Automated Mobility as a Service – Development of a Hierarchical Quality Scale

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AUTOMATED MOBILITY AS A SERVICE – DEVELOPMENT OF A HIERARCHICAL QUALITY SCALE

Research Paper

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Abstract
Despite the broad interest in shared and automated mobility and the need to understand customer expectations to guide further developments, no instrument exists that measures perceived service quality for automated mobility as a service (AMaaS). Using data from 23 exploratory interviews and three empirical surveys with a total of 1431 participants, this study develops and validates a hierarchical, multi-dimensional quality scale. After identifying relevant quality constructs, we purify the initial item set until satisfactory psychometric properties are achieved. Eventually, we identify two primary quality dimensions (outcome quality and trust) and seven significant quality attributes (time efficiency, environmental impact, convenience, flexibility, cybersecurity, privacy, and traffic safety). We confirm the nomological validity to strengthen the scale's predictability further. Our work supports practitioners in developing high-quality customer-oriented mobility offerings and researchers in building stronger theories utilizing thoroughly validated constructs and a measure that predicts customer perceptions reliably.

Keywords: Automated Mobility as a Service (AMaaS), Autonomous Driving, Shared Mobility, Quality, Scale Development.

1 Introduction
The rapid expansion of service offerings in many industries over the last decades has resulted in a contribution of the service sector to the European gross domestic product (GDP) of approximately 65% in 2019 (The World Bank, 2020). For instance, car sharing has been introduced in the late 1980s as a new form of mobility that allows users to share a fleet of cars instead of privately owning them (Wei et al., 2013). Despite the impact of the Covid-19 pandemic on the economy, a steady increase in user numbers is still expected (Statista, 2020). The eventual adoption of automated vehicles in these fleets might further advance the use of on-demand mobility services (Hyland and Mahmassani, 2020). Consequently, mobility providers will be motivated to introduce a new type of transportation service that combines the two developments of shared and automated mobility: Automated Mobility as a Service (AMaaS). Based on Pangbourne et al.'s (2020) conceptualization of mobility as a service, we define AMaaS as a “provision of on-demand door-to-door mobility being offered by self-driving cars, which can be requested via an online platform for individual or shared rides.”

Across industries and especially in the vehicle-based transportation sector, the sharing economy presents an alternative to traditional business models (Marimon et al., 2019). New corporations challenge established car manufacturers by offering “‘bundles’ consisting of customer-focused combinations of goods, services, support, self service, and knowledge” (Vandermerwe and Rada, 1988, p. 316). This so-
called servitization allows mobility providers to continually align their offerings to the customers’ expectations and improve the service outcome and the users’ perceived quality (Akter et al., 2019).

For traditional services, high service quality leads to customer satisfaction (Spreng and Mackoy, 1996), which in turn influences customer’s post-purchase attitudes and future purchase intentions (Howard, 1974). Consequently, service research considers quality as one of the most critical determinants of long-term business-success (Fassnacht and Koese, 2006; Zeithaml et al., 2002). We argue that this causality similarly applies to AMaaS because it affects travel choice (Diana, 2012).

However, quality is "an elusive and abstract construct that is difficult to define and measure" (Cronin and Taylor, 1992, p. 55). So far, there exists no all-encompassing quality model (Reeves and Bednar, 1994). Because of that, Brown et al. (1993) argue that it is not sufficient to adapt the often-used SERVQUAL quality scale (Parasuraman et al., 1988) to assess service quality in some settings effectively. Instead, service quality attributes tend to be context-dependent (Paulin and Perrien, 1996). Consequently, extant research regarding service quality resulted in a rich body of knowledge entailing relevant service attributes that shape the user’s quality evaluation in various contexts. Nevertheless, we deem that the perception of AMaaS quality cannot be fully explained by existing knowledge because automated and shared mobility is different from existing services.

In contrast to other services in the sharing economy, where two people, i.e., the service provider and the service consumer, interact with each other via a brokering platform (Amat-Lefort et al., 2020), for AMaaS, the user and the technology, i.e., the self-driving car, become the interacting entities. Thereby, the autonomous vehicle becomes an independent actor, which is different from other electronic services where the technology is used as a communication medium, e.g., for online shopping. Consequently, quality attributes concerning the car’s and not the provider’s service provision, but also regarding the regulation and liability might become more relevant (Bruckes et al., 2019).

Furthermore, passengers need to release control when sitting in a fully automated vehicle (SAE International). For existing cab or shuttle services, the passenger usually knows that he/she can trust the driver’s capabilities, but with AMaaS, a technology automates a highly complex human task (Koester and Salge, 2020). Hence, the passenger’s perception of the vehicle’s functionality will be judged against a human driver’s ability, and the passenger will typically prefer the method believed to be best (Lee and Moray, 1992). Specific service attributes might become relevant to address the customer’s feeling of being at the self-driving car’s mercy.

As extant literature does not provide a suitable conceptualization considering all particularities of automated and shared mobility quality, we follow a structured scale development approach to investigate and theorize AMaaS service quality. With this, we respond to Blut et al.’s (2015) call for research to examine how service quality perceptions differ across products and markets. By identifying attributes associated with a positive experience with AMaaS (i.e., a smart service), we further contribute to the research gap pointed out by Ostrom et al. (2015). Last, Cheng et al.’s (2018) observation that only a few publications exist regarding perceived quality in ride-sharing services makes us confident to work on a relevant theoretical objective: developing a service quality scale for automated mobility as a service.

In order to fill the existing gap, this study aims to describe the development, refinement, and psychometric evaluation of a multi-dimensional and hierarchical AMaaS quality scale. After outlining the theoretical foundations, we identify salient quality dimensions employing an exploratory study. Next, we propose respective items that we refine and purify iteratively with multiple empirical studies to ensure construct validity. Afterward, we demonstrate the nomological validity of the developed scale, and, finally, we discuss the implications of our results and provide suggestions for further research.

2 Theoretical Foundations

The sharing economy is defined as an internet-enabled, platform-based interaction of individuals or entities providing temporary access to idle assets in exchange for monetary compensation (Akhtmedova et al., 2020). Based on this understanding, three actors interact with each other: (1) a customer who seeks access to an automated vehicle and offers monetary compensation, (2) a service provider who
offers temporary utilization of idle cars, and (3) an internet platform that connects both entities (Amat-Lefort et al., 2020). In contrast to other services in the sharing economy, like Airbnb, where the underutilized asset, i.e., the house, does not independently interact with the customer, for AMaaS, a fourth entity comes into play: (4) the self-driving vehicle. It reacts to incoming requests and serves the customer based on GPS information without the service provider's active involvement.

Based on this extended conceptualization, the vehicle provider, the technology platform, and the self-driving vehicle form a service system that integrates resources (i.e., people, technology, and information) to satisfy the customer needs (Maglio and Spohrer, 2008). The service system's viability depends on the quality of the overall service system's elements (Vargo and Lusch, 2008). Eventually, this quality is the primary driver in creating customer satisfaction and business success in the sharing economy (Akhmedova et al., 2020; Amat-Lefort et al., 2020).

Perceived service quality is defined as the customer's evaluation of the service's overall excellence or superiority (Zeithaml, 1988). We thus define AMaaS quality as: "the overall excellence or superiority that customers of automated mobility as a service experience when they order and ride a car, as well as pay for the mobility service".

The assessment of service quality is individual to each customer, but specific service attributes or dimensions can generate a positive experience (Beltagui and Candi, 2018). Based on the means-ends-chain theory, extant research arranges the dimensions hierarchically on three levels: Customers' overall perception of service quality, primary dimensions, and subdimensions/attributes (Dabholkar et al., 1996). As customers process information at multiple abstraction levels (Parasuraman et al., 2005), they evaluate their service experience in terms of particular service propositions (at the attribute level), which are combined to higher-order dimensions (Blut, 2016). The aggregated evaluation of these dimensions then results in an overall judgment of the customer's service quality perception (Akter et al., 2019). Despite the agreement that service quality perceptions are based on multiple dimensions, there is no general consensus regarding the dimensions' nature or content (Brady and Cronin, 2001).

The service literature stream that aims to identify these quality dimensions and attributes has a long tradition from the beginning of general service quality (e.g., Grönroos, 1984; Parasuraman et al., 1988) to electronic service quality (e.g., Wolfinbarger and Gilly, 2003; Parasuraman et al., 2005; Fassnacht and Koese, 2006), and later investigations of services in the sharing economy (e.g., Arteaga-Sánchez et al., 2018; Marimon et al., 2019; Amat-Lefort et al., 2020). Each stream identified context-specific quality attributes that inform our scale development described in the next sections.

Grönroos' (1984) seminal work highlights the fact that in a face-to-face setting, perceived service quality not only depends on the service outcome but also on how a service is provided. The later developed SERVQUAL service quality scale (Parasuraman et al., 1988) identifies which attributes (i.e., tangibles, reliability, responsiveness, assurance, and empathy) influence a customers' quality judgment.

In a technology-mediated environment, human-related service dimensions like empathy become obsolete while other factors come into place. The fulfillment of online shopping orders has to be ensured (Wolfinbarger and Gilly, 2003; Parasuraman et al., 2005), and customer data needs to be protected (Blut, 2016; Benlian et al., 2011). Besides, efficiency (Parasuraman et al., 2005) and flexibility (Benlian et al., 2011) are critical characteristics of electronic services. Overall, trust is a prerequisite for the intention to use online services (Loiacono et al., 2007; Gefen et al., 2003)

Within the sharing economy, concerns about the environmental impact (Arteaga-Sánchez et al., 2018) start to guide user behavior. Service convenience is identified as a relevant service attribute (Akhmedova et al., 2020), and legal regulations should protect customers from problems that might occur in a peer-to-peer economy (Marimon et al., 2019). Again, both the value proposition of the service provided (Clauss et al., 2019; Akhmedova et al., 2020) and trust (Arteaga-Sánchez et al., 2018) affect the perceived quality and the intention to interact with shared services.
3 AMaaS Quality Scale Development

In order to strive for stronger theories, we recognize that construct measurement is a relevant issue (Venkatraman and Grant, 1986). The unavailability of sound measurement instruments that can be used to assess AMaaS quality impedes new knowledge development and inhibits a thorough investigation of the phenomenon in practice (Lewis et al., 2005). Hence, we follow eminent scale development procedures (Churchill Jr., 1979; Lewis et al., 2005; MacKenzie et al., 2011) to compile an AMaaS quality scale within three steps (see Figure 1): In the next sections, (1) we conceptualize the domain of interest, (2) evaluate and refine the initial instrument, and (3) validate the final measurement properties.

<table>
<thead>
<tr>
<th>Conceptualization</th>
<th>Evaluation and Refinement</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. User interviews to collect AMaaS quality expectations</td>
<td>1. Pre-test with 7 participants to improve survey design</td>
<td>1. Main study with a random sample of 726 participants to validate scale properties</td>
</tr>
<tr>
<td>2. Card sorting exercise to conceptualize AMaaS quality dimensions</td>
<td>2. Two iterative pilot studies with a convenience sample of 342 and a random sample of 363 participants to conduct exploratory factor analyses</td>
<td>2. Confirmatory factor analysis</td>
</tr>
<tr>
<td>3. Literature review to confirm content validity</td>
<td></td>
<td>3. Test of nomological validity in a network of quality, satisfaction, and intention</td>
</tr>
<tr>
<td>• Proposed AMaaS quality dimensions</td>
<td>• Factor structure of 10 AMaaS service quality dimensions established</td>
<td>• Convergent/discriminant validity and reliability of scale validated</td>
</tr>
<tr>
<td>• Initial item pool with 66 items generated</td>
<td>• Final item pool with 45 items retained</td>
<td>• Predictive ability assured</td>
</tr>
</tbody>
</table>

Figure 1. The process followed during scale development (adapted from Benlian et al. (2011))

3.1 Step 1: Conceptualization

The development of good data collection instruments first requires specifying the domain of interest (Churchill Jr., 1979). However, AMaaS represents a new form of service delivery for which the service quality dimensions are not yet known. Nevertheless, our diligent review of past studies regarding commonly cited quality dimensions of (electronic) services and the sharing economy suggests two relevant primary dimensions of AMaaS quality: Outcome quality and trust.

From the beginning, service research recognized that "what the consumer receives as a result of his interaction with a service firm, is important to him and to his evaluation of the quality of the service" (Grönroos, 1984, p. 38). Despite different naming conventions (i.e., outcome quality, technical quality, service product), various studies support the fact that the service outcome is a relevant factor for the customers' quality evaluation (Grönroos, 1984; Berry et al., 1985; Rust and Oliver, 1994; Brady and Cronin, 2001; Collier and Bienstock, 2006). The often identified quality dimension "fulfillment" follows the same rationale. It represents the delivery of a promised product/service as a result of an online service interaction (Parasuraman et al., 2005; Wolfinbarger and Gilly, 2003; Blut et al., 2015). Also, in the sharing economy, the service’s value proposition influences the customer’s overall quality evaluation (Clauss et al., 2019). Likewise, we believe that the service outcome (i.e., individual mobility) needs to be fulfilled to perceive the AMaaS service encounter as high quality. We thus hypothesize:

**H1:** Enhanced levels of outcome quality will increase the level of AMaaS quality.

According to Grönroos (1984) and Berry et al. (1985), customers are not only interested in the outcome of a service process (the what) but in the process itself (the how). The evaluation of this quality dimension is very subjective as it resides in the interaction between a customer and the service organization (Lehtinen and Lehtinen, 1991). There is a general agreement that trust is imperative to all kinds of personal interactions (Ping Li, 2011) and technology usage (Gefen et al., 2003). Following this reasoning, assurance, which inspires trust and confidence within users, has been conceptualized as an element of interaction quality (Beltagui and Candi, 2018; Fleischman et al., 2017; Akter et al., 2019). Besides, trust has been found in the service literature and in the sharing economy to influence the overall quality perception (Arteaga-Sánchez et al., 2018; Barnes and Vidgen, 2002; Teo et al., 2008). Hence, we argue that:
H2: Enhanced levels of trust will increase the level of AMaaS quality.

Like Collier and Bienstock (2006), we do not believe that the latent constructs of outcome quality and trust can capture all dynamics during a service encounter. We model them as second-order dimensions made up of specific attributes. A hierarchical model's advantages are more theoretical parsimony and less model complexity (Edwards, 2001; MacKenzie et al., 2005). Using the primary dimensions as a starting point, we leverage exploratory customer interviews to identify their relevant subdimensions.

We conduct interviews with 23 potential customers (see Table 1 for participant demographics and Wiefel (2021) for more details) to identify the key attributes that constitute the domains of outcome quality and trust. We interview practitioners because they can provide relevant ideas for the phenomenon at hand (Churchill Jr., 1979). As perceived quality also depends on the customer's assessment of alternative offerings (Monroe and Krishnan, 1985), we first explore the perceived advantages and disadvantages of current mobility offerings. Then, we provide a common understanding of AMaaS and continue to investigate in which situations the participants would use the new mobility service and how a high-quality service would look like for them. Last, we address potential concerns regarding automated and shared mobility. Depending on the interviewee’s answers, we examine the respective quality attributes in detail.

Table 1. Demographics of Participants

We transcribe the interviews and extract all statements regarding expected AMaaS quality attributes and their antecedents. To gain a conceptualization reflecting the customers’ view, 38 additional consumers sort the statements into piles based on conceptual similarity. Using an aggregated similarity matrix, multi-dimensional scaling creates two-dimensional coordinates for each statement, which serve as input for hierarchical cluster analysis (Jackson and Trochim, 2002). Throughout the card sorting process, we found support for four subdimensions related to outcome quality (i.e., efficiency, convenience, flexibility, and accessibility) and four subdimensions that can induce trust (i.e., cybersecurity, privacy, traffic safety, and regulatory). Table 2 outlines exemplary interview quotations for each quality dimension.

Next, it is imperative that we consult available literature to ensure construct validity and correctly modeled relationships between the identified quality attributes and the respective second-order dimensions. In extant publications, we find support for the four attributes related to outcome quality.

Efficiency in terms of short in-vehicle times has already been shown to have a strong influence on perceived service quality for most public transportation forms, i.e., air, rail, and busses (Rojo et al., 2012; Roman and Carlos Martin, 2014; Abenoza et al., 2017). Besides, environmental efficiency influences the satisfaction of users traveling with shared mobility services (Arteaga-Sánchez et al., 2018). Thereby, energy consumption is related to outcome quality, for example, in the case of electric car rentals (Miao et al., 2014). This supports our empirically derived hypothesis:

H1a: Enhanced levels of efficiency will increase the level of outcome quality.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Related statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>“Because the autonomous cars drive more disciplined, perhaps even coordinated with each other, the traffic flow becomes very regular and fluid.”</td>
</tr>
<tr>
<td></td>
<td>“If driving is autonomous, then I imagine it to be the same as today only faster, more efficient, straighter, and without traffic lights.”</td>
</tr>
<tr>
<td>Convenience</td>
<td>“That within this driving I also have the possibility to do certain things, to deal with completely different things without having to pay attention to the traffic.”</td>
</tr>
<tr>
<td></td>
<td>“I always have this wasted time of parking. Of course, you could save yourself by just getting off where you want to go and not bothering about the rest because the vehicle then automatically takes the next car park.”</td>
</tr>
<tr>
<td>Flexibility</td>
<td>“Getting from A to B in the fastest possible time and as flexibly as possible. So don’t be dependent on fixed departure times.”</td>
</tr>
<tr>
<td></td>
<td>“Absolute flexibility, in fact, to get out at any time, to continue at any time. Not to be bound to anything or anyone.”</td>
</tr>
<tr>
<td>Accessibility</td>
<td>“So, that means that if you call a taxi, you might wait an hour, and if you have your own car, you can drive directly.”</td>
</tr>
<tr>
<td></td>
<td>“I’d like to see it work in small towns, too.”</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>“If there are any hackers who can hack in. Get access to the credit card, that they’ll just sort of mug you.”</td>
</tr>
<tr>
<td></td>
<td>“Especially if such a car is hacked, probably the doors are also locked somehow electrically, and so, you can’t get out of it anymore, you’ll be trapped like this, right?”</td>
</tr>
<tr>
<td>Privacy</td>
<td>“So, privacy is definitely a big concern!”</td>
</tr>
<tr>
<td></td>
<td>“What worries me is if someone knows where I’m going. Maybe even associate driving patterns of me as a person.”</td>
</tr>
<tr>
<td>Traffic Safety</td>
<td>“If a child runs into the street, and you suddenly have to brake - I don’t know if the car can see that.”</td>
</tr>
<tr>
<td></td>
<td>“Technology could misjudge the environment or surroundings.”</td>
</tr>
<tr>
<td>Regulatory</td>
<td>“This should perhaps be properly anchored in the law, what if something should happen? Who’s liable?”</td>
</tr>
<tr>
<td></td>
<td>“Something like the car’s behavior in an accident can only work if it has been discussed by committees and of course, expert commissions. That rough rules have already been laid down, which are then legitimized again by the parliament.”</td>
</tr>
</tbody>
</table>

Table 2. Exemplary quotes from interview participants for each identified quality dimension

Marketers observe a general rise in consumer demand for convenience (Seiders et al., 2007). It has been identified early to be relevant for the quality perception in the auto industry (Andaleeb and Basu, 1994). Ultimately, convenience has a strong influence on the quality perception of public transport services (Li et al., 2018; Liou et al., 2014), which lets us assume that:

**H1b: Enhanced levels of convenience will increase the level of outcome quality.**

Flexibility is one of the relevant quality attributes of electronic services (Parasuraman et al., 2005). It offers the customer the freedom to change the service's contractual and functional/technical aspects (Benlian et al., 2011). In a mobility context, this can include the maximum travel distance (Xu et al., 2017), service frequency (Allen et al., 2018), or operating hours (Seiders et al., 2007). We thus hypothesize that:

**H1c: Enhanced levels of flexibility will increase the level of outcome quality.**

Accessibility has repeatedly been found to be relevant for public transport (Aydin et al., 2015; Hernandez et al., 2016; Diez-Mesa et al., 2018) and car-sharing services (Kim et al., 2017; Ko et al., 2019). This includes the availability of a free car (Kim et al., 2019), the proximity to the station (Abenoza et al., 2017), and the waiting time (Wong et al., 2020). Based on these results, we deem that:

**H1d: Enhanced levels of accessibility will increase the level of outcome quality.**

In the following paragraphs, we validate the empirically revealed subdimensions of trust by consulting the literature.

For electronic services, cybersecurity is one factor that predicts the judgment of quality (Wolfinbarger and Gilly, 2003; Yang et al., 2004; Benlijan et al., 2011). Besides, it has been identified as an antecedent of online trust (Kim and Peterson, 2017; Gefen et al., 2003). Furthermore, multiple researchers relate cybersecurity with the quality attribute assurance that is defined as the ability to convey trust (Zhuo et al., 2013; Field et al., 2004; Barnes and Vidgen, 2001). This lets us argue that:

**H2a:** Enhanced levels of cybersecurity will increase the level of trust.

Like cybersecurity, information privacy is a predictor of the user's quality perception in online contexts (Wolfinbarger and Gilly, 2003; Parasuraman et al., 2005; Blut, 2016). In addition to that, privacy violations can reduce trust in the online vendor or service (Gefen et al., 2003; Martin, 2018). This is why Collier and Bienstock (2006) defined privacy as an indicator of process quality and why we think that:

**H2b:** Enhanced levels of privacy will increase the level of trust.

In the public transportation context, traffic safety is one of the most relevant service attributes (Nathanail, 2008; Kuo, 2011; Polican Freitas, 2013). Qualitative studies regarding automated driving observe traffic safety as the most controversial discussed factor (Wiefel, 2020). Interviewees mention traffic safety together with the ability to have trust in autonomous public transport (Eden et al., 2017). Further studies support this relationship as they model safety as a subdimension of assurance, the attribute that conveys trust (Awasthi et al., 2011; Akter et al., 2019). Hence, we deem that:

**H2c:** Enhanced levels of traffic safety will increase the level of trust.

Structural assurance, including regulations and legislation, is another crucial factor that instills service quality in the mobility sector and the sharing economy (Policani Freitas, 2013; Cheng et al., 2018; Marimon et al., 2019). Besides, legal protection promotes trust (Gefen et al., 2003; Marimon et al., 2019). Especially in a context in which design decisions can influence the accident outcomes, legislation could oblige the algorithms to act in line with social norms and not deliberately harm other people favoring the driver (Salonen and Haavisto, 2019). Based on these reasonings, our last hypothesis is:

**H2d:** Enhanced levels of regulations will increase the level of trust.

As model misspecification "can have serious consequences for the theoretical conclusions drawn from that model" (Jarvis et al., 2003, p. 212), we diligently determine whether the perceived AMaaS quality should be reflective or formative. Based on the means-ends-chain theory, causality flows from the subdimensions to the primary dimensions and finally to the third-order quality construct. Thereby the indicators are not interchangeable, and the indicators do not need to covary with each other. Furthermore, the quality dimensions do not have the same antecedents and consequences. These four characteristics let us specify a formative model (Jarvis et al., 2003). As a formative measurement model on its own is underidentified and cannot be estimated (Bollen K., 1989), we add reflective indicators to each construct (Jarvis et al., 2003). Thereby, the assumption of error-free indicators is relaxed (Diamantopoulos et al., 2008). The proposed research model is shown in Figure 2.

![Figure 2. Proposed Research Model](image-url)

After developing our model, we derive items for the subsequent analysis from the categorized responses and available literature (MacKenzie et al., 2011). For each (sub)dimension, we collect a set of items (Noar, 2003) that should cover each aspect of the respective domain (Churchill Jr., 1979). As five to six items seem to be adequate for most measures (Hinkin, 1995), we identify six items per dimension
resulting in 66 statements for our AMaaS quality scale consisting of overall AMaaS quality, two primary dimensions, and eight subdimensions. We only use positively worded items to avoid method artifacts and achieve conceptually meaningful results (Babakus and Boller, 1992). Besides, we frame all items as expectations as these are "the only types of evaluations customers would have, about service delivery that they have not yet tried" (Dabholkar, 1996, p. 31). To ensure sufficient variance among respondents for subsequent analyses, we employ a 7-point Likert-scale (Hinkin, 1995).

3.2 Step 2: Evaluation and Refinement

In the next step of the scale development process, we collect data through multiple iterations to evaluate and optimize the AMaaS quality instrument's measurement properties (MacKenzie et al., 2011). First, we conduct a pre-test with 7 participants to improve our survey design. Based on the testers' feedback, we extended our description of AMaaS, which we used to familiarize participants with the subject of the new mobility service. Furthermore, we changed the wording of our attention check and adjusted some items to avoid a mixture of expected feelings and expected service capabilities.

To assess construct validity, we launch the updated survey for a first pilot study. Here, we collect 342 valid responses from a convenience sample. A 1:5 item-to-response ratio, as well as the total number of observations, should be sufficient for a first exploratory factor analysis (EFA) (Hinkin, 1995). To ensure that the data is amenable for factor analysis in SPSS 26, we perform the Kaiser-Meyer-Olkin test, the Bartlett sphericity test, and check for multivariate normality (Lewis et al., 2005). During the EFA, we eliminate items with large cross-loadings (>0.3) on non-hypothesized dimensions or non-significant loadings on the hypothesized dimension (<0.7) (MacKenzie et al., 2011). The results of the first EFA make us eliminate one subdimension: regulation. From a statistical point of view, the items do not load properly on a common factor. From a theoretical perspective, the AMaaS service provider cannot actively influence this quality dimension. The analysis also lets us split the efficiency dimension into two distinct attributes: time efficiency and environmental impact. The six efficiency items divide neatly into the two new factors, each consisting of three items.

After adding additional items to the newly identified constructs of time efficiency and environmental impact, we run a second analysis with 51 remaining items (see Table 5 in the appendix – including the strikethrough items) and a new sample. This time, a market research institute recruits 363 European participants. This counteracts potential selection biases and enables the consideration of representative quotas (Lowry et al., 2016).

Again, we first test if the data is eligible for factor analysis. Then, the maximum likelihood procedure with Promax rotation is used. The EFA is constrained a priori to 11 factors, i.e., overall quality and the previously identified ten quality dimensions. We again iteratively remove items with either low loadings or high cross-loadings. This process results in the final AMaaS quality scale consisting of 45 items (see Table 5 in the appendix – excluding the strikethrough items).

3.3 Step 3: Validity Testing

For our main study, we attain 726 valid responses from another random European sample. Before validating and estimating the measurement and causal models, we test for common method bias (CMB). CMB is a method artifact associated with unidimensional methodologies like our self-reported survey (Podsakoff et al., 2003). To avoid CMB, we encourage the participants to answer spontaneously and honestly. Furthermore, we add the theoretically unrelated marker variable blue attitude (Miller and Chiodo, 2008) to test for CMB using the marker variable technique (Williams et al., 2010). The analysis reveals that no CMB is present.

A complete, confirmatory analysis should prove the validity of our measurement model of the AMaaS quality scale (Loiacono et al., 2007). Convergent validity is assessed following the recommendations of Fornell and Larcker (1981): All item loadings are significant and exceed the threshold value of 0.7 (see Table 5 in the appendix), all construct reliabilities (Cronbach alpha and composite reliability (CR)) are above 0.8, and the average variance extracted (AVE) of each construct exceeds 0.5. Additionally, discriminant validity is given as the AVE's square root is greater than the shared variance between the

construct and the remaining constructs in the model (Fornell and Larcker, 1981). Our data meets all requirements (see Table 3), and good model fit indices (CMIN/DF=1.998; CFI=0.973; SRMR=0.027; RMSEA=0.037; PClose=1.000) can be interpreted as further evidence for the validity of the measurement model (Hu and Bentler, 1999).

The causal model specified earlier implies that AMaaS quality is a multi-dimensional and hierarchical construct. Hence, it can be seen as a third-order factor model which can be tested with structural equation modeling techniques (Brady and Cronin, 2001). Like Blut (2016), we follow a step-wise approach in which we first examine the appropriateness of the primary dimensions, then the suitability of the respective subdimensions, and last the entire model. The model fit measures indicate the degree to which the hierarchical structure with its primary dimensions and subdimensions is supported by the data (Dabholkar et al., 1996). Our analysis produces an excellent model fit for each of the three causal models supporting our conceptualization (see Table 4).

<table>
<thead>
<tr>
<th>Construct</th>
<th>Cr. α</th>
<th>CR</th>
<th>AVE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tbody>
<tr>
<td>QUAL</td>
<td>1</td>
<td>.967</td>
<td>.956</td>
<td>.855</td>
<td>.925</td>
<td>.874</td>
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<td></td>
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<tr>
<td>OUTC</td>
<td>2</td>
<td>.906</td>
<td>.907</td>
<td>.765</td>
<td>.788</td>
<td>.874</td>
<td></td>
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<tr>
<td>TRUS</td>
<td>3</td>
<td>.981</td>
<td>.981</td>
<td>.946</td>
<td>.807</td>
<td>.823</td>
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<td></td>
<td></td>
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<tr>
<td>TIME</td>
<td>4</td>
<td>.975</td>
<td>.976</td>
<td>.769</td>
<td>.610</td>
<td>.579</td>
<td>.604</td>
<td>.953</td>
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<td>ENVI</td>
<td>5</td>
<td>.956</td>
<td>.957</td>
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<td>.541</td>
<td>.524</td>
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<tr>
<td>CONV</td>
<td>6</td>
<td>.945</td>
<td>.947</td>
<td>.781</td>
<td>.756</td>
<td>.764</td>
<td>.795</td>
<td>.620</td>
<td>.498</td>
<td>.884</td>
<td></td>
<td></td>
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<tr>
<td>FLEX</td>
<td>7</td>
<td>.932</td>
<td>.933</td>
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<td>.693</td>
<td>.804</td>
<td>.661</td>
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<td>.733</td>
<td>.881</td>
<td></td>
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<tr>
<td>ACCE</td>
<td>8</td>
<td>.933</td>
<td>.934</td>
<td>.739</td>
<td>.683</td>
<td>.640</td>
<td>.571</td>
<td>.515</td>
<td>.504</td>
<td>.611</td>
<td>.731</td>
<td>.860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CYBE</td>
<td>9</td>
<td>.950</td>
<td>.950</td>
<td>.864</td>
<td>.217</td>
<td>.257</td>
<td>.302</td>
<td>.182</td>
<td>.216</td>
<td>.137</td>
<td>.172</td>
<td>.168</td>
<td>.930</td>
<td></td>
</tr>
<tr>
<td>TRAF</td>
<td>11</td>
<td>.954</td>
<td>.955</td>
<td>.841</td>
<td>.774</td>
<td>.763</td>
<td>.869</td>
<td>.701</td>
<td>.556</td>
<td>.792</td>
<td>.628</td>
<td>.554</td>
<td>.237</td>
<td>.519</td>
</tr>
</tbody>
</table>

Table 3. Construct Reliability and Validity. Diagonal elements (bold) are the square root of the average variance extracted (AVE). Off-diagonal elements are the shared variance.

<table>
<thead>
<tr>
<th>Model</th>
<th>CMIN/DF</th>
<th>CFI</th>
<th>SRMR</th>
<th>RMSEA</th>
<th>PClose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Test of the primary dimensions</td>
<td>1.646</td>
<td>0.998</td>
<td>0.011</td>
<td>0.030</td>
<td>0.998</td>
</tr>
<tr>
<td>2. Test of the subdimensions</td>
<td>2.558</td>
<td>0.970</td>
<td>0.038</td>
<td>0.046</td>
<td>0.992</td>
</tr>
<tr>
<td>3. Test of the overall model</td>
<td>2.417</td>
<td>0.966</td>
<td>0.044</td>
<td>0.044</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Table 4. Step-wise testing of the hierarchical model

The complete model (shown in Figure 3) explains a large portion of the variance for both the overall AMaaS quality (R²=.705) as well as the primary dimensions of outcome quality (R²=.752) and trust (R²=.797). All but one (i.e., accessibility) hypothesized quality (sub-)dimensions are supported. Trust has the strongest effect on AMaaS quality (β=.508; p=<.001), but outcome quality (β=.425; p=.001) has practical relevance as well. Traffic safety (β=.783; p=.001) has a very strong effect size while privacy (β=.154; p=.001) and security (β=.065; p=.001) seem to be less relevant for the perceived level of trust. Outcome quality is explained mainly by flexibility (β=.471; p=.001) and convenience (β=.328; p=.001). Environmental impact (β=.078; p=.017) and time efficiency (β=.074; p=.034) are less predictive. Last, accessibility (β=.040; p=.291) has a non-significant effect on outcome quality.

The control variables of age (β=.011; p=.606) and place of living (β=.021; p=.329) are not significantly affecting the overall quality, but we found gender (β=.043; p=.048) to have a small but statistically significant influence.

Next to ensuring the validity of the measure, we determine whether the measure behaves as expected in relation to other constructs (Churchill Jr., 1979; MacKenzie et al., 2011). This would provide further evidence of the validity of the measure (Hinkin, 1995).
For perceived quality, extant literature suggests a positive relationship with satisfaction in general service contexts (Cronin and Taylor, 1992; Brady et al., 2005), for IT services (Kettinger et al., 2009) as well as for the mobility context (Nguyen-Phuoc et al., 2020). Besides, perceived quality is expected to increase the user’s behavioral intention (Dabholkar, 1996; Lin and Hsieh, 2011; Cronin et al., 2000). Last, satisfaction positively influences behavioral intention (Kettinger et al., 2009; Brady et al., 2005; Cronin et al., 2000). Thus, we conduct a nomological validity test with the related constructs of satisfaction and behavioral intention. To do so, we already included both constructs in our initial survey, where we used widely-cited items (Bhattacherjee, 2001; Venkatesh et al., 2012).

Structural equation modeling confirms that the nomological net of perceived quality, satisfaction, and behavioral intention behaves as expected (see Figure 4). Higher levels of AMaaS quality lead to higher levels of satisfaction ($\beta=.739\; p<.001$) and behavioral intention ($\beta=.460\; p<.001$). Besides, satisfaction increases the behavioral intention ($\beta=.739\; p<.001$). Thus, we can conclude that the predictive validity of the AMaaS quality scale is satisfactory.

4 Discussion

4.1 Theoretical and practical contributions

Although automated and shared mobility services are extensively researched, consumer evaluations of AMaaS service quality have not yet been investigated (Bornholt and Heidt, 2019; Wiefel, 2020). Accordingly, our main research contribution is the development of a context-specific AMaaS quality measure that shows good psychometric properties and offers new insights regarding the relative importance of AMaaS service attributes. AMaaS is an electronic transportation service offered in the sharing economy that leverages autonomous vehicles. Accordingly, our final scale consists of quality dimensions rooted in multiple research streams regarding traditional services (e.g., outcome quality), electronic services (e.g., security and privacy), the sharing economy (e.g., convenience), and automated vehicles (e.g., traffic safety). From an epistemological perspective, we are the first who synthesize the existing domain knowledge to adopt a new perspective for which we build and test a new theory regarding the quality of automated and shared mobility quality (Schryen et al., 2015).
Thereby, our observations support earlier investigations revealing that higher levels of trust increase the level of quality (Teo et al., 2008). We recognize that trust is even more influential than outcome quality. This is in line with Grönroos (1984), who stated that functional quality, i.e., how the service is delivered, is more important than the service outcome as long as the promised service is fulfilled on a satisfactory level.

We identify traffic safety to be the most relevant attribute to build trust in an autonomously acting vehicle. Other studies in the public transport sector have similar results (Kuo, 2011; Policani Freitas, 2013). Moreover, in a medical context, where a service consumer needs to give up control over his/her physical well-being, safety is strongly linked to the perceived service quality (Rathert et al., 2011). A reason might be that safety is one of the basic needs in Maslow's (1943) hierarchy of needs. Only if the customer's safety is ensured, a service can be perceived as trustworthy and therefore as high quality.

Contrary to earlier findings regarding electronic services, cybersecurity and information privacy are less important to build trust. While cybersecurity is one of the most influential quality elements for software as a service (Benlian et al., 2011), for AMaaS, it is least relevant. The reason might be that AMaaS passengers do not actively operate the vehicle. This missing involvement makes AMaaS different from other electronic services, where users strongly interact with the system. A consequence might be a reduced sense of cybersecurity and privacy issues. Besides, passengers might feel a less severe threat when comparing traffic safety with security and privacy. In the first case, our interview participants were concerned about their health and life, whereas they were worried about location tracking and data theft in the second case.

Looking at the outcome quality attributes, it is remarkable that accessibility is not a significant factor. For car-sharing, availability and proximity are strongly relevant factors (Kim et al., 2017; Ko et al., 2019). However, automated vehicles can reposition themselves to serve incoming requests. Research already conducts simulations assessing different relocation strategies (Li et al., 2019) and fleet sizes (Spieser et al., 2014) to fulfill the customers’ mobility needs with minimum waiting times, making the concerns regarding accessibility obsolete for AMaaS.

In contrast, flexibility plays a major role for the expected quality of AMaaS. Future customers are concerned that the automated car will not provide the same flexibility as their own car. For them, flexibility does not only mean being independent of anyone and taking a ride whenever they like. Instead, a service offering providing flexibility consists of large business areas in which customers can travel. Besides, customers require different cars with the required space or interior to fulfill various passenger needs, e.g., a desk for business trips or a comfortable seat and entertainment for longer trips. Again other customers demand the possibility to personalize the route, e.g., to collect/drop-off a friend. Thus, our understanding of flexibility is different from existing research requiring a system that can adapt to changing conditions (e.g., Nelson et al., 2005).

Convenience also has a strong influence on outcome quality. According to Seiders et al. (2007), convenience comprises the time and effort spent when purchasing and using the service and the core benefits of the offering, which links the construct to the outcome quality dimension. The core benefit expected from automated driving is the possibility of relaxing during the ride, i.e., to have less effort driving the car and doing other things while driving (Hein et al., 2018). This new and convenient way to travel would also enable the elderly to benefit from the service offering.

The last two attributes, time efficiency and environmental impact, have a minor impact on the outcome quality, although they have shown significant influence in car-sharing (Arteaga-Sánchez et al., 2018) and public transport (Abenoza et al., 2017). A reason might be that the expected benefits (i.e., fewer cars needed, reduced energy consumption, a smoother driving style leading to shorter traffic times) will be outweighed by more vehicle kilometers traveled. Wadud et al. (2016) expect an increase of 57% of vehicle kilometers driven, which will then still clog the roads. Moreover, according to their research, replacing transit journeys with automated vehicles will double household greenhouse gas emissions.

Overall we can conclude that although all quality elements have been identified in other research streams individually, AMaaS requires a particular composition. Besides, some attributes’ definitions and effect
sizes deviate from earlier research so that available quality scales would not deliver valuable support when evaluating AMaaS offerings.

Looking at the three process steps that we followed during the scale development, each phase results in a valuable deliverable (Lewis et al., 2005). We are among the first researchers who explore quality dimensions for an independently acting technology-based service. As a result of this, we identify two primary quality dimensions and seven significant subdimensions. Our results provide valuable insights for the conceptualization of AMaaS quality and the quality perception of other safety-related autonomous mobility services.

Second, we iteratively refine the measurement instrument until we achieve good psychometric properties in terms of validity and reliability. This allows other researchers to use our operationalizations to build strong theories based on sound measures. The usage of our (self-developed) constructs is not restricted to quality scales but can be used effectively in other theories, too.

Third, we test for nomological validity so that our instrument’s predictive ability is ensured. Thoroughly validated instruments allow replications of studies in heterogeneous contexts (Cook and Campbell, 1979) so that the scale is ready to use for specialized scholars from transportation, service science, and the IS community.

From a managerial perspective, our research supports mobility providers to continually meet customers’ expectations, which results in a competitive advantage hard to overcome (Reeves and Bednar, 1994). The key is to uncover among all potential quality attributes those dimensions that are most crucial to enhance the level of perceived quality (Yang et al., 2004). Only if the management knows the essential attributes leading to perceived service quality, investments can be prioritized. To achieve this target, service designers can leverage our measurement instrument to assess their individual mobility offering’s quality and improve it accordingly.

4.2 Limitations and Further Research

Of course, our results need to be considered in light of their limitations. Our samples are all recruited within Europe. Service quality, however, is perceived differently within various cultures (Ueltschy et al., 2004; Witkowski and Wolfinbarger, 2002). To address this shortcoming, we propose to conduct a cross-cultural study.

In addition to that, we had to build our research on the customers’ expectations because automated mobility as a service is not yet available. Nevertheless, Dabholkar (1996) argues that a quality model that is based on expectations is equally applicable for quality perceptions. Hence, we asked the participants to imagine a realistic scenario. Besides, customer expectations seem to be stable over time (Clow et al., 1998), which makes us assert that our results will still be relevant when AMaaS hits the market. Nevertheless, our results need to be reconfirmed with customers who experienced an automated ride as soon as AMaaS hits the market.

Extant literature indicates that the quality dimensions’ contributions change when new users become more experienced customers (Dagger and Sweeney, 2007). Developing an understanding of this change’s nature will become important soon to build customer long-term customer relationships. In the context of AMaaS, the strong influence of traffic safety might decrease as soon as people get used to this new form of mobility. Supporting this assumption, a study assessing the drivers of loyalty in the airline industry found safety not to be relevant (Vlachos and Lin, 2014). Another study reports an increasing importance of time efficiency in a public transport context (Abenoza et al., 2017). Thus, the low relevance of time efficiency could increase for AMaaS, too. Future longitudinal research should investigate if and how customer perceptions change over time in regard to AMaaS quality.

Finally, given that the AMaaS services are just in their infancy and automotive manufacturers and IT companies primarily lead the development of such services, our work’s practical utility should be validated through a joint research endeavor with a practitioner. For example, an evaluation from industry experts may be effective, and a pilot use of the developed quality measurement instrument could further validate its applicability in a realistic setup.
Appendix

<table>
<thead>
<tr>
<th>Var.</th>
<th>Items</th>
<th>Ld.</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUAL</td>
<td>The quality of the AMaaS ride would be as expected or promised.</td>
<td>.916</td>
<td>(Dagger et al., 2007; Holloway and Beatty, 2008; Xu et al., 2013)</td>
</tr>
<tr>
<td></td>
<td>The service provided by the AMaaS is of a high standard.</td>
<td>.919</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, the level of service quality of AMaaS would be good.</td>
<td>.939</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, I would receive excellent service while driving with AMaaS.</td>
<td>.924</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, the quality of AMaaS would be high.</td>
<td>.925</td>
<td></td>
</tr>
<tr>
<td>OUTC</td>
<td>I believe AMaaS substitutes quiet well for an own car.</td>
<td>.842</td>
<td>(Loiacono et al., 2007; Lamberton and Rose, 2012; Self-Developed)</td>
</tr>
<tr>
<td></td>
<td>The AMaaS is pretty much what I need to be mobile.</td>
<td>.860</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would adequately meet my mobility needs.</td>
<td>.919</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would give me effective door-to-door mobility.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would be an effective way to be mobile even without your own car.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>TRUS</td>
<td>I would have full trust in AMaaS.</td>
<td>-</td>
<td>(Zhang et al., 2019)</td>
</tr>
<tr>
<td></td>
<td>Overall, I expect that I can trust AMaaS.</td>
<td>.970</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I expect that I can rely on an AMaaS.</td>
<td>.971</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overall, I expect AMaaS to be trustworthy.</td>
<td>.977</td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>I expect that traffic congestion will be reduced by the use of AMaaS. (E)</td>
<td>.934</td>
<td>(Hohenberger et al., 2017; Wu et al., 2018; Li and Kamargianni, 2019; Ro and Ha, 2019)</td>
</tr>
<tr>
<td></td>
<td>I believe that the use of AMaaS can improve the traffic quality. (E)</td>
<td>.962</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I believe that AMaaS will improve traffic flow. (E)</td>
<td>.970</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would help to reduce congestion.</td>
<td>.947</td>
<td></td>
</tr>
<tr>
<td>ENVI</td>
<td>I expect automotive emissions to be reduced by AMaaS. (E)</td>
<td>.947</td>
<td>(Hohenberger et al., 2017; Wu et al., 2018; Liu et al., 2019a; Ro and Ha, 2019)</td>
</tr>
<tr>
<td></td>
<td>AMaaS could reduce vehicle emissions and pollution. (E)</td>
<td>.933</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I believe that AMaaS would contribute to a more fuel-efficient way of driving. (E)</td>
<td>.862</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I believe that the use of AMaaS can improve the air quality.</td>
<td>.940</td>
<td></td>
</tr>
<tr>
<td>CONV</td>
<td>For me, AMaaS would be a convenient way to get to my destination.</td>
<td>.919</td>
<td>Self-Developed</td>
</tr>
<tr>
<td></td>
<td>AMaaS would be a convenient way to travel.</td>
<td>.907</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would make the journey more pleasant for me.</td>
<td>.914</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With AMaaS, I could easily reach my destination.</td>
<td>.860</td>
<td></td>
</tr>
<tr>
<td></td>
<td>After driving with AMaaS, I would feel less exhausted than when I drive myself.</td>
<td>.812</td>
<td></td>
</tr>
<tr>
<td>FLEX</td>
<td>AMaaS would give me enough flexibility.</td>
<td>.916</td>
<td>Self-Developed</td>
</tr>
<tr>
<td></td>
<td>Using AMaaS would not limit my flexibility.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With AMaaS, I could drive somewhere whenever I wanted.</td>
<td>.852</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I would be flexible with AMaaS.</td>
<td>.905</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I could use AMaaS at will.</td>
<td>.848</td>
<td></td>
</tr>
<tr>
<td>ACCE</td>
<td>The autonomous vehicles of AMaaS would be optimally distributed to serve the incoming requests as quickly as possible.</td>
<td>.874</td>
<td>(Xu et al., 2013; Möhlmann, 2015; Blut, 2016; Ko et al., 2019)</td>
</tr>
<tr>
<td></td>
<td>The availability of AMaaS would be good.</td>
<td>.827</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would provide the cars within a reasonable time frame.</td>
<td>.840</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would have a large fleet to serve its customers quickly.</td>
<td>.864</td>
<td></td>
</tr>
<tr>
<td></td>
<td>With AMaaS, the vehicle would be available within a short time.</td>
<td>.892</td>
<td></td>
</tr>
<tr>
<td>CYBE</td>
<td>I am concerned that the systems of AMaaS would be hacked.</td>
<td>.929</td>
<td>(Wolfinbarger and Gilly, 2003; Blut, 2016; Hein et al., 2018; Liu et al., 2019b)</td>
</tr>
<tr>
<td></td>
<td>I fear that cybercriminals could gain control over AMaaS.</td>
<td>.922</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would not have adequate security features.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would not be sufficiently protected against hacker attacks.</td>
<td>.938</td>
<td></td>
</tr>
<tr>
<td>PRIV</td>
<td>The service provider would keep my personal information safe.</td>
<td>.910</td>
<td>(Collier and Bienstock, 2006; Blut, 2016; Zhang et al., 2019)</td>
</tr>
<tr>
<td></td>
<td>My data would be treated according to EU data protection law.</td>
<td>.853</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My pers. information would not be used for other purposes without my consent.</td>
<td>.895</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My pers. information would not be shared with other entities without my consent.</td>
<td>.903</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The service provider will not misuse my personal information.</td>
<td>.882</td>
<td></td>
</tr>
<tr>
<td>TRAF</td>
<td>I expect that accidents will be reduced.</td>
<td>.930</td>
<td>(Payre et al., 2014; Xu et al., 2018; Ro and Ha, 2019)</td>
</tr>
<tr>
<td></td>
<td>I would feel safe during riding in the AV.</td>
<td>.942</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMaaS would provide me safety compared to manual driving.</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I expect to reach my destination safely.</td>
<td>.873</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Using AMaaS would decrease accident risk.</td>
<td>.921</td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Items of the AMaaS Quality Scale. Var. = Variable; Ld. = Loading; (E) = Item of the original efficiency construct which was split into time efficiency and environment.

Acknowledgments

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