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THE PARADOX OF PERCEIVED AND ACTUAL PERFORMANCE AND A TYPOLOGY OF MOBILE NETWORK USERS

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THE PARADOX OF PERCEIVED AND ACTUAL PERFORMANCE AND A TYPOLOGY OF MOBILE NETWORK USERS

Research paper

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Abstract

From an information and communication technology (ICT) point of view, the question whether actual, measurable performance of ICT can alter customer satisfaction and continuance intention is not accounted for sufficiently in previous research. Companies align their budgets according to successful operational outcomes. In accordance, the technology related departments are often blamed when targets are not met, and lack evidence for influencing outcomes. Therefore, this research proposes a variation of Expectation Confirmation Theory by integrating Herzberg’s (1966) Two-Factor Theory to account for measurable operational ICT performance as hygiene factor as well as perceived performance as motivational factor in the satisfaction and continuance intention discussion. We examine this theoretical advancement by investigating the use case of a German mobile network operator. Findings suggest that actual network performance in terms of call failures negatively contributes to perceived performance, but not to satisfaction. To account for this striking result, we propose a typology of users derived from a two-step cluster analysis. Our proposed typology of users shows different levels of sensitivity to network issues and that call failures, rather than problems with data connections, can lead to dissatisfaction with a mobile network.

Keywords: Expectation-Confirmation Theory, Two-Factor Theory, Perceived Performance, Actual Performance, Structural Equation Modelling, Cluster Analysis.
1 Introduction and background

User satisfaction and, in consequence, successful continuance intention, have been studied intensively in ICT research and related disciplines. Previous ICT research often focused on behavioural related determinants to account for user satisfaction, such as trust, brand image, reputation, perceived value, perceived usefulness and perceived ease of use (Fang et al., 2014; Calisir and Calisir, 2004; Kim et al., 2013; Wixom and Todd, 2005; Davis et al., 1989; Laumer et al., 2017). Other studies focus on the evaluation of expectations and post-usage experience (Bhattacherjee, 2001; Brown et al., 2008). This research elaborates on a different perspective. While the mentioned constructs are undoubtedly important and should be considered in both research and practice, another set of issues for poor customer satisfaction occurs from a technological point of view. Thus, the inclusion of performance data in the analysis to account for actual performance in addition to surveying perceived performance can provide new insights into user satisfaction.

To address this matter, we use the case of a German mobile network operator (MNO), because its core business thus operational success relies on its technological infrastructure. The number of mobile cellular subscriptions worldwide has been growing exponentially since the 1990s. Nowadays, over 7,740 million mobile cellular telephone subscriptions are present (ITU, 2017). Meanwhile, the number of fixed telephone subscriptions is decreasing, with 972 million subscriptions in 2017 worldwide (ITU, 2017). As for the development of fixed and mobile network subscriptions, the growing rate of mobile network subscriptions outpaces the number of fixed subscriptions by far, transforming every-day life across the globe and thus becoming an essential means of communication for consumers (ITU, 2017; Tyufekchieva and Reichhart, 2018). Thus, the mobile network market is of increasing importance worldwide.

The German mobile network market is oversaturated and as such one of the leading markets in Europe with 135 million active SIM cards, that is 1.68 per inhabitant, with about 70% being fixed contracts (VATM, 2017). 50.4% of the total revenue occurs from data traffic, whereas voice services account for 38.4%. The volume of data traffic rose considerably in the past few years. In 2017, 1,350 billion Gigabyte data traffic was consumed in Germany, 60.2% of which using Long-Term Evolution (LTE) technology (VATM, 2017), as opposed to an European average of 41% (GSMA, 2018). LTE is a standard for wireless mobile communication with a considerably higher speed capability compared to earlier standards such as UMTS.

Even though LTE comes at a higher cost, the increased speed capability was previously proven to be a stimulus to switch contracts from a slower network functionality type such as UMTS to LTE (Kitchen et al., 2015; Park and Joon Kim, 2013). The wide penetration of smartphones and mobile broadband access has increased the competitiveness in mobile network markets not only in Germany but worldwide. Companies face high churn rates and it is challenging to prevent existing customers from moving to a new MNO since switching costs were reduced significantly over the past ten years (Deng et al., 2010; Zhou and Lu, 2011; Oghuma et al., 2016). This highly competitive environment especially applies to Germany for two reasons. First, the German mobile network market is an oligopoly with the three large mobile network operators: Telekom, Vodafone and Telefónica, that have almost equal market shares between 30% and 34%. Second, the German mobile network market has one of the highest price levels in Europe, despite the high penetration with active SIM cards.

The mobile network service is a continuous contractual transaction. Therefore, once a customer is acquired, maintaining this relationship is of utmost importance to the economic success of a MNO, because services are homogenous amongst operators with similar pricing models (Calvo-Porral et al., 2017; Gerpott et al., 2001; Kim, 2010). This especially applies to customers with fixed contracts due to the larger margin for an MNO. These contracts are usually pricier but offer benefits such as reduced prices for mobile devices. Despite the lock-in nature of fixed contracts and due to the intense competition, previous research found these switching costs had surprisingly low influence on the switching intention (Calvo-Porral et al., 2017). Moreover, fixed contract customers are difficult to regain after contract termination (Gerpott and Ahmadi, 2015). Because of their importance for the operational success of an MNO, fixed term customers were in the centre of previous research, for example with regard to proactive
churn management (Gerpott and Meinert, 2018; Gerpott and Ahmadi, 2015). Hence, this research also focuses on fixed contract customers.

Customers tend to blame the lack of investment in mobile network infrastructure for connection issues. These connection issues include for example failed calls or whether there is a gap between the actual speed of a data connection that a user subscribed to and the speed the MNO actually provides. The reasons for these issues are multifaceted and include network coverage, network expansion and the nationwide availability of LTE networks as well as malfunctions of transmitting infrastructures. Hence, corporate management of MNOs tends to blame technology for high churn rates without clear evidence for a causal relationship between actual performance of a network and customer satisfaction or continuance intention, respectively. Consequently, this research addresses the possible gap between how good a customer thinks the network performs and how good it actually performs. This research therefore aims at disclosing the role of actual network performance, along with perceived network performance in customer satisfaction and continuance intention. In so doing, we define the following research questions:

1. Can actual, measurable performance of the mobile network alter customer satisfaction?
2. Is actual poor performance of a mobile network really to blame for poor perceived network performance?

2 Theoretical foundation and hypotheses development

The expectation-confirmation model (ECM) (Oliver, 1980) is rooted in psychology and marketing literature, but has been studied extensively in ICT research to elaborate on user satisfaction and ICT continuance intention in general (Oghuma et al., 2016; Bhattacherjee, 2001; Chiu et al., 2005; Halilovic and Cicic, 2013; Venkatesh et al., 2011). In the narrow context of mobile technologies, it has been validated in the context of MNOs for example with regard to payment (Lu et al., 2017), messaging services (Oghuma et al., 2016), or mobile value-added services (Wang, 2015). The underlying expectation-confirmation theory (ECT) states that customers’ formation of repurchase intention and thus, retention, follows a sequential process as displayed in figure 1.

![Expectation-Confirmation Theory](image)

*Figure 1. Expectation-Confirmation Theory (Bhattacherjee et al., 2012)*

The process starts with the initial expectation prior to a purchase of a product or service and then, after initial consumption, continues with the formation of perceptions about performance in comparison to the original expectation. The degree to which perceived performance meets expectations determines the
satisfaction level (Halilovic and Cicic, 2013). In the context of an MNO, satisfaction refers to a customer’s experience-based evaluation of the service (Gerpott et al., 2001). According to Bhattacharjee (2001), the perceived post-consumption usefulness is represented as ex-post perceived usefulness of ICT continuance intention. It captures the instrumentality of ICT use and thus influences subsequent continuance decisions (Bhattacharjee, 2001; Bhattacharjee et al., 2012). In the context of this research, we examine the perceived network performance to account for the ex-post usefulness. In contrast to pre-performance perceived usefulness of the Technology Acceptance Model (Davis, 1989) and related IS acceptance models such as UTAUT (Venkatesh et al., 2003), the measure of perceived performance employed in this research assesses the post-usage usefulness and thus the post-consumption expectations that may differ from those prior to the use of the technology (Bhattacharjee et al., 2012). This includes concepts of perceived reliability and responsiveness regarding data and call connections as well as overall perceived quality of the network and perceived network coverage.

H1. Perceived network performance is positively related to customer satisfaction.

Although the Post-Acceptance Model of ICT continuance that builds on ECM is widely accepted and cited, and rightly influential in ICT research, Bhattacharjee (2001; 2012) did not account for the possibility that customers are dissatisfied with ICT. Bhattacharjee (2001; 2012) assumed that user satisfaction is basically the opposite of user dissatisfaction. Contrastingly, previous ICT research found that there is a positive-negative asymmetry effect meaning that negative events will have longer lasting and more intense impact on satisfaction than positive events of the same type (Cheung and Lee, 2005). This positive-negative asymmetric effect is closely aligned with the loss aversion described in prospect theory (Cheung and Lee, 2005; Kahneman and Tversky, 1979). This suggests that there are factors that contribute negatively to satisfaction and the users’ perceptions of ICT. Previous research for example considered inhibitors as “individual-level beliefs that foster technology rejection rather than acceptance” (Cenfetelli and Schwarz, 2011). Moreover in a different context, past studies on job satisfaction and job dissatisfaction have shown that the notion of satisfaction and dissatisfaction as opposites may not be true because eliminating employee dissatisfaction does not in turn improve satisfaction (Herzberg, 1966). According to his two-factor theory, Herzberg (1966) argues that antecedents to satisfaction fall into categories of hygiene and motivating factors. As displayed in figure 2, motivating factors positively or negatively relate to overall satisfaction, while hygiene factors cannot positively contribute to satisfaction, but negatively (Herzberg, 1966). The positive evaluation of a hygiene factor would lead to no dissatisfaction, but not, in turn, to satisfaction.

![Diagram of Two-Factor Theory](image_url)

**Figure 2. Two-Factor Theory (Herzberg, 1966)**
Previous research showed that this theory can be applied to the context of ICT research and that technology rejection can be caused by inhibitors (Cenfetelli and Schwarz, 2011). In the context of user experience, an example of an inhibiting hygiene factor is technical quality whereas utility and convenience were identified as motivators (Tuch and Hornbæk, 2015).

Combining this theoretical view with ECM, the potential disconfirmation of believes cannot only occur by the comparison of expectations and perceived performance, but also by hygiene factors that, if not met, negatively contribute to satisfaction. In IS research, the consideration of hygiene factors within an ECM has been examined in the context of e-learning, revealing that e-learning educators’ satisfaction is generated by both environmental and job-specific factors, while dissatisfaction is generated by environmental factors only (Islam, 2011). More recently, two-factor theory was extended to adoption behaviour in the context of mobile apps (Chen et al., 2018). In the same way, Buchwald et al. (2018) reported that hygiene factors could generate dissatisfaction, not satisfaction, for wearable self-tracking devices. In sum, previous post-acceptance research for MNO services focused on geographic region, personal characteristics of the user, perceptions regarding the MNO or service, or usage conditions as independent variables (Gerpott and Thomas, 2014), thus lacking the differentiation of perceived and actual performance of information systems.

In the research domain of mobile technology adoption, different research domains such as marketing, psychology, and ICT are linked to develop synergistic research models (Kranz, 2012). Following the theoretical considerations of ECT and two-factor theory, this research therefore alters the confirmation dimension of ECM as displayed in figure 3.

**Figure 3. Research model**

The functionality and availability of a mobile network can be considered a hygiene factor, because that a mobile network performs the way it should is simply taken for granted by users in developed countries. This is in line with previous research, where technical quality has been identified as hygiene factor in user experience design (Tuch and Hornbæk, 2015). Hence, good actual performance will not improve perceived performance, but poor performance has the potential to lower the perceived performance. In line with our second research question, we hypothesise

**H2.** Poor actual network performance is positively related to low perceived network performance.

Buchwald et al. (2018) showed that for self-tracking devices, hygiene factors such as system unreliability can negatively influence post-usage behaviour. Drawing on the theoretical foundation and the integration of ECT and two-factor theory, actual network performance can be a creator of dissatisfaction when perceived as insufficient not necessarily contributes to satisfaction beyond being perceived as acceptable. In other words, because actual network performance is considered a hygiene factor, it can negatively contribute to satisfaction when being poor, but not positively contribute to satisfaction when being good. Thus, in addition to asking users whether they perceive that their expectations have been
met as done in the confirmation dimension of ECM, we use data provided by the MNO on how network performance actually was in the observation period. This allows us to isolate the technological component of satisfaction. Alongside, this approach addresses the ECM critique that the evaluation of expectations and perceived performance is not accurate, because expectations can change over time (Brown et al., 2008). Moreover, we thereby reduce the issue of response bias that is an issue in survey studies. In line with our first research question, we hypothesise

H3. Poor actual network performance is positively related to low customer satisfaction.

In previous research, customer satisfaction with MNOs has been studied extensively (Hossain, 2013; Aksoy et al., 2013; Calvo-Porral and Lévy-Mangin, 2015a; Calvo-Porral et al., 2017; Deng et al., 2010). Satisfaction is seen as important determinant of customer retention in the service industry (Zeithaml et al., 1996). The prerequisite for retention is continuance intention. Continuance intention has been examined from different perspectives. On the one hand, ICT continuance is considered an extension of acceptance behaviour and satisfaction (Kim and Malhotra, 2005). On the other hand, it is argued that inconsistencies between users’ expectations and the perceived actual outcomes of ICT determine satisfaction and, ultimately, the intention of future use (Bhattacherjee, 2001). Both views have in common that the intention is the foundation of actual acting behaviour, whereas there may be cases where customers act different from their intentions (Bhattacherjee, 2001). Variables such as switching costs need to be accounted for in this regard, which is not in the focus of this research. Continuance intention is different from intentions regarding the intention to initially subscribe to an MNO offer (Gerpott and Thomas, 2014). In more detail, continuance intention is defined a deliberate plan of an individual to continue usage of the contract, in other words not to terminate it (Gerpott and Thomas, 2014). This is not directly observable and is measured by subjective introspection, in accordance with previous research (Gerpott and Thomas, 2014). Based on our previous line of argumentation, we consider ICT continuance intention determined primarily by the satisfaction with prior IT use.

H4: Customer satisfaction is positively related to continuance intention.

3 Research design and results

3.1 Questionnaire and sample characteristics

A questionnaire survey was used to collect data on customer satisfaction, perceived network quality, and continuance intention. The constructs used in this study are derived from established and evaluated previous research to ensure validity of the sample. Continuance intention was measured in accordance to Bhattacherjee (2001). The satisfaction construct was derived from Chuah et al. (2017) and Walsh et al. (2009), in accordance with our notion of satisfaction in the theoretical foundation section of this paper. Perceived network performance was measured following Bhattacherjee (2001) as well as Finley et al. (2017) to make sure the instrument matches our case. Translation and adaption of the instrument have been made using forward-backward translation by several researchers to maintain equivalence of the items. We conducted a pre-test to ensure that all items were developed properly and show consistency. Items were measured on a 5-point Likert scale with anchors ranging from “strongly disagree” to “strongly agree”.

In cooperation with a major German MNO, we sent out a text message in early 2018 with the invitation link to the mobile survey to randomly selected private customers of the MNO with fixed contracts featuring LTE technology. Users were able to participate only once in the survey. Response rate was 3.2%, which is, according to the MNO, in line with previous surveys that were sent out using a SMS link.
We obtained data on actual network performance from the MNO for each respondent, regarding both calls and data connections. Data was collected by the MNO for up to 90 days prior to the survey until the individual date the survey was completed. We were thereby able to add two formative measures. First, call failure rate, which was determined per customer as ratio of all attempted or actual calls and the number of failures prior to the survey, was calculated. Second, data failure rate was determined as ratio of all attempted or actual LTE connections over the mobile network and the number of failures prior to the survey.

Customers were selected randomly by the MNO. 59.4% of the respondents were male, 39.6% female. The mean year of birth was 1974.94, i.e. almost 1975, with a SD of 14.1/3 years. Age and gender were part of the survey (self-reported) as well as of the data set obtained by the MNO (objective data). We eliminated all responses without matching data for these two variables to ensure high quality of the data set. We obtained valid responses of n=998 customers.

3.2 Measurement model

We used a PLS SEM approach in this research (Hair et al., 2017) using SmartPLS. The main reason to choose a PLS approach over covariance-based (CB) SEM was that we included formative variables with the actual network performance data (Hair et al., 2017). Since PLS-SEM is not based on covariances and thus does not have a fit measure, we assess the model using reliability and validity metrics for the reflective constructs (Hair et al., 2017). To test validity of the constructs, we conducted a confirmatory factor analysis. Three factors were extracted. Each indicator loads higher on its respective construct than on other latent variables (Chin, 1998). The measurement model is further assessed by examining the average variance extracted (AVE), composite reliability, and Cronbach’s Alpha of the constructs. The AVE is a measure that explains how well a latent variable is captured by its indicators. AVE values should be greater than .5, i.e., more than 50 percent of the variance of an indicator should be explained by its respective construct, indicating that the majority of the variance is accounted for by the respective construct (Chin, 1998). Table 1 shows that convergent validity is given, with AVE values ranging from .683 to .878. Composite reliability (CR) is a measure of internal consistency. The acceptable value of CR is .7 and above (Hair et al., 2010). All constructs show good composite reliability as displayed in table 1. Additionally, reliability is assessed using Cronbach’s Alpha measure of internal consistency. The reliability coefficient Cronbach’s Alpha is above .7 for all constructs as shown in table 1. Thus, a good level of internal consistency is reached (Cronbach, 1951). Discriminant validity is used to assess the extent to which a specific construct is different from the other constructs. To evaluate discriminant validity, the square root of the AVE of each latent variable is supposed to be greater than the correlations between the latent variable and the other latent variables (Chin, 1998). Table 1 hence shows on the diagonal that the strict Fornell-Larcker criterion is fulfilled and thus, adequate discriminant validity ensured as the square root of the AVE values is greater than the respective correlations of the constructs (Fornell and Larcker, 1981).

Predictive power of the model is assessed by analysing R² values of the endogenous variables (Esposito Vinzi et al., 2010). The model explains 74.1% of variance in satisfaction, 57.3% in continuance intention, and 3% in the perceived network performance. Moreover, we checked VIF values, which were all below the threshold of 5, indicating the absence of multicollinearity (Hair et al., 2017).
Mean | SD | Cronbach’s Alpha | Composite Reliability | R² | AVE | Continuance intention | Perceived network performance | Satisfaction
---|---|---|---|---|---|---|---|---
Continuance intention | 3.77 | 1.341 | 0.862 | 0.935 | 0.573 | 0.878 | 0.937
Perceived network performance | 3.90 | 1.099 | 0.907 | 0.928 | 0.03 | 0.683 | 0.684 | 0.826
Satisfaction | 3.94 | 1.142 | 0.897 | 0.929 | 0.741 | 0.765 | 0.781 | 0.854 | 0.874

Table 1. Construct reliability and validity

The formative measures for actual network performance are not evaluated based on internal consistency measures such as composite reliability or AVE (Hair et al., 2017). Call failure rate was determined per customer as ratio of all attempted or actual calls and the number of failures prior to the survey. The minimum call failure rate was 0%, the maximum call failure rate 25% with a mean of .9249% and a standard deviation of 1.695%. Data failure rate was determined as ratio of all attempted or actual data connections and the number of failures prior to the survey. The minimum data failure rate was .01% and the maximum data failure rate was 47.22% with a mean of 1.005% and a standard deviation of 2.921%.

### 3.3 Structural model

The Stone-Geisser criterion is used to assess predictive relevance (Stone, 1974; Geisser, 1975). $Q^2$ values for satisfaction and continuance intention are greater than zero (continuance intention: .385; satisfaction: .552; perceived network performance .02) and thus show predictive relevance (Hair et al., 2010).

![Figure 4. Results of hypothesis testing](image-url)
Paths analysis shows strong support for H1 and H4. H2 was a one-sided hypothesis and shows weak support for poor perceived network performance regarding call failures, but not regarding failed data connections. H3 is also a one-sided hypothesis but is not supported for neither call nor data connection failures.

The results of hypothesis testing are surprising, as H2 and H3 are deeply grounded in the well-established two-factor theory (Herzberg, 1966). It is therefore essential to evaluate potential causes of the rejections or weak support in case of H2 regarding call connections. Hair et al. (2017) state that the assumption of analysing a heterogeneous data set may lead to misleading results.

### 3.4 Post-hoc cluster analysis

Due to the striking weak significance or insignificance, respectively, of the actual network quality paths, further analysis of the sample is needed. To get first insights and disclose possible heterogeneity in the sample, we visualise the data for the two dimensions of actual network performance (call and data failures) and satisfaction in a scatter plot.

![Scatter plot](image)

**Figure 5. Scatter plot**

As evident from figure 5, it becomes clear that poor actual performance of the network is existent for all levels of satisfaction. This is in line with the insignificance of the PLS paths. The question that arises from this observation is whether clusters can be found that are more sensitive to actual network performance than others.
For a better understanding, we performed a two-step cluster analysis (Chiu et al., 2001) using SPSS. Two-step cluster analysis is suitable in this context, as we are analysing mixed variables measured on different scale levels. In the first stage, the algorithm is executed similarly to the k-means algorithm. Based on these results, the two-step procedure conducts a modified hierarchical agglomerative clustering procedure that combines the objects sequentially to form homogenous clusters (Chiu et al., 2001; Mooi and Sarstedt, 2011; Balijepally et al., 2011). Four clusters were computed as shown in table 2. The silhouette measure of cohesion and separation showed good cluster quality.

**Table 2. Results of the two-step cluster analysis.**

<table>
<thead>
<tr>
<th>Variable Importance</th>
<th>Overall Sample</th>
<th>Cluster 1</th>
<th>Cluster 2</th>
<th>Cluster 3</th>
<th>Cluster 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction</td>
<td>1,0</td>
<td>Median</td>
<td>4.01</td>
<td>4.99</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>[x0.25; x0.75]</td>
<td></td>
<td>[3.01; 4.99]</td>
<td></td>
<td>4.01</td>
</tr>
<tr>
<td>Call Fail Ratio</td>
<td>0.52</td>
<td>Median (%)</td>
<td>0.35</td>
<td>0.14</td>
<td>2.92</td>
</tr>
<tr>
<td></td>
<td>[x0.25; x0.75]</td>
<td></td>
<td>[0.04; 1.09]</td>
<td></td>
<td>0.38</td>
</tr>
<tr>
<td>Data Fail Ratio</td>
<td>0.32</td>
<td>Median (%)</td>
<td>0.39</td>
<td>0.38</td>
<td>8.51</td>
</tr>
<tr>
<td></td>
<td>[x0.25; x0.75]</td>
<td></td>
<td>[0.18; 0.94]</td>
<td></td>
<td>0.38</td>
</tr>
<tr>
<td>Perceived network quality</td>
<td>Evaluation Fields (not used for cluster computation)</td>
<td>Median</td>
<td>4.01</td>
<td>4.99</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>[x0.25; x0.75]</td>
<td></td>
<td>[3.01; 4.99]</td>
<td></td>
<td>4.01</td>
</tr>
<tr>
<td>Continuance intention</td>
<td>Median</td>
<td>4.01</td>
<td>5.00</td>
<td>4.00</td>
<td>4.01</td>
</tr>
<tr>
<td></td>
<td>[x0.25; x0.75]</td>
<td></td>
<td>[3.00; 5.00]</td>
<td></td>
<td>5.00</td>
</tr>
</tbody>
</table>

Table 3. Group analysis (path coeff.; t-values; * one sided sig. at .05; ** one-sided sig. at .01).
Cluster 1 shows almost perfect customer satisfaction, perceived network quality and continuance intention with Likert scores of approximately 5. In comparison to the overall sample, call failure rate is below average, but within the central 50% of the sample. Cluster 2 values for satisfaction, perceived network quality and continuance intention correspond to the sample average. However, users in clusters two show very high data and call failure rates that are well above the third quartile of the sample. Cluster 3 shows similar values for satisfaction, perceived network performance, and continuance intention but the average values of data and call failure rates are almost equal to cluster 1 and thus within the central 50% of the sample. Cluster 4 shows poor values for satisfaction perceived network performance and continuance intention that are well below the first quartile of the sample. Nevertheless, the actual data and call failure rates are slightly below the sample average and within the central 50% of the sample.

From the comparison of the four clusters presented, we can provide an exploratory interpretation and typology of network users.

Customers in cluster 1 are called “enthusiasts”, because the actual network performance for both calls and data connections are average, but their behavioural variables show the highest degree of agreement. Actual network performance does not play an important role in both perceived performance and satisfaction; however, the call failure to satisfaction path shows a weak significance. A possible reason for this could be that call failure rate is rather low for this cluster. Since we consider this a hygiene factor, there is no positive contribution to both perceived performance and satisfaction, but a hypothesized negative contribution when failures are present. Thus, the rather low failure rate is an explanation for the weak significance of the path.

In contrast, users in the second cluster are “pragmatists”. Despite poor actual network performance, they are still averagely satisfied and consider network performance good. Actual network performance has no significant path on either perceived network performance or satisfaction. One reason for this could be that for pragmatists, network performance is not important, for example, because they do not rely on the mobile network in business or private contexts or have alternative means of communication. Another reason could be that in the light of high churn rates, these customers developed a sense of pragmatism as they already experienced different MNOs and are thus aware of (not necessarily better) alternatives to their current contract. Instead of being frustrated and dissatisfied, these users seem to accept the high failure rates.

Customers in clusters 3 show average values for all variables. With average failure rates and average satisfaction, perceived performance, and continuance intention levels, they are called “realists”. As in the overall sample, data failure rate does not have a significant impact on either perceived performance, or satisfaction, but call failure rate shows significant paths for both dependent variables.

The last cluster 4 comprises sceptic customers. Call and data failure rates are average in comparison to the overall sample, but satisfaction, perceived performance and continuance intention levels are poor. Poor call failure ratio shows strong significance for perceived performance of the network, but not for customer satisfaction. Thus, these users are sceptical of the MNO per se and one could argue that they intrinsically expect poor performance, though this assumption would need further evaluation and empirical testing.

4 Discussion and future research directions

The objective of this research was to shed some light on the effect of actual network performance on the perceived performance and satisfaction of MNO customers. In so doing, this research proposes a variation of ECM by integrating Herzberg’s (1966) two-factor theory to account for measurable operational ICT performance as hygiene factor as well as perceived performance as motivational factor in the satisfaction and continuance intention discussion. In addition to testing the effect of actual network performance on perceived performance and satisfaction individually, we moreover identified different customer groups that show a different assessment of actual network performance.
The results confirm that actual performance is a hygiene factor for an MNO. It cannot positively contribute to both perceived performance and satisfaction, but negatively impacts both outcome variables. In more detail, this research showed that call failures, i.e., unsuccessful call setup or dropped calls, shows weak significance for perceived performance in the overall sample and stronger significance regarding both perceived performance and satisfaction for several clusters identified. Contrastingly, data failures, i.e., unsuccessful setup of a data connection or dropped data connections, are not significant regarding both perceived performance and satisfaction. Possible reasons could include the availability of alternatives such as a Wi-Fi connection or the anyhow high level of availability of other network technologies such as UMTS. Despite these differences in effects, the study was able to prove that actual performance of ICT is a hygiene factor using the case of an MNO. Furthermore, results confirm that the importance of satisfaction as antecedent of continuance intention. This is consistent with previous ICT research showing higher satisfaction levels lead to a higher intention to continue the use of ICT and thus building on previous research results, to customer retention (Zeithaml et al., 1996; Bhattacharjee, 2001).

The theoretical and practical contributions, limitations and future research are discussed below.

### 4.1 Implications for research

This study reveals important implications for researchers particularly in the field of mobile network technology, but also in ICT in general. We provided a contribution to existing literature by the integration of ECM and two-factor theory. Building on this model, we tested two variables of actual network performance to disclose their effect on perceived performance and satisfaction, respectively. These variables were obtained from the MNO and not surveyed. The analysis of self-reported variables may be sensitive to a bias. The theoretical surveying of expectations and/or perceptions can lead to exaggerated expectations or frustration. The proposed model is a framework to test ICT determinants in different contexts. Thus, future research can disclose the hygiene factors that contribute or don’t contribute to user satisfaction, and, ultimately, to continuance intention. This adds to the discussion of user acceptance and satisfaction. As such, the comparison of actual and perceived performance and thus the integration of two-factor theory and ECM are a useful means to validate how the actual link between technology and perceived performance is.

Additionally, we disclosed that distinct customer types exist. In so doing, we used customer satisfaction and the two actual performance variables (data failures and call failures) in a two-step cluster analysis. Results show that some clusters are more sensitive to technological malfunction as others. This is a significant contribution to existing research for three reasons: First, the multivariate statistical analysis of the entire dataset can somewhat blurry for methodical reasons when the dataset is heterogenous. Hence, the cluster analysis allows for a more in-depth analysis of the research questions and hypotheses. Second, as evident from our post-hoc analysis, customers’ assessment of actual technology performance differs highly. Thus, we add to the consideration of hygiene factors in ICT research for different user groups. Third, previous research found that even though LTE comes at a higher costs, customers are still likely to switch to this technology (Kitchen et al., 2015; Park and Joon Kim, 2013). The consideration of the proposed customer types reveals that some customers, especially the “pragmatists”, are satisfied despite high data failure rates. Hence even though LTE is a stimulus to switch contracts as evident by previous research, it is not necessarily vital for satisfaction.

Moreover, this research confirmed the theoretical considerations presented in this paper that call and data failures are hygiene factors and cannot positively contribute to customer satisfaction or continuance intention. This is evident from the analysis of the entire data set as well as from the cluster analysis. For example, the “sceptics” show very low data and call failure rates. Contrastingly, they show poor perceived performance and are very dissatisfied. Additionally, we confirmed existing theory as satisfaction has been shown highly significant for continuance intention.
4.2 Implications for practice

From a practical point of view, this study provides valuable insights for mobile network operators, but also for all providers of ICT of any kind in general. Satisfaction and continuance intention, and ultimately, customer loyalty, are crucial for companies worldwide. The chance to identify the components or functions of ICT that lead to dissatisfaction can be an advantage for customer retention in today’s highly competitive environment. In contrast to self-reported perceived performance, the analysis of dissatisfying hygiene factors evades self-reported biases and possible exaggerated expectations. In contrast to perceived performance, actual network performance can be influenced more easily by an MNO, for example by investing in network infrastructure. In the case presented in this study, investment in call infrastructure can reduce call failures and thus the negative contribution to satisfaction. This is especially relevant for highly competitive markets such as the German one in our case to prevent customer churns and thus to retain especially the fixed-contract customer group.

The identification of user clusters according to the satisfaction dimension and the two actual performance variables is also an advancement. Current customer segmentations are often made using either demographic or marketing related variables. With the approach presented in this research, customers that are more prone to technology than others can be identified and addressed accordingly to alter their perceptions. The merit of the different customer groups from a managerial perspective is that customer relationship activities can be planned accordingly to prevent churns.

4.3 Conclusion, limitations and future research directions

Blaming information technology for poor user satisfaction is quite common in both work and private contexts. To address the first research question whether actual, measurable performance of ICT plays a part in perceived performance and customer satisfaction, we provided an integration of ECT and two-factor theory. The proposed model can identify the components of ICT that negatively influence perceived performance and satisfaction and is thus a tool to analyse, which system determinants need to be further elaborated on from an ICT point of view. We examine this theoretical advancement by investigating the use case of a German MNO. Findings suggest that poor actual network performance in terms of call failures lowers perceived performance (research question 2), but not satisfaction (research question 1). To account for this striking result, we propose a typology of users derived from two-step cluster analysis. This cluster analysis provided additional insights by identifying user groups according to their sensitivity to technological malfunction and satisfaction levels disclosing considerable differences. All in all, call issues, rather than problems with data connections can lead to dissatisfaction with a mobile network.

The research findings should be interpreted considering some notable limitations, which at the same time could represent future research avenues. The first limitation is that we analysed the case of a German MNO. Further research should validate results in different contexts regarding both the nature of the ICT as well as the geographical region. Previous research found different usage patterns amongst regions. For example, the comparison of the USA and Asia showed a lower mobile internet usage intensity in the USA (Armey et al., 2011). As for the European market, it was observed that Dutch usage behaviour differs from the one in Greece and Finland, respectively (Bouwman et al., 2010). These differences root in diverging political and cultural values, economic developments and infrastructures (Gerpott and Thomas, 2014). Second, we focused our analysis on the major determinants given by ECM and two-factor theory in line with our second research question. Future research could integrate further variables such as switching costs or reputation and disclose possible interaction effects. Also, age is considered an important factor context in the discussion about consumers’ use of ICT (e.g., Choudrie et al. (2018)) and could be included in further analysis. Moreover, network functionalities used in the current design to account for actual performance of the mobile network are conceptualised as calls and data connections. Future research should include additional features and application areas, such as the differentiation of use contexts of data connections, mobile payment, streaming or mobile gaming.
References


