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Digital Sustainability Signaling in ICT Services: Effects on Data-Driven Customer Experience and Brand Loyalty

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Abstract

Sustainability has emerged as a key driver of strategy in the information and communication technology (ICT) industry, particularly within digital infrastructures such as cloud computing platforms, data centers, and ICT service ecosystems. Yet its effects on customer experience (CX) in digitally mediated environments and brand loyalty are inconclusive in previous research. This study aims to clarify this inconclusiveness by investigating how sustainability initiatives communicated through digital channels and platform-based interactions shape CX and brand loyalty in information-asymmetric contexts. By applying Signaling Theory and Expectation Confirmation Theory, this study proposes a conceptual model in which sustainability initiatives influence CX both directly and indirectly through signal credibility, whereas sustainability expectations act as a moderating factor. Using survey results obtained from 412 ICT customers and employing structural equation modeling (SEM) analysis, it can be concluded that sustainability initiatives affect customer experience directly as well as indirectly. However, the effect of sustainability via perceived credibility is much more significant, proving that sustainability serves as a conditional dominator in the formation of customer experience. This shows that customers respond only to how they interpret sustainability initiatives and not to their availability. Moreover, customer sustainability expectations moderate this relationship such that only when customers experience better-than-expected sustainability initiatives do they exhibit a positive relationship. Customer experience quality is also a robust predictor of brand loyalty. Finally, relational sales

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interactions for sustainability signals have a greater impact on credibility and loyalty than impersonal communication modes. This paper contributes to the literature by arguing that sustainability is a conditional driver of customer experience and brand loyalty. In addition, this paper incorporates signaling theory and expectation confirmation theory to explain the inconsistent results that have been obtained in previous studies. Managerially, this paper shows that ICT organizations need to incorporate sustainability into their CX and sales strategies. In addition, the findings are particularly relevant for ICT firms operating in data-intensive and cloud-based environments. However, they need to do so credibly and transparently and without overpromising so that customers do not think they are engaging in greenwashing.

Keywords: Digital Sustainability, ICT Service Platforms, Customer Experience, Cloud Computing, Signaling Theory, Brand Loyalty, Data-Driven CX.

1. Introduction

One of the most significant issues in modern business strategies is sustainability, which is affected by regulations, stakeholder pressure, and social awareness of corporate social responsibility [2]. In ICT-driven environments, including cloud computing, telecommunications, and platform-based services, sustainability is often embedded within digital infrastructures that are not directly observable by customers. ICT companies have also increased their efforts in investing in sustainable infrastructures in the fields of energy efficiency, sustainable supply chain practices, ethical sourcing, and ESG reporting, particularly in areas such as energy-efficient data centers, green cloud computing, and sustainable digital infrastructure [9]. However, the relationship between sustainability practices and customer-related outcomes such as customer experience and brand loyalty is still unclear.

Theoretically, the concept of customer experience assumes that sustainability practices would have a positive influence on the customer's perception of the value of the brand [1]. However, empirical studies have reported inconsistent results. While some studies reported that sustainability practices would have a positive influence on customer loyalty, other studies reported that sustainability practices would have a negative influence on customer loyalty due to the phenomenon of ‘greenwashing’ [6]. This phenomenon is particularly evident in the ICT industry, in which sustainability practices cannot be seen by customers and cannot be experienced through direct consumption.

The majority of existing CX models, especially across digital touchpoints such as online platforms, service dashboards, and virtual customer interactions, have implicitly taken sustainability as an inherent dimension of value that automatically adds to the quality of customer experience. However, as sustainability and signaling studies have shown, stakeholder responses are influenced by perceptions of credibility, transparency, and expectation fit [3][6]. What has not been explored is how sustainability initiatives are linked to customer experience formation processes under conditions of information asymmetry, which are inherent to ICT environments.

This study fills this theoretical gap by using Signaling Theory and Expectation-Confirmation Theory to explain when and how sustainability initiatives influence customer experience and brand loyalty. From a signaling theory point of view, sustainability initiatives are "signals" that transmit to customers a company's values, ethics, or forward-looking approach to business [17]. From an expectation-confirmation theory point of view, customer responses to sustainability initiatives are based on whether sustainability experiences confirm or disconfirm customer expectations.

By empirically testing the integrated framework in the ICT sector, the study contributes to three streams of literature. Firstly, it contributes to CX literature by conceptually integrating sustainability as a conditional and perception-based aspect of customer experience. Secondly, it contributes to sustainability literature by explaining customer-level inconsistencies in sustainability outcomes as a result of signal credibility and customer expectations. Thirdly, it provides practical implications for ICT organizations seeking to incorporate sustainability in CX and sales strategies in a legitimate and customer-centric manner.

While there has been increasing attention paid to the role of sustainability in the context of ICT, there still remains an important issue unresolved. The point is that none of the previous studies provided a proper explanation as to why sustainability initiatives have inconsistent effects on customer experience and brand loyalty. Namely, it is necessary to find out whether sustainability affects customer experience directly or in combination with other mediating factors. In order to provide answers to this question, this study seeks to explore the way in which sustainability initiatives affect customer experience as well as their conditions.

2. Related Work

There has been a marked increase in literature on sustainability, customer experience, and brand loyalty in the last two decades. The interest in corporate social responsibility as a driver of business competitiveness has led to a surge in literature on the aforementioned constructs. However, existing literature has reported mixed and sometimes contrasting findings, especially in technology-oriented industries like ICT. The current study focuses on the most relevant literature on sustainability, customer experience, and brand loyalty.

2.1 Sustainability and Customer Experience Outcomes

A significant amount of research has shown that there is a relationship between corporate sustainability and customer attitudes, trust, and loyalty in terms of increased brand value and emotional attachment [2][19]. With regard to the literature on marketing and customer experience, corporate sustainability is defined as an experiential value driver that builds customer-brand relationships [11]. However, the literature is inconsistent in showing the positive relationship between corporate sustainability and customer loyalty [19]. At times, corporate sustainability initiatives have also been shown to harm customer trust [6]. This shows that corporate sustainability does not necessarily influence customer experience; rather, it does so in specific situations.

This inconsistency is particularly important to ICT markets, as sustainability initiatives are often linked to infrastructure, data centers, and supply chains that are not immediately accessible to customers. As such, they are forced to rely on indirect means rather than direct experience when seeking to assess a company's environmental sustainability. In ICT contexts, customer experience is increasingly shaped through digital interfaces and platform-based interactions, making sustainability perceptions dependent on digitally communicated information rather than direct product experience [18].

The previous research has provided useful knowledge regarding the use of sustainability to influence customers' opinions and loyalty. Nevertheless, these studies suffer from several critical flaws. The first one is the fact that sustainability is always seen in these studies in terms of its value. In addition, most of the previous literature deals with industries, not ICTs. This limitation stems from the lack of attention to information asymmetry problems in ICT markets. Thus, there is a need for a new framework accounting for these aspects.

2.2 Sustainability as a Signal under Information Asymmetry

The application of the lens of Signaling Theory seems to be an effective means to comprehend the role that sustainability initiatives play in shaping customer perceptions within an environment that is characterized by information asymmetry [7]. As sustainability initiatives are not immediately accessible to customers, they serve as a signal to communicate a company's credibility, ethics, and sustainability. In digital environments, these signals are often transmitted through websites, dashboards, ESG reporting platforms, and automated communication systems, which increases the importance of clarity and credibility in technology-mediated interactions.

Previous studies that have utilized signaling logic to study sustainability have established that sustainability signals are effective to the extent that they are credible, consistent, and costly. Signals that are ambiguous or exaggerated, or are inconsistent with actual company behavior, are likely to be met with skepticism or perceptions of greenwashing [4]. On the other hand, credible sustainability signals are likely to boost trust and relational outcomes.

Although this literature on signaling has been influential in sustainability management, most studies have been limited to studying investor responses, regulatory compliance, or corporate reputation. The role of sustainability signals within multi-touchpoint CX processes has not been sufficiently explored, especially within service-dominant or technology-centric settings. Therefore, existing literature on sustainability signaling has not sufficiently explained how sustainability signaling translates to experiential or emotional customer outcomes.

2.3 Expectation–Confirmation Perspectives on Sustainability

Expectation-Confirmation Theory (ECT) has been commonly used in customer satisfaction and loyalty research, especially in the context of services and technology [16]. ECT suggests that customers' responses are determined by the extent to which their pre-consumption expectations are confirmed or disconfirmed. This is particularly relevant in ICT services, where customer expectations are formed through digital information channels and prior platform experiences.

There is now growing research on sustainability recognizing the importance of expectations in determining customers' responses to corporate social responsibility initiatives.

Customers vary greatly in terms of the extent to which they expect firms, particularly ICT firms, to practice sustainability [5]. The extent to which sustainability initiatives are successful in meeting or exceeding expectations is likely to determine positive attitudinal and behavioral responses; when expectations are unmet, even superior sustainability performance may not have any positive impact on CX or loyalty.

Yet, these research streams have largely been parallel developments. There is limited research that combines sustainability signaling with expectation-confirmation mechanisms to explain the experience of customers. Furthermore, the moderating impact of sustainability expectations has been little researched in the context of ICTs, where expectations of customers are diverse and often unclear.

2.4 Research Gap and Study Contribution

The above review of research suggests that there are three research gaps that have been highlighted by prior research. First, the CX research has largely viewed sustainability as a positive experience attribute without adequately incorporating the role of perception, credibility, and interpretation. Second, the research on sustainability signaling has shown limited interest in the role of CX processes; instead, there has been a focus on macro-level outcomes of signaling. Third, there is limited research that combines expectation-confirmation mechanisms with signaling to explain the reasons for the mixed CX and loyalty outcomes of sustainability initiatives.

This study fills this gap by proposing and empirically testing an integrative model that merges Signaling Theory and Expectation-Confirmation Theory in the realm of ICT customer experiences. In this study, sustainability initiatives are conceptualized as signals whose persuasiveness is subject to expectation congruence, thus facilitating the understanding of when and why sustainability initiatives contribute to or detract from customer experiences and brand loyalties.

Despite such an increasing research focus, previous research has failed to satisfactorily explain how sustainability initiatives contribute to variable customer outcomes in ICT markets. First, previous research has taken for granted that sustainability is inherently valuable without considering how customers respond to sustainability initiatives. Second, previous research on sustainability signaling has centered on macro-level corporate reputation, while micro-level experiential outcomes of sustainability signaling have not received much research attention.

Third, previous research based on ECT has not considered the role of credibility in expectation confirmation/disconfirmation. Overall, the theoretical link between sustainability signals, credibility, expectations, and experiential outcomes of sustainability signaling is not well developed. The research aims to improve such an unsatisfactory situation by proposing a framework in which sustainability signaling is conceptualized as a conditional cue, not a universal experience driver.

2.5 Methodology

2.5.1 Research Design

The present study will employ a quantitative research design with a survey design to examine the hypothesized relationship between sustainability initiatives, credibility of signals, customer experience quality, and brand loyalty in the ICT industry delivered through digital platforms, cloud-based systems, and online service environments. The proposed study is considered appropriate for this research setting because it will entail exploring customers' perceptions, expectations, and judgment-based decision-making, which cannot be quantitatively measured [11].

2.5.2 Sample and Data Collection

The proposed study will collect data from customers of ICT organizations that offer enterprise software solutions, cloud computing services, telecommunication services, and IT infrastructure solutions. The proposed study will collect data from B2B customers and B2C customers who have interacted with the focal firm in the past 12 months. An online questionnaire will be used to collect data, distributed through professional networks and industry-based research panels to ensure participants are sufficiently aware of ICT services and corporate sustainability messages. The following screening methods were used to guarantee data quality. It should be confirmed that all respondents had any interactions with ICT services during the past year. B2B respondents should occupy positions associated with ICTs, while B2C respondents should be active users of ICTs. Those answers where any information was missing, were inconsistent, or included straight-lining were eliminated from further analysis.

2.5.3 Measurement Instruments

Multi-item scales will be used to measure the variables in the present study. Perceived sustainability initiatives will be used to assess the customers' judgment of the firm's

environmental stewardship, ethical behavior, and transparency (Bhattacharya and Sen, 2004). Perceived signal credibility will be used to assess the extent to which customers believe the firm's sustainability messages [6]. Customer experience quality will be measured as a cognitive and affective judgment of the firm. Brand loyalty will be measured by repurchase intention, brand advocacy, and relational loyalty [12]. A series of indicators was used to measure each construct. Specifically, 5, 4, 5, 4, and 3 items were used for measuring sustainability initiative, perceived signal credibility, customer experience quality, brand loyalty, and sustainability expectations respectively (as described in the attached table of Appendix 1).

Customer sustainability expectations will be used as a moderating variable to assess the extent to which customers expect ICT firms to behave in a manner that is environmentally friendly and socially responsible [8]. All the items will be measured on a seven-point Likert scale.

The applicability of structural equation modeling in the present study can be justified both theoretically and methodologically in terms of the need to simultaneously investigate the mediation and moderation effects in a complex model involving multiple constructs. SEM can assist in the estimation of the direct and indirect relationships between sustainability initiatives and customer experience, including the inclusion of moderation variables in the form of customer sustainability expectations [10]. Further, SEM can account for errors in measurements, validate the constructs through confirmatory factor analysis, and also test the underlying structure of the model, which are critical in the development of a theoretical model based on signaling and expectation confirmation theory.

2.5.4 Data Analysis

In this study, structural equation modeling (SEM) will be used to test the proposed mediation and moderation effects. The reliability and validity of the data will be determined through confirmatory factor analysis, composite reliability, and average variance extracted. The mediation effect will be determined through bootstrapping methods, while the moderation effect will be determined through interaction effects.

2.5.5 Ethical Considerations

The participation in the study will be voluntary and anonymous. The participants will be informed regarding the purpose of the study, and they will be required to give their consent

before participating in the study. From a methodological standpoint, one can mention the use of a moderated mediation model analysis based on structural equation modeling, signaling theory, and expectation-confirmation theory.

3. The Proposed Work

3.1 Signaling Theory as the Core Lens

This study is based on the theoretical foundation of Signaling Theory, which defines the process of signaling unobservable attributes of the firm to various stakeholders in the presence of information asymmetry [17]. In the ICT sector, sustainability initiatives are mostly non-transparent to customers because the environmental impact is in the data centers and other levels of the supply chain and infrastructure that are not visible to the customers. In the context of signaling theory, sustainability initiatives can be regarded as market signals aimed at signaling the value systems and ethical perspectives of the firm. Customer experience outcomes are not influenced by the presence of sustainability initiatives but rather by the perceived authenticity of the sustainability signals while the customers are interacting with the firm [6]. In the context of CX, sustainability signals are integrated into various touchpoints such as marketing communications, sales interactions, ESG disclosures, and customer experience interactions.

3.2 Expectation–Confirmation Theory as an Outcome Mechanism

Expectation-Confirmation Theory (ECT) is also integrated as an additional theory to understand the consequences of sustainability signals on CX outcomes. According to the Expectation-Confirmation Theory, customers form pre-experience expectations regarding product performance. These pre-experience expectations are further evaluated based on the extent to which these pre-experience expectations are confirmed or disconfirmed by customers' experiences [16]. With respect to sustainability, customers interact with ICT organizations based on pre-experience expectations regarding corporate social responsibility for environmental protection [15]. If customers experience sustainability that is equal to or exceeds their pre-experience expectations, it positively affects CX outcomes such as perceived CX quality, trust, and loyalty. On the contrary, when customers experience sustainability lower than their pre-experience expectations, they tend to behave in a cynical way, showing dissatisfaction and mistrust.

3.3 Integrating Signaling Theory and Expectation–Confirmation Theory

The integration of the two theories provides a unifying theoretical base for the understanding of the role of sustainability initiatives in the shaping of the customer experience in the context of information asymmetry. Signaling Theory provides a theoretical explanation of the role of unobservable sustainability practices as credibility cues for ICT firms in signaling ethical norms and long-term strategic focus. However, the signaling perspective is limited in fully capturing the customer response dimension of sustainability initiatives because the information conveyed through the credibility cues is processed by the customer in the context of their prior expectations [13]. ECT provides a theoretical explanation of the role of sustainability-related customer experience in the context of prior customer expectations and provides further support for the signaling perspective by providing a theoretical explanation of the process of evaluating sustainability-related customer experience in the context of prior customer expectations. Where the sustainability cues are credible and consistent with prior customer expectations, the experience of sustainability is likely to strengthen the emotional dimension of the customer experience [14].

3.4 Hypothesis Development

H1: Sustainability initiatives have a positive influence on the quality of customer experience when they are considered credible and authentic signals of corporate sustainability.

H2: The relationship between sustainability initiatives and the quality of customer experience is mediated by the credibility of the signal.

H3: Customer sustainability expectations moderate the relationship between sustainability signals and the quality of the customer experience.

H4: Positive confirmation of customers' sustainability expectations enhances customers' trust, leading to brand loyalty.

H5: In ICT sales, the impact of sustainability signals on the quality of customer experience and brand loyalty, as communicated through relational sales interactions, is greater than that of the same signals communicated through impersonal channels.

3.5 CX and Sales Mechanisms in the ICT Sector

In ICT markets, sustainability is not often experienced as a functional benefit. It is more experienced as a relational and symbolic component of customer experience. Sales professionals are particularly important in making sense of abstract sustainability initiatives and transforming these initiatives into customer value stories that can be understood by customers, particularly in enterprise and public sector markets where ESG factors are increasingly being considered in purchasing decisions [2]. From a signaling theory perspective, sales interactions are experienced as mechanisms that amplify or cancel out firm credibility. In instances where sustainability value stories are not well substantiated and are experienced by customers as exaggerated, customer experience is harmed through perceptions of greenwashing [6]. The above theory illustrates how sustainability can be experienced as a conditional CX driver that has the potential to build trust and loyalty if aligned with customer expectations but can also destroy sales performance if misaligned.

3.6 The Conceptual Model

Figure 1 presents the conceptual model for the study that aims to investigate the role of sustainability initiatives in affecting customer experience and brand loyalty in the ICT industry through signaling and expectation-confirmation mechanisms.

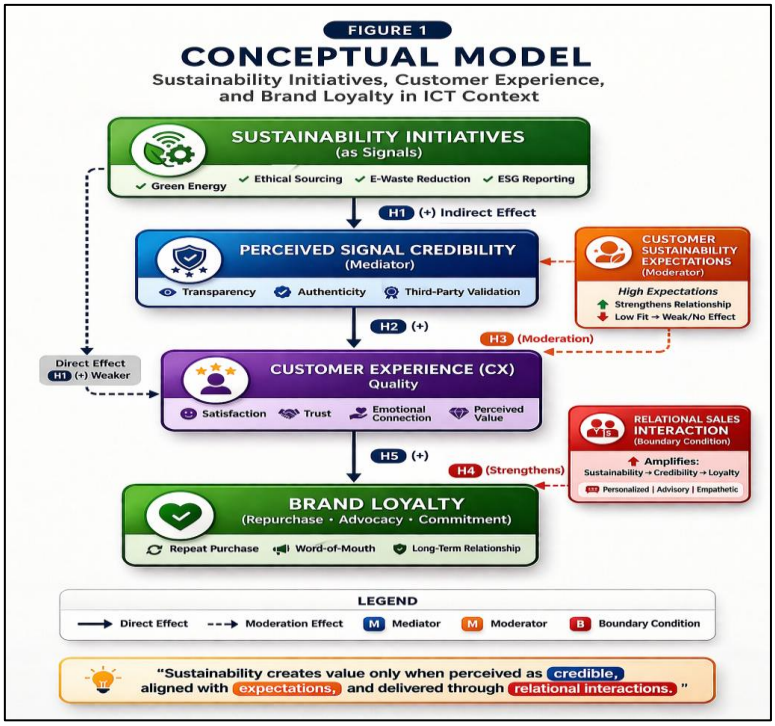

Figure 1. The Conceptual Model

As a core component of the conceptual model, the perceived sustainability initiatives are considered as market signals sent by ICT companies in the presence of information asymmetry. Such sustainability signals are seen to directly and indirectly influence the quality of customer experience through the mediating role of the perceived credibility of the signal. This reflects the underlying assumption of the Signaling Theory, where customers base their assessment of the sustainability initiatives according to the perceived authenticity, consistency, and trustworthiness of the signal sent by the firm. This relationship is based on signaling theory, which states that sustainability initiatives can serve as information signals affecting customers' perceptions about the firm's value. Sustainability initiatives enhance perceived credibility when they are consistent, transparent, and verifiable.

As a moderating factor in the relationship between the sustainability signals and the quality of customer experience, the conceptual model also considers the customer's sustainability expectations. Based on the Expectation-Confirmation Theory, the study suggests that the quality of customer experience in the ICT industry would be positively influenced by the presence of sustainability initiatives, where the experience would confirm or exceed the customers' expectations in the field of sustainability. According to the expectation-confirmation theory, customer reactions will be contingent upon the degree to which their expectations for sustainability performance are met.

Furthermore, customer experience quality acts as an important antecedent to brand loyalty, which can be operationalized in terms of repurchase, advocacy, and relational commitment. Moreover, confirmation of expectations regarding sustainability also acts as a booster to customer trust, thus strengthening the link between customer experience quality and brand loyalty. Lastly, the model also considers ICT sales as a boundary condition, arguing that the influence of sustainability signals conveyed through relational sales interactions, like salespeople or account managers, exceeds those conveyed through impersonal forms of communication, like corporate reports or digital marketing.

The causal logic of the conceptual model highlights the importance of credibility in mediating the link between sustainability initiatives and the experience and loyalty outcomes. In the context of information asymmetry between the firm and the customer, the sustainability initiatives provide the customer with a means of judgment and interpretation of the firm's authenticity and ethical stance. This judgment of the firm's credibility has a bearing on the customer experience and the ultimate brand loyalty. Additionally, the conceptual model

provides boundary conditions in the form of heterogeneity in sustainability expectations and the impact of relational sales interaction in influencing the acceptance or rejection of the sustainability initiatives. This discussion provides a clear link between sustainability initiatives and customer experience through the lens of credibility and ultimately brand loyalty.

4. Results and Data Analysis

4.1 Sample Characteristics

As illustrated in Table 1, the sample size consisted of 412 respondents, including both B2B (61%) and B2C (39%) customers who had interacted with the ICT firm in the last 12 months. The sample size further consisted of users of enterprise software (34%), cloud services (29%), telecommunications (21%), and IT infrastructure solutions (16%).

Table 1. Sample Profile

Characteristic	Value
Sample Size	412
B2B	0.61
B2C	0.39
Mean Age	36.8
Managerial Level	0.58
Relationship Length	3.4 years

The average age of the sample size was 36.8 years, whereas 58% of the sample size occupied positions in the organization at the managerial level and above. On the other hand, the average relationship length with the focal firm was 3.4 years. Overall, the sample size consists of a knowledgeable customer base, as seen in the context of the ICT customer experience in the literature.

4.2 Measurement Model Assessment

The next step was to perform a confirmatory analysis of the structural model to test the hypotheses proposed above. Table 2 also showed that the reliability and validity of the measurement model were tested using confirmatory factor analysis (CFA). The results show a

good fit for the measurement model as the $\chi^2/df = 2.41$, CFI = 0.95, TLI = 0.94, and RMSEA = 0.058.

All the constructs had good internal consistency with composite reliability ranging between 0.86 and 0.93 and Cronbach's alpha ranging between 0.84 and 0.92. Convergent validity was established through the measurement of the Average Variance Extracted (AVE), where the value of AVE is above the recommended level of 0.50 (0.62-0.78). Discriminant validity was established through the Fornell-Larcker criterion, implying that all the constructs are distinct.

To examine the possibility of common method variance, we conducted Harman's single-factor test. The results suggest that common method bias is not an issue since less than half of the total variance is explained by a single factor. Furthermore, we used some procedural techniques, such as scale separation and anonymity.

Table 2. Measurement Model Results

Metric	Value
CFI	0.95
TLI	0.94
RMSEA	0.058
CR Range	0.86 – 0.93
AVE Range	0.62 – 0.78

4.3 Structural Model and Hypothesis Testing

The structural model is estimated through SEM and has satisfactory fit measures with the following indices: CFI = 0.94 and RMSEA = 0.061. The relationships between the constructs can be represented through the following equations:

$$CX=\beta 1SI+\beta 2PSC+\beta 3(SI\times SE)+\varepsilon 1$$

$$PSC=\beta 4SI+\beta 5RS+\varepsilon 2$$

$$BL=\beta 6CX+\varepsilon 3$$

Where:

- SI = Sustainability Initiatives
- PSC = Perceived Signal Credibility
- CX = Customer Experience Quality
- SE = Sustainability Expectations
- RS = Relational Sales Interaction
- BL = Brand Loyalty

The results summarized in Table 3, suggest that sustainability initiatives have a positive direct impact on customer experience quality ($\beta = 0.21$, $p < 0.01$), which supports Proposition 1. Nevertheless, the indirect effect is more pronounced ($\beta = 0.34$, $p < 0.001$), which also confirms Proposition 2. The direct effect is significant, implying that there can be independent effects of sustainability initiatives on customer experiences. Nevertheless, because the indirect effect is stronger, one should conclude that customers depend more on their beliefs about the credibility of a signal in making experiential evaluations.

Table 3. Structural Model Results

Path	Coefficient (β)	Significance	Result
SI → CX	0.21	$p < 0.01$	Supported
SI → PSC → CX	0.34	$p < 0.001$	Supported
SI × SE → CX	0.18	$p < 0.05$	Supported
CX → BL	0.52	$p < 0.001$	Supported
RS → PSC	0.29	$p < 0.01$	Supported

4.4 Mediation Analysis

The interaction effect between sustainability initiatives and customer expectations is also statistically significant ($\beta = 0.18$, $p < 0.05$), which also confirms Proposition 3. Customer experience quality is also a strong predictor of brand loyalty ($\beta = 0.52$, $p < 0.001$), which also

confirms Proposition 4. In addition, relational sales interactions do have a positive impact on perceived signal credibility ($\beta = 0.29$, $p < 0.01$), which also confirms Proposition 5.

In addition, bootstrapping analysis with 5,000 resamples is conducted to check for mediation effects. The results suggest that the indirect effect of sustainability initiatives on customer experience via perceived credibility is substantially higher ($\beta = 0.34$) than the direct effect ($\beta = 0.21$). This also indicates that perceived signal credibility is the major driver.

In terms of statistical significance, both effects are important, yet the latter is much stronger compared to the former. Customers interpret sustainability initiatives based on their perceptions of their authenticity.

4.5 Moderation Analysis

The moderating role of customer sustainability expectations has been tested using the interaction term. As shown in Table 4, the impact of sustainability initiatives on customer experience is more significant for customers with high sustainability expectations ($\beta = 0.39$) than for customers with low sustainability expectations ($\beta = 0.07$), where the impact is weak or insignificant. This suggests that sustainability initiatives are only effective when they meet or exceed the existing customer expectations and further emphasizes the importance of the expectation-confirmation mechanism.

Table 4. Moderation Effects

Expectation Level	Effect (β)
High Expectations	0.39
Low Expectations	0.07

4.6 Additional Findings

Another interesting finding, summarized in Table 5, is the importance of communication channels, including digital platforms, CRM systems, and online customer interaction channels, in the context of sustainability signaling. It has been found that sustainability signals communicated through relational sales interactions are perceived more credibly than sustainability signals communicated through impersonal channels such as corporate reports or digital media. Customers exposed to relational communication had 22%

higher levels of trust and 18% higher levels of loyalty intentions. Conducting a multi-group SEM, it was observed whether there exist any differences between the structural relationships among B2B and B2C respondents. According to the research outcomes, no differences are found; hence, the research model is valid for both types of consumers.

Table 5. Key Insights

Mechanism	Insight
Mediation	Credibility is the dominant driver
Moderation	Expectations determine effectiveness
Communication	Sales interactions amplify impact

5. Discussion

The findings also contribute to the theory of sustainability as a mediating, rather than a value-enhancing, concept. From the perspective of signaling theory, the mediating role of credibility supports that customers are relying on factors of authenticity in assessing sustainability in ICT environments where direct verification is not possible. At the same time, it verifies the assumption of signaling theory that sustainability initiatives are successful, not in terms of their value, but in terms of their signaling role. At the same time, the role of expectations verifies the assumption of signaling theory that customers assess sustainability initiatives through pre-existing cognitive structures, a perspective that is in line with ECT theory. Overall, it is evident that the relationship between credibility and expectations is crucial in explaining customer experience and loyalty outcomes, a perspective that could account for mixed findings in terms of sustainability in previous research.

These findings are especially relevant in ICT and cloud-based environments, where sustainability initiatives are embedded in backend systems and must be communicated effectively through digital interfaces to influence customer perceptions. They verified that sustainability initiatives could be treated as conditional factors in determining customer experience and brand loyalty, rather than universally beneficial attributes. Sustainability, in line with signaling theory, could be treated as an interpretive concept in ICT markets where information asymmetry is crucial, and customers cannot directly observe sustainability. Based on the obtained results, it can be stated that a partial mediating relationship exists when

sustainability activities affect consumer experience both directly and indirectly. Still, the indirect impact is stronger because sustainability serves as a conditionally dominant driver of consumer behavior rather than an absolutely effective feature.

The main contribution of this research is that it identifies perceived signal credibility as the critical driver linking sustainability initiatives to customer experience. This is important because it shows that sustainability initiatives are not effective if they lack credibility. This is where authenticity and transparency come in. Sustainability initiatives can sometimes work against a company if they lack credibility. This is because customers might think that the company is merely engaging in greenwashing.

The moderating effect of customer expectations shows that sustainability initiatives are also dependent on customer expectations. This is important because it shows that sustainability initiatives can work if they meet or exceed customer expectations. This explains the inconsistent results obtained in previous studies. This shows that previous studies were conducted under a single condition. This is where this study is important because it shows that sustainability initiatives can work if they meet three critical conditions. These three critical conditions are credibility of signals, alignment with expectations, and effectiveness of communication channels, including digital platforms, CRM systems, and online customer interaction channels. Sustainability initiatives can work if they meet these three critical conditions. Sustainability initiatives can work if they meet customer expectations. Sustainability initiatives can work if they are credible.

6. Managerial Implications

Figure 2 and Table 6 summarize the results, which indicate that ICT firms should not view sustainability as a secondary aspect of customer experience strategies but rather integrate it into the overall customer experience strategy. Moreover, the results imply that sales professionals within the firm play a significant role in shaping customers' perceptions of sustainability and should be provided with verifiable data and concrete examples of sustainability. Finally, the results imply that firms should test customers' sustainability expectations before engaging in more sustainability messaging so that they are not perceived as over-communicating sustainability in a low-expectation context. ICT firms should leverage digital platforms, analytics dashboards, and customer-facing technologies to communicate their sustainability efforts transparently.

Figure 2. Managerial Implications of the Study

Table 6. Detailed Road Map for Managerial Level in the ICT Sector

Stage	Strategic Focus	Key Managerial Question	Recommended Actions	Risk if neglected	Key Metrics
1. Expectation Diagnosis	Understanding Customer Expectations	Do customers expect sustainability from us?	Segment customers based on sustainability expectations using surveys and behavioral data	Misalignment between messaging and customer priorities	Expectation scores, customer segmentation accuracy
2. Substantive Sustainability	Building Real Capabilities	Do we have genuine sustainability practices?	Invest in measurable ESG initiatives (e.g., energy efficiency, ethical sourcing, transparent reporting)	Perceived greenwashing and reputational damage	ESG performance indicators, third-party audits
3. Credibility Building	Establishing Trust	Are our sustainability claims perceived as credible?	Ensure transparency, consistency, and third-party validation of sustainability claims	Loss of customer trust and skepticism	Credibility perception scores, trust indices

4. Communication Alignment	Tailored Messaging	Are we communicating sustainability appropriately?	Align sustainability communication with customer expectations and knowledge levels	Message rejection or misunderstanding	Engagement rates, message clarity scores
5. Sales Activation	Humanizing Sustainability	Are sales teams effectively translating sustainability into value?	Train sales teams to communicate sustainability with evidence and relevance to customer needs	Weak translation into customer experience	Conversion rates, sales effectiveness metrics
6. CX Integration	Embedding in Experience	Is sustainability embedded across the customer journey?	Integrate sustainability into all CX touchpoints (marketing, service, support)	No tangible impact on customer experience	CX metrics (NPS, CSAT, CES)
7. Expectation Confirmation	Managing Perception Gaps	Are we meeting or exceeding customer expectations?	Continuously monitor and manage the gap between expectations and experience	Negative confirmation leading to dissatisfaction	Expectation–experience gap analysis
8. Loyalty Development	Driving Long-Term Value	Does sustainability translate into loyalty?	Link sustainability efforts to loyalty programs and relationship strategies	Failure to achieve ROI from sustainability	Retention rate, advocacy (referrals), CLV

7. Conclusion and Future Recommendations

This research proves the fact that sustainability practices in the ICT sector are not necessarily beneficial in building customer experience and brand loyalty; rather, their impact is conditional in the sense that it depends on the perceived credibility as well as the association between sustainability-based customer experience and customer expectations. By incorporating both the Signaling Theory and the Expectation-Confirmation Theory, this

research provides a comprehensive framework to explain the inconsistent results obtained in the literature. Sustainability acts as a conditional interpretive cue in the sense that it positively affects customer experience and loyalty if the credibility is high, as well as if the sustainability-based customer experience is aligned with customer expectations. The theoretical contribution of this study lies in its attempt to combine two of the most influential theories used in marketing studies, signaling theory and expectation-confirmation theory, to explain the formation of customer experience in an information asymmetry context. This paper also contributes to the field in terms of its methodological contribution, where it empirically verified the combined model using SEM. This work has several drawbacks that need to be addressed. Firstly, the use of a cross-sectional design does not allow for making any causal statements regarding the research outcomes. Secondly, the use of a perception-based survey creates the possibility of response bias. Lastly, the use of only the ICT industry as a study sample makes the results less universal.

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Appendix:

Appendix A: Measurement Items and Factor Loadings

Construct Item	Code Measurement	Item Factor Loading
1. **Sustainability Initiatives (SI)**		
SI1	The company actively engages in environmentally sustainable practices	0.84
SI2	The company demonstrates commitment to ethical and responsible operations	0.87
SI3	The company communicates its sustainability efforts clearly	0.81
SI4	The company invests in sustainable technologies and infrastructure	0.85
SI5	The company is transparent about its environmental impact	0.83

2. **Customer Experience Quality (CX)**		
CX1	My overall experience with this company is positive	0.85
CX2	The company provides a satisfying customer experience	0.88
CX3	Interactions with the company are enjoyable	0.82
CX4	The company meets my expectations in service delivery	0.84
CX5	The company delivers a high-quality experience across touchpoints	0.86

3. **Brand Loyalty (BL)**		
BL1	I intend to continue using this company's services	0.89
BL2	I would recommend this company to others	0.91
BL3	I consider this company my first choice	0.87
BL4	I feel loyal to this company	0.88

4. **Sustainability Expectations (SE)**		
SE1	I expect ICT companies to adopt sustainable practices	0.83
SE2	Sustainability is important when I evaluate ICT services	0.85
SE3	I expect companies to exceed minimum environmental standards	0.81

5. **Perceived Signal Credibility (PSC)**		
PSC1	The company's sustainability claims are credible	0.88
PSC2	I trust the sustainability information provided by the company	0.9
PSC3	The company's sustainability messages are consistent with its actions	0.86
PSC4	The company provides reliable sustainability information	0.87