteristics, including text length, on sales, finding that product type moderates this effect. Wang (2013) adds to this by showing that the impact of consumer ratings and reviews, which may include text length, differs across product categories. These studies collectively suggest that the impact of average text length of reviews on sales varies between tangible and non-tangible products, with product type and category playing a significant role.

H2: The relationship between average review text length and sales is positive for both tangible and non-tangible products, with a significantly stronger effect observed for non-tangible products.

3.3 Number of reviews

The number of reviews acts as a key indicator for consumers to obtain trust and popularity for a product. Research indicates that reviews significantly influence purchasing decisions, with a higher number of reviews often leading to increased sales (Chevalier & Mayzlin, 2006). However, for non-tangible products this could be a less pronounced indicator for product quality compared to tangible products, since non-tangible products is more about the experience.

The number of reviews impacts sales rank differently for tangible and non-tangible products due to the distinct ways consumers evaluate these product types. For tangible products, such as electronics or clothing, the physical characteristics are easily assessed and compared. A higher number of reviews quickly indicates popularity and social validation, reinforcing consumer confidence in the product's quality and reliability. This quick reassurance can boost sales rank significantly. Conversely, non-tangible products like software or digital services involve more complex and subjective evaluations. Consumers face greater uncertainty and require more detailed feedback to make informed decisions. The number of reviews becomes crucial as it provides a broader spectrum of user experiences and reduces perceived risk. This extensive feedback helps potential buyers gauge functionality, reliability, and satisfaction, which are less evident in non-tangible products. Thus, while the number of reviews boosts sales rank for both product types, its impact is more pronounced for non-tangible products due to their inherent complexity and higher perceived risk.

Social proof theory suggests that individuals look to the behavior and opinions of others to guide their own actions, especially in uncertain situations (Cialdini, 1993). For tangible products, the number of reviews serves as a straightforward heuristic indicating popularity and trustworthiness. Consumers infer that if many others have purchased and reviewed a product, it is likely of good quality, which can swiftly increase its sales rank. However, for non-tangible products, such as digital services or software, the purchasing decision is more complex and fraught with uncertainty. Here, the number of reviews also provides social proof, however it is not a rich information source detailing various user experiences and outcomes. Therefore, while social proof enhances the sales of both tangible and non-tangible products, the effect is more substantial for tangible products.

H3: The relationship between the number of reviews and sales is positive for both tangible and non-tangible products, with a significantly stronger effect observed for tangible products.

3.4 Number of reviews that include visuals

Visual elements in reviews, such as images or videos, provide additional context and clarity, making it easier for consumers to understand product features and quality. According to research, reviews that include images or videos are perceived as more credible and informative, leading to higher consumer trust and increased purchase intentions (Li, Hitt, & Zhang, 2011). This visual content helps to eliminate the gap between online and offline shopping, allowing consumers to make more confident decisions based on the visual verification of product expectations (Park & Lee, 2009). For tangible products, images can illustrate product dimensions, colors, and usability, which are critical for consumer assessment. For non-tangible products, such as software or digital services, video demonstrations can effectively showcase functionality and user experience, addressing consumer concerns about usability and performance. Consequently, reviews with visuals not only enhance the perceived helpfulness of the reviews but also lead to a higher likelihood of purchase, thereby positively impacting sales performance across various product categories.

Media Richness Theory suggests that communication channels differ in their ability to convey information effectively, with richer mediums (inclusion of media) can transmit more signals like durability, quality and size than less rich mediums. Therefore, being more effective for complex messages such as in online reviews where the information needs to be conveyed effectively (Dennis & Kinney, 1998). These visuals in reviews can help reducing ambiguity about the product, giving potential buyers a clearer, more tangible understanding of what they are purchasing which ultimately influences purchase decisions.

The Dual Coding Theory states that information is processed through two channels: verbal and visual (Paivio, 1986). The impact of reviews that include visuals on sales rank differs significantly between tangible and non-tangible products due to how these products are evaluated by consumers. For tangible products, such as gadgets, clothing, or furniture, visual reviews are highly impactful because they provide concrete evidence of the product's physical attributes, quality, and real-world usage. Visuals complement verbal descriptions, enhancing understanding and recall, and significantly boosting consumer confidence and purchase likelihood. This dual coding of information (visual and verbal) makes the reviews more persuasive, leading to a higher sales rank. In contrast, non-tangible products, like software, digital content, or services, are inherently abstract and lack physical form. While visuals can still be helpful, they are less effective in conveying the complete user experience or functionality. Consumers of non-tangible products rely more on detailed verbal descriptions to understand the benefits and potential drawbacks. Therefore, the inclusion of visuals in reviews has a less pronounced impact on the sales rank of non-tangible products. The verbal content remains primary, as it provides the necessary depth and detail needed to evaluate these products fully. Hence, dual coding theory explains why visuals in reviews more significantly affect tangible products' sales ranks compared to non-tangible products.

H4: The relationship between the number of reviews that include visuals and sales is positive for both tangible and non-tangible products, with a significantly stronger effect observed for tangible products.

4. METHODOLOGY

4.1 Dataset

A quantitative analysis will be performed using an Amazon review dataset (Ni et al., 2019). For this study the dataset is split up based on product categories for both tangible and non-tangible will be used, see table 1 below for more specifications. The dataset is split up in two primary tables: products and reviews, linked by the Amazon Standard Identification Number (ASIN). Tangible products are physical items that require shipping, while non-tangible products are digital or services that do not require physical delivery.

Table 1. Data categories

Category	Kind	Number of reviews	Number of products
Automotive	Tangible	119,460	4,815
Books	Tangible	17,536,994	713,439
Clothes, shoes and jewelry	Tangible	745,586	18,516
Electronics	Tangible	202,246	4,535
Digital music	Non-tangible	56,800	12,256
Kindle store	Non-tangible	5,340,437	340,607
Gift cards	Non-tangible	60,139	244
Movies and TV	Non-tangible	3,625,922	48,774
Prime pantry	Non-tangible	110,274	1,978
Software	Non-tangible	46,317	1,991
Video games	Non-tangible	5,172	97

The dataset includes two primary tables for each category. First, the products table that consists of following variables: ASIN, title, feature, description, price, imageURLs, related products, sales rank, brand, categories, technical details, and similar products. The purpose of this table is to provide information about each product, which will be used to categorize the products into tangible and non-tangible categories based on their listed categories. Second, the reviews table consist of following variables: ReviewerID, ASIN, reviewerName, vote, style, review text, overall rating, summary, unixReviewTime, reviewTime, and review images. This table contains all the data related to customer feedback, which will be used to assess the influence of reviews on product sales.

A python script is made for both the reviews and products table. For the products this contains cleaning products without price or rank. Also, the image array is transformed into the number of images, text is transformed to length of text and the rank is normalized between 1 and 1000 to be able to compare between different categories. For the reviews the review description is also transformed into text length, and reviews are grouped by ASIN (products) and following variables are calculated and added: averageStarRating, averageTextLength, numberOfReviews, numberOfReviewsWithImages, averageNumberOfImages based on all the reviews in the dataset for that ASIN.

After processing, cleaning and concatenating these separate datasets, they are combined based on ASIN and put into Rstudio for further data analysis. Both product categories are normally distributed after analysis of a histogram for sales rank. With the mean of tangible products being 268 and for non-tangible 353 (see tables 3 and 4), this suggests that tangible products generally perform better in terms of sales performance compared to non-tangible products. Further statistical analysis in next chapters will be conducted to determine the correlations between variables and sales performance to explore the factors contributing to these variations in sales performance.

4.2 Measures

4.2.1 Dependent variable

The sales rank of a product, as used by Amazon, is used as the dependent variable in this study. The sales rank is an ordinal number that showcases the popularity of that product within its category, whereas the lower the number the higher the sales are. Since absolute sales figures are not available for products on Amazon, the sales rank is used as an indicator for sales performance. This is done in previous studies (Park et al., 2019; Eslami & Ghasemaghaei, 2018; Chevalier & Mayzlin, 2006). To be able to compare between different product categories, the sales ranks are normalized on a scale between 1 and 1000, where 1 is the highest sales rank and 1000 the lowest. This normalization process makes it possible to perform a consistent comparison of sales performance across categories of tangible and non-tangible products.

4.2.2 Independent variables

The independent variables in this study are various features of reviews that could potentially influence the sales rank of products. These characteristics include:

Average Review Rating: The average star rating of a product calculated based on all the reviews it has received. This rating ranges from 1 (extremely negative) to 5 (extremely positive).

Higher average ratings are expected to positively influence sales rank due to the social proof they provide to potential buyers.

Average Text Length of Reviews: The average length of the review texts, measured in the number of characters of the review. Longer reviews provide more detailed information and insights, which can help reduce uncertainty and improve the perceived value of the product.

Number of Reviews: The total number of reviews a product has received. A higher number of reviews can indicate greater popularity and trustworthiness, potentially boosting sales rank. This variable is also an indicator of the social proof effect.

Number of Reviews that Include Visuals: The total number of reviews that contain images or videos a product has received. Visual content can enhance the perceived credibility and informativeness of reviews, helping consumers make more informed purchase decisions. This variable is expected to have a significant impact on the sales rank, especially for tangible products where visual verification of product attributes is crucial.

Table 2. Overview of variables

	Variable	Definition	Sources
Independent variable	Rating	Average rating per product	Mudambi and Schuff (2010)
	Text length	Average of the review text length	Mudambi and Schuff (2010)
	Number of reviews	Average number of reviews per product	Liu (2006); Cui, Lui, and Guo (2012)
	Visuals in reviews	Average number of reviews with visuals per product	Wu et al. (2020)
Dependent variable	Sales Ranking	Sales ranking by date of data collection	Touzani & Van Buskirk, 2016; Chevalier & Mayzlin, 2006

5. RESULTS

5.1 Descriptive Statistics

In table 3 and 4 the descriptive statistics of the variables can be observed, whereas table 3 is related to all non-tangible products and table 4 to all tangible products in the dataset. The mean rank of tangible products is lower compared to the mean rank of non-tangible, indicating a relatively lower sales performance in the non-tangible product category. However, the average rating is slightly higher in for non-tangible products. The mean number of reviews for non-tangible products is 16 while 25 for tangible products, indicating a lower level of customer engagement compared to tangible products. Another interesting statistic is that the average review text length of non-tangible products is lower than for tangible products, 410 versus 484 characters respectively. While this is expected to be the other way around, due to the more personal experience of non-tangible products that needs to be conveyed. However, as expected, the mean number of reviews that include visuals is higher for tangible products, since they can be evaluated purely on product quality.

A correlation analysis is performed for both tangible and non-tangible products, it analyses the relationship between different variables. For both categories, the correlation between rank and rating is negative (-0,231 and -0,306), suggesting that higher ratings are associated with better sales performance, but the effect is stronger for non-tangible products. The number of reviews and rank also show a negative correlation for both (-0,057 and -0,098), indicating that products with more reviews tend to have better sales ranks, however this effect is less pronounced for tangible products. The correlation between text length and rank is positive for both (0,137 and 0,110), suggesting that longer reviews might not necessarily improve sales rank / performance. Finally, the correlation between the number of reviews with visuals and rank is negative (-0,080 and -0,056), indicating that reviews with visuals are associated with better sales performance, but this effect is more pronounced for tangible products.

In summary, tangible products tend to have more reviews and slightly longer review texts, while non-tangible products receive slightly higher ratings. Both categories show a negative relationship with review rating and the number of reviews, indicating that those variable boost sales performance. Reviews with visual content included play a more pronounced role for tangible products.

Table 3. Descriptive and correlation (non- tangible)

Variable	Mean	Rank	Rating	Amount	Text length	Reviews with visuals
Rank	353,489	1				
Rating	4,191	-0,306	1			
Amount	16,422	-0,098	0,059	1		
Text length	410,378	0,110	0,063	-0,033	1	
Reviews with visuals	0,027	-0,056	0,039	0,529	-0,014	1

Table 4. Descriptive statistics and correlation (tangible)

	Mean	Rank	Rating	Amount	Text length	Reviews with visuals
Rank	268,119	1				
Rating	4,024	-0,231	1			
Amount	25,097	-0,057	0,054	1		
Text length	484,666	0,137	0,007	-0,025	1	
Reviews with visuals	0,129	-0,080	0,034	0,307	-0,027	1

5.2 Correlational and regression analysis

A multiple regression analysis is performed to compare the effects of before mentioned variables for tangible and non-tangible products to understand how various review features impact sales performance differently.

For tangible products, the average rating has a significant negative coefficient of -61.047 ($p < 0.000$). While for non-tangible products there is an even stronger negative coefficient of -72.310 ($p < 0.000$). It suggests that higher ratings are strongly associated with better sales performance, however high ratings are crucial for both product types, they are especially important for non-tangible products.

The number of reviews is also a significant factor for both product categories. For tangible products, the coefficient is -0.028 ($p < 0.000$), while for non-tangible products there is a larger negative coefficient of -0.103 ($p < 0.000$). This coefficient is quite low for both product categories, however since the number of reviews can be quite high this is still a relevant variable. Since the coefficient is higher for non-tangible products, potential buyers may require more reviews to reduce perceived risk and make informed purchasing decisions.

The impact of the length of text reviews is almost even for both product categories, for tangible products, the coefficient is 0.055 ($p < 0.000$), indicating that longer reviews are associated with a slight increase in sales rank. While non-tangible products also have a positive coefficient of 0.061 ($p < 0.000$). While this also indicates a slight increase in sales rank with longer reviews. This is an interesting statistic, since is expected that longer reviews decrease the sales rank (better sales performance).

The presence of visuals in reviews has a significant impact on sales performance for both product categories, with a coefficient of -12.015 ($p < 0.000$) for tangible products and -2.043 ($p = 0.061$) for non-tangible products. This suggests that reviews with images or videos boost sales performance by providing additional information that helps reduce uncertainty and build trust. Non-tangible products often involve experiential aspects that may not be fully captured through visuals, making other review features more important

Table 5. Multiple regression analysis (tangible)

term	estimate	std. error	p.value
(Intercept)	489,241	1,242	0,000*
Rating	-61,047	0,297	0,000*
Number of reviews	-0,028	0,001	4,392E-83*
Text length	0,055	0,001	0,000*
Reviews with visuals	-12,015	0,228	0,000*

Multiple R-squared: 0.07793, * $P < 0.001$

Table 6. Multiple regression analysis (non-tangible)

term	estimate	std. error	p.value
(Intercept)	566,962	1,378	0,000*
Rating	-72,310	0,346	0,000*
Number of reviews	-0,103	0,002	0,000*
Text length	0,061	0,001	0,000*
Reviews with visuals	-2,043	1,089	0,061

Multiple R-squared: 0.1165, * $P < 0.001$

5.3 Results of analyses

5.3.1 Hypotheses 1: Average rating

It was argumented that there is a positive relationship between average rating and sales performance (negative relationship between sales rank and average rating), due to previous studies and the social proof theory that increased buyer confidence (Clemons et al., 2006; Amblee & Bui, 2011; Li, 2022). Thereby, tangible products would benefit more from higher average rating than non-tangible products due to the ability to evaluate physical attributes like quality, size, and color without personal experiences intervening. If looked at the data, the regression analysis showed a stronger effect on tangible products if the rating is higher. However, the correlation analysis showed that the effect is more pronounced for tangible products, confirming hypothesis 1.

5.3.2 Hypotheses 2: Average text length of reviews

It was argued that there is a positive relationship between average review text length and sales performance (negative relationship between sales rank and text length), supported by previous studies and the Elaboration Likelihood Model (Petty & Cacioppo, 1984). Non-tangible products benefit more from longer reviews due to the need for detailed information on functionality and user experience, whereas tangible products are quickly assessed through visuals or other features of reviews (Chevalier & Mayzlin, 2006; Zhu & Zhang, 2010). If looked at the data, the relationship is not as expected, for both tangible and non-tangible products the relationship is positive with sales rank (negative with sales performance) indicating that a higher average review length doesn't improve sales performance. However, this is most likely due to the dataset which contained a lot of extensive HTML in the review texts, which inflated the text length without adding valuable content, affecting the overall analysis and not providing the expected level of detail for non-tangible products. Therefore, hypothesis 2 cannot be confirmed.

5.3.3 Hypothesis 3: Number of reviews

It was argued that there is a positive relationship between the number of reviews and sales performance (negative relationship between sales rank and number of reviews), supported by previous studies and social proof theory (Cialdini, 1993). Tangible products benefit more from a higher number of reviews, as it quickly indicates popularity and trustworthiness, whereas non-tangible products require more detailed feedback to reduce perceived risk (Chevalier & Mayzlin, 2006; Chen & Xie, 2008). If looked at the data, for both the regression and correlation analysis the relationship seemed stronger for non-tangible compared to tangible products. Therefore, this hypothesis cannot be confirmed.

5.3.4 Hypothesis 4: Number of reviews that include visuals

It was argued that there is a positive relationship between the number of reviews that include visuals and sales performance (negative relationship between sales rank and visuals in reviews), supported by Media Richness Theory and Dual Coding Theory (Dennis & Kinney, 1998; Paivio, 1986). Visual elements in reviews improve consumer understanding and trust, making them more influential for tangible products, which benefit from clear, visual representation of physical attributes (Li, Hitt, & Zhang, 2011; Park & Lee, 2009). As can be seen in both regression and correlation analysis, the relationship is indeed stronger for tangible products. For tangible products, the coefficient was -12.015 ($p < 0.000$), and for non-tangible products, it was -2.043 ($p = 0.061$). Therefore, this hypothesis can be confirmed.

6. DISCUSSION & CONCLUSION

This study examined the impact of online customer reviews on sales for tangible and non-tangible products in an online marketplace. It was found through statistical analysis that the average review ratings positively influence sales for both product types, with a stronger effect observed for tangible products. The number of reviews also positively impacts sales, with a more pronounced effect for tangible products. Contrary to expectations, the average text length of reviews showed a slight negative relationship with sales for both product types, possibly due to the presence of non-informative content. Reviews that included visuals (images or videos) significantly boosted sales, especially for tangible products, providing clear visual verification of product attributes. All these above listed findings highlight the importance of online customer reviews in the buyer journey. It is therefore useful for businesses to adjust their review possibilities and management according to these findings, focusing on gathering qualitative good reviews that preferably include visuals.

The main aim of this study was to investigate any different impacts between tangible and non-tangible products. The stronger positive relationship between average rating and tangible products suggest that consumers rely on those ratings when evaluating physical products. This is in line with the expectancy-disconfirmation theory (Oliver, 1980), that states that customer satisfaction is influenced by pre- and post-purchase perceptions, by taking previous buyers' opinions in consideration potential buyers feel that they can make a better, more informed decision especially for tangible goods since they include physical easier to assess components.

For both tangible and non-tangible products the number of reviews has a positive relationship with sales, confirming the expectations. This is in line with the social proof theory (Cialdini, 1993), that states that potential buyers often look at behavior and opinions of others to decide, so a higher number of reviews serve for both product categories as evidence and thereby increasing its perceived reliability and increasing sales. However, the impact is more pronounced for tangible products because physical goods are often evaluated based on attributes of reviews rather than more comprehensive reviews (Luan et al., 2016), making the numbers of reviews a more useful indicator of quality and popularity. In contrast, non-tangible products, which are assessed more on experiential and subjective criteria, require not just quantity but also detailed and qualitative feedback to reduce perceived risk and uncertainty, resulting in a slightly less pronounced effect from the number of reviews alone.

It was expected that the average text length of reviews would have showed a positive relationship with sales performance. However, the data showed that there was a slight negative relationship for both product types. This result could be explained from the presence of non-informative content within longer reviews, suggesting that brevity and clarity may be more valuable to consumers than length. Another research concluded that this relationship is negative because customers use reviews to express and alleviate their negative emotions, therefore containing more negative sentiment and decreasing sales performance (Park et al., 2019).

The significant positive impact of reviews with visuals on sales, especially for tangible products, underscores the importance of visual content in reducing consumer uncertainty and enhancing product understanding. For non-tangible products, while visuals still matter, the effect is less pronounced, possibly due to the experiential nature of these products where detailed textual feedback might be more crucial. Overall, these results emphasize the need for businesses to strategically manage their online reviews, focusing on maintaining high ratings and encouraging the inclusion of visuals, particularly for tangible products, to drive better sales outcomes. This is in line with the Media Richness Theory (Dennis & Kinney, 1998), which suggest that any ambiguousness is taking away by more richer mediums.

6.1 Theoretical implications

Theoretically, this study extends the understanding of the impact of online reviews on sales by highlighting the differences between tangible and non-tangible products. It supports the Transaction Cost Economics (Oliver Williamson, 1981) theory, indicating that reviews help reduce information asymmetries and transaction costs, especially for tangible products where physical attributes can be evaluated more objectively. The study also aligns with Uncertainty Reduction Theory (Charles Berger, 1975), demonstrating that reviews play a crucial role in reducing consumer uncertainty, with visuals being particularly effective for tangible products. For non-tangible products, the findings suggest that detailed textual information is more critical, supporting the notion that experiential value derived from user experiences.

6.2 Practical implications

Practically, the results offer valuable insights for businesses and marketers in online marketplaces. For tangible products, maintaining high review ratings and encouraging the inclusion of visual content in reviews should be prioritized to enhance consumer trust and boost sales performance. Businesses should focus on managing the quantity and quality of reviews to use social proof optimally. For non-tangible products, while high ratings remain important, there should be an emphasis on detailed, informative reviews that provide in-depth insights into user experiences and functionality. Online marketplaces can optimize their review systems by facilitating easier inclusion of visuals and encouraging comprehensive feedback from users. By adjusting review management strategies according to product type, businesses can improve customer satisfaction since they can provide reviews that are relevant for potential buyers and achieve better sales performance.

6.3 Limitations & future research

The limitation of this study is that only the quantitative aspects of the reviews and product information are taken into consideration. In a future study, performing more thorough

research by including for example the text mining methodology can bring even more insights. These insights can be linked with the quantitative aspects and draw new conclusions. In addition, the dataset used in this study contained a lot of missing values, such as missing sales rank, product category or descriptions contaminated with HTML code which decreased the quality. For future research it is more useful to take a certain fixed number of products from different categories to increase quality and comparability. Besides that, the data used in this study relies solely on Amazon review data, which may not be representative of other e-commerce platforms or markets. Different platforms may have varied user behaviors and review policies. Amazon-specific features, such as its recommendation algorithms and review verification processes, might influence the results and limit their applicability to apply generally.

6.4 Conclusion

Using amazon review data dated between 1996 and 2018, this study provides insights in the different impact of online customer reviews between tangible and non-tangible products. A comparison is made between four key features of reviews, I hope that these findings help managers to improve the use and retrieval of online customer reviews for those products to help potential buyers on their platform to be influenced and increase sales performance.

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