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Scale Development and Validation of Corporate Digital Responsibility—A Consumer Perspective

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ABSTRACT

Corporate digital responsibility (CDR) is emerging as a prominent issue and has been sporadically discussed in the relevant literature. Due to the limited research on assessing digital responsibility, this study developed a scale that measures CDR from a consumer perspective. A mixed-methods approach was employed to develop and validate the scale. First, an exploratory qualitative study was conducted to conceptualize consumer-centric CDR and formulate the underlying constructs and measures. This was followed by a quantitative study to confirm the validity and reliability of the qualitative results. The scale development and validation process resulted in a measure consisting of six dimensions: digital transparency, digital privacy, digital quality, digital remedy, digital accessibility, and digital inclusiveness. This study contributes to corporate social responsibility research by introducing a consumer-centric CDR scale, which provides practitioners with insights into how to execute responsible practices in the digitalized business arena, reflecting the preferences and expectations of consumers regarding digital responsibility.

1 | Introduction

The digital transformation of enterprises has become an irreversible trend, yet the negative effects of digitization have also sparked growing concerns (Guo et al. 2023; Nicolás-Agustín et al. 2024). In September 2015, Volkswagen, an automotive industry stalwart, proposed a digital solution for managing vehicle emissions, but this initiative was met with accusations from the U.S. Environmental Protection Agency, leading to a scandal known as "Dieselgate." This scandal, which became the most expensive in automotive history with fines and damages exceeding $30 billion, sent shockwaves through the industry and pushed the 80-year-old titan into a whirlwind of challenges (Georg 2022). Volkswagen is not an isolated case in the landscape of corporate digitization mishaps. Other significant instances that underscore the potential negative

implications of digital transformation include the Facebook–Cambridge Analytica data breach scandal and the hefty fine of €345 million (equivalent to $560 million) levied on TikTok by EU regulators for contravening data protection regulations. The issues involving digital responsibility in firms are becoming increasingly prominent, including leakage of personal information, data copyright, and big data ripening resulting from discriminatory algorithms (Lobschat et al. 2021; Kunz and Wirtz 2024). These issues affect consumers' confidence and trust in digital transactions (Perinotto et al. 2022). In recent years, along with the ethical dilemmas posed by digitization, the concept of corporate digital responsibility (CDR) emerges as a critical framework for addressing the ethical and societal implications of corporate digitization (Mueller 2022). According to Lobschat et al. (2021), CDR is the set of shared values and norms that guide an organization's ethical and

responsible management of digital technology and data across creation, operation, inspection, and refinement processes, focusing on the proactive identification, analysis, and mitigation of ethical risks associated with new digital technologies (Weber-Lewerenz and Traverso 2024).

However, CDR research is still in its infancy (Lobschat et al. 2021; Elliott et al. 2021). To date, no consensus has been reached on what or how various aspects of CDR should be assessed. Some studies have suggested that CDR should be embedded in corporate social responsibility (CSR) (Herden et al. 2021; Wade 2020). Others have indicated that traditional CSR cannot adequately address the disruptive nature of digital innovations and the potential harm that could be caused by the abuse and penetration of digital technology (Lobschat et al. 2021; Elliott et al. 2021). A review of the relevant literature shows that very few studies have addressed the measurement of CDR (Weber-Lewerenz and Traverso 2024). The existing studies predominantly approached it from a general perspective. Examples include a digital technology development perspective of CDR with regard to ethical and responsible data-related practices (Cheng and Zhang 2023), a digital governance perspective replacing CDR with digital trust (Kluiters, Srivastava, and Tyll 2023), a digital life cycle perspective exploring the definition of CDR (Lobschat et al. 2021; Yang and Lian 2023), and a responsibility–sustainability framework in the context of in hospitality and tourism businesses (Milwood and Roehl 2019). However, these studies have not taken consumers—the key stakeholders—into account (Herden et al. 2021; Wade 2020; Lobschat et al. 2021). Furthermore, the existing studies either neglect to empirically validate the dimensions and measurement of CDR or opt to employ alternative constructs, such as digital trust (Kluiters, Srivastava, and Tyll 2023), as proxies for CDR in their assessments. In addition, some scholars, such as Jin and Mirza (2024) and Govindan (2022), have only approached digital responsibility as a key dimension within the classic CSR model, which traditionally encompasses economic, environmental, and social responsibilities. However, these frameworks overlook the specific metrics needed to assess the impact of digital technologies on stakeholders, including concerns related to data privacy, cybersecurity, and the ethical deployment of digital technology (Lobschat et al. 2021). This oversight highlights the need for a more nuanced approach to address the unique challenges posed by the digital economy, rather than treating digital responsibility as an afterthought or a mere extension of existing CSR frameworks. Furthermore, traditional CSR models frequently overlook critical issues such as digital inclusion and the digital divide, which are pivotal for ensuring equitable benefits from digital transformation across all societal segments (Jin and Mirza 2024). These studies may not fully capture the multifaceted nature of CDR and its distinct implications for corporate behavior and stakeholder relationships.

In view of the literature void, the current research aims to develop a scale that is psychometrically sound with a focus on consumers by introducing a validated CDR scale. This research is poised to extend the theoretical underpinnings of CSR and enrich the emerging discourse on CDR within the dynamic landscape of digital commerce. The integration of a validated CDR scale into the academic discourse will serve to bridge existing gaps in the literature, offering a comprehensive tool for assessing and enhancing the alignment of corporate actions with consumer values in the digital age. This, in turn, will contribute to evaluating and fostering ethical practices within the digital business sector, ensuring that academic research and practical strategies are grounded in a deeper understanding of consumer-directed responsibilities.

The following section reviews the relevant literature and provides the rationale for the development of the scale. The methodology of scale development and validation is outlined. The results for each phase of the scale development are presented. Discussion and implications of the research findings conclude the paper, and suggestions for future research are given.

2 | Literature Review

2.1 | CSR/CDR

Two views are followed in the CDR literature. One suggests that CDR is an extension of CSR, focusing on the ethical, social, and environmental responsibilities of corporations in the digital age (Van der Merwe and Al Achkar 2022). The other view is grounded in technology ethics, highlighting the unique ethical challenges posed by digital technologies, such as data privacy, algorithmic transparency, and the digital divide. CDR is not merely a subset of CSR (Carl and Hinz 2024); rather, it represents a unique domain that requires its own set of principles and practices to effectively manage the responsibilities and risks associated with digitalization, which is crucial for navigating the complexities of the digital age. By recognizing and addressing the differences between CSR and CDR, organizations can better align their strategies to meet both social and digital responsibilities (Elliott and Copilah-Ali 2024). With the advent of the digital era in the 21st century, corporate responsibility issues have increasingly focused on advocating the use of digital tools and innovations in socially, economically, technologically, and environmentally responsible manners (Cuesta-Valiño et al. 2024; Herden et al. 2021). Consequently, CDR has become a core component of corporate responsibility. Recently, Cheng and Zhang (2023) conceptualized CDR by emphasizing ethical and responsible data-related practices, including unbiased data acquisition, data protection, and data maintenance. These studies indicate that it is imperative to distinguish CDR from CSR (Kunz and Wirtz 2024).

The existing literature has discussed CDR from various perspectives. Herden et al. (2021) suggested that CDR should include the four dimensions of economic, legal, ethical, and charitable, each of which needs to be considered through the lens of digital tools and technologies. At the economic level, companies need to find innovative business models that ensure their competitive advantage, despite the new competitive pressures in the digital world (Koch and Windsperger 2017). At the legal level, companies must comply with new and existing laws and regulations related to digital technologies and data security (Voigt and Von dem Bussche 2017). At the ethical level, digital technologies are being used to both avoid harming and to provide benefits to stakeholders. For businesses to meet the higher expectations of stakeholders, it is important to pursue ethical practices that go beyond legal frameworks and governance to act with integrity, justice, and fairness (Carroll 1991). At the charitable level, companies can make philanthropic efforts that are beneficial

to society. Examples include sharing knowledge, using data and new technologies in ways that promote sustainable development (Stempeck 2014), and contributing to society through funding programs for digital social innovation (Hackenberg and Empter 2011). From the digital governance perspective, Kluiters, Srivastava, and Tyll (2023) explored the impact of digital trust on firm value and governance, proposing that digital trust can serve as a proxy for CDR. They argue that enhancing digital trust through firm- and governance-specific characteristics, such as board size and cybersecurity investments, can increase firm value. Lobschat et al. (2021) and Yang and Lian (2023) examined CDR through the lens of the digital life cycle, focusing on the creation, operation, inspection, and refinement of digital technology and data. They define CDR as a set of shared values and norms guiding an organization's operations across these processes. This perspective provides a comprehensive framework for understanding the ethical implications of digital technology throughout its lifecycle. Milwood and Roehl (2019) introduce a responsibility–sustainability framework within the context of hospitality and tourism businesses. They discuss how digital social innovation can link socially responsible business practices to sustainable performance outcomes. Their study emphasizes the importance of integrating digital responsibility into business models to benefit society, culture, and the environment.

2.2 | Consumer-Centered Digital Responsibility

Since the 1950s, the research of CSR has emerged within the business community, initially focusing on maximizing shareholder value (Smith 2024). However, it was not until the 1980s that CSR research began to pivot toward a more inclusive approach, recognizing the importance of considering a broader spectrum of stakeholders beyond just shareholders. This shift was marked by the mainstreaming of stakeholder theory in CSR research (Bridoux and Stoelhorst 2022), which posits that enterprises should be responsible not only to shareholders but also to a broader range of stakeholders, including suppliers, employees, customers, government, and other groups affected by corporate activities. Some studies have argued that the implementation of digital responsibility practices is usually driven by extrinsic motivations, which mainly originate from different stakeholders (e.g., Carl et al. 2023; Wirtz et al. 2023). Given that companies often have limited budgets for implementing CDR, if that implementation is to be successful, CDR practices need to be aligned with the needs of stakeholders. Among the myriad of stakeholders relevant to corporate responsibility, consumers stand out as one of the most significant, exerting considerable influence on corporate behavior and outcomes (Okazaki et al. 2020). Consumers' perceptions of CDR affect their perception of the company and influence their consumption decisions (Edinger-Schons 2020). Lobschat et al. (2021) and Bhattacharya, Korschun, and Sen (2009) anticipated that effective CDR practices can alleviate consumer resistance to personal privacy exposure, fostering increased trust in the focal firm. This enhanced trust, in turn, is predicted to cultivate a greater willingness among consumers to disclose information. Some studies, such as Homburg, Stierl, and Bornemann (2013) and Saeidi et al. (2015), have also suggested that robust CDR practices not only enhance consumer identification with the company but also contribute to heightened levels of customer satisfaction, trust, and corporate loyalty. These findings collectively underscore the transformative impact of CDR on consumer attitudes and behaviors.

Based on the existing theoretical foundation of CDR, we define customer-oriented CDR as a customer's perception of the commitment by an enterprise to behave ethically and contribute to customer interests while using digital technology to achieve commercial success. Although this definition, in the main, is based on the customer perspective, it also relies heavily on the research literature on CDR, in particular Carl's (2023) study. This definition emphasizes the ethical use of digital technology and its direct impact on customer interests, which is a nuanced aspect not always present in other definitions. It acknowledges the dual role of digital technology in both fostering commercial success and upholding ethical standards, a perspective that is gaining traction in the CDR discourse. Furthermore, this definition differs from existing studies as it is anchored in the customer's perception, aligning with the growing body of literature that recognizes the consumer as a key stakeholder in the digital era. This is evident in the work of Mihale-Wilson et al. (2022), which underscores the importance of consumer preferences and the valuation of CDR dimensions. By focusing on the customer's viewpoint, our definition captures the dynamic nature of CDR, which is not just about compliance but also about meeting the evolving expectations of consumers in the digital age.

2.3 | Rationale for Developing Customer-Oriented CDR Scale

Researchers (e.g., Carl et al. 2023; Thorun et al. 2017) highlighted the importance of a consumer-focus CDR and underscored the urgent need for a comprehensive and empirically validated measurement scale. Existing studies have explored various dimensions of consumer-oriented CDR, including consumer empowerment, informed decision-making, business transparency, and economic fairness (Carl et al. 2023). Bandara, Fernando, and Akter (2020) discussed privacy responsibility and emphasized the importance of consumer control over data, whereas Mihale-Wilson et al. (2022) have advanced a user-centric perspective, highlighting the autonomy of consumers in decision-making processes.

While these contributions provide valuable conceptual frameworks, they fall short in several critical areas. First, much of the existing research remains theoretical, with limited efforts to translate these conceptual dimensions into measurable constructs. For example, although Carl et al. (2023) identified consumer empowerment and transparency, their work does not offer a validated tool for assessing how consumers perceive and evaluate CDR practices in real-world contexts. Similarly, Bandara, Fernando, and Akter (2020) and Mihale-Wilson et al. (2022) centered on privacy and data autonomy without considering the broader landscape of consumer-oriented CDR or integrating these aspects into a unified framework.

Another notable limitation is the fragmented approach to studying consumer-oriented CDR. Existing studies tend to isolate individual dimensions without addressing how these dimensions interconnect or contribute to an overarching construct. For instance, Thorun et al. (2017) emphasized economic fairness

without examining how fairness interacts with other dimensions such as transparency or informed decision-making. This fragmented discussion entails a holistic approach to CDR, which is essential for businesses aiming to build trust and foster long-term relationships with consumers.

Moreover, the lack of empirical validation in previous studies limits their practical applicability. Developing a scale to measure CDR is conducive to assessing the effectiveness of CDR initiatives or to compare how different organizations perform in terms of consumer-oriented CDR. Consistent with the foregoing discussion, this study aims to develop a comprehensive, empirically validated scale to measure CDR from a consumer perspective. This scale is intended to capture the multidimensional nature of CDR and to provide a valuable tool for both researchers and practitioners to evaluate and enhance consumer-oriented CDR practices.

3 | Methodology

3.1 | Research Design

The scale development follows procedures recommended by Churchill (1979) and DeVellis and Thorpe (2021), ensuring a structured approach that comprehensively addressed all relevant aspects of the proposed CDR framework during the scale development. DeVellis and Thorpe (2021) further refines the process by providing detailed guidelines for maintaining the quality of the scale, especially in terms of reliability and validity assessment. As the field of CDR lacks extensive prior research, these procedures offer a reliable foundation for creating a valid and reliable scale. This includes four stages: conceptualization and item generation process, scale development and item editing, item purification, and scale validation (Lee et al. 2023; Liu et al. 2022). Based on the four-phase framework used by Lee et al. (2023), this study adopted a mixed-methods research design, including qualitative and quantitative approaches, in the development of scales for CDR. Initially, qualitative research with in-depth interviews was conducted to identify the domains and items of CDR. Drawing on the findings from the qualitative phase, a quantitative study was conducted to evaluate the validity and reliability of the instrument.

3.2 | Stage 1: Conceptualization and Item Generation Process

3.2.1 | Grounded Theory and Research Design

This research adopted this inductive method considering that, hitherto, a relatively limited amount of research has been conducted on CDR. Thus, by deductive methods involving extensive literature review or existing scales, generating meaningful items is virtually impossible (Lee et al. 2023). Furthermore, this research used the grounded theory method to explore factors and contexts that may influence the construction of CDR. Using the method, this research attempted to discover the factors affecting participants' cognition of a company's digital responsibility and what they pursue, anticipate, and experience in the touchpoints with a company that involves digitalization in terms of CDR.

Theoretical sampling was deemed appropriate for this research. The cumulative method where each subsequent data point is selected based on the analysis of prior data (Strauss and Corbin 1990) allows us to focus on relevant information within the limited research on CDR. This method helps identify the key elements that shape CDR by targeting specific data points related to different aspects of digital responsibility within a company, to be able to capture the various manifestations of CDR that participants encounter in their daily lives. Consistent with Flick's stages of episodic interview (Flick 2000), the interview was first used to present the aim and scope of the study to the participants. This was followed by asking a few questions related to the interviewees' demographic characteristics. The interview explored the examples of CDR experienced by the interviewees in their daily lives. In the third stage, the interviews were designed to delve into the specific perceptions of CDR activities and outcomes. The main interview questions were derived from an extensive preliminary literature review that allowed us to identify potential dimensions of CDR. They were also asked for their reasons for having concerns about CDR, as well as their opinions on corporations' fulfillment of digital responsibility. Table 1 presents the interview guide.

Interviews were conducted by way of offline face-to-face interviews and online video calls within a 4-week period in March 2023. Each interviewee was given a monetary incentive of RMB 60 (or an equivalent small gift) at the end of the interview. Initially, six individuals with in-depth knowledge of CDR were identified. Interviews were conducted with these participants, guided by concepts that emerged from the analysis of previous interviews. The process continued until theoretical saturation was achieved—where no new information was being gleaned for the developing theory (Glaser and Strauss 2017; Douglas 2003). This process resulted in 20 interviews, reaching theoretical saturation. Interviews were conducted in China. With participant consent, interviews were recorded and transcribed verbatim. Notations were also made regarding facial expressions and gestures observed during the interviews. Postinterview discussions were held to share and analyze the findings. Table 2 shows the characteristics of the participants. Due to the novelty and technological complexity of the concept of CDR, limitations in the understanding of less educated individuals may arise. Therefore, a higher proportion of respondents with higher educational backgrounds were selected for the sample population of this study.

The average interview duration for each participant ranged from 50 to 60 min, resulting in a total of approximately 100,000 words of audio-recorded text compiled at the conclusion of the interviews. Following each interview, research team members organized the recordings and notes to form the textual content, which was then sent back to the participants for confirmation. Open coding, axial coding, and selective coding were employed on the retrieved textual data, with grounded theory used to construct a structural dimensional model for interpreting CDR. During data analysis, an initial database was created based on two sources: interview transcripts from 20 participants and 491 related pieces of literature (English and Chinese studies related to the research topic). Two-thirds of the initial data were categorized, organized, and refined. Concepts, conceptual categories, and core categories were sequentially identified, and findings were continuously enhanced through constant comparison.

TABLE 1 | Interview guide developed following Flick's method.

Stage	Theme	Main interview questions
1	Basic information of the respondent	Please briefly introduce your age, occupation, and educational background.
2	Preliminary perception of CDR	Can you describe what you believe corporate digital responsibility is?
		What responsibilities do you think companies should undertake in the digital realm?
3	Specific perception of CDR activities and outcomes	*Digital transparency*: How do you assess the transparency of companies in terms of information disclosure, pricing policies, and data management? Please provide examples.
		Digital privacy: How well do you think companies are protecting user privacy? What specific concerns or suggestions do you have?
		Digital quality: In your view, which factors best demonstrate a company's efforts and commitment to the quality of its digital products or services?
		Digital remedy: If you encounter a problem, how do you expect the company to respond and resolve the issue?
		Digital inclusiveness and accessibility: How do you think companies should ensure that all consumers, regardless of their background, have equal access to and benefit from their digital products and services?
		Digital algorithms: What is your opinion on companies using algorithms to optimize the user experience and reduce costs? How do you think this optimization should balance efficiency and ethics?
4	Expectations and suggestions	In which areas do you hope companies will strengthen the construction of digital responsibility?
		What suggestions do you have to help companies better fulfill their digital responsibilities?

Finally, the remaining one-third of the data was used for theoretical saturation testing.

3.2.2 | Data Analysis and Results

The process of data analysis involved filtering the information that deviated from the research theme and only coding the interview data that responded to the phenomena related to CDR. Open coding is objectively and rigorously summarized into 59 concepts and 24 conceptual categories (Appendix 1). Axial coding identified the relationships between open codes. Based on the logical relationship between the concepts, several theme concepts were categorized to form one main conceptual category, thereby further summarizing and deepening the internal logic between the phenomena. Selective coding based on axial coding is the process of achieving theory saturation by sorting out the relationships between the conceptual categories and thus forming a conceptual model. Based on the results of the main axis coding, an additional set of data was added for the theoretical saturation test. The data were analyzed word-by-word, and the results show that the development of the various core categories of CDR has been relatively complete. The concepts extracted from the data are all in the existing categories, and no new categories have been developed. The dimensions of CDR based on core categories can therefore be considered to have reached theoretical saturation. Finally, we proposed that CDR is a second-order construct that is composed of seven subdimensions (see Appendix 1), containing 46 initial items.

3.3 | Stage 2: Scale Purification and Item Editing

After defining CDR and generating 46 initial items that spanned various facets of customer-oriented CDR, we examined all viewpoints to ensure the items were reflective of the construct's multifaceted nature. Considering the extensive initial pool, we focused on clarity of wording and appropriate response formats as suggested by Netemeyer, Bearden, and Sharma (2003). During the examination process, we identified items with overlapping content within their underlying measurement concepts. For instance, we noted initial items that inquired about whether enterprises should disclose the price composition details of digital products or services, as well as those asking if enterprises should explain the calculation method of product or service pricing. While both items primarily addressed price transparency, their similar phrasing could lead to respondent fatigue and information redundancy, potentially compromising the validity of statistical analysis. Therefore, we decided to merge these items to streamline the scale and enhance its clarity. Redundant items were eliminated, and those with strong face validity were selected for expert scrutiny. Each researcher curated a subset of items, which were then cross-examined by another team member to filter out items with potential biases, following the approach of Baldus, Voorhees, and Calantone (2015). This process narrowed down the list to 38 items.

To establish content and face validity, a panel of 12 judges, consisting of eight industry experts and four academic scholars in marketing and business ethics, evaluated the items on a 5-point

TABLE 2 | Profile of the interviewees.

Interviewee	Gender	Age	Education background	Occupation
XF	Male	41	Postgraduate	IT/communication
LM	Male	20	Undergraduate	University student
HZ	Female	27	Postgraduate	Finance/cashier
WR	Male	20	Undergraduate	University student
HC	Male	36	Undergraduate	Construction
SH	Female	29	Undergraduate	Insurance sales
WB	Male	32	Postgraduate	Finance/securities
YQ	Male	39	Postgraduate	Consulting/think tanks
WL	Female	36	Undergraduate	Insurance sales
HL	Male	45	PhD	Education
XK	Female	29	Postgraduate	Civil servant
ML	Male	48	PhD	Education/consulting
FY	Female	33	PhD	Education
LG	Male	65	PhD	Education
GS	Female	29	Undergraduate	Internet celebrity blogger
ZY	Female	22	Undergraduate	University student
MP	Female	34	Undergraduate	Accommodation/catering
ZL	Female	36	PhD	Education
FJ	Female	20	Undergraduate	University student
XY	Male	20	Undergraduate	University student

Note: Due to the failure to obtain authorization, the interviewees in this study were replaced by letters.

scale for their representativeness and clarity. The judges were encouraged to voice any concerns regarding the items. During the evaluation phase, multiple factors influenced the reduction from 38 to 30 items. Some items were deemed too specialized, focusing on a single aspect of customer-oriented CDR without adequately covering the broader scope of the construct, leading to their removal. Additionally, items with complex or jargon-filled language that could confuse judges and potentially mislead respondents were also dropped to ensure the clarity and comprehensibility of the scale. Postevaluation, 30 items that consistently scored above 4 on the 5-point scale for both criteria were retained. Subsequently, a second round of assessment was conducted with five doctoral candidates specializing in marketing. They were tasked with assigning each of the 30 items to the most fitting dimension of CDR. The interjudge reliability (k) for this round was calculated to be 0.92 ($p < 0.001$), indicating excellent agreement among the judges (Landis and Koch 1977). The refined set of 30 items, with high interjudge reliability, was then utilized for the subsequent steps in the scale development process, ensuring a robust foundation for measuring customer-oriented CDR.

3.4 | Stage 3: Item Purification

Following a comprehensive evaluation and refinement process, the 30-item pool was significantly streamlined. We then conducted preliminary tests on a larger sample size drawn from a pertinent demographic. This additional testing and scale purification phase aids in reducing the number of items by eliminating those that fail to meet specific psychometric standards. While convenience samples may be adequate for preliminary testing, a sample drawn from a relevant target population is recommended (Netemeyer, Bearden, and Sharma 2003). Respondents were asked to rate the importance of each item on a seven-point Likert scale, where 1 = *strongly disagree* and 7 = *strongly agree*. In all, 400 questionnaires were distributed through the Questionnaire Star platform, and 323 valid questionnaires were recovered. Questionnaires that did not pass the attention test and questionnaires that were too short to answer were considered invalid and were therefore excluded.

The purification of the measurement items followed the following two criteria: (1) the correlation coefficient (CITC) of single-item-overall was not lower than 0.50 ($p < 0.05$) and (2) the reliability coefficient of each question item after deletion was not higher than the overall reliability coefficient of the scale. After deleting three low-loading items, the Cronbach's alpha of the overall scale was 0.937, and the Cronbach's alpha of each dimension was greater than 0.842. This indicates that the scale's internal consistency was good.

To examine the factor composition of the items measured by the scale, an exploratory factor analysis (EFA) was conducted. The results show that the KMO value of the sample data of the initial

question items was 0.925, indicating that there were more common factors among the variables. In addition, Bartlett's χ^2 value was 5191.848, which passed the significance test ($p < 0.001$), indicating that the remaining 27 measurement questions of the initial scale were suitable for factor analysis. After several factor extractions and the deletion of items with low cross loadings for the items under one factor, the analysis results show six common factors and 24 items. The loadings of each item were greater than 0.7, and the cumulative variance contribution rate reached 70.315%, indicating that the six extracted common factors could better explain the measurement variables. Thus, a final mix of 24 items was retained for further steps of the scale development process.

3.5 | Stage 4: Scale Validation

3.5.1 | Sample and Data Collection

In this stage, the data were collected through two online questionnaire collection methods, initially with 24 items. First, electronic questionnaires were forwarded to WeChat groups and WeChat friend circles for prize filling. Second, according to the conditions set in the questionnaire, the Questionnaire Star sample service platform was used to distribute questionnaires to groups that met the requirements. In total, 700 questionnaires were distributed, and 578 valid questionnaires were recovered, yielding a valid recovery rate of 82.6%. Following the suggestions of Prentice and Nguyen (2021) and Hair et al. (2010), the data from the 578 samples were randomly divided into two parts: data A ($N = 289$) were used for EFA, and data B ($N = 289$) were used for confirmatory factor analysis (CFA). An independent

samples t-test on the two parts of the data showed no significant differences in variables such as gender, age, education, occupation, and industry (p value above 0.05). Table 3 presents the respondents' demographic information.

3.5.2 | Exploratory Factor Analysis

As suggested by Prentice and Nguyen (2021), EFA was first performed to assess the internal consistency reliability and dimensionality. The results show that the CITC value of each item was greater than 0.5. The Cronbach's alpha value of each dimension of the scale was greater than 0.832, and the overall Cronbach's alpha value was 0.905, indicating good internal consistency reliability of the scale. The results of the EFA showed that the KMO value of the sample data was 0.891, and Bartlett's sphere test was significant. Factors were extracted with an eigenvalue criterion greater than 1. After orthogonal rotation using the maximum variance method, the 24 measurement items were accurately attributed to six common factors. The loadings of the factors corresponding to each question item were greater than 0.6, and no cross-loading phenomenon was observed. The cumulative explanation of the total variance was 69.760%, indicating that extracting six factors is reasonable (Appendix 2).

3.5.3 | Confirmatory Factor Analysis

After extracting the factors from EFA, data B ($N = 289$) were subjected to a validation factor analysis using structural equation modeling in AMOS 26.0. Comparisons were made by constructing several possible models, namely, one-, two-, four-, and

TABLE 3 | Demographic information of the respondents ($N = 578$).

Variable	Option	Quantity	Proportion	Variable	Option	Quantity	Proportion
Gender	Male	297	51.4	Occupation	Student	91	15.7
	Female	281	48.6		Salesperson	84	14.5
Age	<18	9	1.6		Company employee	156	27.0
	18–25	78	13.5		Technical personnel	42	7.3
	26–30	177	30.6		Professionals	124	21.5
	31–40	154	26.6		Others	81	14.0
	41–50	78	13.5	Industry	Advertising/media	57	9.9
	51–60	56	9.7		IT/e-commerce	33	5.7
	>60	26	4.5		Wholesale/retail	94	16.3
Education	High school degree or below	150	26		Education/training	74	12.8
	Associate college	157	27.2		Finance/insurance	75	13.0
	Undergraduate	183	31.7		Machinery/manufacturing	48	8.3
	Graduate degree and above	88	15.2		Communication/network equipment	102	17.6
					Medical/health care	47	8.1
					Others	48	8.3

six-factor (Table 4) models, to determine the optimal model. According to the fit index criteria, χ^2/df values in the range of 1–3 indicate a parsimonious model fit; RMSEA values of less than 0.05 indicate a reasonable model fit. Finally, goodness of fit (GFI), normed fit index (NFI), comparative fit index (CFI), and Tucker–Lewis index (TLI) indices above 0.9 indicate a good model fit. The fitting results of the validated factor analysis model in Table 4 indicate that all the fitting indexes of the six-factor model have reached the range of critical values, in which the χ^2/df value is 1.355. The RMSEA is 0.035, and the GFI, NFI, CFI, and TLI indices are 0.914, 0.906, 0.973, and 0.969, respectively, which are all greater than 0.9. These findings indicate that the six-factor model fitting results are optimized.

3.5.4 | Construct Validity

Based on the results of CFA, we also assessed the reliability and validity of the measurement scale. The convergent validity was examined by checking both the composite reliability (CR) and the average variance extracted (AVE) of all measurements. The CR values should be greater than 0.7, whereas AVE values should be higher than 0.50 (Hair et al. 2010). As shown in Table 5, all observed values exceed the recommended threshold and thus achieve convergent validity. For the discriminant validity of the constructs, the arithmetic square root of each factor's AVE value in Table 4 is significantly larger than the correlation coefficient between that factor and other factors. This finding indicates that the CDR measurement scale developed in this study has sufficient discriminant validity. Therefore, the psychometric properties of all the dimensions of CDR in the study were satisfactory.

The results relating to the model fit indices, as well as the reliability and validity of the scales, confirm that these results can be duplicated and employed in future research.

3.5.5 | Nomological Validity

Nomological validity refers to the alignment of empirical correlations between constructs with their theoretical underpinnings, ensuring that the observed relationships between constructs are logically consistent within a given theoretical framework (Peter 1981). To evaluate the nomological validity of the CDR scale, we collected data and performed structural equation modeling to measure a conceptual model including CDR as well as three other constructs derived from the literature. This study used a questionnaire to collect data, and the questionnaire was based on a five-point Likert scale.

This study collects the questionnaire in two ways. First, the electronic questionnaire is forwarded to the WeChat group and WeChat circle of friends for prize filling. Second, according to the conditions set in the questionnaire, the questionnaire was distributed to the groups that met the requirements by using the Questionnaire Star sample service platform. The questionnaire design consists of four parts. The first part follows the CDR scale developed in this study, which contains six dimensions and is measured through 24 question items. The second part is an investigation of consumers' digital trust and identification. Regarding consumers' digital trust, this study mainly referred to McKnight, Choudhury, and Kacmar's (2002) scale, which contains a total of five question items. Regarding consumers'

TABLE 4 | Comparison of fitted metrics for confirmatory factor analysis model.

Model	χ^2	df	χ^2/df	RMSEA	GFI	NFI	CFI	TLI
One-factor model	1395.122	252	5.536	0.126	0.647	0.593	0.637	0.602
Two-factor model	1191.265	251	4.746	0.114	0.684	0.652	0.701	0.672
Four-factor model	673.586	246	2.738	0.078	0.812	0.803	0.864	0.848
Six-factor model	321.192	237	1.355	0.035	0.914	0.906	0.973	0.969

Note: The two-factor model is Digital transparency + Digital privacy, Digital quality + Digital remedy + Digital accessibility + Digital inclusiveness; the four-factor is Digital transparency, Digital privacy, Digital quality + Digital remedy, Digital accessibility + Digital inclusiveness.

TABLE 5 | Correlation coefficients and reliability and validity tests for each dimension.

	A	B	C	D	E	F
Digital transparency	0.719					
Digital privacy	0.249**	0.712				
Digital quality	0.382**	0.279**	0.758			
Digital remedy	0.242**	0.273**	0.320**	0.785		
Digital accessibility	0.392**	0.316**	0.401**	0.208**	0.822	
Digital inclusiveness	0.251**	0.332**	0.301**	0.312**	0.308**	0.748
Alpha value	0.905	0864	0.855	0.833	0.844	0.824
CR value	0.882	0.837	0.801	0.829	0.862	0.792
AVE value	0.517	0.507	0.574	0.617	0.675	0.559

Note: Asterisk (*) indicates that the variables are correlated, and the value on the diagonal in the matrix is the square root of AVE. * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0005$.

TABLE 6 | Validation factor analysis results.

Dimension	Item	Factor loadings	CR	AVE
CDR	Digital transparency	0.743	0.877	0.543
	Digital privacy	0.720		
	Digital quality	0.722		
	Digital remedy	0.714		
	Digital accessibility	0.759		
	Digital inclusiveness	0.763		
Customer digital trust	I believe that the company can provide me with digital products or services that I'm interested in	0.815	0.906	0.659
	I believe that the company has the resources to carry out digital activities	0.794		
	I believe that the company has the experience in conducting digital activities	0.849		
	I believe that the company can offer sufficient information to help me make decisions	0.823		
	I believe that the company can fully fulfill the agreements reached with consumers	0.777		
Customers' identification	I strongly identify with this company	0.807	0.861	0.608
	I feel good to be a customer of this company	0.794		
	I feel attached to this company	0.758		
	This company shares my value	0.758		
Corporate reputation	The company is highly respected in terms of corporate digital responsibility	0.758	0.832	0.624
	In terms of corporate digital responsibility, the company is a successful one	0.788		
	The company adheres to high ethical standards in corporate digital responsibility	0.822		

identification, reference was made to Ahn, Shamim, and Park's (2021) scale, which contains four items including. The third part is a survey on corporate reputation, which refers to the scale of Keh and Xie (2009), and contains three items. The fourth part is a general summary of the basic information of the sample, including gender, sex, age, and education level.

A total of 500 questionnaires were distributed and 456 valid questionnaires were recovered, with an effective recovery rate of 91.2%. From the statistical characteristics of the sample, men accounted for 52.9%, and women accounted for 47.1%. From the perspective of age, the proportion of 18–30 years old reached 44.3%, and 31–40 years old reached 31.8%. In terms of educational background, the proportion of undergraduate education and above was 67.2%. In terms of occupation, salespersons and company employees were the most numerous, each accounting for 22.8 and 34.0. These statistics show that the sample is well represented.

Reliability analysis was tested with two indicators: Cronbach's alpha and CR value. Cronbach's alpha was greater than 0.75, indicating high internal consistency between the variables. The factor loadings of each item were tested separately, and they were all greater than 0.70, indicating that the items were very significant for the measurement of the dimensions (Table 6).

The validity analysis will test the convergent validity and discriminant validity of the scales respectively, measured by the extracted squared differences (AVE) values of the measurement variables. The higher the AVE value, the better the convergent validity of the latent variables. The AVE are all greater than 0.50, indicating that the measurement of the latent variables each has good convergent validity. The diagonal elements in Table 7 are the square roots of AVE, which are all greater than the correlation coefficients between the latent variables, indicating that the latent variables have a discriminatory force between them and that the model has good discriminant validity.

A model of the impact mechanism of CDR on corporate reputation was constructed, and AMOS 26 was used for path coefficient analysis. Large likelihood estimation was selected to estimate the structural equation model. The results show that the model fit index is as follows: χ^2/df = 1.849, RMSEA = 0.043, GFI = 0.946, AGFI = 0.930, CFI = 0.974, NFI = 0.946, and TLI = 0.970, which are all greater than 0.9, indicating that the model fits well. The path

coefficient plot (Figure 1) shows that CDR perception has a significant positive impact on consumer digital trust and digital identity, with path coefficients of ($\beta = 0.534$, $p < 0.001$) and ($\beta = 0.528$, $p < 0.001$), respectively, and that consumer digital trust and identity have a positive and significant impact on corporate reputation, with path coefficients of ($\beta = 0.409$, $p < 0.001$) and ($\beta = 0.452$, $p < 0.001$). Table 8 shows details.

4 | Discussion

In the rapidly evolving digital landscape, the digital transformation of businesses has not only opened up new opportunities for growth and efficiency but also introduced a complex array of responsibilities that need to be managed effectively. Despite the escalating significance of CDR in shaping consumer trust and corporate reputation, the literature has been remiss in providing a comprehensive measurement tool from the consumer perspective (Cheng and Zhang 2023). This study addresses this void by developing a CDR scale that encapsulates the multifaceted dimensions of digital responsibility as perceived by consumers. The scale development process, informed by a mixed-methods approach, has confirmed that the six dimensions of consumer-centered CDR (digital transparency, digital privacy, digital quality, digital remedy, digital accessibility, and digital inclusiveness) are more concise and relevant for measuring CDR.

Importantly, the final CDR measure did not exactly mirror the CDR dimensions conceptually proposed by scholars (e.g., Mihale-Wilson et al. 2022), providing a robust framework for understanding consumer perceptions of corporate behavior

in the digital realm. Digital transparency in this study requires not only transparency of extensive information on product and service-related aspects but also transparency of price composition, disclosure of basic information (such as business operations and finances), as well as transparency of user information in terms of what is being stored and used (Mihale-Wilson et al. 2022).

Unlike previous studies that have sporadically addressed transparency in various contexts (e.g., Guo et al. 2023; Matheus et al. 2023), our study systematically incorporates digital transparency as a core component of CDR. This dimension is novel in that it specifically focuses on the expectations consumers have regarding the clarity and accessibility of information related to the extent to which companies are open about their digital operations, policies, and data management practices.

The digital privacy factors in this study include the security of user data storage, limited data collection and use, and user data access and correction permissions. The proliferation of digital technology, which inherently facilitates easy access to personal information, has sparked a unique set of privacy issues, thereby catalyzing the evolution of policies specifically designed to tackle those issues (Li, Li, and Tao 2023). Although scholars (e.g., Sarathy and Robertson 2003) addressed the data privacy protection strategy based on the perspective of firms' self-regulation and government regulation under traditional

TABLE 7 | Correlation coefficient matrix and square root of AVE.

Latent variable	1	2	3	4
Corporate digital responsibility (1)	0.737			
Customer digital trust (2)	0.507*	0.812		
Customer's identification (3)	0.482*	0.362*	0.780	
Corporate reputation (4)	0.713**	0.542*	0.562*	0.790

Note: Asterisk (*) indicates that the variables are correlated, and the value on the diagonal in the matrix is the square root of AVE. * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0005$.

TABLE 8 | Path analysis table of corporate digital responsibility on corporate reputation.

	β	SE	CR	p
Corporate digital responsibility → Consumer digital trust	0.534	0.067	9.779	***
Corporate digital responsibility → Consumers' identification	0.528	0.067	9.416	***
Consumer digital trust → Corporate reputation	0.409	0.047	8.133	***
Consumers' identification → Corporate reputation	0.452	0.05	8.586	***

Note: * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0005$.
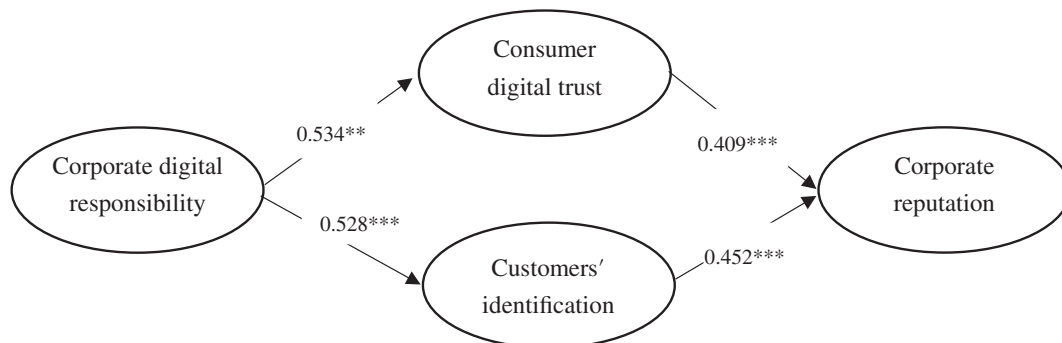

FIGURE 1 | Results of path coefficient analysis. * $p < 0.05$, ** $p < 0.001$, *** $p < 0.0005$.

CSR frameworks, this study responded to the appeal for consumer empowerment on data privacy (Bandara, Fernando, and Akter 2020) by highlighting the importance of data encryption, permission management, and the ethical collection and use of consumer data, which have not been adequately addressed in traditional CSR frameworks.

In this study, digital quality assesses the safety, reliability, and ease of use of digital products and services. Although studies have endeavored to address the customer-perceived quality issues in the electronic or online context (e.g., Parasuraman, Zeithaml, and Malhotra 2005; Su et al. 2022), the digital quality dimension in this study takes a step further by extending the concept of product quality to the digital realm and integrating it into the CDR framework, thereby emphasizing the unique aspects of digital offerings that significantly impact consumer satisfaction and trust. Our findings indicate that consumers expect companies to ensure not only the technical stability and performance of their digital products but also the intuitiveness of their design, differing from the general product quality discussions in CSR literature (e.g., Rahnama and Pentland 2022).

The digital remedy factor refers to the fact that, when a consumer suffers loss or damage in a transaction, the enterprise can give a satisfactory solution mechanism in terms of remedy time and remedy channels. Echoing the perspectives of several scholars (e.g., Janakiraman, Lim, and Rishika 2018; Carl et al. 2023), this dimension embodies the principle of dispute resolution in the realm of digital development scenarios, which remains relatively scarce in the digitization-related research literature (Walsh et al. 2022). This principle broadly encompasses the establishment of mechanisms aimed at addressing the grievances of consumers who have sustained losses or damages (such as financial) during a transaction. These mechanisms provide the consumers with a pathway to seek and secure redress (Ang and Buttle 2012).

Digital accessibility means that companies provide multiple ways to help users better understand and use digital products and services during their online purchasing process. Scholars such as Alperstein (2021) and Herden et al. (2021) have argued that the ethical question should move beyond the ethics of technology. Also to be considered is the ability of the digital technological age (e.g., social media platforms) to exclude participation due to the lack of accessibility of these platforms and their lack of inclusiveness for those who wish to engage with social, political, and environmental issues. The findings of this study are consistent with the call of these studies to emphasize accessibility and inclusiveness in the context of the digital age (Fernández-Díaz et al. 2023; Fisk et al. 2023).

5 | Implications

5.1 | Theoretical Implications

This study developed a scale to measure customer-oriented CDR. Given that CDR research is still in its infancy, this study makes a significant stride toward its further advancement. First, this study enriches the emerging CDR literature by formulating a thorough and empirically validated CDR measurement tool from a consumer perspective. Existing studies have discussed this concept theoretically (Carl et al. 2023; Bandara, Fernando, and Akter 2020; Mihale-Wilson et al. 2022). The CDR scale proposed in this study can be used as a scientifically reliable tool for measuring customer-oriented CDR in the digital era. For example, the developed CDR can be used to evaluate practices like the ethical collection and use of consumer data, improved customer experience through AI-driven customization and personalization, cost reduction via service automation, and the trade-offs between organizational goals and CDR practices for service-oriented enterprises (see Kunz and Wirtz 2024).

Second, the developed scale enriches CSR research. CDR differs from CSR. While CSR has been measured from different perspectives (such as environmental responsibility, social responsibility, and economic responsibility) (Carroll 1991), these scales do not adequately capture the specific dimensions of CDR. For example, these scales do not include dimensions such as digital privacy and digital inclusiveness. The developed CDR scale in this study specifically addresses the digital aspects of corporate responsibility. The six dimensions of CDR identified in this study are unique to the digital context and have not previously been captured in traditional CSR. For instance, digital privacy and digital transparency are particularly relevant in the digital age, where data privacy and transparency in data usage have become major concerns for consumers (Rahnama and Pentland 2022). These dimensions, which are not covered under traditional CSR, reflect a corporation's responsibility to protect users' data and be transparent about the corporation's own data practices.

Similarly, in this study, digital quality and digital remedy pertain to the quality of digital products or services and the mechanisms for addressing any issues or grievances related to these offerings (Sebastian et al. 2017). These dimensions highlight a corporation's responsibility to ensure the reliability of its digital offerings and provide effective remedies when problems arise. In addition, digital accessibility and digital inclusiveness emphasize a corporation's responsibility to make its digital offerings accessible to all users, regardless of their physical abilities, digital literacy levels, or socioeconomic status (Perez-Escolar and Canet 2023). This focus on digital equity is a distinctive aspect of CDR that has not typically been addressed in traditional CSR research.

5.2 | Managerial Implications

The combined development and validation of the CDR scale from the customer perspective offers essential management insights for organizations navigating the complexities of the digital landscape. These insights can be consolidated into four key areas. First, the CDR scale in this study provides a structured framework for the strategic integration of digital responsibility within the fabric of corporate culture. Organizations can use this scale to incorporate ethical considerations into decision-making processes and daily operational practices. This scale can also be used to ensure alignment of digital practices with ethical standards and consumer expectations.

Second, organizations can proactively employ the CDR scale as a risk management tool, focusing on dimensions such as digital remedy and digital accessibility. This approach enables the identification of potential vulnerabilities and establishes robust mechanisms for resolution. By adopting this proactive stance, organizations can mitigate risks associated with digital operations, enhance reputation management, safeguard brand integrity, and foster consumer trust.

Third, the proposed CDR scale facilitates the seamless incorporation of digital responsibility into CSR strategies. By embracing dimensions like digital inclusiveness, organizations can systematically integrate ethical considerations across both traditional and digital realms. This holistic approach underscores enterprises' commitment to responsible business practices, thereby aligning with evolving societal expectations, and enables organizations to ensure their corporate responsibility strategies are comprehensive and inclusive of digital responsibilities.

Fourth, recognizing the pivotal role of the consumer perspective in shaping digital responsibility, organizations can leverage the insights provided by the CDR scale. In particular, dimensions such as digital accessibility and digital inclusiveness offer valuable consumer-centric insights. These insights, when harnessed effectively, enable organizations to innovate and differentiate themselves in the market. By aligning digital practices with consumer values, organizations can use the insights from this study to tailor their digital strategies to meet consumer needs and preferences, thereby enhancing customer satisfaction and gaining a competitive advantage.

In conclusion, adherence to these integrated management insights helps place organizations in a position to judiciously navigate the intricacies of the digital landscape. Such a strategic approach not only fosters responsible corporate practices but also aligns with the evolving expectations of stakeholders in the dynamic and ever-evolving digital business environment.

6 | Directions for Future Research

Development of the CDR scale can serve as a foundation for further research in the field of CDR. First, future research can expand the scope of the scale by incorporating additional dimensions as digital technologies continue to evolve. For example, new forms of digital interactions and technologies such as augmented reality and artificial intelligence become more prevalent, other aspects of CDR related to these technologies may need to be taken into account.

Second, the scale shall be cross-validated in other contexts. Future research could explore how the CDR scale varies across industries such as healthcare, finance, and manufacturing. This would provide a more comprehensive understanding of how CDR is perceived and implemented in different business settings.

Third, undertaking longitudinal studies may provide more insights into consumers' perceptions of CDR change over time. This would help organizations adapt their digital responsibility strategies to meet the evolving expectations of consumers.

Fourth, the scale can be used in cross-cultural research to investigate whether there are differences in the perception and importance of CDR across different countries and cultures. This would assist multinational corporations in tailoring their CDR strategies to local contexts.

Finally, future research could explore the relationship between CDR and other constructs such as corporate reputation, customer loyalty, and financial performance. Understanding these relationships would provide a more complete picture of the value and impact of CDR on organizations.

7 | Limitations

The study acknowledges a few limitations. Given the consumer focus of the scale, future research should explore the components of CDR from multiperspectives and form a unified, scientific, and standardized measurement scale. The sample for this research was drawn from one country, generalizing the findings of this study to other regions must be cautioned. Future research could include participants and corporations from other countries and cultures, which may provide more insights into business digital practice. Finally, as digital technology continues to evolve, scales of CDR need to be updated in real time to more accurately reflect consumer needs.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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The Category and Concept Extracted From Data Coding

Core categories (selective coding)	Conceptual categories (axial coding)	Concepts (open coding)	Sample coded statement
Digital transparency	Information disclosure	Goods/services information; data protection policy; company basic information	... should provide complete details of the goods/services (XK); ... If the relevant data protection policy is not clearly explained, it is difficult for me to trust (HZ); ... I am very brand recognized! If the company is a big brand and I can find all kinds of basic information about it online, I will feel safe (YQ)
	Price transparency	Transparency of pricing principles; price components; price changes	... For example, how is the pricing be listed more clearly (HL); ... very afraid of obviously group buy written clearly no extra consumption, the result is to the arrival and pull all kinds of reasons (XK); their prices change quickly, just buy and then drop prices ... (FY)
	Transparent information storage	Transparency of storage location; transparency of storage duration; transparency of storage rules	... The server and device on which our information is stored should be stated (FJ); For example, if it's about to expire at least tell the user a month in advance to give us plenty of time to prepare (LM);... what kind of storage standards and rules should be made known to us to avoid unnecessary disputes (GS)
	Transparency of data usage	Transparency of purpose of use; transparency of use; transparency of sharing and protection	... We should know where our data is used, often we get irrelevant phone calls that can be really annoying (FJ); the exact way and process of how data is used should be made clear to us (HC); we should know how our data is shared and protected (MP)
	Transparent after-sales service	Transparency of service policy; transparency of service cost; transparency of service progress	... I thought I could get a warranty as long as it was broken, but it turned out to be split between man-made bad or natural damage (GS); ... It was a free warranty when I bought it, and I was finally told that I would be charged $30 for labour (ML); there should be a counterpart when it will probably be fixed and sent back (MP)
Digital privacy	Secure storage of data	Data encryption; backup and recovery; storage environment security	Sometimes our data is sold to a third party without our knowledge, there should be some data encryption technology (WR); ... I used to use another brand, now I change to a new one, but the previous data can be backed up and replied to again (WR); There will be no loss or damage in storage (ML)
	Access to change permissions	View permissions; correcting permissions	... I often check the background data, such as the number of viewers today, the number of likes, etc. (WB); last time, a customer said that his initial registration date and the start date of the insurance policy did not match, and I corrected it for him in the background (WL).
	Restricted data collection	The purpose of collection is clear; the way of collection is legal; the amount of collection is moderate	... should inform me before collecting our information just for registration, never for his use (FY); ... should comply with legal and ethical codes ... (HC). ... just collect what they need, don't collect all the information (FJ)
	Restricted data use	The purpose of use is clear; the way of use is legal; safe and reliable use	it will access my camera permissions, I don't know how much it actually accesses, and I'm afraid if it will steal all the photos (XK); Generally, user data is encrypted, and we won't use it for something illegal (WL); ... so it's better to be able to tell that it won't leak our data and is safe and secure to use (FJ)

Core categories (selective coding)	Conceptual categories (axial coding)	Concepts (open coding)	Sample coded statement
Digital quality	Product safety	Authentication; data encryption	... Nowadays, many smart wearable devices set some password locks for authentication (HC); I hope it comes with security software to encrypt the data content inside (ZL)
	Product reliability	Stable performance; durable	I've been using this mobile phone for two years, and now the performance is still stable and the operation is smooth (XY); their stuff is more durable, and I bought this brand for my whole family (SH)
	Product ease of use	Friendly interface; simple and easy to understand	I hope the interface can be more user-friendly after the update ... (XF); in fact, there are only a few common functions we use every day, so it's not too complicated, and it's better to be simple and easy to understand (WR)
Digital remedy	Remediation time	Quick location; emergency data recovery	Sometimes after communicating for a long time I still can't identify my problem and the time is delayed (SH); I am very anxious when I lost my data and I just hope that the recovery can be carried out quickly (WR)
	Remediation scope	Clear scope; warranty period	I remember when I bought it, the promise was good, free lifetime maintenance, but this time the pen inside was broken, and I was told that I had to bear the maintenance fee for man-made damages ... (XK); when buying, it should be clearly stated how long the warranty period is, although it may not necessarily be repaired when it breaks down later on, but it has to be clearly informed... (GS)
	Channels of remediation	Complaint channels; refund compensation policy	... I hope the company can give me an internal complaint channel, I can not find the law, can be private (YQ); I will contact customer service, you can give me a refund or give me compensation, anyway, to see your action (XF)
Digital accessibility	Customized consultancy	Prepurchase advice; solutions	... I hope that the enterprise can give some purchase advice before purchase (FY); ... For example, the enterprise should provide a good solution when the user has encountered difficulties (SH)
	Online training tutorials	Video tutorials; user manuals	I think a video tutorial should be provided, for example, the last time I bought a mouse, the model in the video and my mouse model did not match (ML); ... before the operation to give us some popularity of the relevant knowledge, give a user manual (LM)
	Security awareness training	Risk management; protection against cyber-attacks; data leakage prevention	... let users make a risk assessment in advance and know what the corresponding consequences are (ZY); there will be some hacking attacks on the Internet, or theft of passwords (SH); in order to prevent the leakage of user data, more secure encryption measures should be taken (WB)
Digital inclusiveness	Basic equity	Hardware; geographic location; social status	Caring for the elderly is our due responsibility, and companies should ensure that they have equal access to digital equipment, such as two systems, to simplify the operation process (XY); In fact, children in the western mountainous areas simply don't have such easy access to e-learning equipment as we do, and their financial conditions are too limited (YQ); ... won't treat everyone differently just because of their different social status (HL)
	Competence equity	Digital knowledge; digital skills	After all, we are highly educated and have certain knowledge and ability to solve the problem what about those who are not highly educated enough (LG) or at least psychologically or physically equipped with the skills to do so (HL)
	Outcome equity	Distribution of benefits; digital consequences	... Every user can share the dividends and benefits of digitization fairly (ZY); ... Of course the consequences should be the same for everyone ... (HZ)

Core categories (selective coding)	Conceptual categories (axial coding)	Concepts (open coding)	Sample coded statement
Digital algorithmic	Improve efficiency	Intelligent tools; operational processes	... Many AI smart tools provide us with too much convenience in learning and life (XF); ... can simplify some more operation processes and reduce unnecessary links (HZ)
	Optimize experience	Personalized recommendations; feedback; interaction	... Now there are user profiles behind the enterprise, which can provide users with some personalised recommendations (WR); ... Increase user feedback (HL) ... Also focus on user interaction (HL)
	Reduce costs	Information costs; security costs	... Sometimes spend a lot of time and energy to search, but the information obtained is still a little far from my expectations ... (WL); ... Since I choose to buy your products and services, you should provide security (ZY)

Appendix 2

Results of Exploratory Factor Analysis

Category	Question item	Factor loading					
		1	2	3	4	5	6
Digital transparency	Firms should disclose experience, financial and risk information	0.762					
	Firms should be transparent with information about the quality of digital products or services	0.815					
	Firms shall disclose information about the price of digital products or services	0.813					
	Companies should inform users about the location, duration and rules of data storage	0.780					
	Companies shall specify the purpose and manner of use of user data	0.769					
	Firms should clarify after-sales service policies and processes	0.749					
	Enterprises shall detail data transfer processes and protocols	0.731					
Digital privacy	Enterprises shall ensure safe storage and processing of user data		0.775				
	Enterprises shall collect user data legally and proportionately		0.776				
	Users have the right to access and modify personal data		0.799				
	The use of user data shall be limited to the agreed purpose		0.787				
	Companies should specify the purpose of user data collection		0.770				
Digital quality	Companies shall ensure the security of the digital products or services provided			0.820			
	The company shall ensure that the digital products or services provided are reliable			0.825			
	The company shall ensure that the digital products provided are easy to operate			0.825			
Digital remedy	Companies shall provide timely after-sales response services				0.837		
	Enterprises shall specify the period and scope of maintenance				0.833		
	Enterprises should provide perfect remedies and ways to defend rights				0.831		
Digital accessibility	Enterprises should ensure that websites and applications are easy to navigate and use for all users					0.787	
	Enterprises should provide users with manuals and tutorials for the use of digital products					0.826	
	Enterprises should provide multiple channels for users to easily access information about digital products or services					0.830	

Category	Question item	Factor loading 1	2	3	4	5	6
Digital inclusiveness	Enterprises should ensure that users have equal access to and use of digital services						0.835
	Enterprises should ensure that users are empowered to use digital tools						0.804
	Enterprises should ensure that users have equitable access to digital technologies						0.828
Eigen value		7.278	2.943	2.032	1.818	1.5865	1.322
Explained variance (%)		30.323	12.261	8.468	7.577	6.605	5.507
Explained cumulative variance (%)		30.323	42.584	51.051	58.628	65.233	70.740