

MASTER

Exploring the Effects of Data-Driven Website Performance on Trust, Customer Satisfaction, and Customer Loyalty in the B2B E-commerce A case study within the automotive industry

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Department of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology

Exploring the Effects of Data-Driven Website Performance on Trust, Customer Satisfaction, and Customer Loyalty in the B2B E-commerce

A case study within the automotive industry

Master Thesis

Master of Science in Innovation Management

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Abstract

This research aims to explain how data-driven website performance factors (system quality, service quality, information quality, and user interface quality) influence behavioural attitudes (trust and customer satisfaction) and what behavioural consequences (customer loyalty) this has in B2B e-commerce. Only limited studies focus on these relationships in B2B e-commerce. Within this research, we contribute to the extant B2B e-commerce literature by proposing a new model and focusing on real-time customer behaviour (e.g., *“Page dwell time”* (customer satisfaction)). We used big data from the automotive industry and conducted multiple regression analyses to test the relationships. Within this research, we found multiple exciting relationships. We found that expected customer behaviour deviates from real-time customer behaviour, which results in unexpected new findings. More specifically, we found new direct relationships between website performance factors (system quality, service quality, information quality, and user interface quality) and customer loyalty which can point out as yet undiscovered literature. We reveal the direct and indirect relationship between information quality and customer loyalty. Our results indicate that customers who cannot find their desired product indirectly increase the number of repurchases. We found that customers in B2B e-commerce are very time sensitive, meaning they do not want to spend too much time on the website searching for their desired product. If customers cannot find their product fast enough, they will contact the e-commerce provider and order via traditional sales channels (e.g., cell phone). Hence, the e-commerce provider orders the product for the customer resulting in a repurchase. Moreover, we found that even though customers could not find their product in one session, they still return to e-commerce. In addition, another key finding is that the more time it takes for a web page to respond or load to a customer’s request in e-commerce (system quality), the more satisfied the customers are. Within this finding, our study argues with prior B2B and B2C e-commerce research, which indicate that a well-performing system increases customer satisfaction. We found in our case that B2B e-commerce customers perform high cognitive tasks and subconsciously use the extra time for a page to respond or load to consider multiple solutions or choices in their decision-making process for their desired product. The results indicated that B2B e-commerce customers need extensive information and have to answer many questions on the spot to find out the desired product details (e.g., *“What size does this part need to be? What is the part number? What brand of the part is required?”*). Hence, within this research, we argue that customers perform highly cognitive tasks in B2B e-commerce, resulting in a significant positive relationship between poor system quality and customer satisfaction, causing enhanced search performance and task completion.

Keywords – website characteristics, trust, customer satisfaction, customer loyalty, B2B, e-commerce

Paper type – Master thesis

Executive summary

Introduction – The past years, understanding customers experience is getting more attention and has become a leading strategic objective to gain a successful electronic commerce (e-commerce). The increasing focus on customer experience is due to the technological revolution which allows companies to translate specific and detailed data into insightful knowledge about individual-level customer behaviour (Lemon & Verhoef, 2016). To understand and manage customer experience, measuring and analysing the customers' perspectives about their experience in their purchase process is becoming more and more important to stay ahead of the (e-commerce) competition. Two key concepts to understand and manage the customer experience are customer satisfaction and customer loyalty (Lemon & Verhoef, 2016). To succeed in e-commerce environment, businesses should have a clear understanding of customer satisfaction, customer loyalty and its antecedents to improve its business performance in the competitive online business environment in order to build long-term customer relationships (Nisar & Prabhakar, 2017; Tandon *et al.*, 2017).

Within this research, we use big data from the automotive industry to capture the relationships between data-driven website performance factors (system quality, service quality, information quality, and user interface quality) on behavioural attitudes (trust and customer satisfaction) and behavioural consequences (customer loyalty). Behavioural attitudes involve feelings or emotions that affect how we act or behave. Moreover, we want to explore the consequences of behavioural attitudes. To explore these relationships with real-time customer behaviour, management can manage and direct the marketing strategy to sustain its competitive advantage. Therefore, we propose the following research question:

RQ. How are website performance factors related to trust, customer satisfaction, and customer loyalty in B2B e-commerce?

Theoretical framework – Figure 1 shows the model proposed for this research, where the objective is to find the relative significance of website performance factors on customer satisfaction and loyalty in B2B e-commerce. The model expects that website performance factors (system quality, service quality, information quality, and user interface quality) create conditions that lead to satisfied or dissatisfied customers, which in turn lead to customers' intentions to stay loyal to the company. In addition, well-functioning e-commerce leads to trusting customers who assume that the company will act to a specific vital behaviour, which leads to satisfied customers and motivates customers to embrace the company to return and repurchase from the e-commerce.

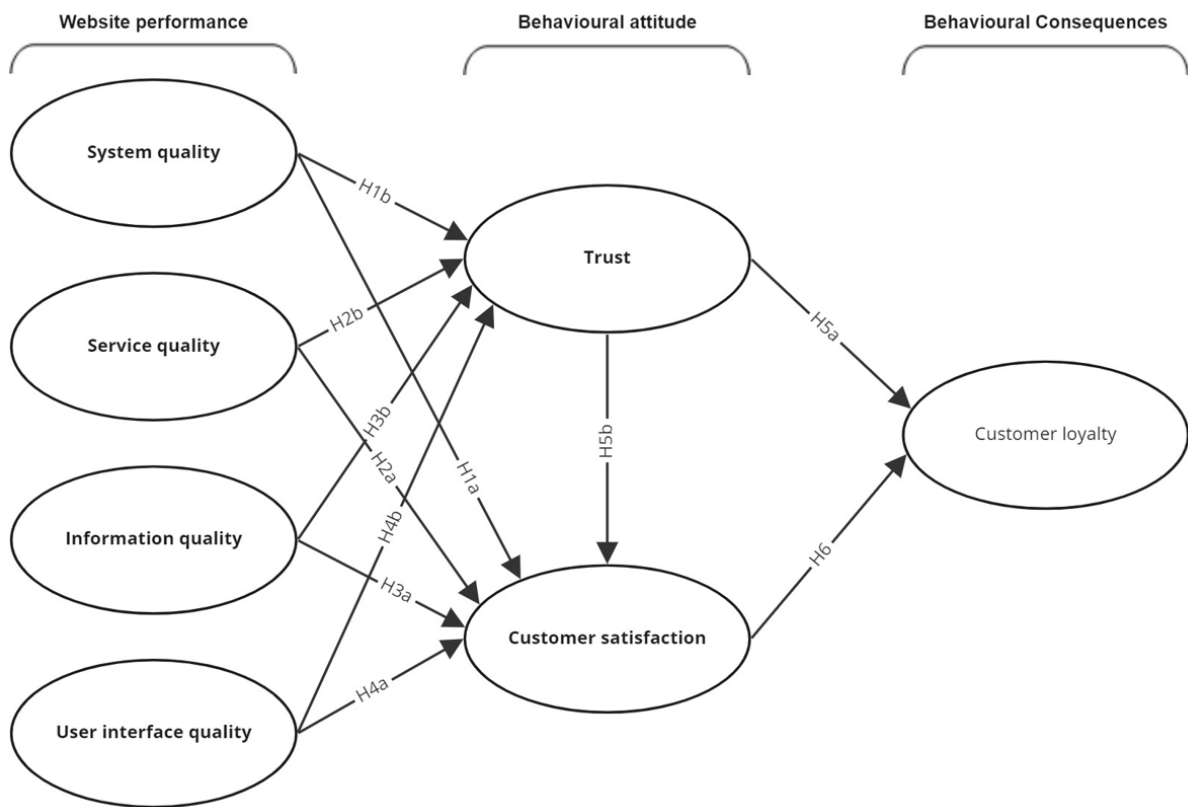


Figure 1 Theoretical framework

Methodology – This research used multiple methodologies to explore, test, and validate the research results.

First, we held ten unstructured interviews to validate the theoretical framework with involved stakeholders (e.g., product owners, part dealers, and customers). The unstructured interviews allowed the respondent to talk in-depth about the topic or another topic they find relevant. This approach helped us to develop a real sense of a person’s understanding of the situation, whereby essential factors which might influence customer satisfaction and loyalty became visible.

Second, we used a pre-test to test and validate our metrics for trust and customer satisfaction. The metrics we use for trust and customer satisfaction are unexplored and never used in this research set-up. Hence, we tested ten customers from the leading commercial vehicle manufacturer in Europe (see Appendix B).

Third, after we validated the theoretical framework and metrics, we started with the data analysis. We collected data in Google Analytics from 01-01-2022 to 01-05-2022 in hours. We used multiple regression as research method and performed the analyses in R-plus. In this method, we predicted how website performance influences trust and customer satisfaction, and what consequences this has for customer loyalty.

Finally, we validated the conclusions by means of semi-structured interviews in Appendix D. After analysing the results we drew conclusions and formulated possible explanations of why a relationship did or did not exist within the framework. However, to assure that our assumptions are correct it is important to validate this by interviews.

Results and managerial implications – Figure 2 and Figure 3 show the results from our tested framework. We can translate our findings in implications for managers in B2B e-commerce. B2B e-commerce providers should understand the needs of their customers to be able to provide an effective e-commerce. The findings from this research can support a manager by monitoring the web performance and customer behaviour real-time. In other words, we translate the founded relationships and effect sizes into key performance indicators (KPI). KPI's are metrics which measures the performance over time for a specific objective. Within this research we established one category of KPI's, namely "customer consequences". This category serves as the primary indicator of the level of success in attaining a loyal customer base. We used different sets of metrics that present single variables that get measured (e.g., "*speed performance*" (system quality)), whereas the KPI's are unique metrics identified as a central assessment for customer loyalty (e.g., "*Repurchase rate*" (customer loyalty)). KPI's help managers to get an overview of the real-time performance which helps to define, act, and react on the marketing strategy. The metrics used for the website performance are the "business as usual" measures that still are important measures but are not critical measures the company need to achieve. From our research managers can use the KPI's "*Repurchase rate*" and "*Customer retention rate*" to track the loyalty level in the e-commerce and from there see which metric is performing poorly, acceptable, or excellent.

First, from our research we find that managers should focus to improve information quality by means of delivering the information via the e-commerce to the customer such that they can easily find the product and buy it. This finding was supported by previous studies that accurate and relevant information in e-commerce will increase customer satisfaction, that will lead to less careful and more confident decision-making process, which results in the initial purchase in the e-commerce (Eid, 2011; Khristianto *et al.*, 2012). As such our research shows that the online environment is striving to find their products easily and timely, and that this will indirectly enhances customer loyalty.

Second, our findings suggest that managers should stimulate to provide excellent service quality. Managers should enhance the performance of the e-commerce while using the website, placing an order, and making a transaction (Lin & Lin, 2006; Vida & Jonas, 2011). Our findings indicate that service quality stimulates customer loyalty. More specifically, we expect that customer who experience a good session will improve the number of repurchases and the number of returning customers. Previous studies suggested that e-commerce businesses that provide good service quality to their customers based on their preferences may achieve a competitive advantage in securing satisfied customers who have future purchase intentions. When online e-commerce customers believe their needs have been met well, the service quality is considered good (Lin and Lin, 2006; Vida and Jonas, 2011).

Third, we found that managers should spent time in developing user interface of the e-commerce webshop. Our findings expect that excellent user interface quality increases the number of repurchases. In other words, managers should design an interface such that the customer can navigate easily to their desired product, order basket, and payment page. Literature suggests that managers should spent time to develop a mental map to see how various pages relate to each other with multiple navigation tools such as menus, frames, buttons, directories, site maps, subject trees, a search engine, image maps, and colors (Clyde, 2000). Our research implicates that it is crucial to have excellent interface quality to enhance the loyal customer base in the B2B e-commerce.

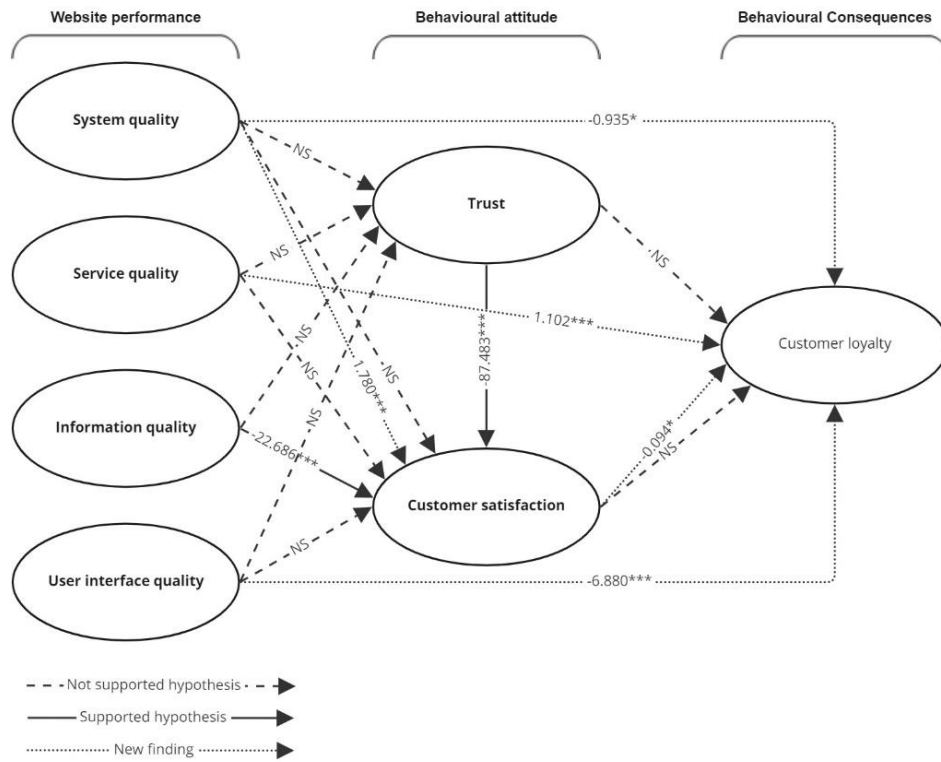


Figure 2 Hypothesized model. Notes: Customer loyalty = repurchase rate; Supported hypotheses and new findings indicate the parameter estimates with the significance level: ***P-value<0.001, **P-value<0.01, *P-value<0.05

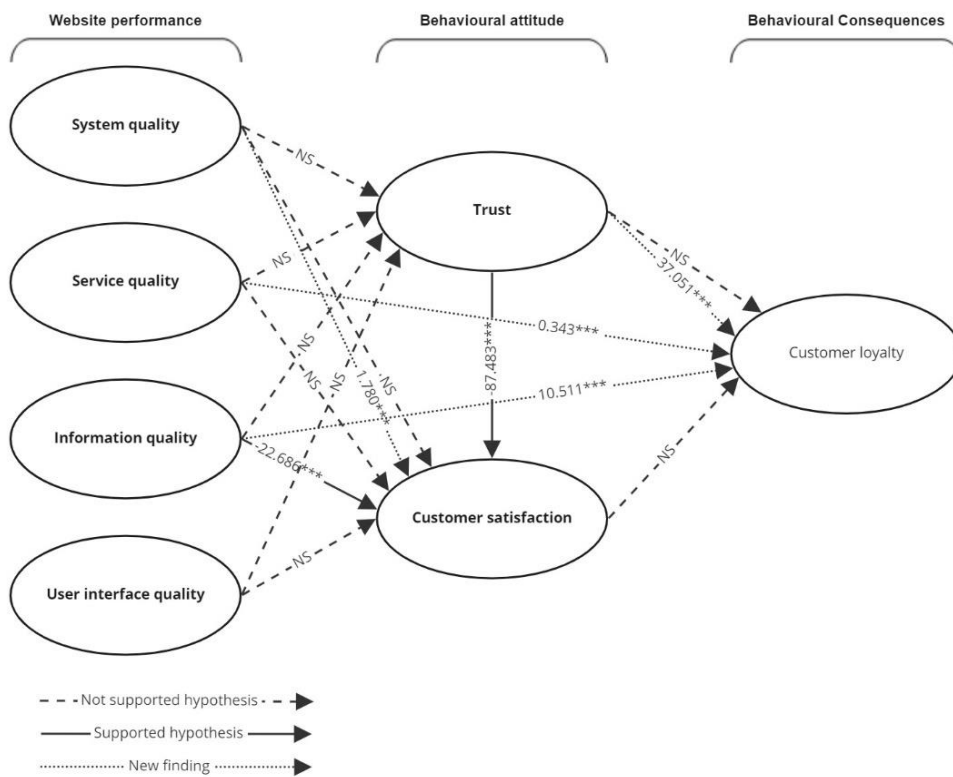


Figure 3 Hypothesized model. Notes: Customer loyalty = Customer retention rate; Supported hypotheses and new findings indicate the parameter estimates with the significance level: ***P-value<0.001, **P-value<0.01, *P-value<0.05

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1. Introduction

Electronic commerce (e-commerce) is becoming more prevalent than ever in customers' and businesses' daily lives (Dospinescu *et al.*, 2018). E-commerce companies operate in multiple business environments, for example, Business to Consumer (B2C), Business to Business (B2B), Consumer to Business (C2B), and Consumer to Consumer (C2C). B2C e-commerce is the most explored research environment in the literature, which involves the direct selling of products to potential online customers (Turban *et al.*, 2017). In contrast, B2B businesses have recently recognized the potential of e-commerce, and the popularity of B2B e-commerce is rising (Statista, 2022).

E-commerce has four key benefits that make the environment attractive for businesses and customers. (1) *No investment in real estate*. There is no need to invest in real estate for customers to shop since the products and services in e-commerce are approachable with a few clicks on a webpage every moment of the day, worldwide. Companies only need to invest in a warehouse where they can stock and make orders ready for delivery. Orders can be shipped from one central point to every part of the world. (2) *Fewer employees needed*. E-commerce makes physical stores obsolete. Therefore, companies no longer need employees to run the stores, which is a substantial cost saving (Gu *et al.*, 2021). (3) *Big data*. Via online websites, companies can assess big data. Data analysis tools can translate big data and make every customer activity visible and insightful. Companies can measure the customers' traffic through their e-commerce websites and make this information insightful for their market strategy (Nisar & Prabhakar, 2017). (4) *Availability*. Customers can access information and order their products or services 24/7 via e-commerce. Availability is especially relevant in B2B businesses since customers do not need to take into account when the physical stores are open to getting their fabrics. For this reason, customers get more freedom to schedule their own production and delivery targets (Gu *et al.*, 2021). The technological revolution from a physical store to e-commerce changed every characteristic of business activities and increased efficiency throughout the value chain (Nisar & Prabhakar, 2017).

In addition, COVID-19 has a positive effect on the growth of e-commerce and changed customers' behaviour from traditional retail shopping to online shopping (Gu *et al.*, 2021). COVID-19 regulations caused physical stores to close, whereby e-commerce websites could offer a solution to still offer the products and services to the customers (Gu *et al.*, 2021; Tokar *et al.*, 2021). Due to this behavioural change from traditional to online shopping, multiple benefits such as competitive pricing, contactless payments, portability, and scalability became visible to customers (Gu *et al.*, 2021). In addition, the benefits and COVID-19 restrictions cause an increase in the supply and demand of e-commerce websites during the last few years. This behavioural change to online shopping is expected to last long, even after the pandemic (Kim, 2020).

The past years, understanding customers experience is getting more attention and has become a leading strategic objective to gain a successful e-commerce. The increasing focus on customer experience is due to the technological revolution which allows companies to translate specific and detailed data into insightful knowledge about individual-level customer behaviour (Lemon & Verhoef, 2016). To understand and manage customer experience, measuring and analysing the customers' perspectives about their experience in their purchase process is becoming more and more important to stay ahead of the (e-commerce) competition. Two key concepts to understand and manage the customer experience are customer satisfaction and customer loyalty (Lemon & Verhoef, 2016). Customer satisfaction is one of the most studied concepts in marketing literature and has an evident role in the competing e-commerce environment since it affects on sustaining old customers and

acquiring new ones (Chen *et al.*, 2012; Chung & Shin, 2010). Moreover, traditionally customer satisfaction refers to the difference between delivered performance and customer expectations (Lemon & Verhoef, 2016) that causes increased customer retention, sales growth (Chen *et al.*, 2012), and repurchase intentions (Yiu *et al.*, 2007). For establishing long-term loyal relationships, satisfied customers are key since they are more likely to return and repurchase than dissatisfied customers (Nisar & Prabhakar, 2017).

In addition, customer satisfaction and loyalty are needed for e-commerce businesses to maintain its market share. A dynamic approach is needed to sustain in this hyper-competitive business environment. E-commerce is a game-changing technological breakthrough that affected on almost every business field. E-commerce is a transparent market regarding product information and prices. Moreover, transparency is beneficial for its customers but it is a competitive danger for the companies since the competition can obtain this information too. This business environment forces e-commerce businesses to review the needs of their customers. Moreover, to succeed in e-commerce environment, businesses should have a clear understanding of customer satisfaction, customer loyalty and its antecedents to improve its business performance in the competitive online business environment in order to build long-term customer relationships (Nisar & Prabhakar, 2017; Tandon *et al.*, 2017).

Furthermore, customer satisfaction and loyalty studies focus fundamentally on B2C e-commerce (e.g., Lin *et al.*, 2016; Nisar & Prabhakar, 2017; Pham & Ahmmad, 2017; Ting *et al.*, 2016). To the best of our knowledge, only five studies exist on these topics in B2B e-commerce environments (Chen *et al.*, 2013; Elsässer & Wirtz, 2017; Hsu *et al.*, 2013; Kassim & Abdullah, 2010; Wang, 2009). Although both business environments have a lot in common and have multiple similar essential influencing factors (e.g., system quality, service quality, information quality, and user interface quality), they have two major differences. (1) *Purpose of purchasing*. Both environments have different purposes for purchasing products. B2C e-commerce customers purchase products to meet a personal need, but they also often purchase products because they get influenced by marketing advertising. B2C e-commerce customers allow themselves to be influenced unconsciously or consciously without having a clear goal in advance and still purchase the product. In contrast, B2B e-commerce customers have a clear goal when they purchase a product. B2B e-commerce customers purchases a product to increase productivity or efficiency within the company. (2) *Decision-making style*. B2B and B2C environments differ in their decision-making style in the purchase process. B2C e-commerce customers make the decisions based on their emotional needs while deciding whether to buy the product. In contrast, B2B e-commerce customers make decisions based on strategic plans and less on their emotional feeling. B2B e-commerce customers proactively identify a need through research and look for a solution. More specifically, B2B customers gather all information needed and consider situational aspects before deciding on purchasing (Gattiker *et al.*, 2000). Due to the limited B2B e-commerce literature, we will also use the explored B2C e-commerce literature within this research to build our hypotheses. We need to consider the differences when interpreting and using B2C literature since the differences affect the extent to which we can transfer B2C to a B2B e-commerce environment.

In addition, the existing literature focuses on expected customer behaviour (e.g., “*I am very happy with the online organization*” (Kassim & Abdullah, 2010)). Within this research, we contribute to the literature by focusing on real-time customer behaviour (e.g., page dwell time). Real-time customer behaviour allows management to manage and direct the marketing strategy to sustain its competitive advantage. More specifically, we use big data from the automotive industry to capture the relationships between data-driven website performance factors (system quality, service quality, information quality, and user interface quality) on behavioural attitudes (trust and customer

satisfaction) and behavioural consequences (customer loyalty). Behavioural attitudes involve feelings or emotions that affect how we act or behave. Moreover, we want to explore the consequences of the behaviour of trusted and satisfied customers. Therefore, we propose the following research question:

RQ. How are website performance factors related to trust, customer satisfaction, and customer loyalty in B2B e-commerce?

1.2 Case description

We conducted a case study at a leading vehicle manufacturer in Europe. The vehicle manufacturer orders their truck parts through suppliers or via their internal stock necessary for the production of the trucks. The vehicle manufacturer aims to sell spare parts via e-commerce to their dealers, who conduct maintenance for the trucks in use. Moreover, the dealers are responsible for promoting and selling the spare parts to various customers. The aim of the e-commerce is to simplify the ordering process between the dealers and their customers since they are located worldwide (see Figure 4).

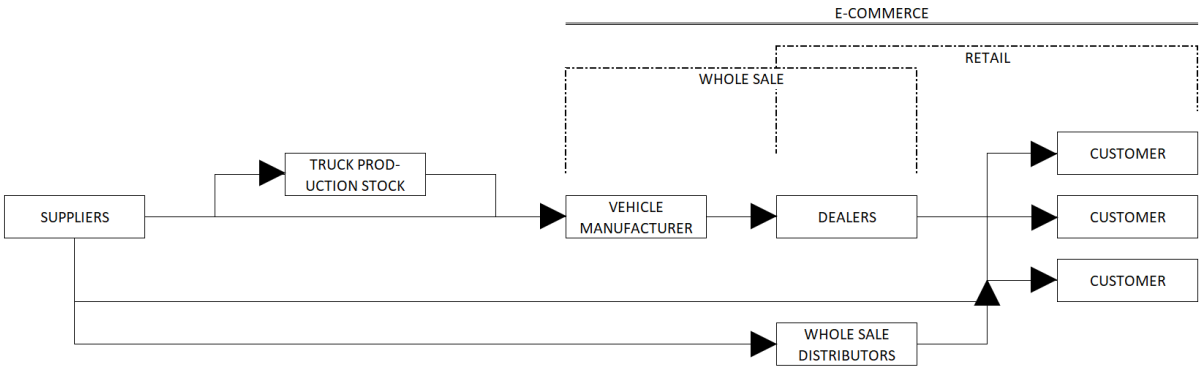


Figure 4 Organizational process flow

1.3 Thesis outline

We organized the remainder of this thesis as follows. First, we review the literature in regard to the concepts of trust, customer satisfaction, and customer loyalty. Then, we propose our theoretical framework and formulate our hypotheses. Next, we present the measurement model and research methodology to test our framework. Finally, we discuss our results, offer theoretical and managerial implications, and show our limitations and future research.

2. Theoretical background

This research builds on behavioural attitudes (trust and customer satisfaction) and behavioural consequences (customer loyalty) in B2B e-commerce. We first turn our attention to the literature with our main focus on customer loyalty, and then cover a small part of the literature on trust and customer satisfaction. In section 2.2 we present our theoretical framework and hypotheses.

2.1 Literature

According to Oliver (2010), a historic definition for customer loyalty refers to a deep commitment with a company to regularly repurchase or patronize a preferred product or service in the future, notwithstanding the possibility for situational factors and marketing attempts to trigger switching behaviour. This type of loyalty is a customer who ardently desires to repurchase a product or service and will not consider alternatives.

Customer loyalty is widely used construct in the marketing since it impacts a company's profit by maintaining a loyal customer base (Oliver, 2010; Srinivasan *et al.*, 2002). Multiple studies refer to this construct as behavioural intentions that include renewing the contract, giving recommendations, and growing support (Bowen & Shoemaker, 2003; Lapierre *et al.*, 1999; Woo & Ennew, 2004; Zeithaml *et al.*, 1996). Moreover, Rauyruen and Miller (2007) propose three types of customer loyalty. (1) *Behavioural loyalty*. Behavioural loyalty is the willingness of the customer to repurchase the product and to continue cooperating with the suppliers. (2) *Attitudinal loyalty*. Attitudinal loyalty uses attitudinal information to verify the customer's emotional and psychological affiliations and commitment, such as the spread of positive word-of-mouth of the product the company offers. (3) *Composite loyalty*. Composite loyalty combines behavioural and attitudinal loyalty. Composite loyalty results from trust in a product or service. A customer is genuinely loyal only when brand commitment is present, mediated by a high level of psychological and emotional brand conviction and attitude strength. There is an inclination to be devoted to a brand when a customer states to have strong resistance to changing brands and has durable belief through time, resulting in loyalty measurement (Rauyruen & Miller, 2007).

In the informational system environment, where companies operate in e-commerce, keeping customers loyal is difficult (Gommans *et al.*, 2001). Therefore, customer e-loyalty is a key factor for e-commerce success (Cao & Li, 2015). According to Nisar and Prabhakar (2017), customers that make multiple online purchases within the same e-commerce can be considered loyal. Luo and Bhattacharya (2006) define customer loyalty as a positive attitude to e-retailing that results in repeat purchases. Srinivasan *et al.* (2002) refer to e-loyalty as a customer's intention to make a purchase from a website and not shift to another website to buy the same product. Likewise, Anderson and Srinivasan (2003), refer to e-loyalty as the customers' positive or negative attitude about an e-commerce company to recurring their purchases.

Loyalty is a principal consequence of effective customer behaviour. Key determinants as trust and satisfaction are customer attitudes toward an e-commerce provider which reflects on the opinion of the customer regarding their confidence in using the website and making online purchases (Faraoni *et al.*, 2019). Trust builds a customers' confidence to interact safely with the company. In content-driven e-commerce websites, customers that use the information are trustors, and the information providers are trustees (Singal & Kohli, 2014). Furthermore, customer satisfaction is the customer's overall evaluation of the product or service after the purchase process (Choi *et al.*, 2013). According to Kotler (1997), customer satisfaction results from the customer's experiences during the purchasing process and has an impact future purchase behaviour. In addition, advantages of web-based information systems are that they can increase user satisfaction by offering rapid access to critical

information, more straightforward complaint response, and ease of use of the information system interface. Satisfaction is a well-known and commonly utilized behaviour indicator (Bailey & Pearson, 1983; Smith, 1998; Zviran & Erlich, 2003) and is an essential measure of an e-commerce system (DeLone & McLean, 2003).

In addition, when a customer is satisfied with a company's product, it is more likely to continue using it or another product from the same brand (Anand & Bansal, 2016). Moreover, Anderson *et al.* (1994) argue that overall satisfaction is a key performance indicator since it significantly impacts the company's behaviour and economic elements. Henning and Hansen (2000) stated that increased customer satisfaction results in higher customer loyalty and retention. Furthermore, customer satisfaction impacts the willingness to spend of the customer. For this reason, many companies are using customer satisfaction as a determinant to focus on the most critical business strategies in increasing revenue and profit (Anand & Bansal, 2016). Moreover, according to Tandon *et al.* (2017), customer satisfaction is one of the most studied constructs in marketing since its impacts on retaining old consumers and introducing new ones. Customer satisfaction plays a significant role in competitive e-commerce marketplaces since it leads to increased customer retention and repurchase intentions (Yiu *et al.*, 2007).

Developing a loyal customer base entails maintaining the same number of customers over time. However, it is also about developing customer relationships to stimulate future purchases and advocacy. A supplier will figure out how their efforts to preserve strong relationships can help their profit levels if they know their company customers' loyalty levels (Rauyruen & Miller, 2007). Moreover, given the smaller knowledge gap between the companies and customers, there is a growing interest in determining what motivates customers to stay loyal in online e-commerce environments. Relationships produce revenues only in later engagements when the costs of providing loyal customers decreases. Companies that run e-commerce must establish a deep understanding of the key antecedents of e-loyalty to realize the benefits of a loyal customer base. E-commerce companies can obtain a competitive advantage by designing methods to enhance e-loyalty with this knowledge (Srinivasan *et al.*, 2002).

2.2 Theoretical framework

Within this research we define customer loyalty as customers who return to the e-commerce and make more than two purchases per year. Figure 5 shows the model proposed for this research, where the objective is to find the relative significance of website performance factors on customer satisfaction and loyalty in B2B e-commerce. The model expects that website performance factors (system quality, service quality, information quality, and user interface quality) create conditions that lead to satisfied or dissatisfied customers, which in turn lead to customers' intentions to stay loyal to the company. In addition, well-functioning e-commerce leads to trusting customers who assume that the company will act to a specific vital behaviour, which leads to satisfied customers and motivates customers to embrace the company to return and repurchase from the e-commerce.

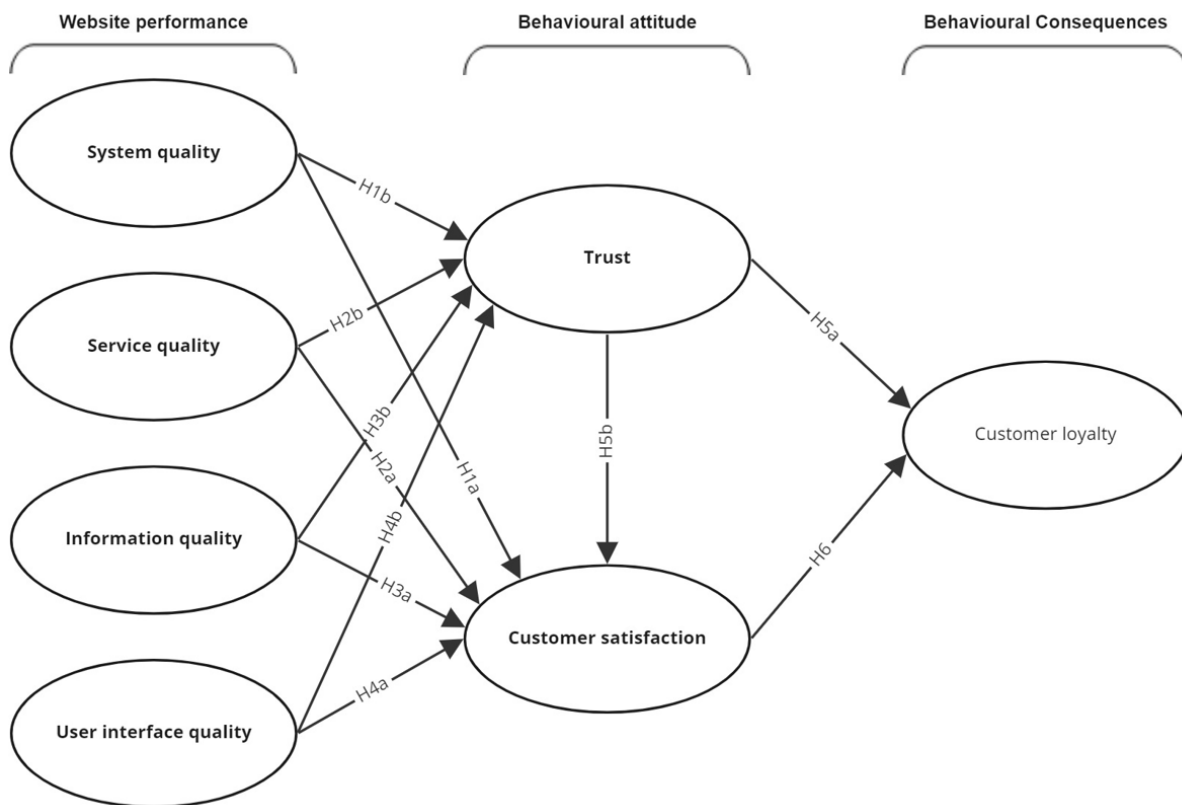


Figure 5 Theoretical framework

2.2.1 Effect of system quality on behavioural attitudes

This research expects system quality to significantly positively affect behavioural attitudes (trust and customer satisfaction). B2B e-commerce researches (Chen *et al.*, 2013; Hsu *et al.*, 2013; Wang, 2009) and multiple B2C e-commerce researches (e.g., Ghobakhloo *et al.*, 2015; Yang & Ding, 2009) support the positive effect of system quality on trust and customer satisfaction. We refer to system quality to what extent the speed performance of the website functions properly in e-commerce. Moreover, system quality is essential for e-commerce websites since customers' previous experience regarding system quality can indicate customers' chance to visit and purchase from the website (Cao & Li, 2015). Responsive websites are essential for e-commerce businesses since it reduces the chance of losing customers (Robbins & Stylianou, 2003). For example, if a web page does not respond fast enough, the customer will become impatient and re-direct to the competitors' e-commerce website (Dellaert & Kahn, 1999; Weinberg, 2000).

In addition, an e-commerce website needs a qualitative well-functioning system to provide information and service to the customer. For this reason, a website cannot exist without its system quality. If the e-commerce is not functioning, such that it is not reliable and keeps getting interrupted, customers will lose their trust in the quality of the system, causing them to give up using the e-commerce website (Zhou & Zhang, 2009). This research hypothesizes that good system quality positively influences a customer's perception of the e-commerce website, causing trusted and satisfied customers. Therefore, we propose the following hypotheses:

H1a: There is a significant positive relationship between system quality and customer satisfaction in B2B e-commerce

H1b: There is a significant positive relationship between system quality and trust in B2B e-commerce

2.2.2 Effect of service quality on behavioural attitudes

We expect service quality to significantly positively affect behavioural attitudes (trust and customer satisfaction). We define service quality as to what extent the e-commerce is functioning. E-commerce businesses that provide good service quality to their customers based on their preferences may achieve a competitive advantage in securing satisfied customers who have future purchase intentions. When online e-commerce customers believe their needs have been met well, the service quality is considered good. Good service quality involves the customers feeling about the level of service offered while using the website, placing an order, and making a transaction (Lin and Lin, 2006; Vida and Jonas, 2011). Customers' perceptions of service quality should influence their evaluation of the e-commerce website and their overall satisfaction with using the system. Satisfied customers encounter an enhanced level of service when using e-commerce compared to not using the website.

In addition, companies must deliver a constant service quality level to the customer. A customer does not know if the performance of the e-commerce is trustable if the service is fluctuating from time to time. Customers have a strict schedule to meet their own delivery targets. Therefore, customers need to be able to trust the e-commerce to deliver the same or improved service every session the customer visits the website. Support for these hypotheses comes from related work on trust and customer satisfaction in B2B (Chen *et al.*, 2013; Hsu *et al.*, 2013; Kassim & Abdullah, 2010; Wang, 2009) and B2C e-commerce research field (e.g., Akroush *et al.*, 2021; Eid, 2011; Faraoni *et al.*, 2019; Ghobakhloo *et al.*, 2015; Zhou & Zhang, 2009) because good service quality causes trusted and satisfied customers, we posit that these findings apply to this research context. Therefore, we propose the following hypotheses:

H2a: There is a significant positive relationship between service quality and customer satisfaction in B2B e-commerce

H2b: There is a significant positive relationship between service quality and trust in B2B e-commerce

2.2.3 Effect of information quality on behavioural attitudes

Within this research we define information quality as the extent to which customers can easily find relevant and accurate information to make informed decisions before purchasing on the e-commerce website. Hence, we expect that information quality has a significant positive relationship on behavioural attitudes (trust and customer satisfaction). Information quality influences customers' overall evaluation and the final decision, balanced by the degree of accuracy, timeliness, informativeness, and relevance (Lin, 2013). Moreover, information quality assists customers in making informed decisions by comparing products by their specifications and enhancing secure transactions (Liu & Arnett, 2000; Park & Kim, 2003). Relevant and accurate information motivates customers to purchase the products (Kuo & Chen, 2011) since customers are cautious about accepting the e-commerce websites' information during the decision-making process (Ghasemaghaei & Hassanein, 2013). Accurate and relevant information in e-commerce will increase trust and customer satisfaction, then lead to less careful and more confident decision-making process, which results in the initial purchase (Eid, 2011; Khristianto *et al.*, 2012). Multiple B2B (Hsu *et al.*, 2013; Wang, 2009) and B2C studies (e.g., Ghobakhloo *et al.*, 2015; Rasli *et al.*, 2018; Zhou & Zhang, 2009) support the hypotheses that proposes that informed decision procedures lead to higher levels of trust and satisfied customers. We posit that these findings apply to this research context. Therefore, this study proposes the following hypotheses:

H3a: There is a significant positive relationship between information quality and customer satisfaction in B2B e-commerce

H3b: There is a significant positive relationship between information quality and trust in B2B e-commerce

2.2.4 Effect of user interface quality on behavioural attitudes

This research expects user interface quality to have a significant positive relationship on behavioural attitudes (trust and customer satisfaction). User interface quality refers to the ease of navigation in the e-commerce. User interface quality is closely related to information quality since the information provided through products and other content in figures and images makes navigation through the e-commerce website easy. However, navigation is still one e-commerce challenge where many websites run into. When customers experience navigating problems, they lose track of the context and are unsure how to proceed to their desired web page (Levene, 2001). Moreover, customers become dissatisfied when they do not know how to navigate through the e-commerce website (Bhatti *et al.*, 2000). A good user interface design ensures that customers navigate well through the website and provides the customers with a mental map to see how various pages relate to each other. Navigation tools consist of menus, frames, buttons, directories, site maps, subject trees, a search engine, image maps, and colors (Clyde, 2000). Navigation tools mitigate design challenges and ensure customers can see the layout, manoeuvre easily around, and find the information they need to get to their desired goal page (Clyde, 2000; Hudson *et al.*, 2000). Moreover, an effective user interface design has the relevant information content that helps customer trust their e-commerce since they know how they can navigate to their goal page (Gefen, 2002; Wolfinbarger & Gilly, 2002). This research adopts the propositions of the B2B e-commerce studies that user interface quality might (in)direct affect trust, which leads to different levels of customer satisfaction (Hsu *et al.*, 2013; Kassim & Abdullah, 2010). Therefore, we propose the following hypotheses:

H4a: There is a significant positive relationship between user interface quality and customer satisfaction in B2B e-commerce

H4b: There is a significant positive relationship between user interface quality and trust in B2B e-commerce

2.2.5 Effect of trust on behavioural attitude and consequences

Within this research we define trust as a secure relationship between the e-commerce user and provider. We expect trust to mediate the effect between website performance on customer satisfaction and loyalty. To comply with the customers' relationship and commitment within e-commerce website, trust is a representative website behaviour to measure the degree of confidence a customer has in the e-commerce website and the brand itself. Well-designed e-commerce can build trust and confidence in the customers since they know what they can expect from the website performance (Hansen, 1999). Specifically, past B2B (Hsu *et al.*, 2013) and B2C e-commerce research (Eid, 2011; Faraoni *et al.*, 2019; Zhou & Zhang, 2009) suggests investigating the relationships among website characteristics (system quality, service quality, information quality, and user interface quality) through trust on relationship characteristics (customer satisfaction and customer loyalty) in a B2B e-commerce environment. Therefore, we propose:

H5a: There is a significant positive relationship between trust and customer loyalty in B2B e-commerce

H5b: There is a significant positive relationship between trust and customer satisfaction in B2B e-commerce

2.2.6 Effect of customer satisfaction on behavioural consequences

Customer satisfaction influences the competitive e-commerce marketplaces since it leads to increased customer retention and increased repurchase intentions (Yiu *et al.*, 2007). Therefore, this research expects that customer satisfaction has a significant positive impact on customer loyalty. We define customer satisfaction as a customers' overall evaluation of the e-commerce's ability to meet their needs. If a customer is satisfied with a company's product, it is more likely to continue using it or another product from the same brand (Anand & Bansal, 2016). In addition, customer satisfaction impacts the willingness to spend the customer. Hence, many companies are using customer satisfaction as a key performance indicator to focus on the most critical business strategies for increasing revenue and profit (Anderson *et al.*, 1994; Anand and Bansal, 2016). Marketing aims to successfully deliver customer satisfaction to attract them to return to the company (Kotler & Armstrong, 2014). Companies look for innovative opportunities to analyse and develop new or improved products. As a result, businesses must assess how well their product satisfies their customers frequently (Anand & Bansal, 2016). Customer satisfaction is a construct that measures how well a company's products and services satisfy its customers' expectations. This performance indicator aids businesses in successfully monitoring and controlling their operations (Anand & Bansal, 2016). Multiple B2B (Elsäßer & Wirtz, 2017; Kassim & Abdullah, 2010) and B2C e-commerce studies (e.g., Lin *et al.*, 2016; Pham & Ahammad, 2017) have adopted the relationship between customer satisfaction and loyalty before. Therefore, we propose the following hypothesis:

H6: There is a significant positive relationship between customer satisfaction and customer loyalty in B2B e-commerce

3. Methodology

In the previous chapter we developed the theoretical framework and hypotheses. The next step is to conduct an empirical study which requires a suitable approach. First, we will discuss the metrics which we will use to test our theoretical framework. Next, we will discuss the type of research, methodology and descriptive statistics. Furthermore, we add an additional section where we redefine the measurement model from section 3.1. This section is necessary since we observed some notables during our pre-analysis which required attention. Finally, we close this chapter with the performance accuracy and mediation.

3.1 Measures

To operationalise the theoretical framework, a mixture of existing measures and newly proposed measures are used when necessary (see Appendix A and Figure 6). Moreover, we will discuss the key concepts' definition and conceptualization.

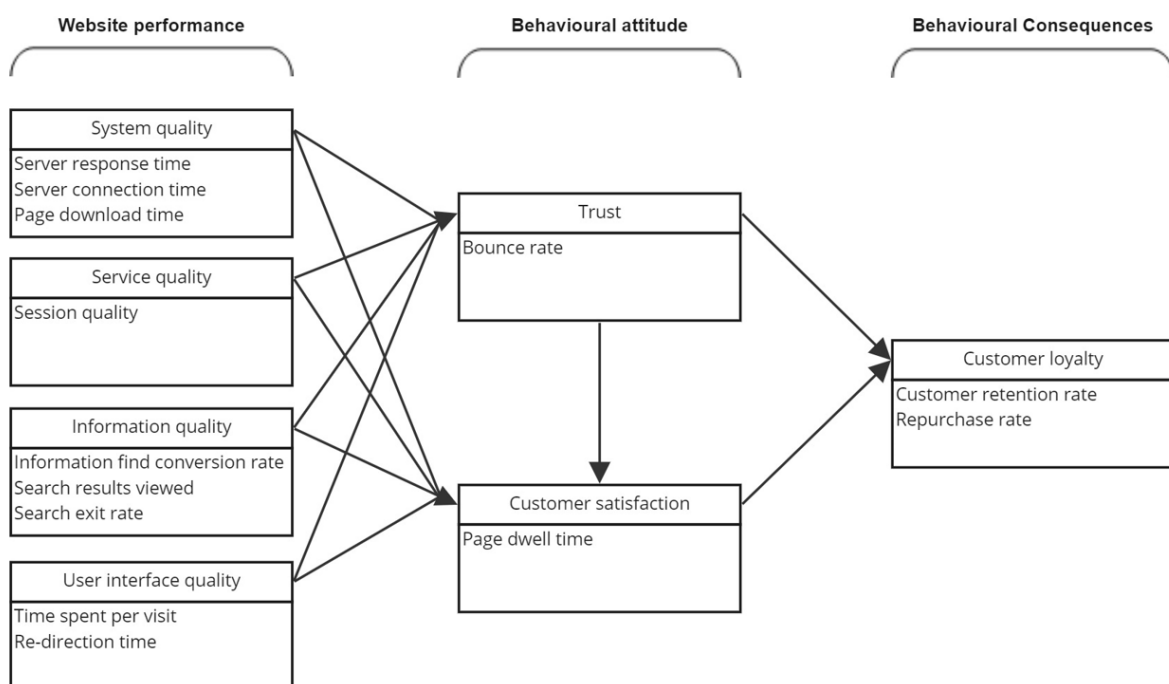


Figure 6 Measurement model

3.1.1 Customer loyalty

We will use two metrics for behavioural loyalty. (1) *Customer retention*. Customer loyalty is often measured with customer retention (e.g., Bolton *et al.*, 2004; Gupta & Zeithaml, 2006; Keiningham *et al.*, 2007; Lemon & Verhoef, 2016; Reynold & Arnold, 2000). Moreover, customer retention refers to the preservation of the business relationship between the customers and the e-commerce provider over a period of time. Customer retention measures the behavioural consequences of satisfied or dissatisfied customers who remain loyal by returning to the company (Rauyrueen & Miller, 2007). Although, the quite short measurement period (5 months) and the unit of analysis (hour) made the chance for a customer to return the next hour very small. Hence, we define customer retention as the number of registered customers who return to e-commerce website. Returning customers are more valuable to the e-commerce compared to first-time users since they are more likely to order products (Pfeifer, 2005). The metric shows how successful the e-commerce is in building and retaining old customers (Lemon & Verhoef, 2016). (2) *Repurchases*. Customer loyalty is often measured by the number of repurchases (e.g., Keiningham *et al.*, 2007; Lemon & Verhoef, 2016; Rauyrueen & Miller,

2007; Reynold & Arnold, 2000) and is the most common assessment of behavioural loyalty (Bloemer & Kasper, 1995). However, these studies focussed more on bivariate relationships. We define a customer's repurchase behaviour as the emotional and psychological affiliations and commitment to the e-commerce website. Moreover, we consider a customer loyal when it purchases two or more times per year. The combination of customer retention and the number of repurchases will show if customers are not only loyal to the e-commerce by returning to the website, but also by making actual purchases.

3.1.2 Customer satisfaction

We define customer satisfaction as a customers' overall evaluation of the e-commerce's ability to meet their needs. Customer satisfaction is a qualitative non-metric variable since this is a feeling or emotion a customer has about e-commerce. Hence, traditionally, customer satisfaction is measured through an ordinal scale (e.g., 1 = strongly disagree and 5 = strongly agree) (e.g., Chen et al., 2013; Elsässer & Wirtz, 2017; Hsu et al., 2013; Kassim & Abdullah, 2010; Wang, 2009). However, this research uses a ratio scaled metric ("Page dwell time") to predict the level of customer satisfaction by means of customer behaviour in the e-commerce. Page dwell time refers to the total amount of time spent on a single page. Earlier studies explored that page dwell time is an indicator of customer satisfaction (Fox et al., 2005; Hassan et al., 2011; Liu et al., 2010). The studies found that the more time a customer spends on a search result, the more profit it gains from the web page. Hence, the more time a customer spends on the web page, the more satisfied the customer is. However, precise modelling of page dwell time is not unbiased since the duration a customer stays on a webpage also depends on, for example, the mood of the customer or the time of the day, which may not be fully captured in the log data (Liu et al., 2010). The study of Liu et al. (2010) found the "negative aging" phenomenon, that is that the rate of customers leaving the web page decreases over time and that this effect is stronger for less informative pages (see Figure 7). In addition, 99% of all websites suffer from this negative aging phenomenon. The negative aging phenomenon captures the evaluation of the customer when it decides if the web page is informative or not. Hence, the web page needs to communicate the page's value proposition within 10 to 30 seconds, or there is a high probability that the customer will leave the web page. Suppose the customer is convinced within 30 seconds of the value the webpage offers. In that case, the probability curve will flatten, which means that there is a chance that the customers will stay for a more extended period of time on the webpage. This research adopts the theory of Hassan et al. (2011) and Liu et al. (2010) and assume that customers that stay less than 30 seconds on a page are considered dissatisfied, and customers that stay 30 seconds or more on a web page are considered satisfied. In addition, past literature uses how customers end their search sessions (e.g., to purchase or not) as a metric for customer satisfaction (Fox et al., 2005; Hassan et al., 2011). However, this is a behaviour consequences and will not be incorporated in our study as customer satisfaction but as customer loyalty.

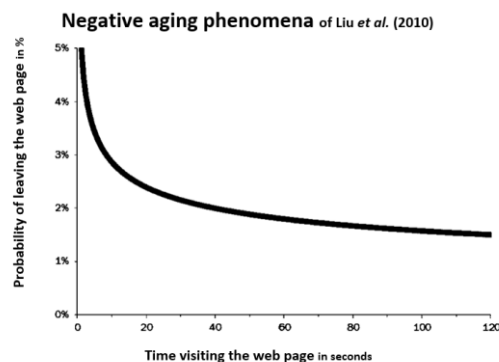


Figure 7 Negative aging phenomena

3.1.3 Trust

This research adopts trust as a secure relationship between the e-commerce user and provider. Trust measures to what extent a customer has the confidence to shop on the e-commerce website. Trust is a qualitative non-metric variable like customer satisfaction since this compacts a customer's feelings or emotions about e-commerce. Hence, traditionally, trust is measured through an ordinal scale (e.g., 1 = strongly disagree and 5 = strongly agree)(e.g., Kassim & Abdullah, 2010). However, this study uses a ratio scaled metric ("*Bounce rate*") to predict the level of confidence a customer has by means of how the customer behaves in the e-commerce. Bounce rate is a customer who immediately leaves the website after viewing only one web page. A high bounce rate indicates that the website does not meet the customers' expectations in terms of not having enough trust in the brand of website to meet their needs. In B2C research a bounce rate higher than 40% has distrusted customers, and needs attention to its website performance (Singal & Kohli, 2014).

3.1.4 System quality

In this research system quality refers to what extent the speed performance of the website functions properly in e-commerce. Customers are more probable to lose interest in the site when they experience that they need to wait too long till a web page is viewed. Older studies found that a customer waits between eight to ten seconds before the customer will end their purchase and leave the website (Dellaert & Kahn, 1999; Nielson, 1996; Weinberg, 2000). Furthermore, long page download times engender increased frustration and dissatisfaction of the customer, which can result in lost revenue. E-commerce website appearance and pages need to load fast to keep the (satisfied) customers on the e-commerce website (Selvidge *et al.*, 2002; Weinberg, 2000). Previous studies found that the response and download time of the system is related to customer satisfaction in service evaluations (Roslow *et al.*, 1992; Selvidge *et al.*, 2002; Schleifer and Amick, 1989). In addition, one would presume that faster response times are usually preferable when analysing website response times. However, according to the study of Selvidge *et al.* (2002), web pages with shorter wait durations surprisingly increases lostness, but improves task completion. More about, this study concludes, that for most websites it is better to have pages with shorter download times. Although, this depends on the cognitively demanding tasks, where more time to consider during delays positively enhance search performance and task completion on the e-commerce website. Hence, it is important when evaluating these web metrics to take into account the purpose of the search request.

This research proposes three metrics to predict the systems' speed performance (see Figure 8). (1) *Server response time*. "*Server response time*" is the time it takes for a server to respond to a customers' request on the website. When a customer first arrives at the website, a Domain Name System (DNS) lookups arises, this confirms the connection to a DNS server, which equals a domain name to its registered IP address. (2) *Server connection time*. Then a Hypertext Transfer Protocol (HTTP) which encodes and transfers the information between the web browser and the web server and makes the connection to Tim to First Byte (TTFB). TTFB is the time between the server is requesting information and it receives the first byte of information. (3) *Page download time*. The up-following events in the chain belong to "*Page download time*". "*Page download time*" starts with content download, this event starts when the whole page has loaded, such as images. Further, the Document Object Model (DOM) load, which is the data portrayal of the objects that includes the structure and content of a document. Finally, the page load that is the time it takes for a page to appear on a customer's screen.

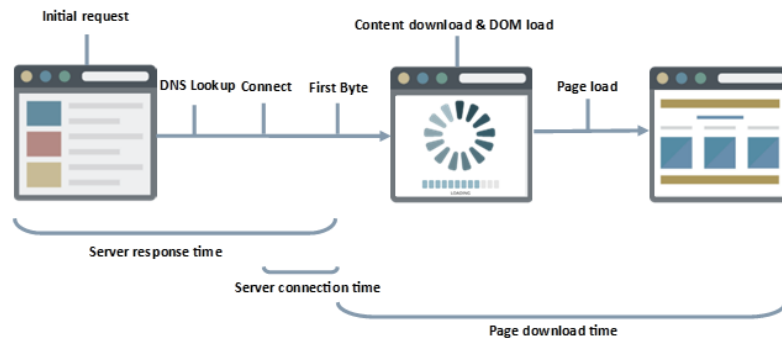


Figure 8 A system's speed performance

3.1.5 Service quality

In this research service quality refers to what extend the e-commerce is functioning. Service quality measures the performance of the e-commerce while using the website, placing an order, and making a transaction (Lin & Lin, 2006; Vida & Jonas, 2011). If a customer does not like the e-commerce they are likely to drop out before the check out. This research uses "Session quality" to measure service quality. "Session quality" indicates how good the e-commerce was performing during a customers' session and how close the customer was to transacting. The higher the score of "Session quality", the closer the customer was to transacting conversely, the lower the score, the further the customer was to transacting (see, Figure 9). Thus, when the average session quality score is close to 1 it means that the visit on the e-commerce website was very low quality in terms of the proximity to generating a purchase. In addition, if the score is close to 100, then the visit to the website was very high quality in terms of generating a purchase on the website. Note, that when the "Session quality" is 100, it does not always mean that a transaction occurred on the website, a session with a transacting and session quality score are approximately equal to each other.

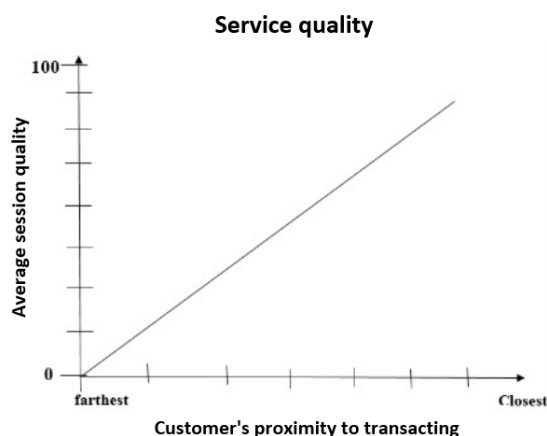


Figure 9 Session quality relative to customer's proximity to transacting

3.1.6 Information quality

Information quality refers to the extent to which customers can easily find relevant and accurate information to make informed decisions before purchasing on the e-commerce website. The search facility to enter keywords and numbers helps customers to find the information they want to acquire and the need to make informed decisions (Huizingh, 2000). This research proposes three metrics for information quality. (1) Search exit rate. "Search exit rate" measures the frequency a customer

performs a search query and then leave the Search Engine Results Page (SERP) without selecting a result. A high “*Search exit rate*” suggest that the quality of provided information on the website is low since customers cannot find what they are looking for. (2) *Information find conversion rate*. In contrast to search exit rate, “*Information find conversion rate*” measures how often customers click on a result from the SERP, which is also called the goal page. A goal page is a commonly used term in Google Analytics that represents a complete search activity, which is also called a conversion. A high “*Information find conversion rate*” indicates that the e-commerce provides excellent information in such way the customers can complete their search quest and find their desired product (Singal & Kohli, 2014). (3) *Search results viewed*. “*Search results viewed*” measures the number pages a customer visits after relative to its number of search assignments.

3.1.7 User interface quality

User interface quality refers to the ease of navigation in the e-commerce. User interface quality measures how a customer will get to where they want to go and do what they want to do. Easy navigation needs to allow the customer to perform tasks with efficiency and ensures that customers can locate the information they are looking for. This research uses two metrics for user interface quality. (1) *Re-direction time*. “*Re-direction time*” measures the success of e-commerce navigation in terms of user interface design and content presentation (Cao *et al.*, 2005). A customer re-directs back to a webpage when it does not know how to navigate to their desired webpage (see Figure 10). Hence, the lower the “*Re-direction time*” the more efficient the customer navigates through the website, if there are no re-directs, the value for this metric is expected to be 0. (2) *Time spent per visit*. “*Time spent per visit*” supports “*Re-direction time*” and measures how long a customer spent on the website. When a customer re-directs multiple times in the website, this variable is likely to increase as well (Singal & Kohli, 2014).

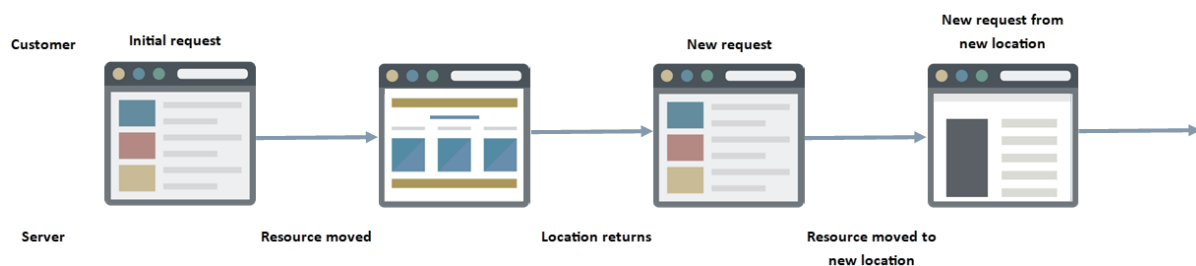


Figure 10 Re-direction on a web page

3.2 Type of research

We collected data from a leading commercial vehicle manufacturer in Europe in Google Analytics to test the theoretical framework and hypotheses. The vehicle manufacturer is a B2B company that sells spare parts for truck maintenance and repair via e-commerce to customers worldwide. This research used multiple methodologies to explore, test, and validate the research results.

Theme based analysis. We held ten unstructured interviews to validate the theoretical framework in Dutch with involved stakeholders (e.g., product owners, part dealers, and customers). The unstructured interviews allowed the respondent to talk in-depth about the topic or another topic they find relevant. This approach helped us to develop a real sense of a person’s understanding of the situation, whereby essential factors which might influence customer satisfaction and loyalty became visible.

Case analysis. We used a pre-test to validate our metrics for trust and customer satisfaction. The metrics we use for trust and customer satisfaction are relatively unexplored and never used in this

research setup. Hence, we tested ten customers from the leading European commercial vehicle manufacturer (see Appendix B). Within the pre-test, we prepared two cases. In each case, the customer was asked to search for a product on the e-commerce website. We used two products with the same kind of specifications such that there is an as little distinction as possible between the cases. However, we expected that case 1 would yield satisfied customers and case 2 dissatisfied customers. We expected this distinction between the two cases because we did not get any complaints for case 1 and did receive multiple complaints in case 2 in the e-commerce. Hence, we can observe behavioural differences between satisfied and dissatisfied customers. After each case, each customer was asked to answer survey questions. The survey questions capture the customer's attitude regarding their last purchase process on the e-commerce website. Moreover, we recorded the entire search quest to compare the customers' attitudes and real-time behaviour.

Multivariate analysis. After we validated the theoretical framework and metrics, we started with the data analysis. We used one data source and collected the data in Google Analytics from 01-01-2022 to 01-05-2022 in hours. This research contains a single metric dependent variable that is proposed to be related to two or more independent variables (see Figure 11). We used multiple regression as research method and performed the analyses in R-plus. The aim of multiple regression analysis is to estimate how the dependent variable will change when the independent factors change. This objective is achieved through the statistical rule of least squares (Hair *et al.*, 2014). In short, this research aims to predict how website performance influences trust and customer satisfaction, and what consequences this has for customer loyalty. Before we started the analysis, we cleaned the data by handling the missing values and outliers (see Appendix C for more detailed steps).

Multiple Regression Analysis

$$\begin{array}{ccc}
 Y_1 & = & X_1 + X_2 + X_3 + \dots + X_n \\
 \text{(metric)} & & \text{(metric, nonmetric)}
 \end{array}$$

Figure 11 Relationship of Multiple Regression Analysis

Validation analysis. We validated the conclusions by means of semi-structured interviews. After analysing the results we drew conclusions and formulated possible explanations of why a relationship did or did not exist within the framework. However, to assure that our assumptions are correct it is important to validate this by interviews. We prepared the questions in advance based on our conclusions. Moreover, the questions are not set in a strict order or in phrasing to collect open ended answers about the interviewee's thoughts, emotions, or feelings towards the e-commerce. In total five customers participated in the interview. In addition, we analysed the interviews and summarized the most important findings in Appendix D.

3.3 Descriptive statistics

Table 1 shows the descriptive statistics which summarises the data and its measures. The results show that the mean of "Repurchase rate" (customer loyalty) is 17.37% and for "Customer retention rate" (customer loyalty) 96.10%. The descriptive statistics indicate that customers are likely to return to the e-commerce website, but that the returning customers not always purchase a product when they visit. In addition, Figure 12 shows that most visitors arrive between 09:00 and 09:59 on the e-commerce. The amount of customers remain approximately the same between 09:00 till 15:59, and then declines in the number of users. We expect this declines because more customers finish their work for that day. Figure 13 shows the highest order value which indicates how much a customer's spent each time it places an order on the e-commerce. The results show the highest revenue of an e-commerce transaction in the beginning of the day at 07:00-07:59, which shows a fluctuating pattern with a small peak in the afternoon and a high peak at the end of the day at 18:00-18:59.

Table 1 Descriptive statistics

Descriptive statistics							
Construct	Variable	Min	Mean	Max	Median	Std. deviation	N
Dependent variables							
Customer loyalty	Repurchase rate	1.65	17.37	48.48	16.93	5.84	890
Customer loyalty	Customer retention rate	72.92	96.10	100.00	96.71	2.76	890
Mediators							
Customer satisfaction	Page dwell time	49.03	70.63	91.27	70.90	5.44	890
Trust	Bounce rate	0.06	0.20	0.42	0.20	0.01	890
Independent variables							
System quality	Page download time	0.01	0.06	0.44	0.05	0.05	890
System quality	Server connection time	<0.01	0.02	0.15	0.02	0.02	890
System quality	Server response time	0.37	1.35	4.20	1.30	0.49	890
Service quality	Session quality	5.27	14.33	21.60	14.43	2.08	890
Information quality	Information find conversion rate	7.14	54.87	100	52.81	19.08	890
Information quality	Search results	1.00	1.19	1.68	1.18	0.07	890
Information quality	Search exit rate	0.06	0.20	0.42	0.20	0.05	890
User interface quality	Time spent per visit	42.00	556.50	930.10	559.10	100.95	890
User interface quality	Re-direction time	0.05	0.23	1.08	0.21	0.10	890
Control variables							
	Order value	2.97	513.78	6477.42	380.84	567.58	890
	Price	2.68	70.12	2668.97	49.90	146.85	890
	Monetary value	4.59	24759.66	99948.34	358.00	20270.46	890

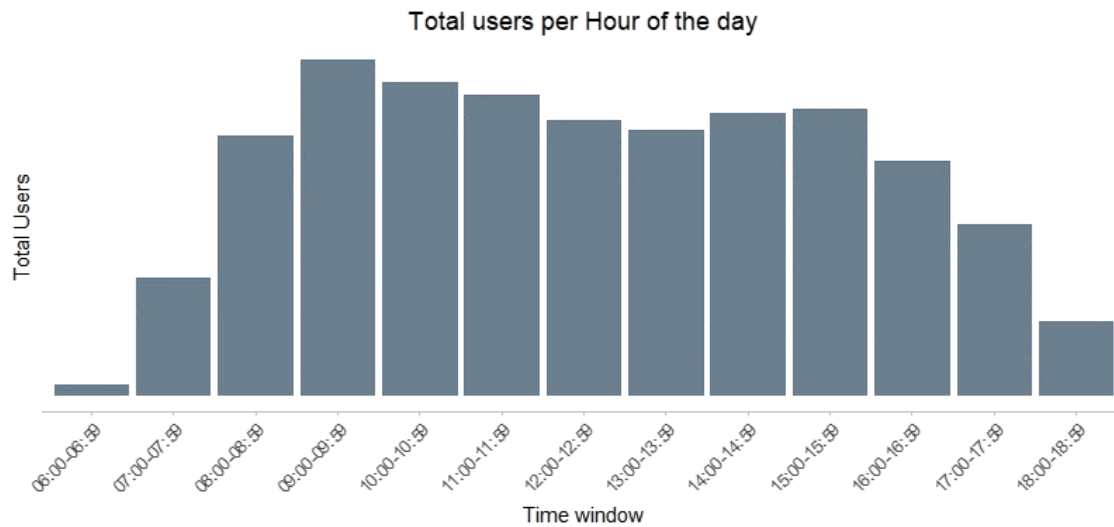


Figure 12 Total users per hour of the day

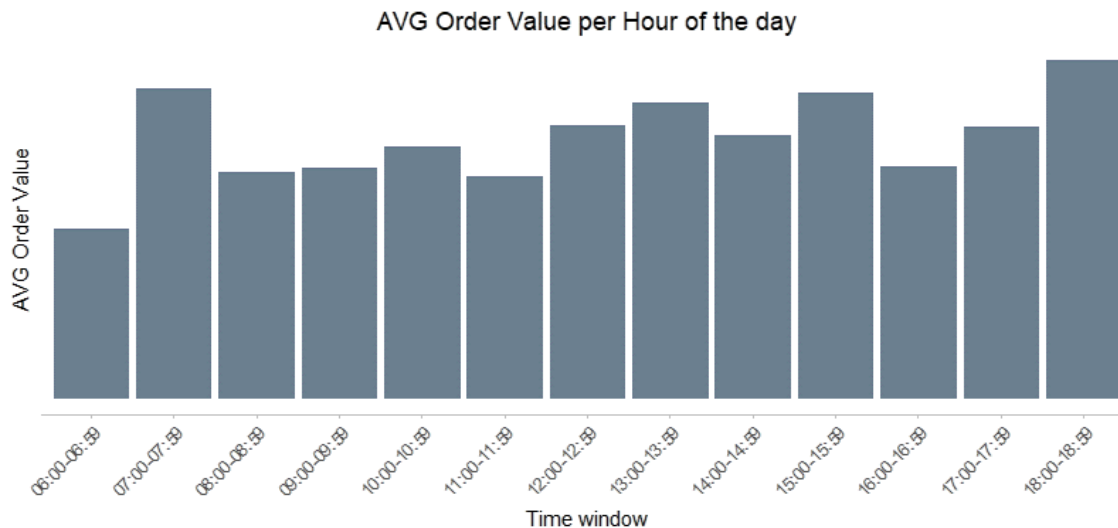


Figure 13 Order value per hour of the day

3.4 Redefined measurement model

During data preparation we observed some notables, which needed attention in considering to redefine the measurement model before testing the hypotheses. More specifically, we found that some variables do not belong in the same construct. Hence, we added an additional section where we redefined the measurement model by creating new variables and deleting old ones before starting the analysis.

3.4.1 Observations

In the raw data set, we observed low correlation coefficients among the variables representing the same construct. However, since there were still inadequate data points in the sample (e.g., outliers), the low correlations could be caused by excessive variance. Hence, a new correlation matrix would show if these low correlation coefficients still hold with clean data. The results from the new correlation matrix show little difference, such that there are still low correlation coefficients (see Table 2). The results indicate that there are very weak linear relationships between the variables. Still, we used exploratory factor analysis (EFA) to test if the variables belong to each other in the same construct.

Table 2 Correlation matrix: raw data versus clean data

			1	2	3	4	5	6	7	8
System quality	1	Page download time	1							
	2	Server connection time	0.30	1						
	3	Server response time	0.02	0.05	1					
Information quality	4	Information find conversion rate				1				
	5	Search results				0.11	1			
	6	Search exit rate				-0.12	0.04	1		
User interface quality	7	Time spent per visit							1	
	8	Re-direction time							-0.07	1
Correlation matrix raw data										
			1	2	3	4	5	6	7	8
System quality	1	Page download time	1							
	2	Server connection time	0.30	1						
	3	Server response time	-0.01	0.09	1					
Information quality	4	Information find conversion rate				1				
	5	Search results				0.11	1			
	6	Search exit rate				-0.15	0.04	1		
User interface quality	7	Time spent per visit							1	
	8	Re-direction time							-0.02	1
Correlation matrix clean data										

EFA can translate lower level measurements (e.g., “*Server response time*”, “*Server connection time*”, and “*Page download time*”) to higher level construct (e.g., system quality). We conducted EFA for each construct individual with at least three variables and once with all variables to check if other constructs may exist. EFA did not yield any results and thus showed that none of the variables belong to each other in the same factor, thus construct.

A possible explanation why EFA did not yield any results is that the theory used other kind of data to test the theoretical framework. For example, the theory used survey data that measures expected customer behaviour, while we use data from google analytics that measures real-time customer behaviour. Besides, another possible explanation could be that the variables of system quality measure each a different dimension of a system’s speed performance, which all have different technical causes. In addition, the variables for information quality come from a proposed research framework by Singal and Kohli (2014). However, the research did not test framework yet, which could explain why the proposed web metrics do not belong to each other. Finally, a possible explanation why the metrics do not belong to each other is that we combined and proposed the metrics of user interface quality from two different studies (Cao *et al.*, 2005; Singal & Kohli, 2014).

From these observations, we conclude that the theory does not match the data in practice. Hence, it is necessary to redefine the measurement model with careful consideration before starting the analysis.

3.4.2 Refinement

First, taking the observations from section 3.4.1 into account, we reconsidered the proposed measures “*Server response time*” (system quality), “*Server connection time*” (system quality), and “*Page download time*” (system quality) for the construct system quality. The results from the unstructured interviews in the pre-analysis showed that customers observe “*Page download time*” (system quality). Customers observed a loading bar when clicking on a new web page. In addition, we observed the same loading bar in the video recordings from the pre-test. From both the unstructured interviews and the pre-test, the customers did not experience other remarks regarding “*Server response time*” (system quality) or “*Sever connection time*” (system quality). The results from the descriptive statistics show that it takes an average of 1.35 seconds for a server to respond to a customer’s request and only takes 0.06 seconds for a page to download. From the unstructured interviews, the pre-test, and descriptive statistics it is hard to foretell which variable is the best predictor for system quality. As seen in section 3.1, “*Server response time*” (system quality) ends where “*Page download time*” (system quality) starts. Hence, it is possible to combine these two metrics by adding them together. Even though both variables measure another dimension of a website’s speed performance, it still can predict to what extent the full speed performance of the website functions properly in e-commerce. We call this new variable “*Speed performance*” (system quality) which we refer to as the total time a system needs to respond or load a page to a customers’ request (see Table 3 for the descriptive statistics).

Table 3 Descriptive statistics of “*Speed performance*” (system quality)

Descriptive statistics							
Construct	Variable	Min	Mean	Max	Median	Std. deviation	N
System quality	Speed performance	0.416	1.416	4.234	1.359	0.486	890

Second, we proposed “*Information find conversion rate*” (information quality), “*Search results viewed*” (information quality), and “*Search exit rate*” (information quality) as the measures for information quality. After careful consideration, we decided to omit “*Information find conversion rate*” (information quality) and “*Search results viewed*” (information quality) for further analysis. The

variable “*Search results viewed*” (information quality) indicates how many pages a customer visits after a search quest. We expected that an increase of “*Search results viewed*” (information quality) would enhance customer satisfaction because customers find the requested information relevant and therefore visit more web pages. However, the results from the unstructured interviews showed that customers view many pages after performing a search quest because they cannot find the desired information or product. Hence, this variable can have a double entendre and is therefore not a good measure for information quality. In addition, “*Information find conversion rate*” (information quality) and “*Search exit rate*” (information quality) show the direct effect of a customer’s ability to find the relevant and accurate information to make informed decisions before purchasing the product. Both variables contrast each other and show that a customer did find the products it was looking for or did not find the products it was looking for and leave the website after the search quest. Models 1 and 2 show the regression output of customer satisfaction in Table 4. The output shows that model 1 which includes “*Search exit rate*” (information quality) performs better than model 2 which includes “*Information find conversion rate*” (information quality) and has therefore a better model-fit (*Model 1: $R^2 = 23.4\%$, Adjusted $R^2 = 22.8\%$; Model 2: $R^2 = 22.2\%$, Adjusted $R^2 = 21.7\%$). Furthermore, models 3 and 4 in Table 4 perform practically the same with trust as its outcome variable (*Model 3: $R^2 = 4.5\%$, Adjusted $R^2 = 3.9\%$; Model 4: $R^2 = 4.5\%$, Adjusted $R^2 = 4.0\%$). In addition, when taking the direction and magnitude into account, we expect that the change in customer satisfaction is larger for a 1% improvement in “*Search exit rate*” (information quality) than for a 1% improvement of “*Information find conversion rate*” (information quality). Hence, we omit “*Information find conversion rate*” (information quality) and include “*Search exit rate*” (information quality) in the measurement model.**

Table 4 Multiple regression output models 1, 2, 3, and 4

DV = Customer satisfaction					
Concept		Model 1		Model 2	
		Estimate	P-value	Estimate	P-value
	Intercept	63.530	<0.001***	59.645	<0.001***
Trust	Bounce rate	-49.983	0.008**	-48.391	0.011*
Service quality	Session quality	-0.316	<0.001***	-0.277	0.002**
Information quality	Information find conversion rate			-0.004	0.629
Information quality	Search exit rate	-12.977	<0.001***		
User interface quality	Time spent per visit	0.022	<0.001***	0.024	<0.001***
User interface quality	Re-direction time	4.998	0.005**	4.920	0.006**
System quality	Speed performance	0.924	0.011*	0.929	0.011*
	R ²	0.234		0.222	
	Adjusted R ²	0.228		0.217	
	*** P - value <0.001				
	** P - value <0.01				
	* P - value <0.05				

Note: Customer satisfaction = Page dwell time

DV = Trust					
Concept		Model 3		Model 4	
		Estimate	P-value	Estimate	P-value
	Intercept	<0.001	<0.001***	0.013	<0.001***
Service quality	Session quality	<0.001	0.003**	<0.001	0.009**
Information quality	Information find conversion rate			<0.001	0.374
Information quality	Search exit rate	-0.003	0.568		
User interface quality	Time spent per visit	<-0.001	<0.001	<-0.001	<0.001***
User interface quality	Re-direction time	-0.005	0.088	-0.005	0.100
System quality	Speed performance	<0.001	0.233	<0.001	0.199
	R ²	0.045		0.045	
	Adjusted R ²	0.039		0.040	
	*** P - value <0.001				
	** P - value <0.01				
	* P - value <0.05				

Note: Trust = Bounce rate

Third, we proposed “*Time spent per visit*” (user interface quality) and “*Re-direction time*” (user interface quality) as the measures for user interface quality. After careful consideration we decided to include “*Re-direction time*” (user interface quality) and exclude “*Time spent per visit*” (user interface quality) in the measurement model. Table 5 presents the regression output for models 5, 6, 7, and 8. The output shows that model 5, which includes “*Time spent per visit*” (user interface quality), outperforms model 6 which includes “*Re-direction time*” (user interface quality) (*Model 5: $R^2 = 22.7\%$, Adjusted $R^2 = 22.2\%$; Model 6: $R^2 = 9.8\%$, Adjusted $R^2 = 9.3\%$). Furthermore, comparing models 7 and 8, than again the model which included “*Time spent per visit*” (user interface quality) has a better model-fit than the model which includes “*Re-direction time*” (user interface quality) (*Model 7: $R^2 = 4.1\%$, Adjusted $R^2 = 3.7\%$; Model 8: $R^2 = 1.4\%$, Adjusted $R^2 = 1.0\%$). Thus, based on model-fit, the variable “*Time spent per visit*” (user interface quality) is adding more value to the model than “*Re-direction time*” (user interface quality). However, “*Time spent per visit*” (user interface quality) could mean that a customer is very satisfied with the e-commerce and decides to stay longer on the website to purchase more products. Alternatively, the customer cannot find the product that it was looking for and need to re-direct before fetching their desired web page and is,**

therefore, a long time on the e-commerce. Hence, this measure can have a double entendre and should be combined with another measure to draw conclusions about the ease of navigation. In contrast, “*Re-direction time*” (user interface quality) shows if a customer navigates directly to the desired web page or if it needs re-directions. For this reason, this measure shows the ease of navigation so that customers end up on their desired page. In addition, we expect that the change in customer satisfaction is larger for a 1 second improvement in “*Re-direction time*” (user interface quality) than for a 1 second improvement in “*Time spent per visit*” (user interface quality). Thus, despite the deviation in model-fit, we include “*Re-direction time*” (user interface quality) and omit “*Time spent per visit*” (user interface quality) in the measurement model.

Finally, our considerations above lead to a redefined measurement in Figure 14. Before starting the analysis in chapter 4, 5, and 6 we checked the data for multiple assumptions in Appendix E.

Table 5 Multiple regression output models 5, 6, 7, and 8

DV = Customer satisfaction					
Concept		Model 5		Model 6	
		Estimate	P-value	Estimate	P-value
Trust	Intercept	65.558	<0.001***	75.759	<0.001***
	Bounce rate	-53.010	0.005**	-91.189	<0.001***
Service quality	Session quality	-0.360	<0.001***	-0.173	0.053
	Search exit rate	-12.950	<0.001***	-25.256	<0.001***
User interface quality	Time spent per visit	0.022	<0.001***		
User interface quality	Re-direction time			5.605	0.004**
System quality	Speed performance	0.710	0.045*	1.534	<0.001***
R ²		0.227		0.098	
Adjusted R ²		0.222		0.093	

*** P - value <0.001
 ** P - value <0.01
 * P - value <0.05

DV = Trust					
Concept		Model 7		Model 8	
		Estimate	P-value	Estimate	P-value
Service quality	Intercept	0.012	<0.001***	0.006	0.058
	Session quality	<0.001	<0.001***	<0.001	0.019*
Information quality	Search exit rate	-0.003	0.564	0.006	0.357
	Time spent per visit	<0.001	<0.001***		
User interface quality	Re-direction time			-0.006	0.060
System quality	Speed performance	0.001	0.111	<0.001	0.620
R ²		0.041		0.014	
Adjusted R ²		0.037		0.010	

*** P - value <0.001
 ** P - value <0.01
 * P - value <0.05

Note: Customer satisfaction = Page dwell time

Note: Trust = Bounce rate

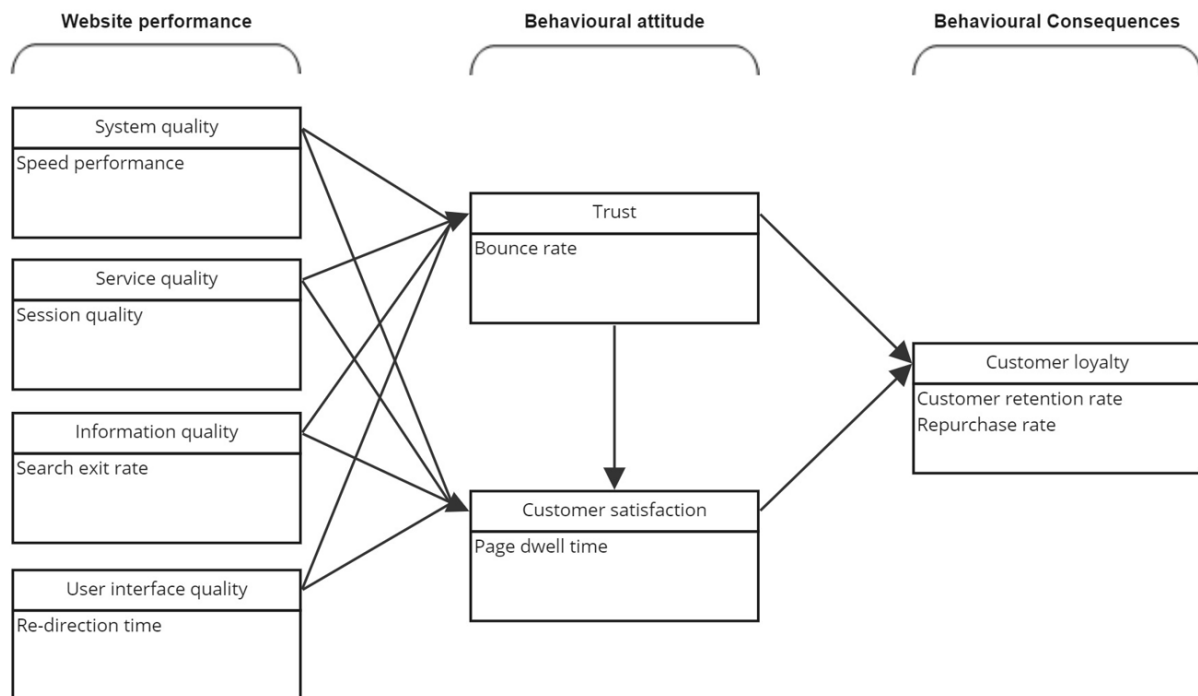


Figure 14 Redefined measurement model

3.5 Performance accuracy

The data set consists of a large sample size of 890 observations, whereby the total sample is split into training data and test data. The model is trained with training data, and the predictions are made with test data to ensure the performance accuracy of the model. The purpose of performance accuracy is to minimize the difference between the actual and fitted values, also known as the residual sum of

squares (RSS). The data set is randomly split into a training set of 713 rows of data (80%) and a test set with 177 (20%) rows of data. To check the out-of-sample model accuracy with the test set, this research used R squared (R^2), Mean Absolute Error (MAE), and Mean Absolute Prediction Error (MAPE).

In-sample model comparison. R^2 predicts how well the model fits the data. In other words, the metric predicts the proportion of variance in the dependent variable which is explained by the independent variables in the model. The R^2 has a value range between 0 and 1 and must be as high as possible. In addition, the value of R^2 depends on the unexplained variance in the model, for this reason, if the model has a low R^2 , it could be that the variables are harder to explain because there is more noise in the data. Hence, the R^2 should be interpreted carefully to make proper interpretations. Furthermore, the R^2 always increase if more variables are in the model, therefore, this research uses the Adjusted R^2 as well. The Adjusted R^2 prevents overfitting since it compares the different models with the same dependent variable but considers the different number of independent variables.

Out-of-sample model comparison. MAE predicts the average absolute difference between the predicted values and the actual values, while MAPE predicts the absolute difference between the predicted values and the actual values in percentage. For both values, the lower the value, the better the model can predict new data. In general MAPE is better understandable since it gives a percentage of the predicted model-fit which is easier to compare across different models. However, if the observed values of the dependent variable can be or are close to 0, then MAPE is not useful, and we will only use MAE for performance accuracy.

3.6 Mediation

We use the technique described by Baron and Kenny (1986) to test for mediation. Baron and Kenny (1986) believe that a mediation effect may exist when the total effect (c) is significant (see Figure 15). In recent years, many researches criticized this statement. Researchers believe that there is only one requirement for mediation effect and that is that the indirect effect ($a \times b$) is significant (see Figure 15)(Shrout & Bolger, 2002; Zhao *et al.*, 2010). Hence, we adapt the statement of Baron and Kenny (1986) in this research and argue that a mediation exist when $a \times b$ is significant.

In addition, if a mediating effect exists and the direct effect (c') completely disappears, there is a full mediating effect (see Figure 15). However, if c' still exists, but to a lesser extent, there is partial mediation (see Figure 15). More specifically, we classified five types of mediating effects by estimating the coefficients for a , b , and c . We distinguish the mediation effect by (1) *indirect-only mediation*. The indirect effect $a \times b$ is significant, but the total effect c is not. (2) *direct-only nonmediation*. The indirect effect $a \times b$ is not significant, but the total effect c is significant. (3) *no effect nonmediation*. The indirect effect $a \times b$ and the total effect c are not significant. (4) *Complementary mediation*. Both the indirect effect $a \times b$ and the total effect c are significant and the multiplication of $a \times b \times c$ is positive. (5) *Competitive mediation*. Both the indirect effect $a \times b$ and the total effect c are significant and the multiplication of $a \times b \times c$ is negative (Zhao *et al.*, 2010). Finally, we used the Sobel Z-test to support the mediating effect on its significance (Mackinnon *et al.*, 2007).

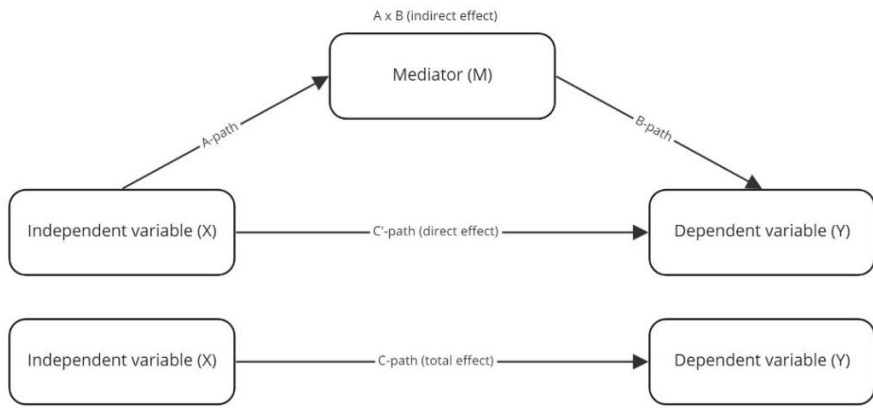


Figure 15 Mediating paths

4. Results trust

This chapter presents the results of the empirical study regarding the concept trust. We will first introduce the equation with the included variables. In addition, the chapter continues with the output of the multiple regression analysis and its performance accuracy.

4.1 Trust - Bounce rate

We present equation of “Bounce rate” (trust) in Equation 1. With the equation we test the hypotheses H1b, H2b, H3b, and H4b from the theoretical framework in section 2.2. The equation consists of four website performance variables “Speed performance” (system quality), “Session quality” (service quality), “Search exit rate” (information quality), and “Re-direction time” (user interface quality).

Equation 1 Bounce rate (Trust)

$$Bounce\ rate_i = \alpha + b_1Speed\ performance_i + b_2Session\ quality_i + b_3Search\ exit\ rate_i + b_4Re-direction\ time_i + \varepsilon_i$$

4.1.1 Output

The output of model 9 in Table 6 presents the estimation results and model-fit statistics (R^2 , adjusted R^2 , and F-statistic). Moreover, model 9 shows the relationship between website performance and trust. The results show that none of the variables are statistically significant on trust at the 5% significance level. In other words, there are no indications that website performance factors are related to trust.

Both variables, “Search exit rate” (information quality) and “Re-direction time” (user interface quality), have high standard errors ($b_3 = < 0.001, SE = 0.009$; $b_4 = -0.006, SE = 0.006$) and are therefore insignificant ($P = > 0.050$). The standard errors of “Speed performance” (system quality) and “Session quality” (service quality) are too small to judge on the significance level since the values are < 0.001 . For this reason, the estimates and standard errors are multiplied by 10.000 to increase the values ($b_1 = 3.768, SE = 8.182$; $b_2 = 3.832, SE = 2.064$). Again, the results show a higher standard error pertaining to the estimate; we thus can justify the insignificant results at the 5% significance level.

Furthermore, for this model, we used the F-statistic to check if the joint effect of all variables is significant. The results show insignificant results for the F-statistic ($F = 1.602, P = 0.172$), meaning that the variables do not individually predict well in the model. In addition, the results show a poor model-fit ($R^2 = 1.5\%, Adjusted\ R^2 = 1.0\%$), denoting that the model can explain 1.5% of the variance in the data.

Table 6 Multiple regression output model 9

DV = Trust		MODEL 9		
Concept		Estimate	Std. Error	P-value
	Intercept	0.006	0.005	0.186
System quality	Speed performance	<0.001	<0.001	0.645
Service quality	Session quality	<0.001	<0.001	0.064
Information quality	Search exit	<0.001	0.009	0.950
User interface quality	Re-direction time	-0.006	0.006	0.351
	R^2	0.015		
	Adjusted R^2	0.010		
	F-statistic	1.602		0.172
	*** P - value <0.001			
	** P - value <0.01			
	* P - value <0.05			

Note: Trust = Bounce rate

4.1.2 Performance accuracy

Table 7 shows different predictive performance accuracy measures for model 9 (R^2 and MAE). We built model 9 in Table 6 from the training data and used the test data to test the trained model. The measures compare the difference between the test and the training data to assure the model does not under- or overfit the data. The R^2 performs better on the train data and has a shrinkage of 0.9%. The small shrinkage value between the two data sets is proof for an accurate model-fit such that we can generalize it to a larger set of data. In addition, the results indicate that MAE performs equally well on the test and trainings data. Moreover, MAE is scale dependent. Hence, we observe MAE of 0.007% as an accurate predictor for forecasting future data since the data points of “*Bounce_Rate*” (trust) ranges between 0.06% and 0.42% (see Table 1 in section 3.2).

Table 7 Performance accuracy model 9

	R^2		MAE	
	Test data	Train data	Test data	Train data
Model 9	0.006	0.015	0.007	0.007

5. Results customer satisfaction

This chapter presents the results of the empirical study regarding the concept customer satisfaction. We will first introduce the equation. In addition, the chapter continues with the output of the multiple regression analyses, performance accuracy, and its mediation effects. At the end we present the conclusion and the validation.

5.1 Customer satisfaction - Page dwell time

We present the equation of “*Page dwell time*” (customer satisfaction) in Equation 2. With the equation we test the hypotheses H1a, H2a, H3a, and H4a from the theoretical framework in section 2.2. The equation consists of four website performance variables “*Speed performance*” (system quality), “*Session quality*” (service quality), “*Search exit rate*” (information quality), and “*Re-direction time*” (user interface quality) and behavioural attitude variable “*Bounce rate*” (trust).

Equation 2 Page dwell time (Customer satisfaction)

$$Page\ dwell\ time_i = \alpha + b_1Speed\ performance_i + b_2Session\ quality_i + b_3Search\ exit\ rate_i + b_4Re-direction\ time_i + b_5Bounce\ rate_i + \varepsilon_i$$

5.1.1 Output

The output of models 10 and 11 in Table 8 present the estimation results and model-fit statistics (R^2 and adjusted R^2). Moreover, model 10 shows the relationship between website performance and customer satisfaction. The results show that some of the variables are statistically significant on the dependent variable customer satisfaction at the 5% significance level. In other words, there are indications that website performance is partially related to customer satisfaction. In model 11 we include trust in the relationship between website performance and customer satisfaction.

Because signs of parameters do not differ across the two models, the remainder of this section solely interprets the findings of the full model (model 11 in Table 8). First, we find strong evidence for a positive significant relationship between “*Speed performance*” (system quality) and customer satisfaction ($b_1 = 1.780, SE = 0.507, P = < 0.001$). Meaning, that the change in time spent per web page, and thus customer satisfaction, is expected to increase by 1.747 seconds for a customer that needs to wait 1 second longer on the website to load or respond to their request, holding other variables in the model constant. Second, following the expectations we find a significant relationship between “*Search exit rate*” (information quality) and customer satisfaction ($b_3 = -22.686, SE = 5.343, P = < 0.001$). In other words, we expect a decrease in time spent per web page, and thus in customer satisfaction of 22.735 seconds if there is a 1% increase in the number of times a customer perform a query and then leave the website without clicking on a result, holding other variables in the model constant. Third, we observe for both variables “*Session quality*” (service quality) and “*Re-direction time*” (user interface quality) higher standard errors respectively to the estimates ($b_2 = -0.166, SE = 0.124$; $b_4 = 4.242, SE = 2.637$). Hence, the results show insignificant relationships ($P = > 0.050$) of “*Session quality*” (service quality) and “*Re-direction time*” (user interface quality) on customer satisfaction. Last, the results show a considerable negative effect between “*Bounce rate*” (trust) and customer satisfaction ($b_5 = -87.483, SE = 24.688, P = < 0.001$). By way of explanation, we expect a decrease in time spent per web page, and thus customer satisfaction of 87.688 seconds if there is a 1% increase in customers that leave the website without taking an action, holding other variables in the model constant.

In addition, we appraise for both models a poor model-fit. Compared with model 10 (*Adjusted $R^2 = 6.7\%$*), model 11 (*Adjusted $R^2 = 8.6\%$*) significantly improves the goodness-of-fit. The improvement indicates that trust adds value to the model.

Table 8 Multiple regression output models 10 and 11

DV = Customer satisfaction							
Concept		MODEL 10			MODEL 11		
		Estimate	Std. Error	P-value	Estimate	Std. Error	P-value
	Intercept	74.368	2.424	<0.001***	74.913	2.340	<0.001***
System quality	Speed performance	1.747	0.503	<0.001***	1.780	0.507	<0.001***
Service quality	Session quality	-0.199	0.126	0.115	-0.166	0.124	0.182
Information quality	Search exit rate	-22.735	5.464	<0.001***	-22.686	5.343	<0.001***
User interface quality	Re-direction time	4.740	2.826	0.094	4.242	2.637	0.108
Trust	Bounce rate				-87.483	24.688	<0.001***
	R ²	0.072			0.092		
	Adjusted R ²	0.067			0.086		
		*** P - value <0.001					
		** P - value <0.01					
		* P - value <0.05					

Note: Customer satisfaction = Page dwell time

5.1.2 Performance accuracy

Table 9 shows different predictive performance accuracy measures for models 10 and 11 (R², MAE, and MAPE). The R² performs for both models better on test data than training data. Generally, training data performs slightly better than test data because we train the model on training data. However, both differences (*difference model 10: R² = 1.9%; difference model 11: 2.1%*) are very small resulting in an accurate model-fit. In addition, we observe for both models small values regarding MAE and MAPE. Indicating that models 10 and 11 are accurate and have a good predictive power. Comparing both models, model 11 performs slightly better than model 10 and has the highest performance accuracy.

Table 9 Performance accuracy models 10 and 11

	R ²		MAE		MAPE	
	Test data	Train data	Test data	Train data	Test data	Train data
Model 10	0.091	0.072	4.496	3.948	0.064	0.056
Model 11	0.113	0.092	4.417	3.922	0.063	0.056

5.1.3 Mediation

The output of models 9, 10, and 11 show that trust does not mediate the effect between website performance and customer satisfaction. The results from model 10 show that “*Speed performance*” (system quality) and “*Search exit rate*” (information quality) have a statistically significant total effect on customer satisfaction ($b_1 = 1.747, P = < 0.001$; $b_3 = -22.735, P = < 0.001$) (see Table 8 and Table 10). Further, the results did not find a significant total effect of “*Session quality*” (service quality) and “*Re-direction time*” (user interface quality) on customer satisfaction which is not necessarily to get full mediation effect. However, the results from model 9 in Table 6 indicate that none of the website performance factors is significant on trust ($P \Rightarrow 0.050$). Hence, a mediation effect is not possible. Yet, against all expectations, the Sobel Z-test is significant for “*Session quality*” (service quality) and “*Re-direction time*” (user interface quality)(see Table 11). False significant outcomes of the Sobel Z-test can sometimes occur since the 95% intervals symmetrically around the mean estimates of the indirect effect. This suggests that the confidence interval's (CI) lower bound for the positive indirect effect is less than 2.5% of the real sample to the left. So the CI can improperly include zero (Zhao *et al.*, 2010). Since there are no significant effects between the needed relationships, the same conclusion holds that no mediating effect occurs.

Table 10 Mediation effect (M = Bounce rate (Trust), Y = Page dwell time (Customer satisfaction))

Construct	Independent variable	Total effect	Direct effect	Mediation effect	Mediation	Type
System quality	Speed performance	1.747***	1.780***	-0.033	False	Direct-only
Service quality	Session quality	-0.199	-0.166	0.365	False	No-effect
Information quality	Search exit rate	-22.735***	-22.686***	-0.049	False	Direct-only
User interface quality	Re-direction time	4.740	4.242	0.498	False	No-effect

*** P - value <0.001

** P - value <0.01

* P - value <0.05

Table 11 Sobel Z-test (M = Bounce rate (Trust), Y= Page dwell time (Customer satisfaction))

Construct	Independent variable	Z-value	P-value	Mediation
System quality	Speed performance	-1.084	0.278	False
Service quality	Session quality	-2.244	0.025*	True
Information quality	Search exit rate	0.394	0.693	False
User interface quality	Re-direction time	1.995	0.046*	True

*** P - value <0.001

** P - value <0.01

* P - value <0.05

6. Results customer loyalty

This chapter presents the empirical study's results regarding the concept customer loyalty. We discuss the results for each measure separately. First, we will introduce the equations in sections 6.1 and 6.2. In addition, both sections continues with the output of the multiple regression analyses, performance accuracy, and mediation effects.

6.1 Customer loyalty - Repurchase rate

We present the equation of “*Repurchase rate*” (customer loyalty) in Equation 3. With the equation we test the stated hypotheses H5a and H6 from the conceptual model (section 2.2). The equation consists of two behavioural attitude variables “*Bounce rate*” (trust) and “*Page dwell time*” (customer satisfaction) and four website performance variables “*Speed performance*” (system quality), “*Session quality*” (service quality), “*Search exit rate*” (information quality), and “*Re-direction time*” (user interface quality).

Equation 3 Repurchase rate (Customer loyalty)

$$\text{Repurchase rate}_i = \alpha + b_1 \text{Bounce rate}_i + b_2 \text{Page dwell time}_i + b_3 \text{Speed performance}_i + b_4 \text{Session quality}_i + b_5 \text{Search exit rate}_i + b_6 \text{Re-direction time}_i + \varepsilon_i$$

6.1.1 Output

The output of models 12, 13, 14 and 15 in Table 12 presents the estimation results and model-fit statistics (R^2 and adjusted R^2).

Model 12 shows the relationship of trust and customer satisfaction on customer loyalty. The results show that both variables are statistically significant on the dependent variable customer loyalty at the 5% significant level. In other words, there are indications that both behavioural outcome variables are related to customer loyalty. From the model we observe a higher standard error for “*Bounce rate*” (trust) ($b_1 = 67.822, SE = 34.162, P = < 0.048$). Yet, the P -value show a small significant result. In this situation, the P -value is the decisive factor, indicating that “*Bounce rate*” (trust) is borderline significant on customer loyalty causing to reject the null hypothesis. In addition, model 4 indicates a poor model-fit ($Adjusted R^2 = 2.2\%$), meaning that the model can only explain 2.2% of the variance in the data.

Model 13 shows the relationship between website performance and customer loyalty. The results show that all independent variables are statistically significant on customer loyalty at the 5% significance level, except for “*Search exit rate*” (information quality). In addition, the model-fit of model 13 ($Adjusted R^2 = 20.1\%$) shows a significant improvement compared to model 12. In other words, website performance factors are adding value to the model.

Model 14 is an extension of model 13 which includes trust in the model. Signs of parameters remain the same for the website performance factors compared to model 13. However, the significant effect of “*Bounce rate*” (trust) in model 12 changes and disappears in model 14 ($b_1 = 46.760, SE = 28.987, P = 0.107$). In addition, the model-fit improves with 0.40% ($Adjusted R^2 = 20.5\%$) compared to model 13.

Model 15 includes all variables in the model. The results show that some of the variables are statistically significant on the dependent variable customer loyalty at the 5% significance level. First, from the output we observe a negative statistically significant effect of “*Page dwell time*” (customer satisfaction) ($b_2 = -0.094, SE = 0.045, P = 0.036$). In other words, we expect that 1 second extra spent per web page, and thus in customer satisfaction, decreases the number of repurchases by 0.094%, holding other variables in the model constant. Second, “*Speed performance*” (system quality)

remains significant ($b_3 = -0.935, SE = 0.401, P = 0.020$) on customer loyalty compared to model 13 and 14. By way of explanation, we expect that 1 extra second for a customer who needs to wait on the web page to load or respond decreases the number of repurchases with 0.935%, holding other variables in the model constant. Third, we found strong evidence that “*Session quality*” (service quality) is positively significant related to customer loyalty ($b_4 = 1.102, SE = 0.125, P = < 0.001$). Each customer that scores 1 point higher on session quality is expected to increase the number of repurchases with 1.102%, holding other variables in the model constant. Fifth, the results show a considerable negative significant effect of “*Re-direction time*” (user interface quality) ($b_5 = -6.880, SE = 2.296, P = 0.003$). Hence, we expect that a customer who spends 1 extra second to re-direct to their initial visited web page decreases the number of repurchases by 6.880%. Last, both variables “*Bounce rate*” (trust) and “*Search exit rate*” (information quality) have high standard errors ($b_1 = 38.568, SE = 28.984$; $b_5 = -8.647, SE = 4.829$), therefore, remain insignificant in the final model ($P = > 0.050$). In addition, model 15 has the highest model-fit compared to the other models with a adjusted R^2 of 21,1%. The increase in model-fit is proof that the included variables are adding value to model and are explaining more of the variance in the data.

Table 12 Multiple regression output models 12, 13, 14, and 15

DV = Customer loyalty													
		MODEL 12			MODEL 13			MODEL 14			MODEL 15		
Concept		Estimate	Std. Error	P-value	Estimate	Std. Error	P-value	Estimate	Std. Error	P-value	Estimate	Std. Error	P-value
	Intercept	24.509	3.490	<0.001***	5.749	2.403	0.017*	5.458	2.384	0.024*	12.472	4.123	0.002**
Trust	Bounce rate	67.822	34.162	0.048*				46.760	28.987	0.107	38.568	28.984	0.184
Customer satisfaction	Page dwell time	-0.111	0.048	0.029*							-0.094	0.045	0.036*
System quality	Speed performance				-1.084	0.403	0.007**	-1.101	0.399	0.005**	-0.935	0.401	0.020*
Service quality	Session quality				1.135	0.122	<0.001***	1.117	0.124	<0.001***	1.102	0.125	<0.001***
Information quality	Search exit rate				-6.497	4.725	0.170	-6.523	4.719	0.167	-8.647	4.829	0.074
User interface quality	Re-direction time				-7.543	2.346	0.001**	-7.277	2.335	0.001**	-6.880	2.296	0.003**
	R ²	0.025			0.205			0.211			0.218		
	Adjusted R ²	0.022			0.201			0.205			0.211		
	*** P - value <0.001												
	** P - value <0.01												
	* P - value <0.05												

Note: Customer loyalty = Repurchase rate

6.1.2 Performance accuracy

Table 13 shows different predictive performance accuracy measures for models 12, 13, 14, and 15 (R^2 , MAE, and MAPE). The results show that the R^2 for each model is higher on the train data. Model 15 has the biggest deviation in R^2 and shows a shrinkage of 7.5% between test and training data. We observe the deviation not as a problem as long as the shrinkage of R^2 between the train and test data is 10% or less (Cannon *et al.*, 2018). Hence, models 12, 13, 14, and 15 have accurate model-fits. In addition, the results do not show alarming deviations in accuracy in test and training data for MAE and MAPE. However, the models 13, 14, and 15 show acceptable, but definitely no excellent prediction power. Model 12 shows the worst performing model ($MAE = 4.429, MAPE = 25.4\%$) which we observe as poor prediction power. The other models are acceptable since MAPE scores below 25% prediction accuracy (Cannon *et al.*, 2018). Comparing all models, model 13 has the highest performance accuracy.

Table 13 Performance accuracy models 12, 13, 14, and 15

	R ²		MAE		MAPE	
	Test data	Train data	Test data	Train data	Test data	Train data
Model 12	<0.001	0.025	4.429	4.272	0.254	0.243
Model 13	0.158	0.205	4.087	3.902	0.242	0.229
Model 14	0.152	0.211	4.092	3.891	0.243	0.229
Model 15	0.143	0.218	4.129	3.885	0.248	0.228

6.1.3 Mediation

The output of models 9, 13, 14 show that trust does not mediate the effect between website performance and customer loyalty. The results from model 13 show that “*Speed performance*” (system quality), “*Session quality*” (service quality), and “*Re-direction time*” (user interface quality) have a statistically significant total effect on customer loyalty ($b_3 = -1.084, P = < 0.007$; $b_4 = 1.135, P = < 0.001$; $b_6 = -7.543, P = < 0.001$) (see Table 12 and Table 14). Further, signs of parameters do not deviate between models 13 and 14 for “*Speed performance*” (system quality), “*Session quality*” (service quality), and “*Re-direction time*” (user interface quality), thus partial mediation is still possible. However, as concluded before in section 4.1.3, model 9 shows that there is no significant effect between the website performance factors and trust. Hence, we do not observe a mediation effect. Furthermore, as expected all Sobel Z-tests show insignificant results (see Table 15).

Table 14 Mediation effect (M = Bounce rate (Trust), Y = Repurchase rate (Customer loyalty))

Construct	Independent variable	Total effect	Direct effect	Mediation effect	Mediation	Type
System quality	Speed performance	-1.084**	-1.101**	0.017	False	Direct-only
Service quality	Session quality	1.135***	1.117***	0.018	False	Direct-only
Information quality	Search exit rate	-6.497	-6.523	0.026	False	No-effect
User interface quality	Re-direction time	-7.543**	-7.277**	-0.266	False	Direct-only

*** P - value <0.001

** P - value <0.01

* P - value <0.05

Table 15 Sobel Z-test (M = Bounce rate (Trust), Y = Repurchase rate (Customer loyalty))

Construct	Independent variable	Z-value	P-value	Mediation
System quality	Speed performance	1.061	0.289	False
Service quality	Session quality	1.759	0.079	False
Information quality	Search exit rate	-0.393	0.694	False
User interface quality	Re-direction time	-1.798	0.072	False

*** P - value <0.001

** P - value <0.01

* P - value <0.05

In addition, the output of models 11, 14, 15 shows evidence that customer satisfaction partially mediates the effect of website performance and trust on customer loyalty.

First, “*Page dwell time*” (customer satisfaction) partially mediates the effect between “*Speed performance*” (system quality) and customer loyalty. First, model 14 shows a significant total negative effect between “*Speed performance*” (system quality) and customer loyalty ($b_3 = -1.101, P = 0.005$) (see Table 12 and Table 16). Second, model 11 shows a significant effect between “*Speed performance*” (system quality) and “*Page dwell time*” (customer satisfaction) ($b_1 = 1.780, P = < 0.001$). Model 15 shows that “*Page dwell time*” (customer satisfaction) is significantly related to customer loyalty ($b_2 = -0.094, P = < 0.036$). Hence, there is a mediation effect. However, since the signs of parameters remain significant for “*Speed performance*” (system quality) in model 15 but to a lesser extent ($b_3 = -0.935, SE = 0.401, P = 0.020$), we observe partial mediation effect (*Mediation effect* = -0.166). Finally, the Sobel Z-test sustains the mediation effect with a significant outcome in Table 17.

Second, “*Page dwell time*” (customer satisfaction) fully mediates the effect between “*Search exit rate*” (information quality) and customer loyalty. Both models 14 and 15 show an insignificant effect between “*Search exit rate*” (information quality) and customer loyalty (*Model 16*: $b_5 = -6.523, P = 0.167$; *Model 17*: $b_5 = -8.647, P = 0.074$). As discussed above, model 15 shows a significant effect between “*Page dwell time*” (customer satisfaction) and customer loyalty. Hence, there is a full mediation effect (*Mediation effect* = 2.124). The Sobel Z-test supports the results with a significant outcome in Table 17.

Third, “Page dwell time” (customer satisfaction) fully mediates the effect between “Bounce rate” (trust) and customer loyalty. Both models 14 and 15 show an insignificant effect between “Bounce rate” (trust) and customer loyalty)(Model 16: $b_1 = 46.760, P = 0.107$; Model 17: $b_1 = 38.568, P = 0.184$). As discussed above, the results found a significant effect between “Page dwell time” (customer satisfaction) and customer loyalty in model 15. For this reason, we observe a full mediation effect ($Mediation\ effect = 8.192$). Furthermore, the Sobel Z-test is significant and therefore validates the mediation effect (see Table 17).

Last, “Page dwell time” (customer satisfaction) does not mediate the effect of “Session quality” (service quality) and “Re-direction time” (user interface quality) on customer loyalty, since both variables are not significant on “Page dwell time” (customer satisfaction) in model 11 (see Table 8).

Table 16 Mediation effect ($M = Page\ dwell\ time\ (Customer\ satisfaction), Y = Repurchase\ rate\ (Customer\ loyalty)$)

Construct	Independent variable	Total effect	Direct effect	Mediation effect	Mediation	Type
System quality	Speed performance	-1.101**	-0.935*	-0.166	Partial mediation	Complementary
Service quality	Session quality	1.117***	1.102***	0.015	False	Direct-only
Information quality	Search exit rate	-6.523	-8.647	2.124	Full mediation	Indirect-only
User interface quality	Re-direction time	-7.277**	-6.880**	-0.397	False	Direct-only
Trust	Bounce rate	46.760	38.568	8.192	Full mediation	Indirect-only

*** P - value <0.001

** P - value <0.01

* P - value <0.05

Table 17 Sobel Z-test ($M = Page\ dwell\ time\ (Customer\ satisfaction), Y = Repurchase\ rate\ (Customer\ loyalty)$)

Construct	Independent variable	Z-value	P-value	Mediation
System quality	Speed performance	-2.471	0.013*	True
Service quality	Session quality	1.194	0.233	False
Information quality	Search exit rate	3.191	0.001**	True
User interface quality	Re-direction time	-1.416	0.157	False
Trust	Bounce rate	2.282	0.022*	True

*** P - value <0.001

** P - value <0.01

* P - value <0.05

6.2 Customer loyalty – Customer retention rate

We present the equation of “Customer retention rate” (customer loyalty) in Equation 4. With the equation we test the stated hypotheses H5a and H6 from the conceptual model (section 2.2). The equation consists of two behavioural attitude variables “Bounce rate” (trust) and “Page dwell time” (customer satisfaction) and four website performance variables “Speed performance” (system quality), “Session quality” (service quality), “Search exit rate” (information quality), and “Re-direction time” (user interface quality).

Equation 4 Customer retention rate ($Customer\ loyalty$)

$$Customer\ retention\ rate_i = \alpha + b_1 Bounce\ rate_i + b_2 Page\ dwell\ time_i + b_3 Speed\ performance_i + b_4 Session\ quality_i + b_5 Search\ exit\ rate_i + b_6 Re-direction\ time_i + \varepsilon_i$$

6.2.1 Output

The output of models 16, 17, 18, and 19 in Table 18 present the estimation results and model-fit statistics (R^2 and adjusted R^2). Model 16 shows the relationship between behavioural attitudes and customer loyalty. Model 17 shows the relationship between website performance and customer loyalty. Moreover, Model 18 is an extension of model 17, which includes trust in model. Finally, model 19 includes all variables in the model.

Because signs of parameters do not differ across the two models, the remainder of this section solely interprets the findings of the full model (model 19). First, we find strong evidence for a positive

significant relationship between “Bounce rate” (trust) and customer loyalty ($b_1 = 37.051, SE = 12.173, P = 0.002$). In other words, we expect that 1% increase in customers that leave the website without taking an action improves customer retention with 37.051%, holding other variables in the model constant. Second, the results show a positive effect of “Session quality” (service quality) ($b_4 = 0.343, SE = 0.078, P = < 0.001$) at the 5% significance level. The results indicate that every 1 point increase in session quality is expected to improve the number of returning customers with 0.343%, holding other variables in the model constant. Third, the results show a considerable positive effect between “Search exit rate” (information quality) and customer loyalty ($b_5 = 10.511, SE = 2.452, P = < 0.001$). By explanation of, we expect an improvement of 10.511% in returning customers if there is a 1% increase in the number of times a customer perform a query and then leave the website without clicking on a result, holding other variables in the model constant. Last, the output shows that “Page dwell time” (customer satisfaction), “Speed performance” (system quality), and “Re-direction time” (user interface quality) show insignificant results ($P \Rightarrow 0.050$) and are therefore not related with customer loyalty.

Comparing all models together, the output of model 16 shows a poor model-fit ($R^2 = 2.1\%, Adjusted R^2 = 1.8\%$), denoting that the model can explain 1.8% of the variance in the data. In addition, model 17 significantly improves the goodness-of-fit with 7.5% which means that the website performance factors add value to the model ($R^2 = 9.9\%, Adjusted R^2 = 9.3\%$). Finally model 18 and 19 outperform the other two models and perform equally well on the data (Model 18: $Adjusted R^2 = 10.5\%$; Model 19: $Adjusted R^2 = 10.5\%$).

Table 18 Multiple regression output models 16, 17, 18, and 19

DV = Customer loyalty													
		MODEL 16			MODEL 17			MODEL 18			MODEL 19		
Concept		Estimate	Std. Error	P-value	Estimate	Std. Error	P-value	Estimate	Std. Error	P-value	Estimate	Std. Error	P-value
	Intercept	95.904	1.584	<0.001***	89.106	1.678	<0.001***	88.885	1.687	<0.001***	87.468	2.310	<0.001***
Trust	Bounce rate	44.153	12.625	<0.001***				35.397	11.852	0.002**	37.051	12.173	0.002**
Customer satisfaction	Page dwell time	-0.004	0.022	0.854							0.019	0.022	0.381
System quality	Speed performance				0.219	0.240	0.362	0.206	0.244	0.399	0.172	0.250	0.491
Service quality	Session quality				0.354	0.078	<0.001***	0.340	0.078	<0.001***	0.343	0.078	<0.001***
Information quality	Search exit rate				10.102	2.496	<0.001***	10.082	2.469	<0.001***	10.511	2.452	<0.001***
User interface quality	Re-direction time				-1.816	1.658	0.274	-1.615	1.753	0.357	-1.695	1.750	0.333
	R ²	0.021			0.099			0.112			0.113		
	Adjusted R ²	0.018			0.093			0.105			0.105		
	*** P - value <0.001												
	** P - value <0.01												
	* P - value <0.05												

Note: Customer loyalty = Customer retention rate

6.2.2 Performance accuracy

Table 19 shows different predictive performance accuracy measures for models 16, 17, 18, and 19 (R^2 , MAE, and MAPE). The results show that the R^2 for each model is higher on the train data. Model 18 the biggest deviation in R^2 and shows a shrinkage of 6.9% between test and training data. Hence, we observe for every model an accurate model-fit and we thus can proceed to analyse the further measures. MAE and MAPE show accurate and high predictive power for all models. Comparing all models, model 19 has the highest performance accuracy.

Table 19 Performance accuracy models 16, 17, 18, and 19

	R ²		MAE		MAPE	
	Test data	Train data	Test data	Train data	Test data	Train data
Model 16	0.003	0.021	1.891	1.799	0.020	0.019
Model 17	0.045	0.099	1.813	1.708	0.019	0.018
Model 18	0.043	0.112	1.815	1.697	0.019	0.018
Model 19	0.048	0.113	1.805	1.698	0.019	0.018

6.2.3 Mediation

The output of models 9, 17, and 18 show that trust does not mediate the effect between website performance and customer loyalty. The results from model 19 show that “*Session quality*” (service quality) and “*Search exit rate*” (information quality) have a statistically significant effect on customer loyalty ($b_4 = 0.354, P = < 0.001$; $b_5 = 10.102, P = < 0.001$) (see Table 18 and Table 20). Further, signs of parameters do not deviate between model 17 and 18 for “*Session quality*” (service quality) and “*Search exit rate*” (information quality), thus partial mediation is still possible. However, as concluded before in section 4.1.3, model 9 shows that there is no significant effect between the website performance factors and trust. Hence, we do not observe a mediation effect. Yet, against all expectations, the Sobel Z-test is significant for “*Session quality*” (service quality) and “*Re-direction time*” (user interface quality)(see Table 21). However, since there are no significant effects between the needed relationships, the same conclusion holds that no mediating effect occurs.

Table 20 Mediation effect ($M = \text{Bounce rate (Trust)}$, $Y = \text{Customer retention rate (Customer loyalty)}$)

Construct	Independent variable	Total effect	Direct effect	Mediation effect	Mediation	Type
System quality	Speed performance	0.219	0.206	0.013	False	No-effect
Service quality	Session quality	0.354***	0.340***	0.014	False	Direct-only
Information quality	Search exit rate	10.102***	10.082***	0.020	False	Direct-only
User interface quality	Re-direction time	-1.816	-1.615	-0.201	False	No-effect

*** P - value <0.001

** P - value <0.01

* P - value <0.05

Table 21 Sobel Z-test ($M = \text{Bounce rate (Trust)}$, $Y = \text{Customer retention rate (Customer loyalty)}$)

Construct	Independent variable	Z-value	P-value	Mediation
System quality	Speed performance	1.076	0.281	False
Service quality	Session quality	2.113	0.035*	True
Information quality	Search exit rate	-0.394	0.694	False
User interface quality	Re-direction time	-1.959	0.050*	True

*** P - value <0.001

** P - value <0.01

* P - value <0.05

The output of models 11, 18, and 19 show that customer satisfaction does not mediate the effect between website performance and trust on customer loyalty. The results from model 11 show that “*Speed performance*” (system quality), “*Search exit rate*” (information quality), and “*Bounce rate*” (trust) have a significant effect on customer satisfaction ($b_1 = 1.780, P = < 0.001$; $b_3 = -22.686, P = < 0.001$; $b_5 = -87.483, P = < 0.001$)(see Table 8 and Table 22). However, “*Page dwell time*” (customer satisfaction) is not significant on customer loyalty in model 19 ($b_2 = 0.019, P = 0.381$). Hence, a mediation effect is not possible. Furthermore, all Sobel Z-tests show insignificant results (see Table 23).

Table 22 Mediation effect ($M = \text{Page dwell time (Customer satisfaction)}$, $Y = \text{Customer retention rate (Customer loyalty)}$)

Construct	Independent variable	Total effect	Direct effect	Mediation effect	Mediation	Type
System quality	Speed performance	0.206	0.172	0.034	False	No-effect
Service quality	Session quality	0.340***	0.343***	-0.003	False	Direct-only
Information quality	Search exit rate	10.082***	10.511***	-0.429	False	Direct-only
User interface quality	Re-direction time	-1.615	-1.695	0.080	False	No-effect
Trust	Bounce rate	35.397**	37.051**	-1.654	False	Direct-only

*** P - value <0.001

** P - value <0.01

* P - value <0.05

Table 23 Sobel Z-test (M = Page dwell time (Customer satisfaction), Y = Customer retention rate (Customer loyalty))

Construct	Independent variable	Z-value	P-value	Mediation
System quality	Speed performance	-0.994	0.320	False
Service quality	Session quality	0.435	0.663	False
Information quality	Search exit rate	0.084	0.933	False
User interface quality	Re-direction time	-0.546	0.585	False
Trust	Bounce rate	0.208	0.835	False

*** P - value <0.001

** P - value <0.01

* P - value <0.05

7. Discussion

This research addresses the unexplored aspects of website performance (system quality, service quality, information quality, and user interface quality) on customers' behavioural attitudes (trust and customer satisfaction) and its consequences (customer loyalty) in B2B e-commerce. Figure 16 and Figure 17 provide a graphic presentation of the results of the tested hypotheses. Our results did support only two hypotheses (see Table 24). We found that expected customer behaviour deviates from real-time customer behaviour which results in unexpected new findings (see Table 25). In the next section we will discuss our theoretical contribution to the B2B e-commerce literature, followed by the practical implications. Finally, we discuss the limitations and future research opportunities.

Table 24 Summary hypotheses

Hypotheses	Supported
<i>H1b: There is a significant positive relationship between system quality and trust in B2B e-commerce</i>	Not supported
<i>H2b: There is a significant positive relationship between service quality and trust in B2B e-commerce</i>	Not supported
<i>H3b: There is a significant positive relationship between information quality and trust in B2B e-commerce</i>	Not supported
<i>H4b: There is a significant positive relationship between user interface quality and trust in B2B e-commerce</i>	Not supported
<i>H1a: There is a significant positive relationship between system quality and customer satisfaction in B2B e-commerce</i>	Not supported
<i>H2a: There is a significant positive relationship between service quality and customer satisfaction in B2B e-commerce</i>	Not supported
<i>H3a: There is a significant positive relationship between information quality and customer satisfaction in B2B e-commerce</i>	Supported
<i>H4a: There is a significant positive relationship between user interface quality and customer satisfaction in B2B e-commerce</i>	Not supported
<i>H5a: There is a significant positive relationship between trust and customer loyalty in B2B e-commerce</i>	Not supported
<i>H5b: There is a significant positive relationship between trust and customer satisfaction in B2B e-commerce</i>	Supported
<i>H6: There is a significant positive relationship between customer satisfaction and customer loyalty in B2B e-commerce</i>	Not supported

Table 25 New findings

New findings	Supported
<i>There is a significant positive relationship between high "Speed performance" (system quality) and high customer satisfaction in B2B e-commerce</i>	Supported
<i>There is a significant positive relationship between high "Bounce rate" (trust) and high customer loyalty in B2B e-commerce</i>	Partially supported
<i>There is a significant negative relationship between high "Speed performance" (system quality) and low customer loyalty in B2B e-commerce</i>	Partially supported
<i>There is a significant positive relationship between high "Session quality" (service quality) and high customer loyalty in B2B e-commerce</i>	Supported
<i>There is a significant negative relationship between high "Re-direction time" (user interface quality) and low customer loyalty in B2B e-commerce</i>	Partially supported
<i>There is a significant negative relationship between high "Search exit rate" (information quality) and low customer loyalty in B2B e-commerce</i>	Partially supported

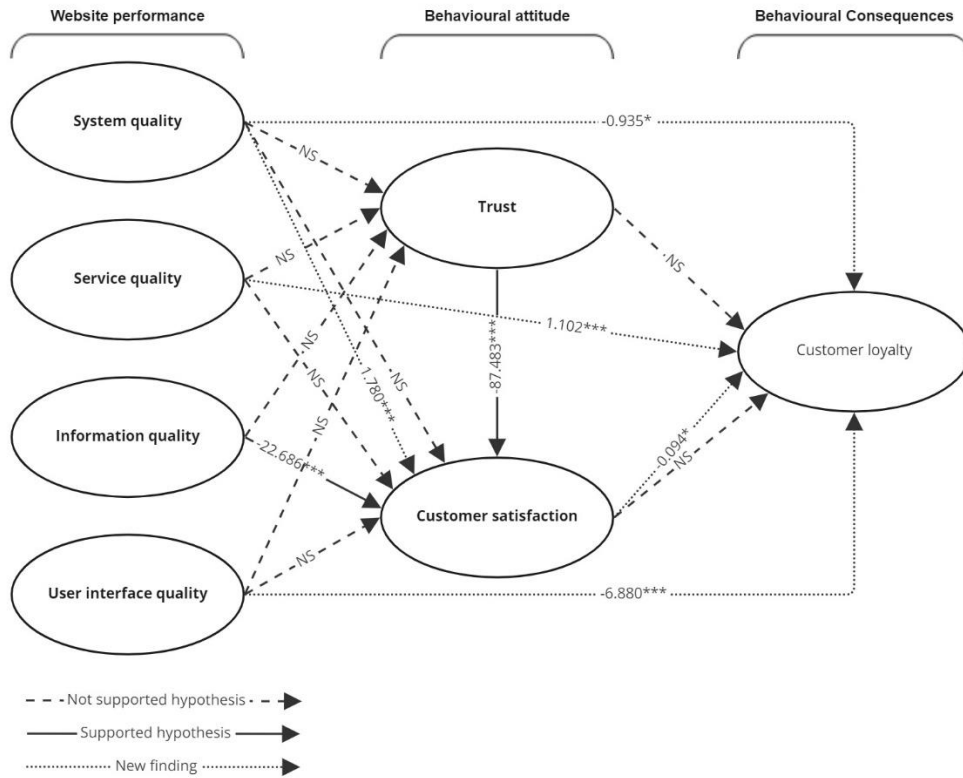


Figure 16 Hypothesized model. Notes: Customer loyalty = Repurchase rate; Supported hypotheses and new findings indicate the parameter estimates with the significance level: ***P-value<0.001, **P-value<0.01, *P-value<0.05.

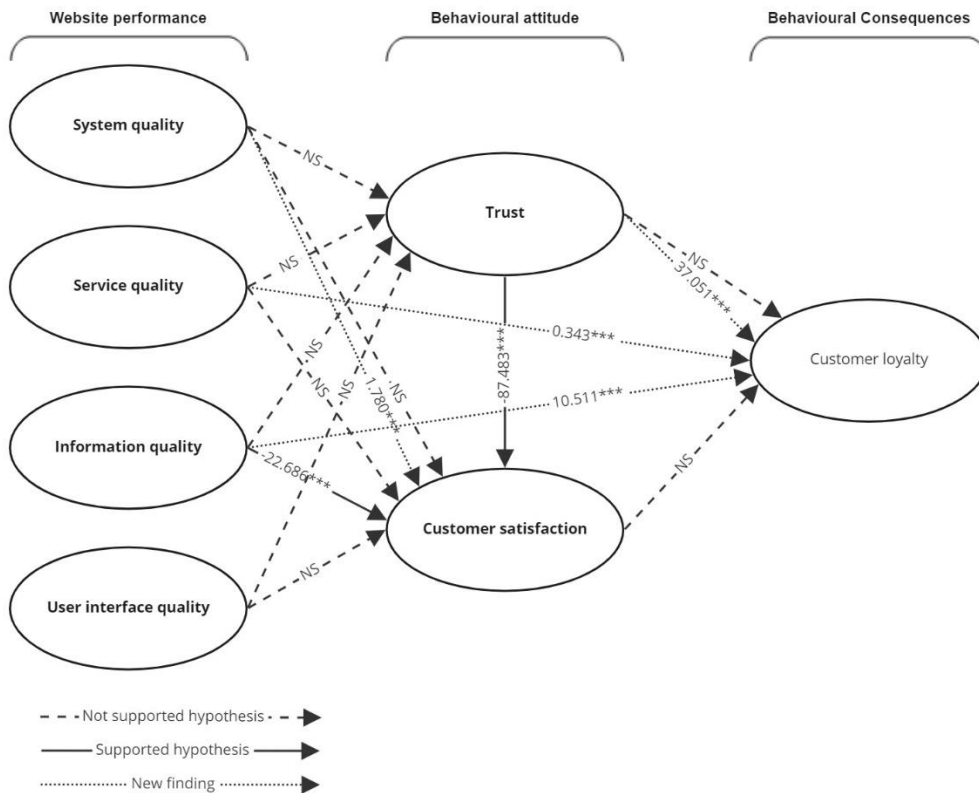


Figure 17 Hypothesized model. Notes: Customer loyalty = Customer retention rate; Supported hypotheses and new findings indicate the parameter estimates with the significance level: ***P-value<0.001, **P-value<0.01, *P-value<0.05

7.1 Theoretical implications

Our work contributes to the B2B e-commerce marketing literature.

First, our research finds new direct relationships between website performance factors (system quality, service quality, information quality, and user interface quality) and customer loyalty which can point out as yet undiscovered literature. Our research did not test specific theories when finding these new relationships, but the results did broaden our research scope (Golder *et al.*, 2022). Our research found that service quality positively relates to customer loyalty. In other words, the results indicate that “*session quality*” (service quality) directly increases the number of returning customers and repurchases. Customers who experiences a good functioning website will go through the e-commerce more easily during their session, and thus, are more likely to come back and order products from the e-commerce. If customers service quality is not performing adequately than this could indicate that something in the e-commerce is not working properly what prevents customers from using the e-commerce for its real purposes (ordering products). In addition, our results showed that information quality positively influences customer loyalty. By explanation, the results indicate that even though customers could not find their product in one session, they still intend to return to the webshop. B2B e-commerce customers are generally more dependent on a limited number of providers (Glynn, 2012). Hence, customers do not always have a choice to switch to another provider to order their products which explains why they still intend to come back even though they cannot find their products. Nevertheless, we can also argue that the e-commerce, in this case, generally provides enough information for customers to find their desired product since the maximum of customers leaving e-commerce after performing a search quest is 0.42%. Hence, customers still intend to return to e-commerce. Customers in our semi-structured interviews indicated that they are satisfied with the information provided by e-commerce. A customer explained, “*I like to use the MATER webshop. The webshop of MATER is unique because it provides additional information which other providers do not deliver. And with this information, I am sure I have the right product in my order basket*”. Furthermore, our results indicated that user interface quality negatively affects customer loyalty. Meaning, that customers who cannot navigate easily and efficiently in e-commerce decreases the number of repurchases. We surmise that customers who cannot navigate easily to their desired product tend to stop and switch to another provider. Customers indicated in the semi-structured interviews that they are very time sensitive in B2B e-commerce, which could explain why user interface quality considerably impacts customer loyalty. A customer mentioned, “*Sometimes it is hard to navigate to the right page, especially in the main group navigation. If it takes me too long, then I will stop and try it at *competitors name**”.

Second, by demonstrating that we did not find any significant results that website performance factors (system quality, service quality, information quality, and user interface quality) are related to trust. Hence, we argue against prior B2B and B2C e-commerce research, which found a significant positive effect of website performance on trust (Eid, 2011; Hsu *et al.*, 2013; Zhou & Zhang, 2009). The research of Singal and Kohli (2014) indicated that a website with a “*Bounce rate*” (trust) higher than 40% has distrusted customers and needs attention in its website's performance. However, our findings found an average “*Bounce rate*” (trust) of 0.20%. In B2B, there are generally fewer providers than in a B2C environment, and they often have an already-developed relationship with the e-commerce provider since they buy products more regularly (Glynn, 2012). Moreover, in a B2B e-commerce environment, companies often only let customers access information about the products and prices with an account. This is necessary since the website of B2B e-commerce includes sensitive information which the competition could use (Gu *et al.*, 2021). When (new) customers request an account on the e-commerce, they are prepared to enter into a partnership with the provider. In other words, we expect (new) e-commerce users to trust the brand enough to meet their needs when using the e-

commerce website. Moreover, our study also addresses in the semi-structured interviews that customers would leave the website to (1) switch to another computer for better depiction, (2) help a customer at the counter, or (3) solve an emergency. By explanation, the reasons why a customer would leave the website without taking action are not trust-related. Nevertheless, from the semi-structured interviews, it emerged that customers do have some trust-related concerns. A customer mentioned, "*hence, I sometimes wonder where the price for MATER products comes from*". The customer indicates that the price of the webshop is often high and, therefore, questions whether the e-commerce provider uses a fair profit margin on their products. In addition, as mentioned before, the automotive industry is very time sensitive. Meaning, in this case, every minute a truck is not on the road due to maintenance will cost money. For this reason, the delivery time of products is vital. A customer explained, "*the timing of the products is key for efficiency and planning*". Hence, we emphasized that trust might be more important in B2B e-commerce regarding other aspects, such as selling the product at a fair price and delivering the products on time. We will discuss these findings for future research in section 7.3.

Third, our study argues with prior research that responsive websites are essential for e-commerce businesses, increasing customer satisfaction (Chen *et al.*, 2013; Ghobakhloo *et al.*, 2015; Hsu *et al.*, 2013; Wang, 2009; Yang & Ding, 2009). In contrast, our results indicate that the worse a website system performs, the more satisfied the customers are. In other words, customers subconsciously use the extra time for a page to respond and load to consider multiple solutions or choices in their decision-making process for their desired product. Our findings are in line with the study of Selvidge *et al.* (2002), which found that web pages with longer wait durations positively enhance search performance and task completion for customers who complete high cognitive tasks. A customer explained in the semi-structured interviews that "*the MATER web shop provides extensive information that I need to find the right part number*". By explanation, the customer indicates that different types of information are necessary to find the desired product. Many truck parts differ per truck type, for which many questions arise during a search quest (e.g., "*What size does this part need to be? What is the part number? What brand of the part is required?*"). A customer explained, "*it is sometimes a difficult search process with a lot of thinking involved*". Hence, we argue that customers perform highly cognitive tasks in B2B e-commerce, resulting in a significant positive relationship between poor system quality and customer satisfaction, causing enhanced search performance and task completion. In addition, we found a new relationship that system quality is indirectly (mediated by customer satisfaction) and directly negatively related to customer loyalty. Moreover, we found a direct negative relationship between customer satisfaction and customer loyalty. Our findings suggest that something prevents customers from making a purchase within these relationships. With our current scope of analyses we cannot identify the actual reason. However, we conjecture that there is another determinant that might influence both of these negative relationships on customer loyalty (Zhou *et al.*, 2010). In our semi-structured interviews, we observed that customers drop out because of the price. The gross of the customers are price sensitive and try to purchase their products for the lowest price possible. A customer explained, "*the MATER webshop provides extensive information that I need to find the right part number and based on that number, I can look up the same product at the competition for a lower price*". We surmise that price might influence the negative relationship between customer satisfaction and customer loyalty. More specifically, we suspect that customers use the website as an information source but do not make an actual purchase because of the price. Hence, both of these relationships are opportunities for further research, which we discuss in section 7.3.

Fourth, we complement the extant marketing literature by finding a significant negative relationship between information quality and customer satisfaction (Ghobakhloo *et al.*, 2015; Hsu *et al.*, 2013; Rasli *et al.*, 2018; Wang, 2009; Zhou & Zhang, 2009). The results from this research and prior

research do not agree to be positively related to the outcome variable, yet they still agree in the conclusion. In this research, a high *“Search exit rate”* (information quality) indicates poor information quality leading to decreased customer satisfaction. In addition, we also found that customer satisfaction positively mediates poor information quality on customer loyalty. In other words, our results indicate that customers who cannot find their product indirectly increase the number of repurchases. As mentioned before, within our semi-structured interviews, we found that customers in B2B e-commerce are very time sensitive, meaning they do not want to spend too much time on the website searching for their desired product. A customer explained, *“I need to act quickly, and I need my products quickly, but often I leave the website, and I will call the dealer to fix my problems, and he will order my products for me. This is a piece of service I expect, and it unburdens me”*. Hence, we argue that customers who cannot find their desired product on e-commerce orders via traditional sales channels (e.g., cell phone). Hence, the e-commerce provider orders the product for the customer resulting in a repurchase, causing poor information quality indirectly enhances the number of repurchases.

7.2 Managerial implications

Our findings also contribute with implications for managers in B2B e-commerce. B2B e-commerce providers should understand the needs of their customers to be able to provide an effective e-commerce. The findings from this research can support a manager by monitoring the web performance and customer behaviour real-time. In other words, we translate the founded relationships and effect sizes into key performance indicators (KPI). KPI's are metrics which measures the performance over time for a specific objective. Within this research we established one category of KPI's, namely *“customer consequences”*. This category serves as the primary indicator of the level of success in attaining a loyal customer base. We used different sets of metrics that present single variables that get measured (e.g., *“speed performance”* (system quality)), whereas the KPI's are unique metrics identified as a central assessment for customer loyalty (e.g., *“Repurchase rate”* (customer loyalty)). KPI's help managers to get an overview of the real-time performance which helps to define, act, and react on the marketing strategy. The metrics used for the website performance are the *“business as usual”* measures that still are important measures but are not critical measures the company need to achieve. From our research managers can use the KPI's *“Repurchase rate”* and *“Customer retention rate”* to track the loyalty level in the e-commerce and from there see which metric is performing poorly, acceptable, or excellent.

First, from our research we find that managers should focus to improve information quality by means of delivering the information via the e-commerce to the customer such that they can easily find the product and buy it. This finding was supported by previous studies that accurate and relevant information in e-commerce will increase customer satisfaction, that will lead to less careful and more confident decision-making process, which results in the initial purchase (Eid, 2011; Khristianto *et al.*, 2012). It shows that the online environment is striving to find their products easily and timely, and that this will indirectly enhances customer loyalty. As such, our research expects that every 1% increase in times a customer performs a query and then leaves the website without clicking on a result will decrease the time spent per web page, and thus customer satisfaction with 22.686 seconds, and indirectly improves the number of repurchases with 2.357%.

Second, our findings suggest that managers should stimulate to provide excellent service quality. Managers should enhance the performance of the e-commerce while using the website, placing an order, and making a transaction (Lin & Lin, 2006; Vida & Jonas, 2011). Our findings indicate that service quality stimulates customer loyalty. More specifically, we expect that every point extra scored on *“Session quality”* (service quality) will improve the number of repurchases with 1.102% and

the number of returning customers with 0.343%. Previous studies suggested that e-commerce businesses that provide good service quality to their customers based on their preferences may achieve a competitive advantage in securing satisfied customers who have future purchase intentions. When online e-commerce customers believe their needs have been met well, the service quality is considered good (Lin and Lin, 2006; Vida and Jonas, 2011).

Third, we found that managers should spent time in developing user interface of the e-commerce webshop. Our findings expect that a customer who spends 1 extra second to re-direct to their initial visited web page decreases the number of repurchases by 6.880%. In other words, managers should design an interface such that the customer can navigate easily to their desired product, order basket, and payment page. Literature suggests that managers should spent time to develop a mental map to see how various pages relate to each other with multiple navigation tools such as menus, frames, buttons, directories, site maps, subject trees, a search engine, image maps, and colors (Clyde, 2000). Our research implicates that it is crucial to have excellent interface quality to enhance the loyal customer base in the B2B e-commerce.

7.3 Limitations and future research

Our study has provided new insights in B2B e-commerce environment, but has a number of limitations that create several opportunities to explore for further research.

First, our study limits in setting benchmarks and norms for metrics to interpret the performance as poor, acceptable, or excellent. Consequently it is challenging to interpret and set targets for this metrics, and so managers need to make guesses when they set targets for development. The B2C theory has certain standards which they use as a tipping point before performance indicators requires attention. We observed in our analyses in the pre-test that the time to communicate the page’s value proportion, and thus time spent per web page (customer satisfaction) is higher in B2B compared to B2C. Hence, we suspect that the probability curve will flatten at a later moment in the time frame. In other words, in B2B e-commerce the customer needs more time to evaluate if the web page is informative or not (see Figure 18). In light of our pre-analysis, future research should explore how to judge and interpret metric’s as poor, acceptable, or excellent in B2B e-commerce environment. Moreover, research should explore to what extent the standards differ in B2B to B2C.

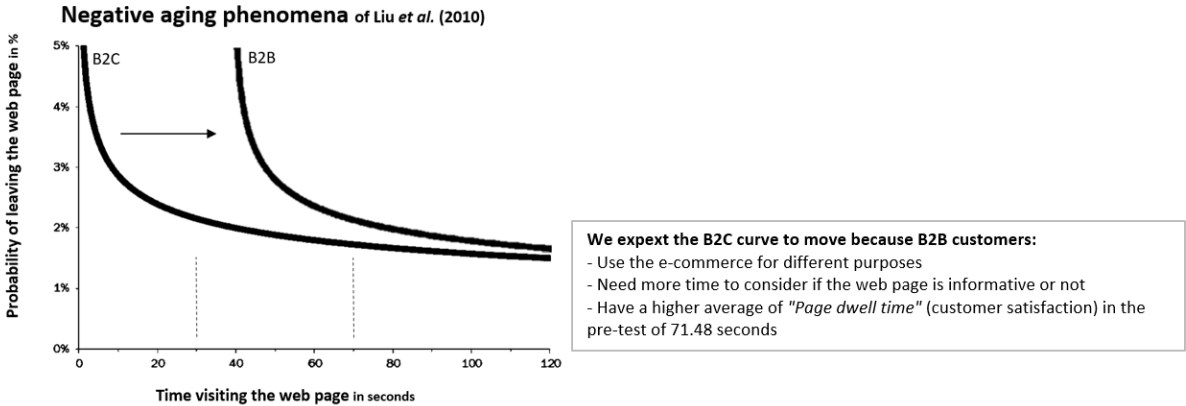


Figure 18 Future research: Negative aging phenomena B2C versus B2B

Second, our data was limited to a certain maximum for each metric. It would be interesting to explore if system quality keeps positively related to customer satisfaction if the maximum value of "Speed performance" (system quality) increases. We suspect the positive linear effect can be

maintained to a certain maximum. Customers in the B2B e-commerce use the time a web page needs to respond or load to their request to think about what specifications they are looking for their desired product. However, if customers need to wait too long, we expect this effect to decrease satisfaction. In addition, we criticize the positive linear relationship between “Search exit rate” (information quality) and the number of returning customers. We surmise that there is a significant positive relationship because customers experience almost no discomfort when looking for information because the number of dropouts after performing a search quest is a maximum of 0.42%. Hence, customers are intended to return to e-commerce. However, we expect that customers are less likely to return to e-commerce if they drop out more often. In other words, future research should explore if metrics reach other maximums it causes to change the positive linear effect into a parabolic effect which changes the direction of the estimate (see Figure 19).

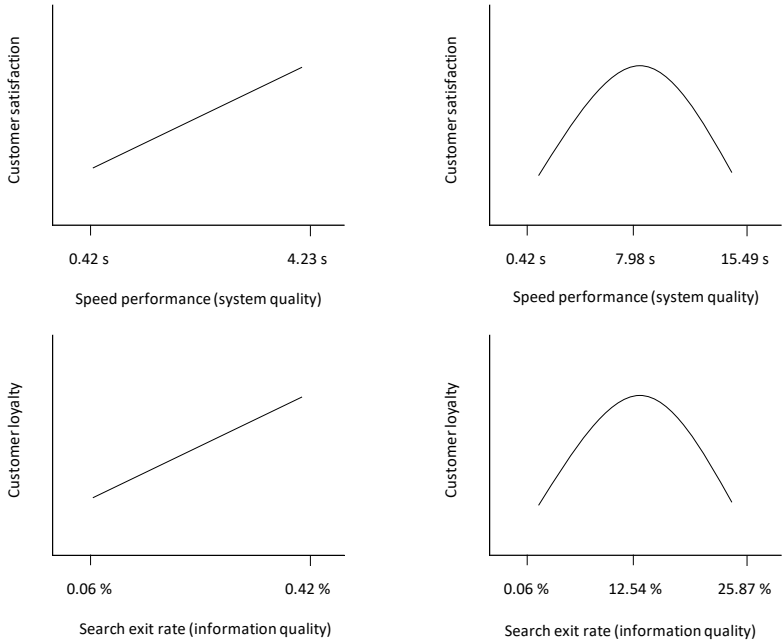


Figure 19 Future research: Linear effect versus parabolic effect

Third, our data set limited our research to take other possible omitted variables into account to explain relationships. From our research, we are still determining two relationships on customer loyalty. We expect that some omitted variables should be included in our theoretical framework (Zhou *et al.*, 2010). First, we must explain the negative relationship between customer satisfaction and loyalty. We need to understand why satisfied customers would not repurchase from the e-commerce. As discussed in section 7.1, we conjecture that price is an omitted mediator that might influence the negative relationship between customer satisfaction and customer loyalty, which deters customers from making a purchase. Future research should take this variable into account when testing this relationship. Second, we must explain the complementary mediated relationship between system quality and customer loyalty. Within this relationship, it is odd that system quality is indirectly (mediated by customer satisfaction) and directly negatively related to the number of repurchases. Future research should explore what is causing the relationship to be negative. Researchers could, for example, conduct an experiment to test this relationship in a controlled setting. The experiment could randomly assign participants among similar B2B e-commerce webshops. Each participant would be assigned a task to perform a search quest with similar difficulty completion levels. Moreover, each task should control the lengths in “Speed performance” (speed performance) and measure behavioural

attitudes and consequences, "*Page dwell time*" (customer satisfaction) and "*Repurchase rate*" (customer loyalty) in order to see if something might change in the relationships we found on customer satisfaction and customer loyalty if the maximum in "*Speed performance*" (system quality) exceeds the 4 seconds. Next, each participant could be questioned by a semi-structured interview to discover why the negative relationship holds and hopefully uncover new omitted variables. After that, researchers could complete the framework and test it again.

Fourth, our data aggregated e-commerce users per hour, which allowed us to uncover average behavioural patterns. However, this limited us to looking at individual-level data. Future research with individual-level data could segment customers into different groups. For example, suppose we segment customers at different loyalty levels (e.g., committed buyer, habitual buyer, or price-sensitive buyer). In that case, we can investigate whether customers who are less loyal have a different behavioural pattern (e.g., drop out earlier if the website performs poorly) compared to very loyal customers. Moreover, individual-level data could be combined with other types of data such as website feedback (e.g., five point Likert-scale: "*how satisfied was I during my visit*" or leaving a feedback note). The combination of individual-level qualitative and quantitative website behaviour provides a more complete picture of customer behaviour and attitude during their visit.

Finally, in light of our findings it is interesting to investigate trust in another context. In this research we defined trust as the confidence a customer has in the brand and in meeting their needs. However, the results showed no evidence that by means of definition and measurement that trust has an evident impact in our B2B e-commerce research context. However, the results from the semi-structured interviews showed that customers do have some trust related concerns regarding maintaining a fair profit margin and delivering products in time which should be explored in future B2B e-commerce research.

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Appendices

Appendix A

Variables used in the measurement model.

Table 26 Variable definitions

No.	Construct	Variabele	Definition	Scale	Reference
1	Customer loyalty	Repurchase rate	$\frac{\text{Returning visitors who bought a product}}{\text{Total number of unique vistors who bought a product}} * 100\%$	Ratio	Keiningham et al., 2007; Lemon & Verhoef, 2016; Reynold & Arnold, 2000; Rauyruen & Miller, 2007
2	Customer loyalty	Customer retention rate	<i>A e-commerce user who has already been to your website in a predetermined timeframe and has initiated another session using the same browser on the same device</i>	Ratio	Lemon & Verhoef, 2016; Keiningham et al., 2007; Bolton et al., 2004; Reynold & Arnold, 2000; Gupta & Zeithaml, 2006
3	Customer satisfaction	Page dwell time	$\frac{\text{Total time on page}}{(\text{Total page views} - \text{Total exits})}$	Ratio	Fox et al., 2005; Hassan et al., 2011; Liu et al., 2010
4	Trust	Bounce rate	<i>The percentage of visitors that leave a webpage without taking an action</i>	Ratio	Singal & Kohli, 2014
5	System quality	Server response time	<i>The average time in seconds the site's server takes to respond to the users request</i>	Ratio	Roslow et al., 1992; Schleifer & Amick, 1989
6	System quality	Server connection time	<i>The time from connecting till it receives the first byte of infromation</i>	Ratio	Based on: Schleifer and Amick, 1989; Weinberg, 2000
7	System quality	Page download time	<i>The time neede for a page to load the content to the page is viewed</i>	Ratio	Weinberg, 2000; Dellaert and Kahn, 1999
8	Service quality	Session quality	<i>A proximity of how close the sessions were to transacting, ranging from 1 to 100</i>	Ratio	Based on: Lin & Lin, 2006; Vida & Jonas, 2011
9	Information quality	Information find conversion rate	$\frac{\text{Total number of visits to the goal page}}{\text{Total visits with site search}}$	Ratio	Singal & Kohli, 2014
10	Information quality	Search results	$\frac{\text{Number of page views of search result}}{\text{Total unique searches}}$	Ratio	Based on: Huizingh, 2000

11	Information quality	Search exit rate	<i>The number of times a customer perform a query then leave the SERP without clicking on a result</i>	Ratio	<i>Based on: Huizingh, 2000</i>
12	User interface quality	Time spent per visit	$\frac{\text{Total session duration}}{\text{Total number of sessions}}$	Ratio	<i>Based on: Singal & Kohli, 2014</i>
13	User interface quality	Re-direction time	<i>The time spent in redirection before fetching the page</i>	Ratio	<i>Based on: Cao et al., 2005</i>
14	Control variable	Order value	<i>The average revenue of an e-commerce transaction</i>	Ratio	<i>Zeithammel, 1988</i>
15	Control variable	Price	<i>Average revenue per item</i>	Ratio	<i>Zeithammel, 1988</i>
16	Control variable	Monetary value	<i>Is the amount of money associated with a transaction</i>	Ratio	<i>Zeithammel, 1988</i>

Appendix B

Pre-test to face validate measurement.

Pre-test guide

Part A Test information.

“Hello. My name is Noortje Gevers and I am a masters’ student of Technical University of Eindhoven. I am conducting a case study at MATER. This company is the leading commercial vehicle manufacturer in Europe. This test takes about fifteen minutes and aims to study customer behaviour in B2B e-commerce. The test consist of two different parts. In each part I will ask you to search for a product on the MATER webshop, whereafter, you will answer some questions. In addition, the entire test will be recorded, and the obtained information will be anonymously used to validate the metrics in the master thesis.”

MATER = Anonymized company name

Part B. Main topics to be addressed in the pre-test.

“In a minute I will ask you to do a search quest for a product. You will receive as much product information as you would get in a normal setting. After the first and second search, you can answer the questions I hand out to you, when answering those questions I want you to think about the search quest you just made.”

Case 1 Satisfied customer behaviour

“Locate one of the three coolant lines from the BPV valve in the e-commerce website of MATER”

Case 2 Dissatisfied customer behaviour

“Locate a glow plug of the parking heater with chassis number XXXX in e-commerce webshop of MATER”

Table 27 Survey questions core concepts

Core concepts	Measuring tool	References
Satisfaction	Overall, I am satisfied using the MATER webshop	Casaló <i>et al.</i> , 2010; Cen & Li, 2020; Chiou, 2004; Deng <i>et al.</i> , 2010; Shankar <i>et al.</i> , 2003
Satisfaction	The experience of information searching and trading on this webshop is pleasing	Cen & Li, 2020; Yoon <i>et al.</i> , 2013
Satisfaction	This online B2B platform well meets my needs for business information	Cen & Li, 2020; Yoon <i>et al.</i> , 2013
Trust	I feel protected when I use the MATER webshop	Cao <i>et al.</i> , 2005
Trust	The webshop of MATER is reliable	Cao <i>et al.</i> , 2005
Trust	I can count on MATER on follow through on commitments	Hsu <i>et al.</i> , 2013; Smith, 1998
Trust	I only use a webshop of the brand I trust, otherwise I intent to leave the website immediately	Self-developed based on: Singal & Kohli, 2014
Loyalty	The MATER webshop is my first choice when I need to make a purchase	Pham & Ahmend, 2017; Rose <i>et al.</i> , 2012;
Loyalty	I regularly repurchase from the MATER webshop	Pham & Ahmend, 2017; Rose <i>et al.</i> , 2012;

Loyalty	I Intent to browse to the MATER webshop for my next purchase	Pham & Ahmend, 2017; Rose <i>et al.</i> , 2012;
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Part C. *Control variables.*

Table 28 Survey questions control variables

Control variables	Measuring tool
Experience	How long have you been using the MATER e-commerce webshop?
Level of difficulty	I find it very difficult to search for product 1/2

Part D. *Respondent information.*

Table 29 Survey questions demographics

Core concepts	Measuring tool
Demographic	What is your age?
Demographic	What is your gender?
Demographic	What is your occupation?
Demographic	What is your level of education/specialization?

Results

The results from the pre-test showed that 90% of the respondents were male and 10% were female. The age of the users was fairly distributed, meaning that from each group, someone participated (see Figure 20). In addition, 60% of the participants are mechanics or chef mechanic, and the remaining 40% is purchaser, warehouse employee or Admin. Every participant is responsible for ordering the spare parts on the e-commerce and has secondary vocational education as a level of education.

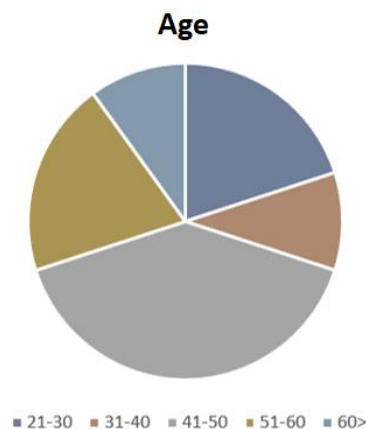


Figure 20 Age of respondents

Control variables

The results show that every participant had at least 1 to 5 years of experience; this indicates that they are familiar with the e-commerce webshop and know how to use it (see Figure 22). In addition, we deliberately prepared two cases, each with a different difficulty level. Moreover, in case 1, we expected the customers to have no problem searching for the product and for case 2 we expected that customers did experienced difficulty in searching for the product. The results show that there is indeed a difference between case 1 and case 2. 80% of the participants did not experience any difficulty in

case 1, and 70% of the participants found case 2 difficult to very difficult to search for (see Figure 21). This difference in difficulty means there is a clear distinction between case 1 and 2, allowing us to observe the possible differences in behaviour between the two cases.

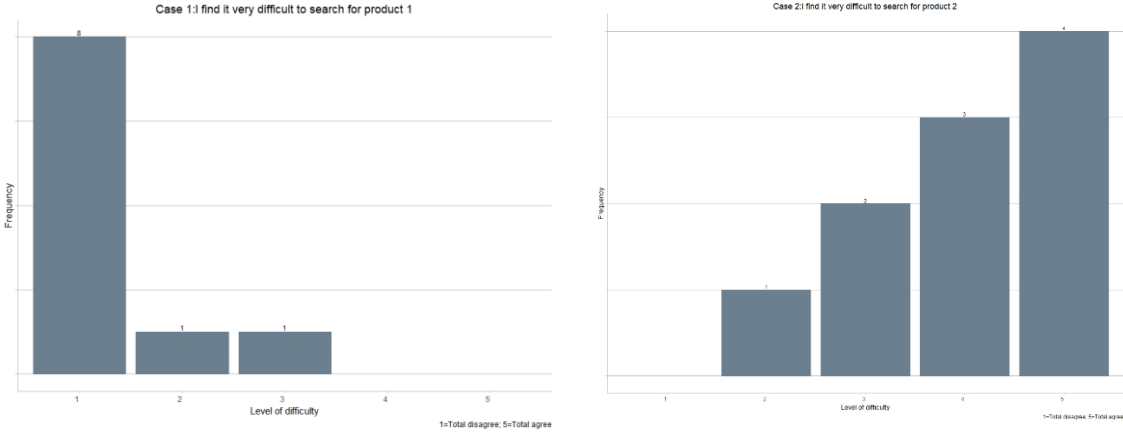


Figure 21 Level of difficulty per case

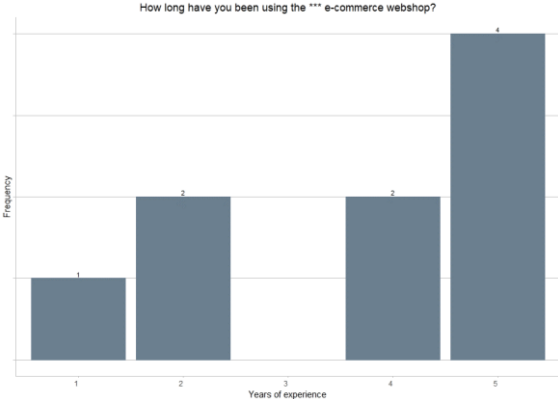


Figure 22 Years of e-commerce experience

Video recordings results

The output of Table 30 shows the descriptive statistics of the video recordings, deviated between case 1 and 2. The results show a significant distinction between case 1 and case 2. Moreover, “Time spent per visit” and “Number of visited web pages” are higher for case 2, indicating that the participant needed more time and re-directions to navigate to the desired webpage. More specifically, on average, a participant spent 403.20 seconds longer on the webshop and visited eight pages more than in case 1. In addition, “Page dwell time” (customer satisfaction) is higher for case 1, indicating that the participant spent, on average, 12.21 seconds longer on a webpage in case 1 than for case 2.

Table 30 Descriptive statistics video recordings

		Descriptive statistics					
Construct	Variable	Min	Mean	Max	Median	Std. deviation	N
Case 1	Case 1						
	Time spent per visit	301.00	383.50	444.10	389.50	50.90	10
	Total visited web pages	4.00	5.40	7.00	5.00	0.84	10
Customer satisfaction	Page dwell time	60.06	71.48	80.83	73.37	6.57	10
	Case 2						
Case 2	Case 2						
	Time spent per visit	588.30	786.70	968.70	819.10	131.68	10
	Total visited web pages	9.00	13.40	16.00	14.00	2.41	10
Customer satisfaction	Page dwell time	50.00	59.27	70.45	57.47	7.03	10

Survey results

Figure 23, Figure 24, and Figure 25 show the survey output regarding customer satisfaction for cases 1 and 2. Every Figure on the left presents the survey output from case 1 and on the left from case 2. The results show a difference in the level of customer satisfaction between the two cases. More specifically, the results show that, generally, customers are more satisfied in case 1 than in case 2. Figure 23 shows the most significant difference in customer satisfaction. Figure 23 shows that in case 1, 20% are satisfied, and 80% of the participants are extremely satisfied. In contrast, the output from case 2 shows that 10% of the participants are satisfied, and only 40% are extremely satisfied with the webshop. Moreover, 20% of the participants are dissatisfied, 10% are extremely dissatisfied, and the remaining 20% are neutral. In addition, Figure 24 shows, for case 1, that 80% of the participants are extremely satisfied with the information search on the webshop, while that is only 50% for case 2. Further, the results indicate that 20% of the participants are satisfied in both cases. The remaining 30% for case 2 are neutral about their experience of information searching. Last, the output from Figure 25 shows no extensive difference between the degree of satisfaction regarding the online platform that can meet a customer's needs for business information. The participants are only 10% more satisfied in case 1 than in case 2. Furthermore, we observe that 10% of the participants are dissatisfied with the platform meeting customers' need for business information in case 2.

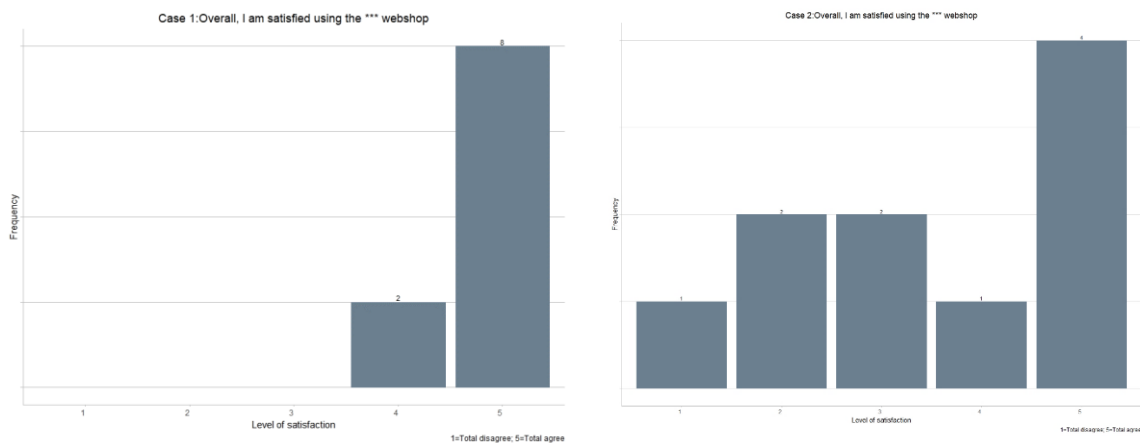


Figure 23 Overall, I am satisfied using the MATER webshop

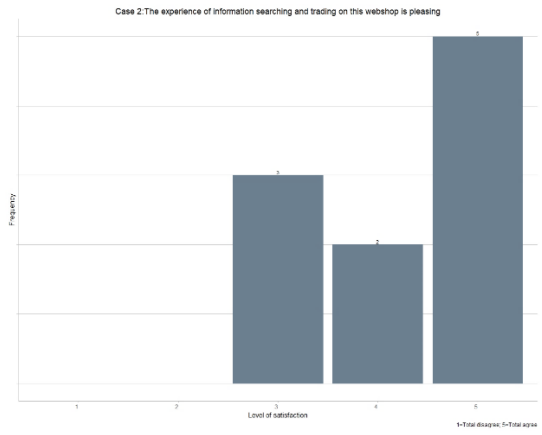
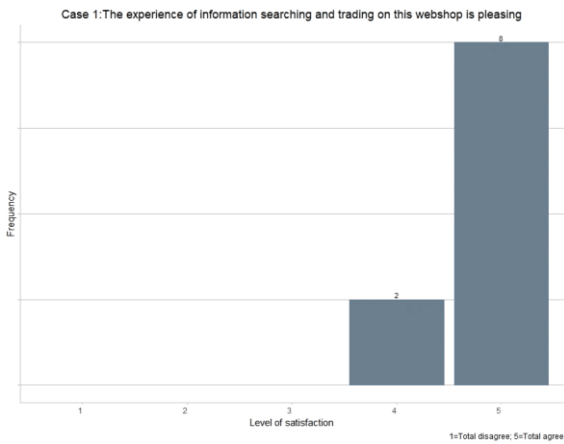


Figure 24 The experience of information searching and trading on this webshop is pleasing

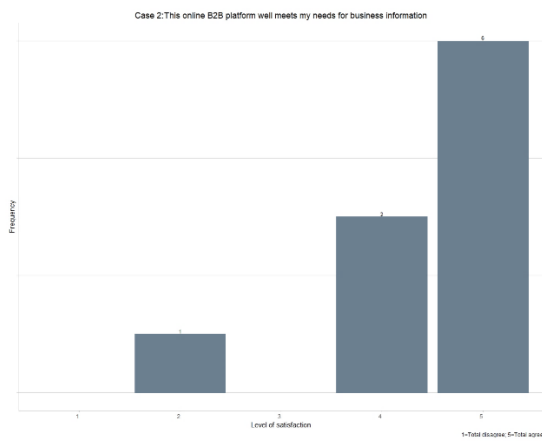
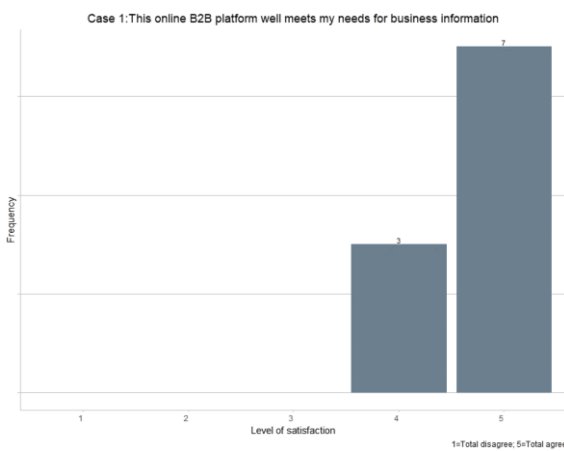


Figure 25 This online B2B platform well meets my needs for business information

Second, Figure 26, Figure 27, Figure 28, and Figure 29 show the survey output regarding trust for cases 1 and 2. Every Figure on the left presents the survey output from case 1 and on the left from case 2. The results show no apparent difference in the level of trust between the two cases. More specifically, the results indicate that every participant trusts e-commerce equally well regarding protection, reliability, commitment, and branding.

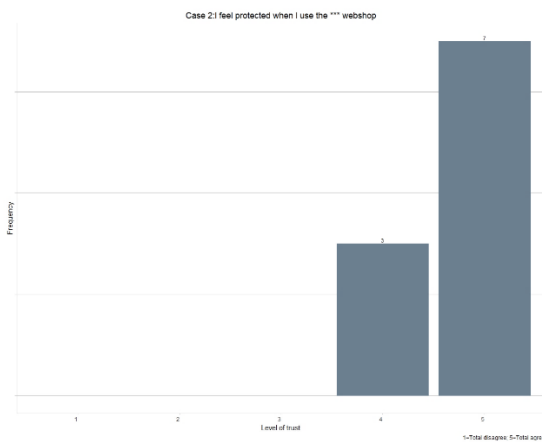
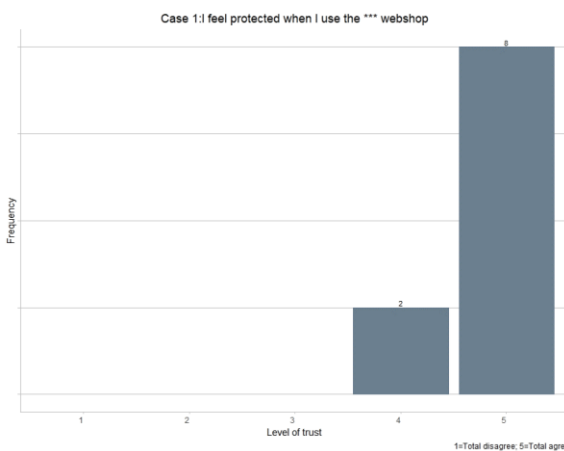


Figure 26 I feel protected when I use the MATER webshop

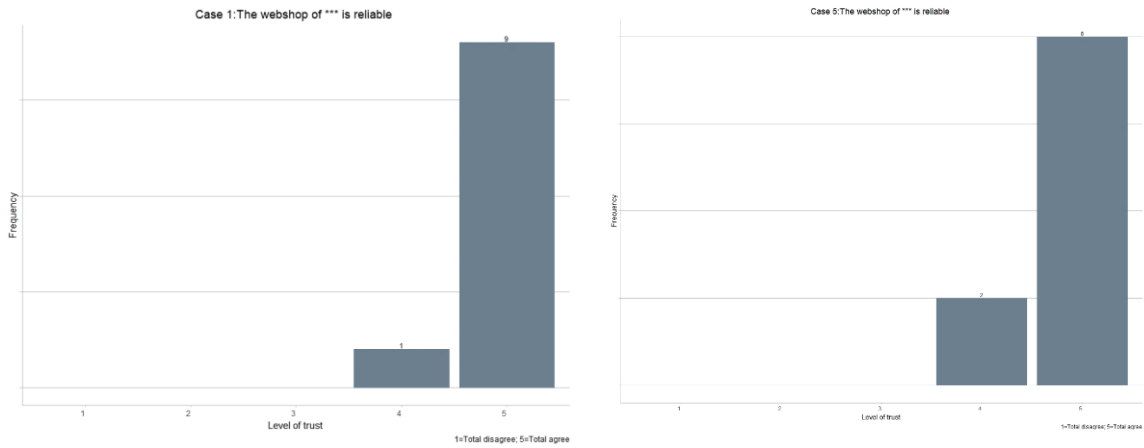


Figure 27 The webshop of MATER is reliable

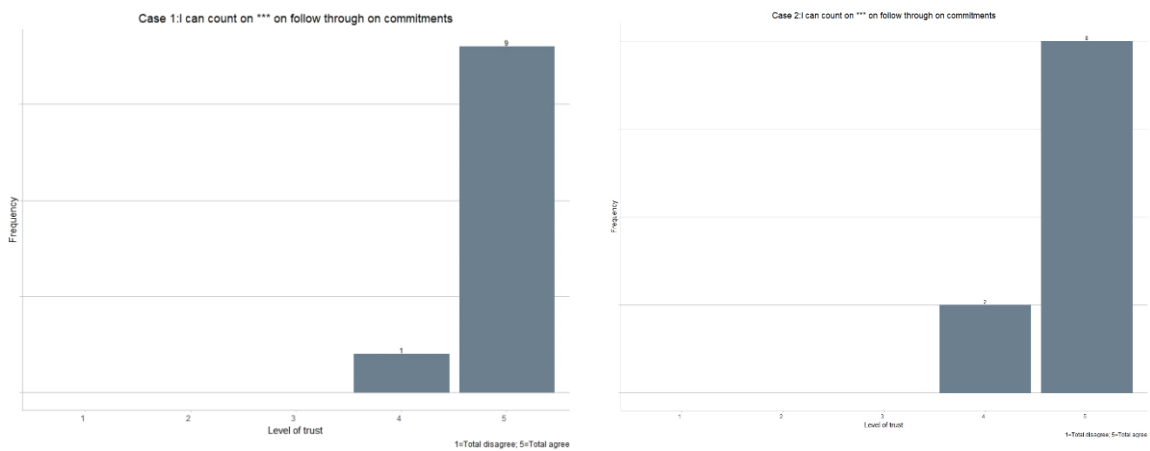


Figure 28 I can count on MATER on follow through commitments

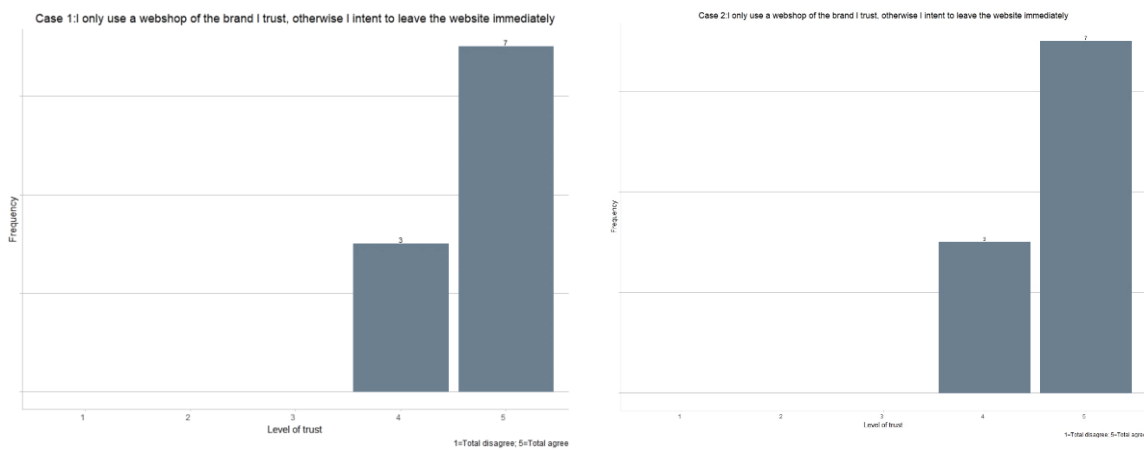


Figure 29 I only use a webshop of the brand I trust, otherwise I intent to leave the website immediately

Third, Figure 30, Figure 31, and Figure 32 show the survey output regarding customer loyalty for cases 1 and 2. Every Figure on the left presents the survey output from case 1 and on the left from case 2. The results show a slight difference in customer loyalty between the two cases. Moreover, the results from Figure 30 show that 60% of the participants agree or totally agree to use MATER webshop as their first choice when making a purchase, while this is only 30% for case 2. However, the results in Figure 31 show that the survey output scores about equally well on actually making a repurchase from the MATER webshop. Hence, the participants indicate that they regularly make a repurchase on the webshop, even though in case 2, the webshop is not their first choice. Last, Figure 32 shows that the

participants score about equally well on the intention to use the MATER webshop for their next purchase.

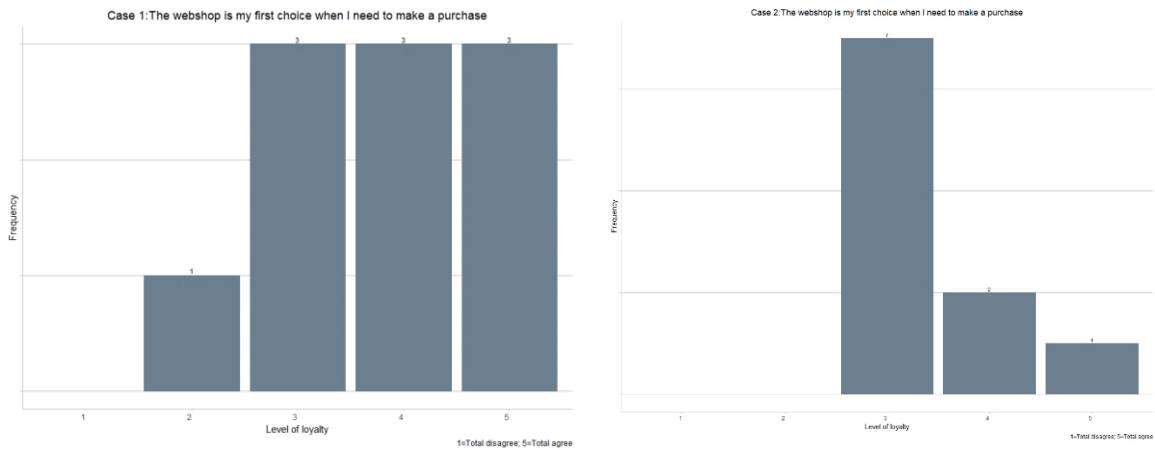


Figure 30 The website is my first choice when I need to make a purchase

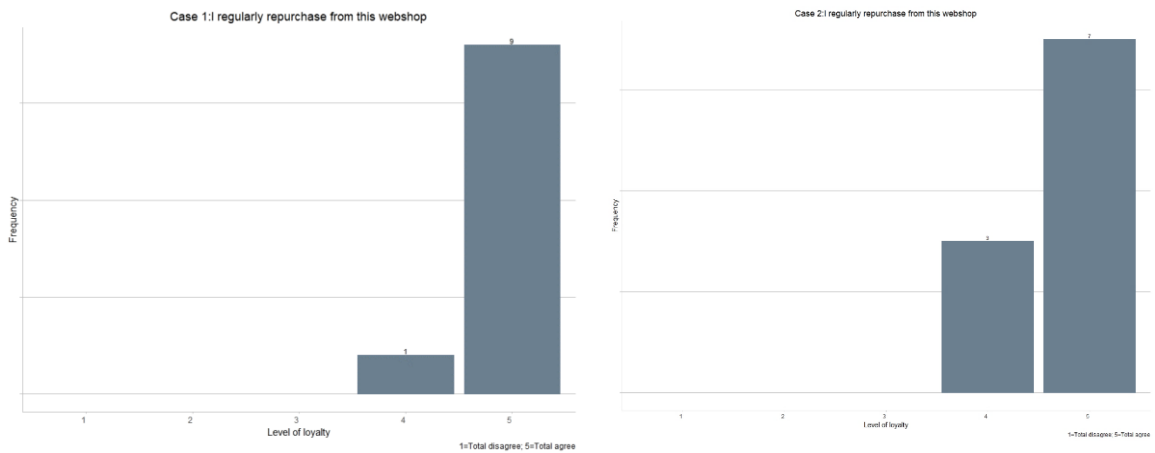


Figure 31 I regularly repurchase from the website

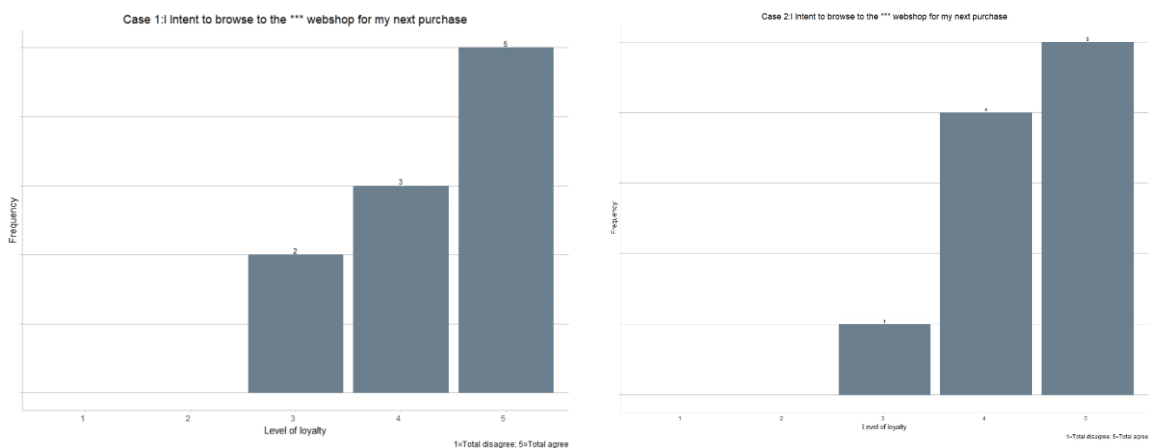


Figure 32 I intent to browse for the MATER webshop for my next purchase

Conclusion

This research uses newly developed metrics to measure customer behaviour in the theoretical framework. We conducted this test to validate if the theory of trust and customer satisfaction applies in this framework. However, the pre-test only consisted of 10 participants, indicating that this test has low reliability and validity due to the limited number of respondents. Hence, we cannot conclude the results but only make assumptions based on the observations.

We assume that the negative ageing phenomena of Liu et al. (2010) exist in this research. Hence, we assume that “Page dwell time” (customer satisfaction) is a valuable metric for customer satisfaction. The results clearly distinguish between the time spent per web page and the level of customer satisfaction. More specifically, more satisfied customers spend more time on the page than less satisfied customers. However, the research of Liu et al. (2010) indicated that the web page needs to communicate the page’s value proportion within 10 to 30 seconds, or there is a high probability that the customers will leave the web page. However, the results from this pre-test showed that the time to communicate the page’s value proportion is higher. The results showed that satisfied customers spend 71.48 seconds on a web page. Hence, we suspect that the probability curve will flatten at a later moment in the time frame in B2B e-commerce. In addition, we assume that customers do not experience any trust issues regarding e-commerce. However, the participants indicated that if they did experience trust issues, they would immediately leave the webshop, which corresponds to the theory of Singal and Kohli (2014). Hence, we assume that “Bounce rate” (trust) is a valuable metric for trust.

Appendix C

Data cleaning by handling missing values and outliers.

Missing data

The raw data collected from Google Analytics consist of missing data. Missing data are a statistical analysis problem primarily resulting from data collection or entry errors. Before handling the missing data, we excluded some observations from the data set. The excluded observations are not missing since there was no measurement at that moment and, therefore, do not belong to the population. Hence, we excluded the rows with “*Out of office hours*”, “*Saturday*”, and “*Sunday*” from the data set.

The data indicates a 0 for missing values. However, some variables can also be observed as the value 0. Hence, it is difficult to distinguish between an observed 0 or a missing value. To get a valid and reliable view of the data, we made assumptions and rules for 11 variables with 0 values (see Table 31). When the rules accept the value 0, than it is a valid observation. If the value does not meet the criteria, then we consider this as a missing value. We translated the missing values as not applicable (NA) in the data set. For example, we assume that the “*Order value*” (control variable) cannot be 0 if “*Price*” (control variable) or “*Monetary value*” (control variable) is greater than 0. More specifically, we assume that when there is an order value, a price per item should be paid, resulting in monetary value.

In addition, website updates and maintenance can explain the identified missing values. During updates or maintenance, it is sometimes necessary to shut the website down for a moment or parts of the website. Hence, the website does not measure anything or some parts, which results in missing values. The moments for updates and maintenance are usually planned outside office hours or during the weekend. For this reason, the customer does not need to suffer from the website shutdown. However, sometimes this is not possible and will occur during office hours on workdays. Besides, there are missing values due to errors, whereby it can happen that Google Analytics has stopped tracking the e-commerce website.

Table 31 Rules missing values

No.	Construct	Variable	Assumption	Rule
1.	System quality	Page download time	In any case, it will take some time to load the web page. Hence, when the user value is greater than 0, the page load time cannot be equal to 0.	Missing value if “ <i>Total users</i> ” are > 0 , else an observation with the value 0.
2.	System quality	Server connection time	In any case, it will take some time to connect to the server. Hence, when the user value is greater than 0, the page load time cannot be equal to 0.	Missing value if “ <i>Total users</i> ” are > 0 , else an observation with the value 0.

3.	System quality	Server response time	In any case, it will take some time for the server to respond. Hence, when the user value is greater than 0, the page load time cannot be equal to 0.	Missing value if <i>"Total users"</i> are > 0, else an observation with the value 0.
4.	Information quality	Information find conversion rate	When results per page views and search exits are observed, there should be an observation for the information find conversion rate.	Missing value if <i>"Search results viewed"</i> OR <i>"Search exit rate"</i> are > 0, else an observation with the value 0.
5.	Information quality	Search results viewed	When search exits and information find conversion rates are observed in the data, there should be values for the results per page views.	Missing value if <i>"Information find conversion rate"</i> OR <i>"Search exit rate"</i> are > 0, else an observation with the value 0.
6.	Information quality	Search exit rate	The search exit rate can be 0 since a customer does not need to leave the e-commerce website immediately after searching for a product. Therefore, this value does not need to be missing when it is 0%. It is only a missing value when the value is marked as <i>"NA"</i> from the data set itself.	Missing value if <i>"NA"</i> occur in the data set, else an observation with the value 0.
7.	Trust	Bounce rate	The bounce rate can be 0 since a customer does not need to leave the e-commerce website immediately after searching for a product. Therefore, this value does not need to be missing when it is 0%. It is only a missing value when the value is marked as <i>"NA"</i> from the data set itself.	Missing value if <i>"NA"</i> occur in the data set, else an observation with the value 0.
8.	Customer loyalty	Repurchase rate	When no new users are using the e-commerce website, and the average price, order value, or monetary value are greater than 0, then there should be purchased by a returning user.	Missing value if <i>"New users"</i> = 0 AND <i>"Price"</i> OR <i>"Order value"</i> OR <i>"Monetary value"</i> are > 0, else an observation with the value 0.
9.	Control variable	Monetary value	When orders are placed, or an average price per item is observed on the e-commerce website, perceived monetary value should be observed.	Missing value if <i>"Price"</i> OR <i>"Order value"</i> are > 0, else an observation with the value 0.
10.	Control variable	Price	When orders are placed, or a monetary value is observed on the e-commerce website, there should be an observation for the average price perceived.	Missing value if <i>"Order value"</i> OR <i>"Monetary value"</i> are > 0, else an observation with the value 0.

11. Control variable	Order value	When an average price per item, or a monetary value is observed on the e-commerce website, there should be an observation for the average order value perceived.	Missing value if "Price" OR "Monetary value" are > 0, else an observation with the value 0.
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Given the observation that the missing values are not ignorable, it is necessary to evaluate the missing data patterns. Figure 33 and Figure 34 indicate the number and percentage of missingness in each variable. With the help of this visualization, it is simple to determine which variable has the most missing data and which variable has the least missing data. The variable "Monetary value" (control variable) has the most missing values. The variable has 149 missing values, equal to 13.48% of missing values, and is the only variable indicating a higher number of missingness. The remaining variables are all below the 40 missing variables which is below the 4% of missing values and therefore do not indicate any notables from these plots.

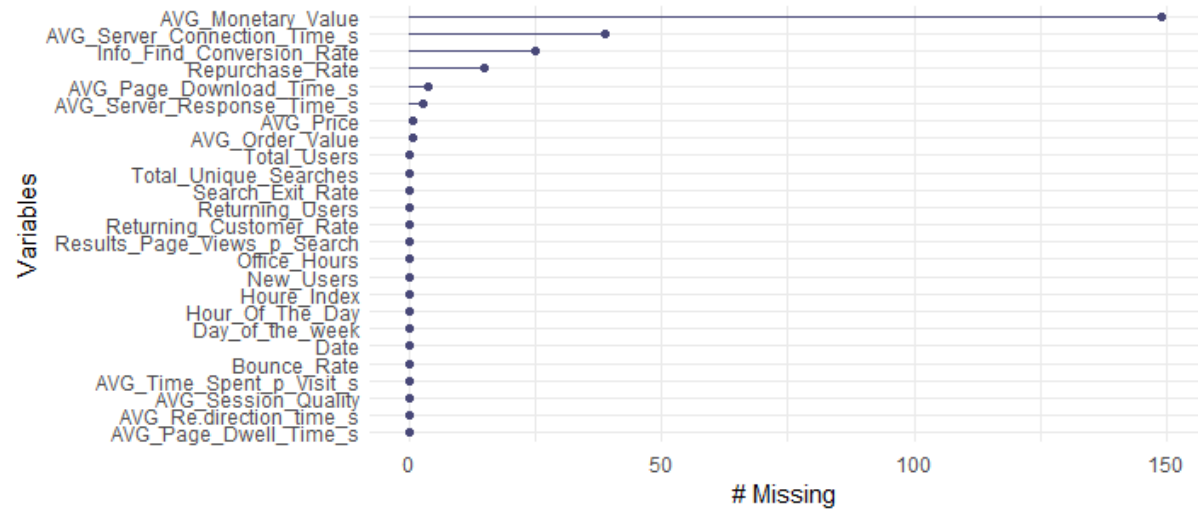


Figure 33 GG-plot of the number of missing values in each variable

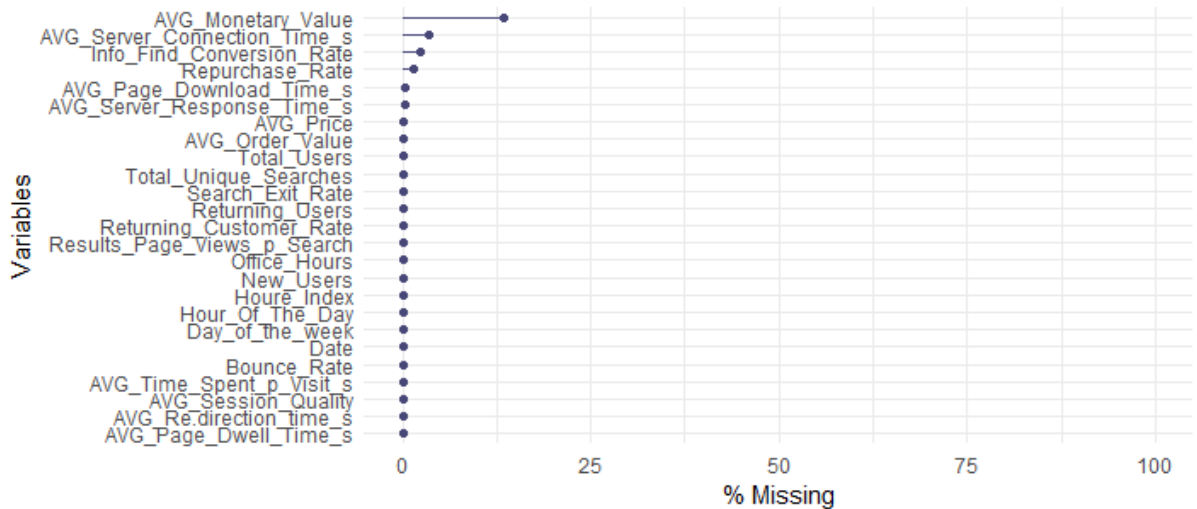


Figure 34 GG-plot of the percentage of missing values in each variable

Figure 35 visualizes the pattern and gap of missingness. The information on the variables and combinations of missingness can be seen through the black dots in the plot, the horizontal bars show the number of missingness per variable, and the vertical bar indicates the number of missing values in the combinations. The plot shows 10 bars with combinations of missing values in 5 variables; the first bar indicates that the most missing values do not occur in a combination but only in a single variable, "Monetary value" (control variable), namely 132 times. In addition, the 8th bar shows a combination in an observation where all variables from that plot have missing values; this combination appears two times in the data. Thus, five gaps of missingness in the data appeared two times. Next, the 5th bar shows a combination of 4 variables with missingness that appeared five times in the data set, equal to 4 gaps of missingness. Only five out of 16 variables in the dataset were involved in the upset plot since these variables have three or more intersecting with each other regarding missing data.

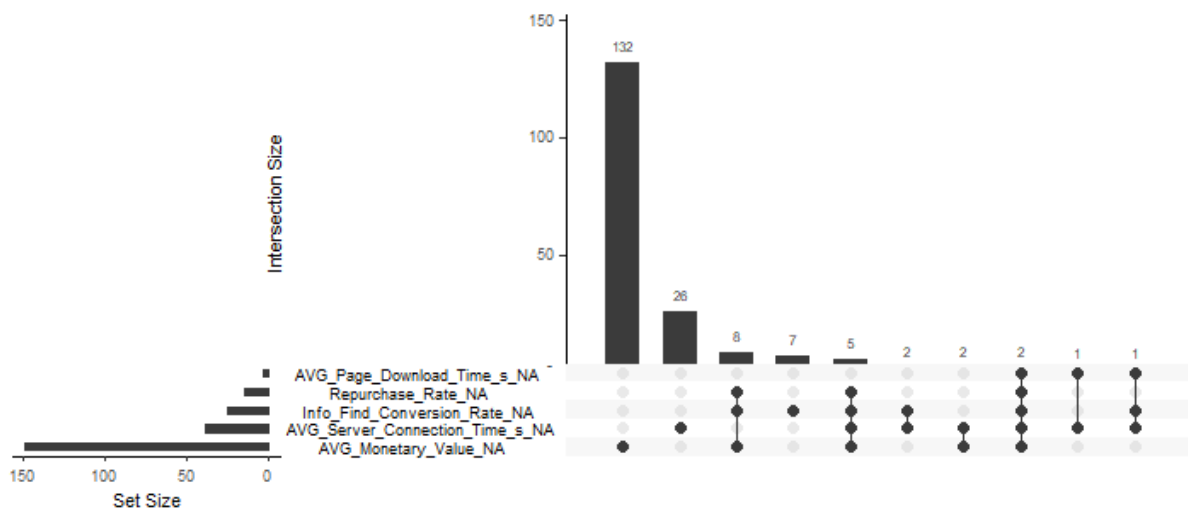


Figure 35 Upset plot

Last, Table 32 summarises all numbers and the percentage of missingness from the data set. From the table, no exceptionally high levels of missing data were identified. In total, there are 919 observations with no missing data of any variables and 186 observations with missing data, equivalent to 16.83% of cases with missing values. The sample size of 919 will provide the sample size available

for analysis if remedies are not applied. Moreover, this depends on the diagnose of the randomness of the missing data process.

Table 32 Summary of missing values

No.	Construct	Variable	Total values	Missing values	Scale	Percentage missing
1	Control variable	Monetary value	1,105 h	149	Ratio	13.48 %
2	System quality	Server connection time	1,105 h	39	Ratio	3.53 %
3	Information quality	Information find conversion rate	1,105 h	25	Ratio	2.26 %
4	Customer loyalty	Repurchase rate	1,105 h	15	Ratio	1.36 %
5	System quality	Page download time	1,105 h	4	Ratio	0.36 %
6	System quality	Server response time	1,105 h	3	Ratio	0.27 %
7	Control variable	Price	1,105 h	1	Ratio	0.09 %
8	Control variable	Order value	1,105 h	1	Ratio	0.09 %
9	Information quality	Search exit rate	1,105 h	0	Ratio	0 %
10	Information quality	Search results viewed	1,105 h	0	Ratio	0 %
11	Service quality	Session quality	1,105 h	0	Ratio	0 %
12	User interface quality	Time spent per visit	1,105 h	0	Ratio	0 %
13	User interface quality	Re-direction time	1,105 h	0	Ratio	0 %
14	Trust	Bounce rate	1,105 h	0	Ratio	0 %
15	Customer satisfaction	Page dwell time	1,105 h	0	Ratio	0 %
16	Customer loyalty	Customer retention rate	1,105 h	0	Ratio	0 %

Missing data is important to analyse since the sample should be representative of the population (validity) and the conclusions should be generalisable to the population (reliability). If there is no systematic process driving the missing values, then we can ignore the missingness and do a valid regression analysis with Missing Completely At Random (MCAR) or Missing At Random (MAR) (Hair *et al.*, 2014). We conducted a two-sample t-test to compare the mean of the complete and incomplete cases to check if MAR is present in this data set for “*Monetary value*” (control variable). The two-sample t-test is significant ($P - value = < 0.001$), meaning that MAR applies in this data set. The high missingness from “*Monetary value*” (control variable) depends on variables “*Information find conversion rate*” (information quality), “*Repurchase rate*” (customer loyalty), “*Server connection time*” (system quality), and “*Page download time*” (system quality), but not on the variable itself, and no systematic difference exists between observations with missing data and observations without missing data. The remaining variables with missing values are below 4% and therefore qualify for the rules of thumb, where any imputation methods can be applied when the missing data are this low (Hair Jr. *et al.*, 2014).

Based on the results of the two-sample t-test and the book of Hair *et al.* (2014), the Expectation-Maximization (EM) imputation method is best to apply for the “*Monetary value*” (control variable) since MAR appears in this data on this variable. However, before we decided on which imputation method to use, we conducted a correlation matrix for all available cases. The correlation coefficients indicate whether the variables function as good predictors among each other. The EM imputation method maximizes a likelihood function such that the observed data is most probable.

However, the low correlation coefficients in Table 33 indicate that it is hard to make predictions for this data set using EM imputation method. Hence, we choose to use all cases imputation method (also called listwise method) by using complete sample with only valid data to represent the remedy method. However, this approach has its disadvantage that it will lower the statistical power since the dataset will decrease (Hair *et al.*, 2014). Since this dataset has a low level of missing data and a large sample size, the remedy will not affect the statistical power adversely and is therefore appropriate to use in this case. After we applied the complete case approach and deleted the rows with missing values the data set is ready for further analysis. Moreover, the data set is complete with 919 observations.

Table 33 Correlation matrix raw data

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
System quality	1	Page download time	1														
	2	Server connection time	0.30	1													
	3	Server response time	0.02	0.05	1												
Service quality	4	Session quality	-0.06	0.01	0.11	1											
	5	Information find conversion rate	-0.02	-0.09	-0.07	0.29	1										
Information quality	6	Search results viewed	0.04	-0.06	0.09	0.03	0.11	1									
	7	Search exit rate	0.08	0.02	0.01	-0.11	-0.12	0.04	1								
User interface quality	8	Time spent per visit	-0.06	-0.01	0.19	0.18	-0.07	0.05	-0.29	1							
	9	Re-direction time	0.20	0.07	-0.18	-0.23	-0.05	-0.04	0.01	-0.07	1						
Trust	10	Bounce rate	-0.06	0.00	0.04	0.06	0.00	-0.07	0.01	-0.16	-0.08	1					
Customer satisfaction	11	Page dwell time	-0.02	-0.01	0.18	-0.10	-0.10	-0.11	-0.21	0.38	0.05	-0.07	1				
	12	Repurchase rate	-0.06	-0.09	-0.03	0.43	0.87	0.12	-0.12	0.02	-0.13	0.05	-0.12	1			
Customer loyalty	13	Customer retention rate	0.00	-0.07	0.09	0.27	0.21	0.10	0.04	-0.07	-0.07	0.11	-0.02	0.27	1		
	14	Order value	0.17	0.06	0.00	-0.06	-0.02	0.06	0.02	-0.03	0.02	-0.05	-0.01	-0.05	-0.05	1	
Control variables	15	Price	0.21	0.10	-0.03	-0.12	0.02	0.05	0.06	-0.11	0.01	-0.05	-0.03	-0.08	-0.10	0.49	1
	16	Monetary value	0.05	-0.05	-0.02	0.05	0.15	0.03	-0.03	0.12	-0.07	-0.07	0.07	0.23	0.07	0.23	0.13

Outliers

Besides missing values, the data might contain outliers. The data is examined to check whether any values deviate from the norm, as this could suggest that the value in question is invalid. It may, however, also be an exceptional value for a justifiable reason. Therefore, it is important to analyse and thoroughly evaluate these outliers. The outliers are identified from a multivariate perspective using several histograms, boxplots and quantile-quantile (QQ) plots (see Figures 36 to 51).

The underlying distribution of the data determines whether an observation qualifies as an outlier. If the variables are not normally distributed, the data's non-normality may be responsible for the outlier classification rather than the variables themselves. We used histograms with a density curve to show the distribution of the data is related to. However, for some variables, it is hard to evaluate if there is skewness in the graph. Hence, we used a QQ-plot as well. The histograms and QQ-plots show that most variables are skewed left or right-tailed and, therefore, are not normally distributed. A few variables, "Page dwell time" (customer satisfaction)(see Figure 39), "Page download time" (system quality)(see Figure 41), "Session quality" (service quality)(see Figure 44), "Time spent per visit" (user interface quality)(see Figure 46), and "Search exit rate" (information quality)(see Figure 48), seem to have a normal density curve

based on the histograms. However, the QQ-plots show that the ends of the data points deviate from the line for "Page dwell time" (customer satisfaction) and "Search exit rate" (information quality). Hence, we consider the variables as not normally distributed. "Page download time" (system quality), "Session quality" (service quality), and "Time spent per visit" (user interface quality) show a slight deviation from the line, but we consider this as acceptable and, therefore, as normally distributed.

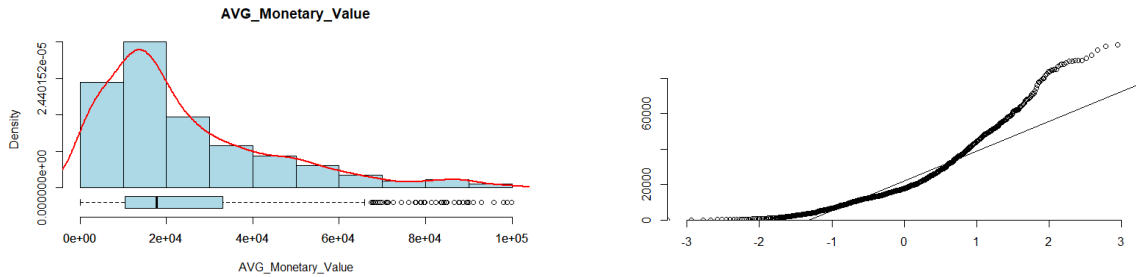


Figure 36 Histogram, boxplot, and QQ-plot of Monetary value

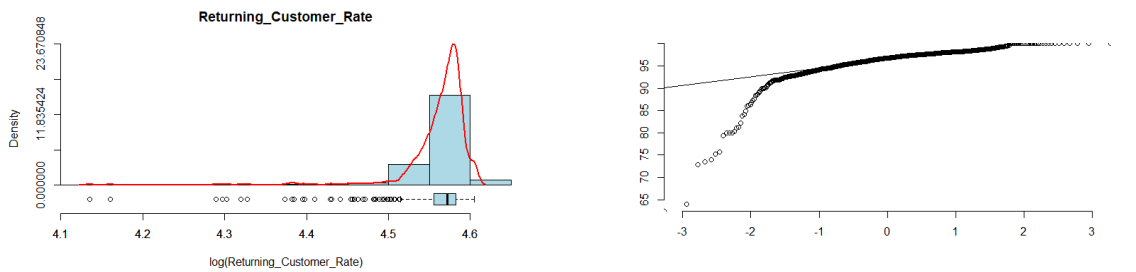


Figure 37 Histogram, boxplot, and QQ-plot of Customer retention rate

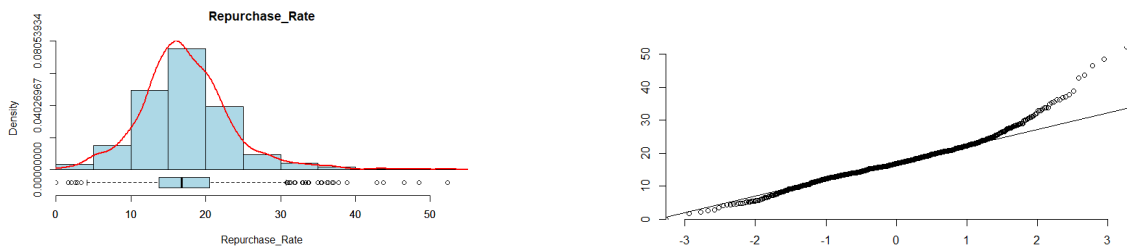


Figure 38 Histogram, boxplot, and QQ-plot of Repurchase rate

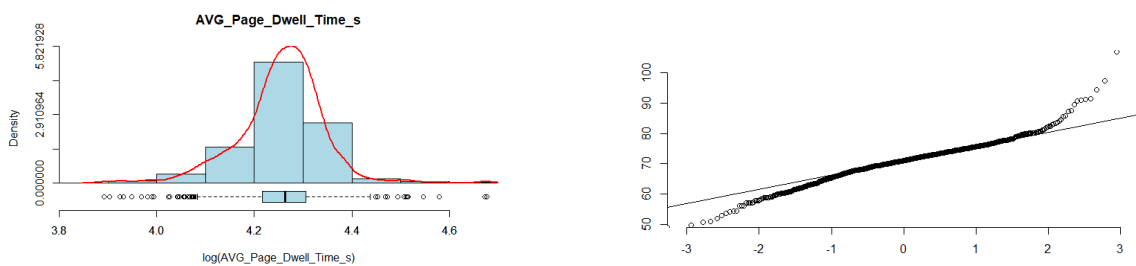


Figure 39 Histogram, boxplot, and QQ-plot of Page dwell time

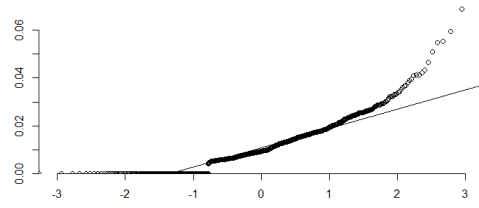
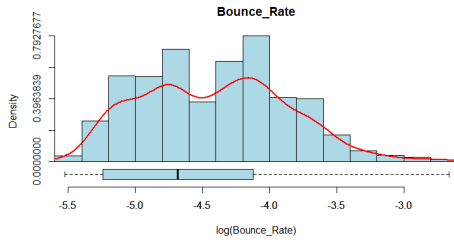


Figure 40 Histogram, boxplot, and QQ-plot of Bounce rate

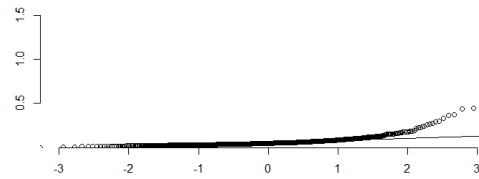
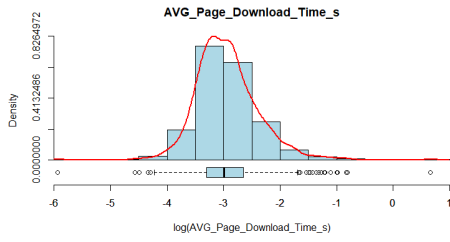


Figure 41 Histogram, boxplot, and QQ-plot of Page download time

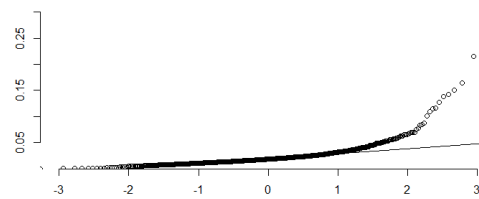
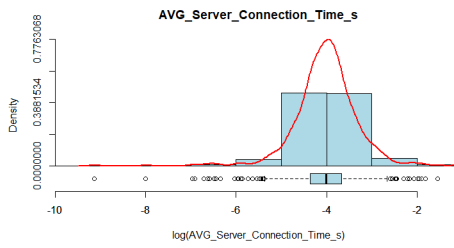


Figure 42 Histogram, boxplot, and QQ-plot of Server connection time

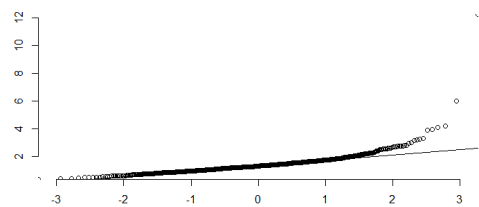
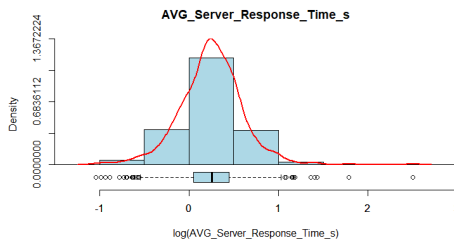


Figure 43 Histogram, boxplot, and QQ-plot of Server response time

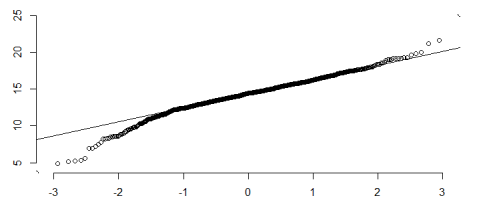
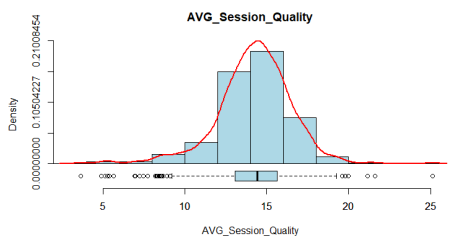


Figure 44 Histogram, boxplot, and QQ-plot of Session quality

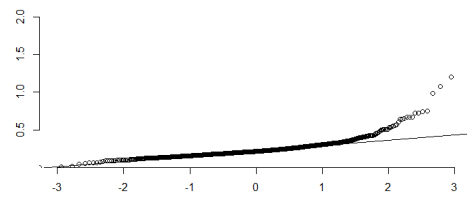
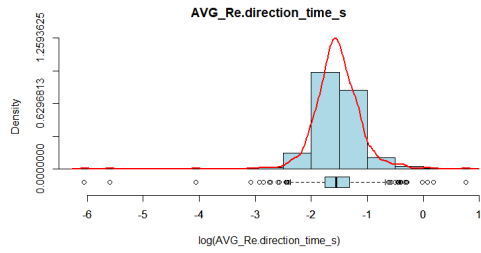


Figure 45 Histogram, boxplot, and QQ-plot of Re-direction time

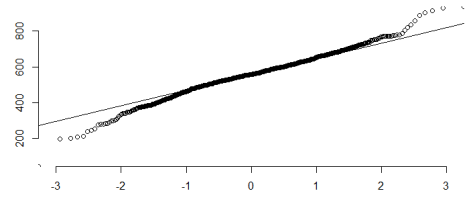
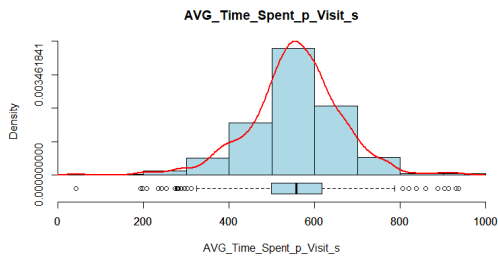


Figure 46 Histogram, boxplot, and QQ-plot of Time spent per visit

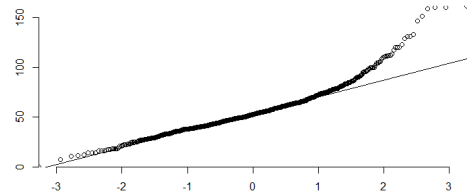
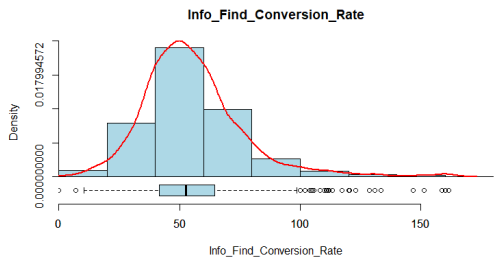


Figure 47 Histogram, boxplot, and QQ-plot of Information find conversion rate

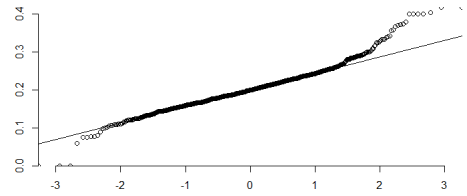
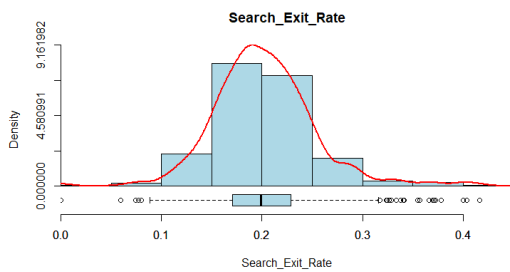


Figure 48 Histogram, boxplot, and QQ-plot of Search exit rate

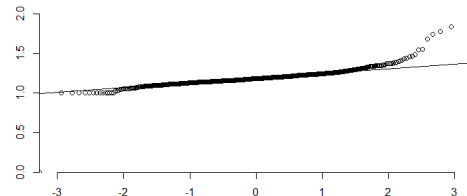
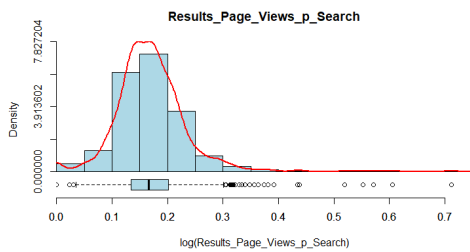


Figure 49 Histogram, boxplot, and QQ-plot of Search results viewed

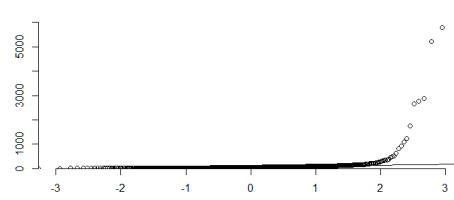
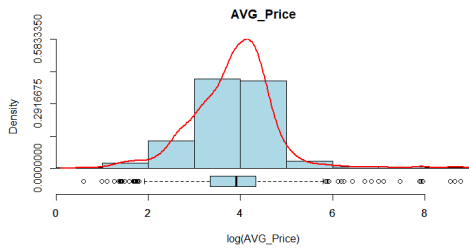


Figure 50 Histogram, boxplot, and QQ-plot of Price

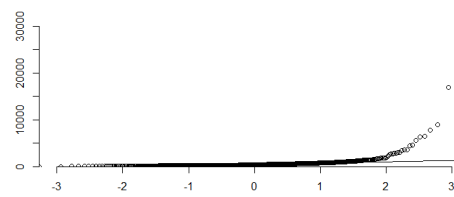
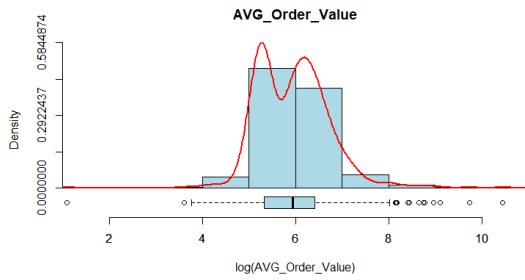


Figure 51 Histogram, boxplot, and QQ-plot of Order value

In addition, the box plots (see Figures 36 to 51) show potential outliers that might differ significantly from the other data points. The Mahalanobis Distance identifies the distances of the potential outliers (see Figure 52). Moreover, the Mahalanobis Distance calculates the distance in multidimensional space from the centre of the data to each data point (Hair *et al.*, 2014). We detected 182 outliers by the Mahalanobis Distance (see Figure 52 and Table 34). Whether to decide if the data point is an outlier or not, we can use the rule of thumb, which assumes that all distances greater than 3 are outliers if the data is normally disturbed (Hair *et al.*, 2014). However, since most variables are not normally distributed we did not use the rule of thumb. We evaluated the potential outliers by checking each observation in the data set. If values in the data set significantly from other data points, then we removed the data points from the data set. In total, we observed and deleted 29 outliers. The data set remains with 890 observations.

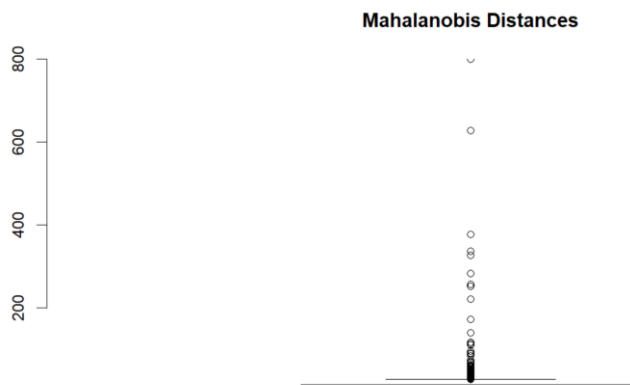


Figure 52 Boxplot Mahalanobis distance

Table 34 Quartile values Mahalanobis Distance

Min.	1 st Quartile	Median	Mean	3 rd Quartile	Max.
1.229	4.639	7.137	15.983	13.386	800.713

Appendix D

Semi-structured interviews to validate the conclusions.

Semi-structured interview guide

Part A. Interview information.

“Hello. My name is Noortje Gevers and I am a masters’ student of Technical University of Eindhoven. I am conducting a case study at MATER. This company is the leading commercial vehicle manufacturer in Europe. This interview takes about thirty minutes and aims to validate the conclusions in the study. The research is about customer behaviour in B2B e-commerce. In order to guide the interview I prepared some questions. However, feel free to deviate from the questions if you feel the need to discuss other important topics. In addition, the entire interview will be recorded, and the obtained information will be anonymously used to validate the conclusions in the master thesis.”

MATER = Anonymized company name

Part B. Main topics to be addressed in the semi-structured interview.

Table 35 Interview questions main topics

Measuring tool
Can you describe your relationship with MATER and for how long you are a customer?
What do you think of the MATER webshop and what is the reason that you order products here?
What are the advantages and disadvantages of the MATER webshop?
Are there other providers where you order products? If yes, how many and what is the reason why you order the products at other providers?
Do you feel that MATER webshop can meet your needs? Why?
Do you feel that the MATER is reliable? Why?
Do you have any concerns when you order products at MATER webshop?
What is your experience about navigating through the MATER webshop to the desired web page?
What information do you need to find your desired product? Does that type of information differ often?

Part C. Scenario questions.

Table 36 Interview questions scenario

Measuring tool
Imagine you start the webshop and directly leave the webshop again. Can you describe your emotion or feeling you could have and what the exact reason is why you would close down the webshop?
Imagine you perform a search quest and you directly leave the website after your search results appear on your screen. Can you describe your emotion or feeling you could have and what the exact reason is why you would close down the webshop?

Part D. Respondent information.

Table 37 Interview questions respondent information

Core concepts	Measuring tool
Experience	How long have you been using the MATER e-commerce webshop?
Demographic	What is your age?

Demographic	What is your gender?
Demographic	What is your occupation?
Demographic	What is your level of education/specialization?

Results

Interviewee 1

Experience e-commerce webshop: 5 years
 Age: 64 years old
 Sex: Male
 Profession: Mechanic
 Education: MBO

Interviewee 1 has been a customer of MATER since the beginning of his career, which means that their business relationship holds for more than 40 years. Moreover, he started using the MATER webshop five years ago to order his products for truck repair. Interviewee 1 called the webshop “great” and “it is my favourite webshop to use so far”. However, he also mentioned that he sometimes orders products from other e-commerce providers. The main reason he shops at other providers is that they can offer the products at a lower price. Although he also indicated that he always uses MATER’s webshop to search for the products, if he finds the price too high, he uses the part number from MATER to search for the product at the competition for a lower price. He explained “the MATER webshop provides extensive information that I need to find the right part number and based on that number I can look up the same product at the competition for a lower price” and “the webshop from the competition does not have a webshop where I can deduce whether I am ordering the right product, that is why I always dot his via the MATER webshop”.

In addition, interviewee 1 explained that he would open the webshop and then leave without taking action because he would switch his computer to another computer to use a bigger screen and search more easily on the site. However, he did not feel any direct emotion or feeling about this scenario. Last, he explained that he would leave after performing a search quest because he could not find the product. He will search at the competition or call the dealer to order this product. In this scenario, he would feel irritated because he is in a hurry, and if he cannot find his desired product quickly, it will slow him down.

Interviewee 2

Experience e-commerce webshop: 5 years
 Age: 63 years old
 Sex: Male
 Profession: Chef workshop
 Education: MBO

Interviewee 2 is deeply committed to MATER because he maintains and sells this brand of trucks in his shop. He explained, “if you have this truck brand in your workshop, you will often automatically be a customer here, or you will miss out on products”. He indicated that other webshops do not always provide all the required products for truck repair. Moreover, he mentioned, “the webshop is super nice to use, and I search all my products on it. I have a few other suppliers, but that is mainly because I also

have other brands of trucks in my workshop. And if I search for MATER products on another webshop, it is because they can offer me a better price”.

Furthermore, interviewee 2 mentioned that he has some concerns about the delivery of the products when he orders at MATER. He also indicated he has no concerns regarding the brand or e-commerce itself. He explained that it is super important that MATER delivers its products on time. He said *“If I order now, it is better that they delivered yesterday, then today”*. Nevertheless, he also mentioned that *“the delivery time is usually good, but sometimes I have to wait. And when I have to wait to start a truck repair, it means the truck is not on the road, and this costs me a lot of money”*.

In addition, sometimes, he experiences difficulties in the ease of navigation. He indicated that some parts are assigned to a different category than you would logically despise. Moreover, he mentioned that when you perform a search quest, you think about different things, for example, *“what size does this part need to be? What is the part number? What brand of the part is required?”*. Besides, he also needs to think about the official name of the part. The webshop usually uses official names for the parts, while it is common to use jargon in the automotive industry among the mechanics. If a customer does not use the official part name to perform a search quest, then the desired part will not appear in the results. Interviewee 2 experienced it as *“it is sometimes a difficult search process with a lot of thinking involved”*.

Finally, concerning the scenario questions. Interviewee 2 would never close the webshop without performing any actions. Besides, he indicated that he would leave e-commerce after he performed a search quest because he could not find the product he was looking for. He explained, *“I need to act quickly, and I need my products quickly, but often I leave the website, and I will call the dealer to fix my problems, and he will order my products for me. This is a piece of service I expect, and it unburdens me”*.

Interviewee 3

Experience e-commerce webshop: 5 years

Age: 28 years old

Sex: Male

Profession: Reception/ Purchase manager

Education: Middelbaar beroep onderwijs MBO

Interviewee 3 has worked with MATER products since the beginning of his career. He started using e-commerce as his former employee five years ago. Now he is working with his new employee and has been using the webshop daily for over a year. He indicated, *“I like to use the MATER webshop. The webshop of MATER is unique because it provides additional information which other providers do not deliver. And with this information, I am sure I have the right product in my order basket”*.

Besides, interviewee 3 orders at order at other suppliers because they could offer him a better price. He explained, *“Normally I use the MATER webshop to find my products, but I know that their price is often higher than the price of *competitors name*. Often this saves me more than 100 euros. My customers cannot afford expensive truck repairs, and that means I need to decrease my profit margin. So if the products are of the same quality, but I can get a better price at *competitors name* then I will. Hence, I sometimes wonder where the price for MATER products comes from”*. Further, he can experience some concerns regarding the delivery time of the products. He indicated that this usually does not affect him. However, sometimes it is difficult to get special products delivered on time because MATER does not have many in stock.

In addition, regarding the ease of navigation. He mentioned *“Sometimes it is hard to navigate to the right page, especially in the main group navigation. If it takes me too long, then I will stop and try it at *competitors name*”*. However, he also mentioned *“I generally succeed in looking up products quite well, especially on this website. However, for example, for product X I need to know multiple things like the measurements of the part and whether this side (points out something on his laptop) is also included or whether it is delivered separately. That is not always obvious and if this is also missing in the picture, then I am not sure at all”* and *“usually if I cannot find the product or whether I am not sure if I have the right product in front of me, I will see if I can find the product at *competitors name* and then I will buy it there”*. He explained *“I often need a lot of different information. You will not receive this information in advance, because the used parts are very dirty when they come of the used truck and you can no longer read the article number or size. So what you think you need is actually more based on experience. Then, usually during the search for the product you find out what specifications you will need”*.

Finally, based on the scenario questions. Interviewee 3 assumed he would close the webshop without performing any actions because he has a customer at the counter who demands his attention first. He explained, *“I often need to look up information for other people and then it can happen that I will close some tabs”*. Besides, he said, *“as I explained before, I would leave after I would perform a search query because I cannot find the product. I will call MATER to solve this, and I would feel irritated”*.

Interviewee 4

Experience e-commerce webshop: 4 years

Age: 34 years old

Sex: Male

Profession: Chef workshop

Education: MBO

Interviewee 4 is responsible for ordering the products and is one of the most loyal customers of MATER. The company he works for helps MATER transport their products to the desired destination. Hence, interviewee 4 is very loyal to MATER. He mentioned, *“we order from the webshop at the moment we need spare parts for maintenance, and for that reason, we are extremely time sensitive. However, our customer is not price sensitive till a certain margin, which is why we can stay loyal to MATER if the products can be delivered on time. Because in general MATER is a bit more expensive than the competition. However, it just saves us much time if we buy everything from the same webshop.”*

In addition, he mainly uses the search bar to find his products and screens the products based on content. More specifically, initially, he screens the products based on his pictures. Then when he clicks on a product, he will check for the specifications. He added regarding the ease of navigation, *“because I work with the webshop every day, it is very easy for me to use it”*.

Finally, based on the scenario questions. he indicated that he would close the webshop without performing any actions because he needs to solve an emergency. A truck is stuck on the road, and he needs to solve that first. The same explanation holds for why he would leave the website after he would perform a search query. He mentioned, *“I would feel rushed to solve this problem quickly, but after that, I would start a new session on the webshop”*.

Interviewee 5

Experience e-commerce webshop: 2 years

Age: 49 years old

Sex: Male

Profession: Mechanic/Purchase manager

Education: MBO

Interviewee 5 is responsible for ordering the spare parts and for truck maintenance. He explained that MATER is the most used webshop for ordering spare parts. However, this is also the most expensive webshop, especially if you compare the prices with **competitors name** and **competitors name**. He said, *"I often buy from the competitors because it can help save me a lot of money. For example, I had a price difference of €175,- for the same filter. Then the choice is easy, and I use this part number from MATER to search for a better offer at the competition. This is not the only case when this happens; this happens all the time"*.

Further, he mentioned that he needs different types of information when he performs a search quest. For example, he needs to know the maximum load of the material, the length, the number in the package, and the connections of the parts. He explained, *"MATER offers a lot of information which is a big advantage in searching for the right spare parts"*.

In addition, interviewee 5 mentioned that he has some concerns regarding delivery time. He explained, *"the timing of the products is key for efficiency and planning"*. Interviewee 5 has special couriers to deliver his spare parts if the stock is unavailable in his area. He said, *"this usually happens on Saturdays, when the delivery of MATER is closed" and "a great add-on of the MATER webshop is that if they could show me when they could deliver the spare parts. For example, the *competitors name* has a time frame on his website of when the new delivery will be shipped. That is perfect since I can plan my repairs based on that time frame"*.

Finally, based on the scenario questions. Interviewee 5 would never close the webshop without performing any actions. He indicated that he only closes the webshop if he is done using it. Besides, he would leave the webshop after he performed a search query because he could not find the product. He said, *"I just had this scenario yesterday, and then I just call MATER if he can order this product for me. But I did not feel a specific emotion with it, it is just an automatic reaction for me"*.

Appendix E

Assumptions to check what conclusions we can draw regarding our model estimates.

Assumptions

Linearity

The first assumption is to test is linearity, this is if the linear relationship holds between the independent and dependent variable. If the relationship is not linear, data transformation are made in the model specification. The added-variable plots in Figure 53 show no noticeable pattern that deviates from the blue line in each plot. For this reason, there is no need to include a quadratic term in the variable. Thus, for all variables holds a linear relationship between the independent and dependent variable.

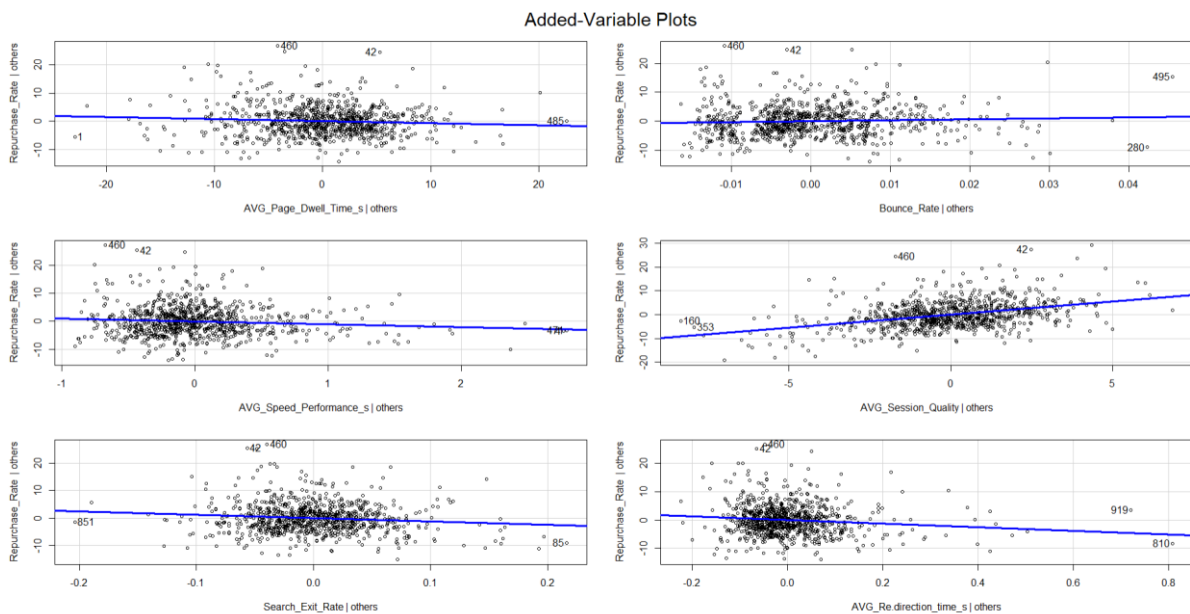


Figure 53 Added-variable plots

Normality

The second assumption is the normality of the distributed error terms. This assumption is important for the significant tests from the regression output. The values of the standard error, t-value, and p-value are based on normally distributed data; if not, the values are incorrect. However, in this dataset, this assumption is irrelevant according to the central limit theorem. The central limit theorem states that if the data set is greater than 30 data points, the dependent variable is independently sampled from the identical distribution with finite variance. This leads to a sample mean which tends to a normal distribution, regardless of the underlying distribution.

Homoscedasticity

The third assumption is homoscedasticity which is the constant variance of the error term. This assumption is important since it can affect the validity of the regression output's standard errors, t-value, and p-value. However, if homoscedasticity does not hold in this data set, then heteroskedasticity applies, meaning there is no constant variance of the error term. However, then the ordinary least squares, including the R^2 , are still valid. The diagnostic plot in Figure 54 does not show a specific structure within the data points, which means that no heteroskedasticity is observed from this plot. In addition, to ensure no variance holds in the data, we used the Breusch-Pagan to test for

heteroskedasticity of error terms. The results of the Breusch-Pagan test are significant ($P = < 0.001$). Hence, we rejected the null hypothesis, meaning that heteroskedasticity applies in the data set. Furthermore, we applied the heteroskedasticity-robust standard error to obtain unbiased standard errors of the ordinary least squares. Usually, the robust standard errors are larger than the standard errors. However, this is not always the case.

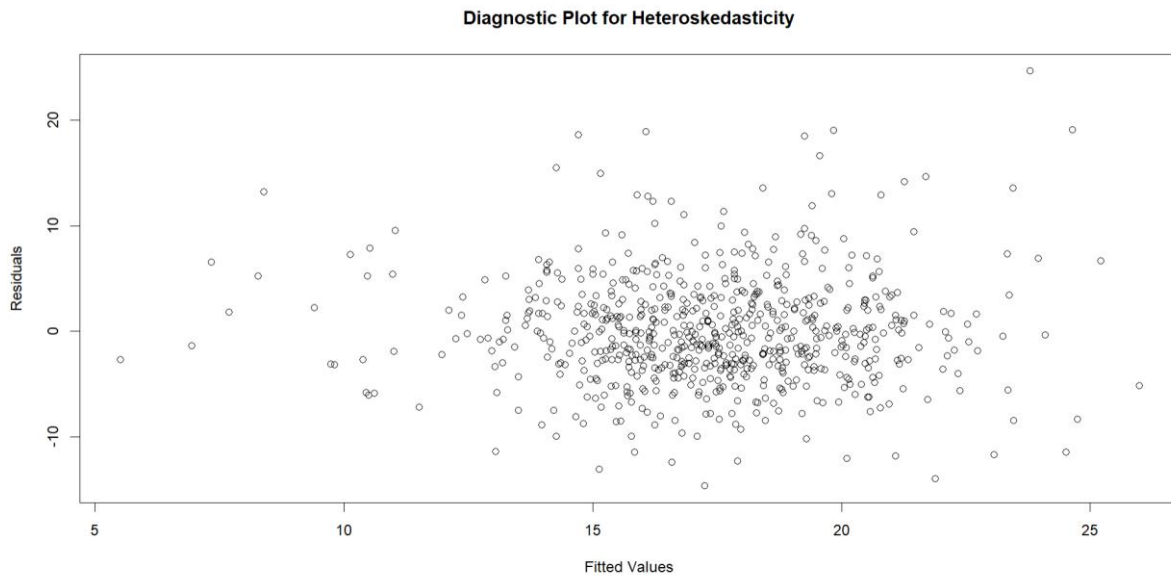


Figure 54 Diagnostic plot for heteroskedasticity

Exogeneity

The fourth assumption is exogeneity, meaning that the independent variables are independent of the error term. Unfortunately, we cannot test this assumption. However, this assumption needs to hold to be able to make causal interpretations, which we need for prescriptive analyses. The error term includes all omitted variables, that is all variables that influence the dependent variable and are not in the model. Within this research model, we assume that exogeneity does not hold in this data set since we cannot know for sure if this assumption is true or not. For this reason, we can only make correlation interpretations from the model for descriptive and predictive analyses.

Multicollinearity

Multicollinearity is not an assumption of multi-linear regression analysis. However, it is a phenomenon that needs attention since the more the multicollinear independent variables are, the larger the standard errors of the estimated parameters. Multicollinearity tests if two or more variables co-move, which means that multiple variables change at the same time. The Variance Inflation Factor (VIF) diagnoses multicollinearity within a model. The lower the VIF score, the better. According to the rule of thumb of Hair *et al.* (2014), we need to reconsider a model if the VIF score is larger than 2, and we should drop a variable if the VIF score is larger than 10. However, this is no hard rule since the score level depends on the model's situation. Table 38 show that no multicollinear relationships hold for this research model since all VIF scores are below 2.

Table 38 VIF scores

Construct	Variable	VIF score
Customer satisfaction	Page dwell time	1.11
Trust	Bounce rate	1.04
System quality	Speed performance	1.07
Service quality	Session quality	1.07
Information quality	Search exit rate	1.07
User interface quality	Re-direction time	1.11