

## Modelling Customer Satisfaction of Smartphones in the Czech Republic

DOI: 10.12776/QIP.V27I1.1818

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Received: 2023-01-10 Accepted: 2023-03-05 Published: 2023-03-31

### ABSTRACT

**Purpose:** The goal of this paper is to model customer satisfaction of smartphone select manufacturers in the Czech Republic (CR). Furthermore, the paper aims to model the factors which affect customer satisfaction of the smartphone.

**Methodology/Approach:** A questionnaire was sent to 1,063 respondents in CR to collect data. Using structural equation modelling, relationships between factors of customer satisfaction within three models of customer satisfaction of select smartphone manufacturers were modelled.

**Findings:** Effects of all investigated factors of customer satisfaction were verified, as well as all items which constituted the factors. Additionally, the functioning of the factor of total satisfaction with dimensions of general satisfaction and price tolerance was verified.

**Research Limitation/Implication:** The research is limited by its focus exclusively CR, the number of manufacturers included in the research is rather low and small number of factors and items included in those factors.

**Originality/Value of paper:** The models differed from each other in terms of the strength and direction of the relationships between the factors, which has implications for these recommendations. In general, each manufacturer has its own strengths and weaknesses (factors) that affect customer satisfaction with its product. Individual manufacturers can increase customer satisfaction by strengthening the positive factors or by learning from their competitors and eliminating or improving the factors that currently affect customer satisfaction negatively.

**Category:** Research paper

**Keywords:** customer satisfaction; smartphones; hardware and software; design; image

## 1 INTRODUCTION

Customer satisfaction in the smartphone industry has been subject to intense research in the last 20 years (see e.g. Türkyılmaz and Özkan, 2007; Shin, 2014; Haba and Hassan and Dastane, 2017; Shrestha, 2020). Nevertheless, certain areas remain unexplored by contemporary research. One of these areas is the factors affecting customer satisfaction, including mutual relationships between these factors as well as between the factors and customer satisfaction as a whole. These relationships have been researched from using customer satisfaction index in the study by Türkyılmaz and Özkan (2007) or Shin (2014), with the industry being studied as a whole. In research by Kim et al. (2016), Putra et al. (2020) and Nath and Saha and Hossain (2015), simple relationships between various factors and customer satisfaction were examined. More complex relationships including mutual relationships between investigated factors received attention in studies by Shin (2015), Yazdanparast and Tran (2021), and Diputra and Yasa (2021).

The purpose of the paper is to find out which factors affect customer satisfaction of the smartphone, i.e., which factors customers perceive as important and how these factors affect satisfaction. Knowledge about these factors will allow smartphone manufacturers to improve the focus of their innovations and improve those parameters which are the most important from a customer satisfaction perspective. This is beneficial, as high customer satisfaction affects customer loyalty (Kim et al., 2016), i.e., the ability to retain a customer in the long-term. Furthermore, customer satisfaction increases business performance (Morgan and Rego, 2006) and thereby enables returns on investments. Proving an effect of price tolerance on customer satisfaction as a component of satisfaction is important for addressing questions regarding product pricing following innovations in areas which affect customer satisfaction.

A model of customer satisfaction focused specifically on factors of satisfaction relevant for smartphones has the potential to address the research gap outlined above. In this paper, such a model is constructed. It included factors never used together in a standalone model before. This represents an opportunity to construct relationships between factors which have not been investigated before and construct a unique model in this regard. Another potential direction of research includes constructing customer satisfaction as a composite of price tolerance and general customer satisfaction, which is also done in this paper.

## 2 THEORETICAL FRAMEWORK

There are several definitions of customer satisfaction. Perhaps the most comprehensive definition is provided by Giese and Cote (2000, p.15): “Consumer satisfaction is a summary affective response of varying intensity, with a time-specific point of determination and limited duration, directed toward focal aspects of product acquisition and/or consumption”. Customer satisfaction in the smartphone industry specifically was studied by Turel and Serenko (2006)

and Türkyılmaz and Özkan (2007). In this paper, customer satisfaction is constructed as a single factor, in order to more clearly isolate it from other factors which affect it. This is in line with Shrestha (2020) and Panigrahi and Azizan and Shamsi (2021).

An effect of price satisfaction on general customer satisfaction was found in the smartphone industry (Bolton et al., 1999). Price satisfaction is not usually included in research of customer satisfaction in the smartphone context. Furthermore, a strong relationship was found between price satisfaction and price tolerance (Pandey et al., 2020; Yol and Serenko and Turel, 2006), which is investigated in the context of customer satisfaction in the smartphone industry.

A unique two-dimensional construct of customer satisfaction was created in this paper, which contains not only the dimension of general satisfaction but also the dimension of price tolerance. This factor of customer satisfaction corresponds in its construction and content most closely to the single-factor multidimensional construct by Galbreatha and Shum (2012) or Shrestha (2020) and Valvi and West (2013). This factor was constructed as general customer satisfaction (the first dimension) in line with the approach of Türkyılmaz and Özkan (2007), supplemented with the dimension of price tolerance in line with the approach of Yol and Serenko and Turel (2006).

Customer satisfaction seems to be affected by a number of factors depending on who investigated the concept and how. An appropriate approach lies in constructing factors based on specific customer demands, i.e., parameters which the customer considers important. Cerit and Küçükyazıcı and Kalem (2014) distinguish seven factors, another categorization is offered by Malaquias and Silva Júnior (2020), Hsiao (2013), Ahmad (2017) or Choudhury and Gulati (2020). The studies above lead to the conclusion that a large number of items were examined and subsequently (in some studies) categorized as parts of factors.

Even the number and conceptualization of the factors differ from author to author. A closer inspection reveals that two primary factors can be distinguish in regard to technical parameters: hardware and software (Cerit and Küçükyazıcı and Kalem, 2014; Malaquias and Silva Júnior, 2020). According to Kim et al. (2015) and Swanson and Taylor (2011), the primary hardware factors affecting customer satisfaction are network card (connection speed) and processor performance. One of the most often evaluated features and significant satisfaction parameters is battery life (Cerit and Küçükyazıcı and Kalem, 2014; Kim, 2011). This parameter is related to charging speed, which also significantly affects customer satisfaction (Ahmad, 2017; Kanagaraju and Karthikeyan, 2021). In relation to the growing trend of using smartphones to consume audio and video content, the importance of sound quality (Kochkin, 2002) and camera quality (Song, 2018; Ahmad, 2017) has increased.

Based on the above mentioned, the following hypothesis was stated:

H1: Satisfaction with a smartphone's hardware has a positive effect on customer satisfaction.

Software may then include the operating system, security and interconnectivity with other devices. A significant factor that directly (Kim et al., 2015) or indirectly (Shin, 2015) influences customer satisfaction is the operating system. Operating system is one of the factors which affect smartphone choice and purchase (Rajasekaran and Cindhana and Anandha Priya, 2018). The second factor is device security. Based on research by Roy and Halevi and Memon (2015), the majority of users protect access to their devices with some form of authentication and are concerned about their data. The third factor addresses satisfaction with the ecosystem of devices connected to the smartphone. Research by Kim et al. (2015) and Chang et al. (2011) shows that ecosystems of various manufacturers differ from each other. Based on the above mentioned, the following hypothesis was stated:

H2: Satisfaction with a smartphone's software has a positive effect on customer satisfaction.

Considering the large number of hardware items, design items were separated into their own factor. This is contrary to research by Malaquias and Silva Júnior (2020), but in accordance with the approach of Sabir (2020) and Hsiao (2013). Two factors addressed smartphone design. The first focused on the look of the device (appearance), i.e., satisfaction with size, weight, materials and style. The look of the device is therefore an important factor of customer satisfaction (Sabir, 2020; Haverila, 2011; Barkhuus and Polichar, 2011). The second factor was connected to device durability, such as resistance to scratching or breaking, water-resistance etc. Durability was suggested as a criterium for device choice by Işıklar and Büyüközkan (2007). Ahmad (2017) shows that the effect of durability on satisfaction is quite strong, Choudhury and Gulati (2020) on the other hand found a medium effect. Based on the above mentioned, the following hypothesis was stated:

H3: Satisfaction with a smartphone's design has a positive effect on customer satisfaction.

Research of customer satisfaction in the smartphone industry often includes brand image (Türkyılmaz and Özkan, 2007; Kusumah, 2018; Abubakar and Sugito, 2019; Diputra and Yasa, 2021). Although image and its parameters are not among the technical parameters such as hardware and software, it is still a significant factor, affecting customer satisfaction even more than price (Abubakar and Sugito, 2019) and quality (Kusumah, 2018). Kim et al. (2016) examined the effect of corporate image on customer satisfaction in parallel with product features and found corporate image showed the second most significant correlation with customer satisfaction, after technical soundness of the product.

Further two factors were concerned with manufacturer image and its effect on customer satisfaction. The first concerns brand image, which may be defined as how a current or future customer perceives the brand and what they connect with the brand (Haba and Hassan and Dastane, 2017). Research shows that brand image positively affects customer satisfaction (Chusnaini and Rasyid and Candraningrat, 2022). The second factor focused on the emotional connection between the customer and the brand (corporate image). During brand image building, it is important to capture the customer with an emotional experience (Nanda et al., 2008). Emotional connection with the brand in the smartphone industry and its effect on customer satisfaction was confirmed by Kim et al. (2016). Based on the above mentioned, the following hypothesis was stated:

H4: Satisfaction with a smartphone's image has a positive effect on customer satisfaction.

Research shows that consumers rate mobile services from a utilitarian as well as hedonic perspective (Novak and Hoffman and Duhachek, 2013; Van der Heijden, 2004). According to Zhang et al. (2014), the type of service affects the general purpose of features and services which will be used (utilitarian perspective). Furthermore, they examined the extent to which emotions affect choice and rating of a device by its user (hedonic perspective). Both perspectives were shown to affect customer satisfaction (Shin, 2015). Based on the above mentioned, the following hypothesis was stated:

H5: Customer's perception of utilitarian or hedonic value of the device has a positive effect on customer satisfaction.

### **3 METHODOLOGY**

#### **3.1 Questionnaire and Statistical Methods**

An online questionnaire was used to collect data for the quantitative research. This questionnaire contained closed questions focused on demographic data (age, gender, highest achieved education, job and size of town). These were supplemented with the type of smartphone the respondent owned. These questions were used to judge the representativeness of the sample of respondents. Another set of questions addressed the investigated variables and factors – hardware, software, design, image, utility/hedonicity and total satisfaction. These questions were evaluated on five-point Likert scales, in line with research by e.g. Shrestha (2020) and Diputra and Yasa (2021).

The structural equation modelling method (SEM) was used to analyse the data. Considering the large number of latent variables used to saturate the individual variables, as well as the number of factors and modelled mutual relationships, the sample size is appropriate for using the SEM method (see Wolf et al., 2013; Nachtigalla et al., 2003).

A number of tests were used to verify the robustness of the models. First, the Comparative Fit Index (CFI) was used. According to Bentler and Bonett (1980), values should not fall under 0.9. The second test used was the Tucker-Lewis Index (TLI). The minimal recommended value of TLI is 0.9 (Nazim and Ahmad, 2013; Bentler and Bonett, 1980). Next, Standardized Root Mean Square Residual (SRMR) was used. Generally, the maximum acceptable SRMR value is 0.08 (Shi and Maydeu-Olivares and DiStefano, 2018). Finally, the Root Mean Square Error of Approximation (RMSEA) was used. The maximum acceptable value for RMSEA is 0.08 (Hu and Bentler, 1999).

### 3.2 Research Sample

A research sample consisted of a total of 1,063 respondents from throughout the Czech Republic. The sample of respondents consisted exclusively of end consumers who purchased a smartphone for personal use. Data collection took place in November and December 2021. The respondents were contacted using various channels (Facebook, database of email addresses).

Comparison of chosen demographic characteristics of the sample and of the Czech Republic in 2020 (most recent available data) can be viewed in Tab. 1. There is a difference in gender composition between the sample and the Czech population, it is small enough (3 percentage points) to consider the sample representative. The situation is similar for samples by manufacturer: Apple – 51% men and 49% women, Samsung – 48% men and 52% women, Xiaomi – 52% men and 18% women.

*Table 1 – Demographic Characteristics (Preparing by Authors using Czech Statistical Office (2019, 2020a, 2020b))*

Demographic characteristics		Number of respondents in the sample		CR
		Absolute	%	%
Gender	Male	554	52%	49%
	Female	509	48%	51%
Size of town of residence	Under 1,000 residents	166	15.5%	17%
	1,000-6,000 residents	232	22 %	12%
	6,000-10,000 residents	92	8.5%	9%
	10,000-25,000 residents	97	9%	9%
	25,000-50,000 residents	111	10.5%	12%
	Over 50,000 residents	365	34.5%	41%

The sample can also be considered representative regarding the size of the respondent's town of residence, where the sample structure matches the structure of Czech population in four parameters out of six (the maximum difference is

1.5 percentage points here) and only two parameters differ in a more significant way (6.5 and 10 percentage points respectively). The situation is similar again for the samples by manufacturer: Apple has the largest deviation for the four parameters mentioned 1.7%, for the other two 8.1% and 9.4%; Samsung – 1.3%, 5.7% and 11.2%, Xiaomi – 1.3%, 6.1% and 10.8%.

Regarding age structure, education and job, the differences between the sample (including samples by manufacturer) and Czech population are large enough to reject representativeness of the sample in these parameters. These other demographic characteristics are shown in Tab. 2.

Table 2 – Additional Demographic Characteristics

Demographic characteristics		Number of respondents in the sample		CR
		Absolute	%	%
Age group	Under 14	20	2%	16%
	15-24	257	24%	9%
	25-44	531	50%	28%
	45-64	227	21.5%	27%
	65 and older	28	2.5%	20%
Education	Primary	128	12%	13%
	Secondary without state exam	155	14.5%	33%
	Secondary with state exam	573	54%	34%
	Tertiary	207	19.5%	20%
Job	Student	237	22%	16%
	Unemployed	26	2.5%	1%
	Employee	637	60%	49%
	Entrepreneur	130	12%	12%
	Pensioner	33	3%	22%

Representativeness of the sample was further checked from the perspective of smartphone ownership in the Czech market (see Tab. 3). Although the Czech smartphone market contains hundreds of different smartphone models, it is divided between four largest manufacturers, who collectively control almost 90% of the entire market.

Table 3 – Brands Most Represented in the Sample (Preparing by Authors Using Statcounter (2021))

Manufacturer	Number of respondents		CR
	Absolute	%	%
Apple	298	28%	27.91%
Samsung	272	25.6%	22.9%
Xiaomi	255	24%	23.38%
Huawei	109	10.3%	13.63%
Other	129	12.1%	12.18%

Characteristics in Tab. 3 shows that the sample is representative regarding the structure of smartphones sold, as the relative differences between smartphone brands represented in the sample and in the population is minimal, with the greatest difference reaching only 3.33 percentage points (in case of Huawei).

## 4 RESULTS AND DISCUSSION

In this section, results of the three partial models of customer satisfaction for the brands Apple, Xiaomi, and Samsung will presented, followed by the summary model of satisfaction for the entire industry.

### 4.1 Apple

The model of customer satisfaction for Apple smartphones is visualized in Fig. 1. CFI and TLI values were both 0.999, RMSEA value was 0.043 and SRMR was 0.057. P-value of the model:  $p < 0.01$ . Each of the relationships within the model is statistically significant, but some of the coefficients (hardware and utility/hedonic) are very low, their impact on Apple customer satisfaction is therefore minimal (negligible) and so we will not deal with them further.

Every formulated hypothesis can be considered confirmed, except H3, which is concerned with design. It is interesting that the relationship between design and customer satisfaction is negative, i.e., that design reduces customer satisfaction. Although this relationship is weak, it is statistically significant. No conclusions can be made whether design (including looks and durability) is less important for the Czech customer. On the other hand, the research shows that it is the third most important factor (factor with the third strongest influence on customer satisfaction).

The influence of the other factors on customer satisfaction is positive, with software having the strongest effect, followed by image. The factor with the weakest effect are hardware and the utility vs. hedonicity.



Security (1.13) and ecosystem (1.06) have a stronger effect on total satisfaction than the operating system itself. This may be caused by the fact that iOS has been in gradual development for years. On the other hand, security and ecosystem have seen more radical changes in Apple smartphones. Mohamed and Patel (2015) argue that iOS is more resistant to attacks than Android, especially due to restrictions within the only application marketplace – the App Store. Satisfaction with security has been growing over recent years primarily due to 3D face scanning technology Face ID, which, according to Bud (2018).

As for the Apple ecosystem, Bosch (2009) argued that the most important factor in the success of software ecosystems is the number of customers using the operating system who are available to developers for monetization. Furthermore, according to Tilson and Sorensen and Lyytinen (2012), contrary to iOS devices, Android devices have access to multiple stores. Some websites offer unverified and unofficial applications outside of the Android Google Play store. Owners of iOS devices therefore encounter a lack of opportunities to install apps.

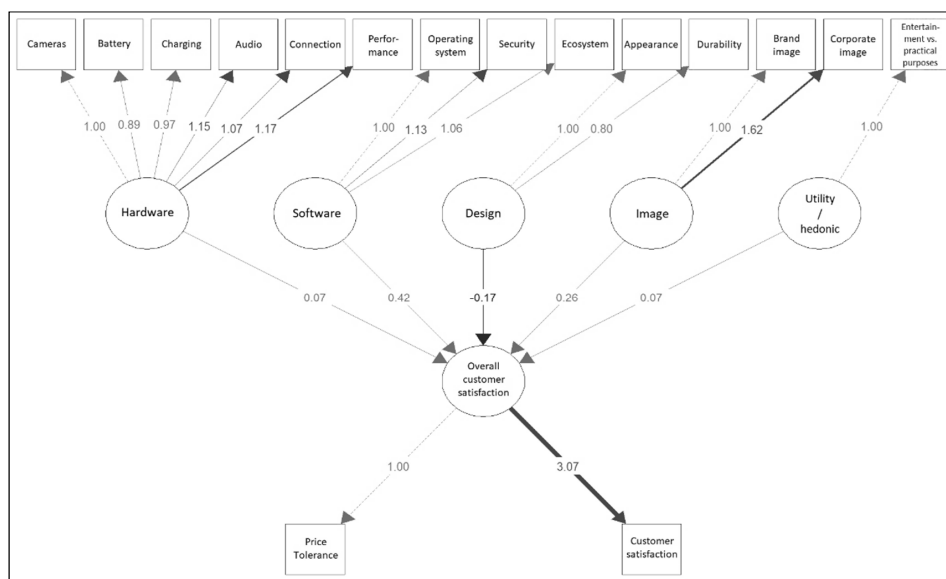


Figure 1 – Partial Model of Customer Satisfaction for Apple Smartphones

The emotional relationship of an individual with the Apple brand has a stronger effect than the brand itself, which is not surprising considering the longevity of the device and its support. As asserted by Eaton et al. (2015), the iOS system receives constant incremental changes, which made it an example for the industry and many competitors from among Android manufacturers attempt to replicate Apple’s success by prolonging the software support for their devices.

Cusumano (2010) argues that from a long-term perspective, the most valuable asset of a company is and will remain its online services and platforms. The negative relationship between Apple smartphone design and customer

satisfaction can be understood from several perspectives. Apple's results correspond to some extent with the fact that Apple aspires to a specific design (Dospinescu, Florea, 2016), which is not very appreciated by Czech customers. On the other hand, the lower weight of the influence of this indicator on satisfaction found in this research corresponds with Apple's focus on other factors, especially image (Dospinescu and Florea, 2016).

Smartphones in general increase in size, weight, and volume year by year. According to Dospinescu and Florea (2016), the shape, size and material of the smartphone are among the most significant factors in satisfaction with the design. A study by Evelyn (2019) demonstrates dissatisfaction of customers with Apple design especially due to construction faults. Customers (including Czech) also perceive the Apple smartphone as a luxury brand with a higher price (Kapferer, 2016; Malá, 2020), they perceive negatively that at first glance this smartphone does not differ (in appearance or endurance) from others.

## 4.2 Xiaomi

Customer satisfaction model for Xiaomi smartphones is visualized in Fig. 2. CFI values reach 0.993, TLI values reach 0.99, RMSEA reaches 0.077 and SRMR reaches 0.075. P-value of the model:  $p < 0.01$ . Each relationship in the model is statistically significant, but some of the coefficients (image and utility/hedonic) are very low and their impact on Xiaomi customer satisfaction is therefore minimal (negligible).

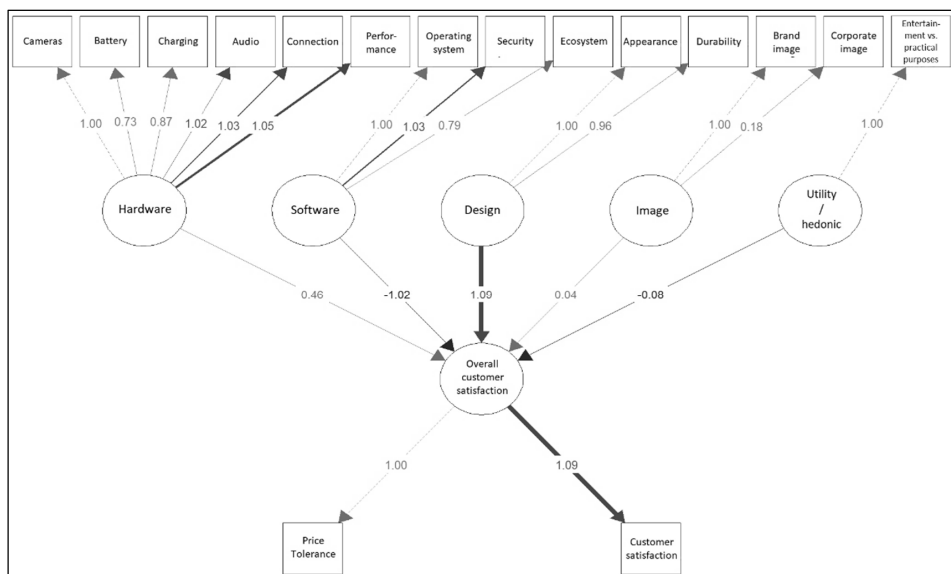


Figure 2 – Partial Model of Customer Satisfaction for Xiaomi Smartphones

Every formulated hypothesis can be considered confirmed, except H2 and H5, which were concerned with software and utility/hedonicity. It is interesting

that the effects of both software and especially utility/hedonicity on customer satisfaction are negative. It runs contrary to previous research, which asserted that the effect of utility/hedonicity on customer satisfaction is positive, regardless of preference for either hedonicity or utility (Shin, 2015). The negative effect of utility/hedonicity is rather very weak and so we will not deal with them further (together with image). In contrast, the negative effect of software is the second strongest.

It seems that software does not bring greater satisfaction to customers (especially security followed by ecosystem and operating software), which then projects into lower customer satisfaction. This brings about the question whether the lower satisfaction is caused by inadequate price or by specific parts of the software.

The effect of the other factors is positive, with design having the strongest effect (especially looks, followed by durability). This is followed by hardware (especially performance, connectivity, audio and photo). General satisfaction of the respondent with their device also has a relatively strong effect, though significantly weaker than in the case of Apple. Effect of price tolerance is comparable to effect of general satisfaction (equivalent to Apple's case).

Based on results of the model for Xiaomi, the conclusion can be made that owners of these smartphones perceive their satisfaction completely differently than Apple users. Performance is the most important variable in the hardware factor (1.05), with the ecosystem variable being the least important in the software factor. This is primarily because Xiaomi is a young company in CR (from 2016) – its ecosystem exists, but it is not based on software and interconnected devices through its own operating system. In this aspect, Xiaomi is dependent on Google (Martinásek, 2021). According to Tong and Guo and Chen (2021), Xiaomi creates an ecosystem through contracts with gadget manufacturers which allows it to quickly penetrate markets, as opposed to Apple, which focuses on a closed ecosystem of devices and operating systems. Xiaomi's ecosystem can work with devices from Apple and other manufacturers. While in China Xiaomi (in terms of software and especially the ecosystem) has a similarly strong position as Apple in the CR (and in the world) (Sun and Fah, 2020), in the CR its position is significantly weaker and it cannot take advantage of the benefits (especially the ecosystem = connecting other devices) as in China (Martinásek, 2021). This is the main reason for the strong negative impact of software on Xiaomi's customer satisfaction in CR.

There is a significant difference in emotional bonds with brand between Xiaomi and Apple. The emotional bond to Xiaomi is more than eight times worse than to Apple. Though Xiaomi does maintain a community, it has yet to build up a customer base as loyal as Apple. Additionally, Xiaomi includes a protective silicone case in the packaging of its smartphones, which may explain the positive effect of design on customer satisfaction. Garg et al. (2018) confirm that owners of Xiaomi smartphones are very satisfied with the quality, looks and design.

Badiangsie and Lapien and Tumbuan (2019) confirms strong customer satisfaction with the design (especially the appearance) of Xiaomi.

Software has a strong negative effect on Xiaomi customer satisfaction, which may be caused by the Android based MIUI custom ROM created by a community in China. This lower satisfaction is caused by faults in this expansion over recent years, where even stable versions of the operating system encountering trivial glitches. According to Pee et al. (2019), MIUI glitches are fixed in Chinese beta versions of the operating system, where each user may receive a ranking for reporting bugs, which allows them to vote on prioritization of other bugs to be fixed.

### 4.3 Samsung

Model of customer satisfaction with smartphones for Samsung is visualized in Fig. 3. CFI value reached 0.995, TLI value reached 0.993, RMSEA is 0.073 and SRMR is 0.055. P-value of the model:  $p < 0.01$ . Each relationship in the model is statistically significant, but some of the coefficients (design and utility/hedonic) are very low and their impact on Samsung customer satisfaction is therefore minimal (negligible).

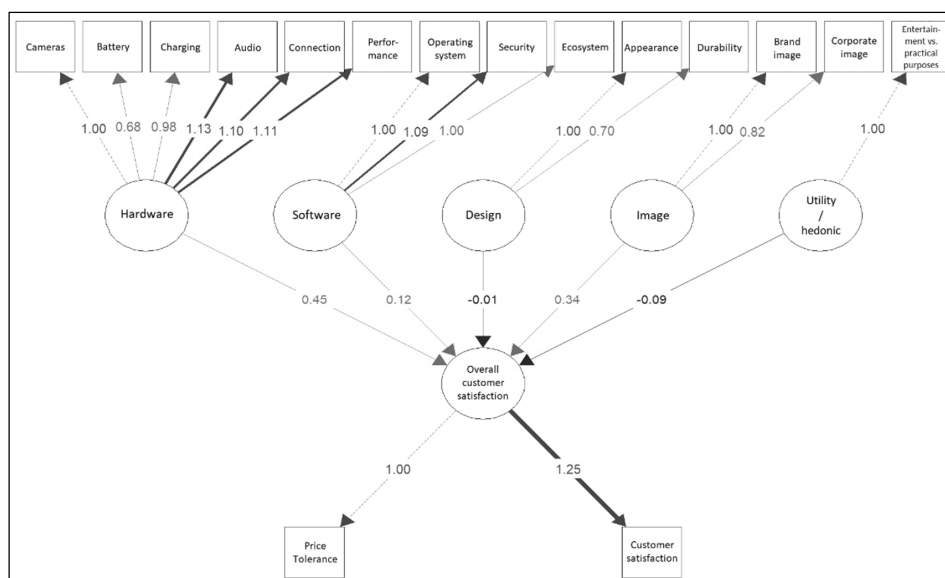


Figure 3 – Partial Model of Customer Satisfaction with Smartphones for Samsung

Each formulated hypothesis was confirmed except H3 and H5, which have to do with design and utility/hedonicity, however, their impact on customer satisfaction is negligible and so we will not deal with them further.

Effect of the remaining factors is positive, with hardware having the strongest effect (especially audio, connectivity, performance and camera). This is similar to Apple's case. Next in line is image (brand image followed by emotions). The effect of software can be classified as weaker (security is the most important item in this factor). General satisfaction with the device also has a relatively strong effect on total satisfaction (this is stronger than in Xiaomi's case, but significantly weaker than in Apple's case). Effect of price tolerance is weaker (same as in Apple's and Xiaomi's cases).

Owners of Samsung devices value hardware quality much more (six times as much) than Apple users. One of the key items which affected satisfaction with Samsung's hardware was performance (1.11). However, Halpern and Zhu and Reddi (2016) warn that current techniques of smartphone-specific processor development have poor future prospects, as they do not fit within temperature limits and energy-consumption limits. Samsung as a company should consider investment into new processor development, or focus on software optimizations.

Contrary to Xiaomi, Samsung has fewer issues with its Android overlay One UI than Xiaomi, which is reflected in the positive effect of software on customer satisfaction. According to Thomas and Devi (2021), MIUI in recent years had problems with a lagging basic launcher, with short battery life, overheating, security updates and with GPS. One UI has features similar to MIUI, however, using One UI requires owning more expensive hardware within the price category compared to Xiaomi.

Samsung's brand image is positive, mainly due to the brand image item, with a comparatively lower effect of emotions. Similar results (including the strength of the effect of image on customer satisfaction) were obtained by Abubakar and Sugito, (2019). The strength of the effect of image on customer satisfaction in CR is higher for Samsung than for Apple (although the effect is strong and positive in both cases), which corresponds with the results of Havard et al. (2021).

#### **4.4 The Smartphone Industry**

The summary model of customer satisfaction for the entire industry is visualized in Fig. 4. CFI value reaches 0.996, TLI is 0.995, RMSEA is 0.06 and SRMR is 0.046. P-value of the model:  $p < 0.01$ . Each relationship within the model is statistically significant, but some of the coefficients (utility/hedonic) are very low and their impact on smartphone industry customer satisfaction is therefore minimal (negligible).

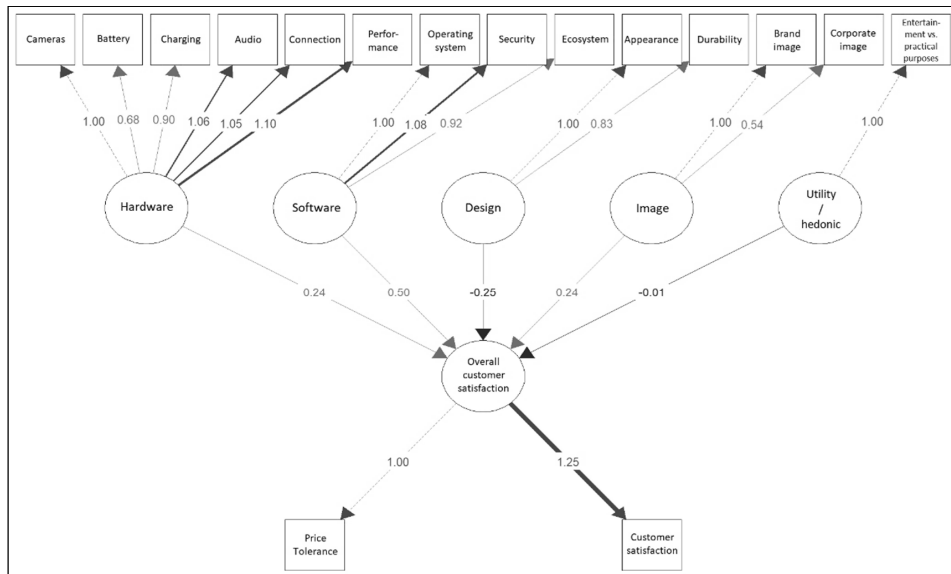


Figure 4 – Summary Model of Customer Satisfaction in the Smartphone Industry

Each hypothesis was confirmed except H3 and H5, concerned with design and utility/hedonicity.

In Tab. 4, you can see a comparison of the strength of the impact of each of the factors examined on customer satisfaction by manufacturer and across the industry.

Table 4 – The Strength of the Impact of Each Factor on Customer Satisfaction by Manufacturer and Across the Industry in the Czech Republic

Manufacturer	Hardware	Software	Design	Image	Utility/hedonic
Apple	0.07	<b>0.42</b>	-0.17	0.26	<b>0.07</b>
Samsung	0.45	0.12	-0.01	<b>0.34</b>	-0.09
Xiaomi	<b>0.46</b>	-1.02	<b>1.09</b>	0.04	-0.08
Smart phone industry	<b>0.24</b>	<b>0.50</b>	<b>-0.25</b>	<b>0.24</b>	<b>-0.01</b>

The negative effect of design on satisfaction is in line with the cases of Apple and Samsung. The relationship between utility/hedonicity is similar to the cases of Xiaomi and Samsung. The negative effect of design is relatively strong, the effect of utility/hedonicity is very weak and therefore there is no purpose in dealing with it further. Both negative effects are statistically significant.

Respondents' satisfaction with design (primarily looks followed by durability) is low, which reduces to total satisfaction with smartphones. According to Cordella et al. (2021), the entire industry should consider using stronger materials for the

rear side of the smartphone, as well as designing their devices with greater impact resistance in mind. Thus, it seems that the low satisfaction with design is not caused by price, but directly by the design itself (especially durability). This is because price tolerance has a positive effect on total satisfaction (Yol and Serenko and Turel, 2006), from which it follows that it is relatively high.

The effect of other factors on satisfaction is positive, with software having the strongest effect (especially security), in line with Apple's case; followed by image (primarily brand image). The effect of hardware is the same as image (within this factor, performance, audio and connectivity are the most important items).

Research has confirmed the positive relationship of image on customer satisfaction (Chusnaini and Rasyid and Candraningrat, 2022; Kim et al., 2016). This relationship is quite strong, both in the industry model and in Apple and Samsung smartphone models, which corresponds to the strength of the image itself (especially brand image) of the three strongest manufacturers: Apple, Samsung and Huawei, and explains the weak impact of Xiaomi a customer satisfaction due to weak brand image (Valjaskova and Kral, 2019).

## 5 CONCLUSION

The constructed models of customer satisfaction in the smartphone industry proved the effect of hardware, software, design, image, and utility/hedonicity on customer satisfaction. The impact of design and utility/hedonicity was generally negative (Samsung Xiaomi), but very small to negligible (which was also reflected in the smartphone industry model) and therefore not relevant to take into account.

The negative effect of design (Apple, Samsung) is primarily connected with materials and size, as well as with the smartphone's durability. It seems that users are not satisfied with these attributes, which projects into a negative effect on total satisfaction. The effect of this factor is relatively weak (except Xiaomi). This means that durability and construction are very important parameters for (increasing) customer satisfaction only from Xiaomi. The effect of design is relevant for Apple, where this negative effect is the third strongest, but less for Samsung, where it is quite weak. In Xiaomi's case, design has the strongest and most positive effect, meaning that other manufacturers can take inspiration from this company's design. However, research results with smartphone satisfaction show that the influence of durability is moderate and appearance is weak but positive (Malaquias et al., 2020).

The influence of software is positive for Apple (it is the strongest factor in this model), the influence is weaker for Samsung (it is the third strongest factor in the model) and the strongest factor is in the Xiaomi model, where its influence is negative. The research shows that software is very important for smartphone users' satisfaction, and it needs to function perfectly in order to increase

satisfaction. For Xiaomi, this means improving its software to eliminate defects or at least minimize their number and severity so that customers start to perceive it positively.

There are also significant differences in the hardware and image factors. In the case of Samsung, hardware is the dominant factor and image is the second strongest. For Xiaomi, the strong influence of hardware is confirmed, but the influence of image is the smallest. In the case of Apple, the opposite is true - hardware has the weakest influence and image the second strongest. The research shows that both of these factors are important for Samsung's customer satisfaction, for Xiaomi, hardware is more important and for Apple, image is more important. This confirms the strength of brand image, where the top three brands are Apple, Samsung and Huawei, which in the case of the Czech Republic has also influenced the whole smartphone industry.

The results show the unique situation of the examined manufacturers in terms of the direction and strength of the relationships between factors and satisfaction. Apple's customer satisfaction is most influenced by (positive) software and image and (negative) design, while Xiaomi's customer satisfaction is most influenced by (positive) design and hardware and (negative) software. Samsung's customer satisfaction is most influenced by (positive) hardware, image and software.

Furthermore, the research reveals a two-dimensional approach to customer satisfaction as viable, where general satisfaction was supplemented by price tolerance. The strength of price tolerance (relatively significant compared to general satisfaction, in partial models for Samsung and Xiaomi) proves the significance of this variable not only in models of customer satisfaction, but also in satisfaction as its own factor.

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Conceptualization, R.S. and P.S.; Methodology, R.S.; Software, R.S.; Validation, R.S.; Formal analysis, R.S. and P.S.; Investigation, R.S.; Data curation, R.S.; Original draft preparation, P.S.; Review and editing, P.S.; Visualization, R.S.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.



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