

Signaling Sustainability: A Study of Environmental Communication in the Building Sector

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LIST OF TABLES AND FIGURES

Tables

- TABLE 1 Overview of Environmental Sustainability Concepts in Literature
- TABLE 2 Signal Observability and Cost Definitions and Examples
- TABLE 3 Information Asymmetry in B2B Signaling Environments
- TABLE 4 Constructs Table and Development of Case Organization Interview Protocol
- TABLE 5 Constructs Table and Development of Architects Interview Protocol
- TABLE 6 Information Table of Interviewees with Case Organization - Aisti
- TABLE 7 Information Table of Interviewees with Architects
- TABLE 8 Cross-Tabulation of Codes Frequency By item and Respondent (Case Organization)
- TABLE 9 Cross-Tabulation of Codes Frequency By item and Respondent (Architects)
- TABLE 10 Comparison of Architects & Supplier Views on Signaling Environments
- TABLE 11 Signaler Characteristics Implication on Signal Interpretation & Formation
- TABLE 12 Signal Observability & Cost Impact on Signal Formation & Interpretation
- TABLE 13 Outline of Study RQs & Answers
- TABLE 14 Study Quality Measurement & Test (Adam et al., 2014)

Figures

- FIGURE 1 Research Structure Outline
- FIGURE 2 Vesal et al. (2021) Overview of Literature Gap on B2B vs. B2C Environmental Sustainability
- FIGURE 3 Connelly et al. (2011) Signaling Theory Concepts and Timeline
- FIGURE 4 Balmer and Gray's (1990) Strategic Corporate Communications Model
- FIGURE 5 Study Theoretical Framework Model
- FIGURE 6 Bruan and Clark (2005) Thematic Analysis Steps
- FIGURE 7 Product Environmental Signals Calibration by Architects
- FIGURE 8 Signals Observability & Cost Implication on Signal Strength
- FIGURE 9 Signaling Environment Implication on Information Asymmetry Between Suppliers & Architects
- FIGURE 10 Information Asymmetry Implication on Signal Observability & Cost
- FIGURE 11 Signaling Framework for Communication Signal
- FIGURE 12 Signaling Process between Suppliers & Architects

ABSTRACT

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<p>Abstract</p> <p>Sustainability communication has become a top priority for B2B corporate communication strategies. The building sector, in particular, faces a challenge in effectively conveying their environmental responsibility amidst the saturation of sustainability messaging and the public's raised expectations. To establish a positive reputation and cut through the noise, companies in this industry must convey credible environmental messages.</p> <p>The primary scope of this paper is to investigate environmental communication in the building sector, with a focus on the communication process between building material suppliers and architects. The study discusses the central concept through the lens of signaling theory to understand the formation of environmental communication messages (signals) and the impact of communication context (signaling environment and information asymmetry) on stakeholders' perceptions of a firm's environmental impact. The thesis contributes to Corporate Communication literature and expands the literature on Corporate Social Responsibility by seeking responses to the B2B sustainability communication literature gap.</p> <p>The research problem and questions were the guiding factors in selecting this study's research interpretive philosophy and qualitative methodology. The study collects primary data from 13 expert interviews in two phases: Phase 1: Four expert interviews of communication decision-makers in a Finnish building material supplier (case organization). Phase 2: Nine semi-structured interviews with Nordic architects (targeted stakeholder group).</p> <p>The finding of this study demonstrated that the observability and qualities of costly environmental signals are critical drivers behind persuasive communication messages. Secondly, the study reveals the role of signaling environments and information structure on the environmental messages' credibility. Finally, the study presents the signaling process between suppliers and architects to offer practitioners insights into transmitting impactful sustainability messages to architects.</p>	
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TABLE OF CONTENT

LIST OF TABLES AND FIGURES

ABSTRACT

TABLE OF CONTENT

01 Introduction	1
1.1 Research Context	1
1.2 Theoretical Context	2
1.3 Research Purpose & Questions	3
1.4 Research Structure	4
02 Theoretical Framework	7
2.1 B2C VS B2B Sustainability Communication	7
2.1 Environmental Communication	9
2.2 Signaling Theory: Overview	12
2.2 The Signaler: Signal Formation	15
2.3 Signals: Observable and Costly Signals	15
2.3.1 Signal Characteristics	16
2.3.2 Signals and Environmental Communication	18
2.4 The Receiver: Signal Interpretation and Attitude Change	19
2.5 Signaling Environment and Information Asymmetry	20
2.5.1 B2B Signaling Environments	21
2.5.2 Information Asymmetry	22
2.6 Summary of the Theoretical Framework	24
03 Data and Methodology	26
3.1 Research Paradigms	26
3.1.1 Qualitative Research Methodology	27
3.2 Data Collection	28
3.2.1 Case Organization Selection	28
3.2.2 Case Organization Description	29
3.2.3 Semi-structured Interviews	29

3.3 Sampling Technique	31
3.3.1 Sample Overview	32
3.4 Data Analysis	34
3.4.1 Thematic Analysis	34
3.4.2 Interpretative Analysis	36
04 Analysis and Results	37
4.1 Phase 1: Signal Formation	37
4.1.1 Signaler Characteristics and Signal Formation	39
4.1.2 The Impact of Signaling Environment on Signal Formation	40
4.1.2.1 Online Signaling Implication on Signal Cost	41
4.1.3 Developing Credible and Factual Signals	42
4.1.3.1 Costly Environmental Signals	43
4.1.3.2 Ambiguous Environmental Sustainability Messaging	45
4.1.4 Summary of Signal Formation	46
4.2 Phase 2: Architects Expert Interviews - Signal Interpretation	46
4.2.1 The Impact of Signaling Environment on Signal Interpretation	48
4.2.1.1 High Regulations Impact on Information Asymmetry	48
4.2.1.2 Saturation of Environmental Communication	50
4.2.1.3 Online Signaling Impact on Costly Signal Attributes	51
4.2.2 The Impact of Signal Cost and Observability on Signal Interpretation	53
4.2.3 The Impact of Signaler Characteristics on Signal Interpretation	58
4.2.4 Signals and Decision-making	59
4.2.5 Summary of Signal Interpretation	60
4.3 Overview of the Results: Bridging the Communication Process	62
4.3.1. Signaling Environments	62
4.3.2 Signals Cost and Observability: Effective and Credible Signaling	67
Summary of Results on Signaler Characteristics	67
Summary of Results on Signal Observability & Cost	69
05 Discussion	73
5.1 Theoretical Contribution	73

5.1.1 Assessment of The Signaling Theory	75
5.1.2 Addressing the Research Questions	76
5.2 Managerial Contribution	79
5.3 Study Evaluation	82
5.3.2 Study Validity and Reliability	83
5.3.3 Study Limitations	85
5.4 Directions for Future Studies	86
5.5 Concluding Remarks	87
REFERENCES	89
Appendix 1 Interview Protocol for Case Organisation (Aisti)	96
Appendix 2 Interview Protocol for Architects	98

01 Introduction

The first chapter of the thesis introduces the research and theoretical context and then outlines the research purpose and questions. Finally, the chapter presents an overview of the thesis structure and main chapters.

1.1 Research Context

In the wake of climate change, stakeholders view companies as the most responsible actors in driving positive environmental change in society; therefore, they increasingly demand that firms do right by the planet (“Trend Watch 2023,” 2022).

Sustainability has transformed the Business-to-Business (B2B) ecosystem and opened financial growth opportunities for firms that were quick to answer demands for corporate environmental accountability (Winkler & Hostetter, 2022). In 2019, B2B firms globally invested more than €27 trillion in ESG reporting and sustainability communication (Henisz et al., 2019). Despite these efforts, over 90% of firms’ sustainability communications fail to positively impact customers’ perceptions of corporate impact (RepRank, 2022). In 2021, a report by McKinsey & Co (2021) also found that firms continued to see no significant impact from sustainability communication on the firm value perception, revenue, or product pricing.

The building sector is one industry under tremendous pressure from governments and environmental activists (UNEP, 2022). The building sector accounts for 39% of global carbon emissions, polluting the environment and accelerating irreversible climate change hits (Blohmke et al., 2020). In addition, the World Green Building Council has confirmed the urgency for immediate actions and declarations from stakeholders in the construction sector about their role in decarbonizing the sector and mitigating climate impact on the environment, biodiversity, and the economy (Adams et al., 2019).

Today, stakeholders and firms across the construction and building sector are under tremendous pressure from regulators and activities to do better for the environment and accurately and transparently communicate about their business environmental impact (Darko et al., 2017). Blohmke et al. (2020) also state that stakeholders across the sector, especially architects, are responsible for making sustainable decisions on building materials to achieve those net zero targets by 2050. Also, regulations and environmental agencies challenge building material suppliers to produce circular and carbon-neutral materials to achieve those goals (UNEP, 2022). Thus, B2B firms compete to communicate their environmental impacts to answer public expectations accurately (Darko et al., 2017).

In Finland, the building and construction sector offers another unique perspective on developing sustainability communication in B2B sectors because of stakeholders' magnified attention and demand. The Finnish government has committed to becoming carbon neutral by 2030, forcing all stakeholders to take serious action to communicate about their carbon emissions and energy use (*Net Zero Carbon Commitment, 2023*).

The study focuses and context present three important conclusions:

1. Suppliers operating in the building sector are under tremendous and increasing pressure to communicate about their environmental impact, especially in Finland (Darko et al., 2017; UNEP, 2022).
2. External factors impact the communication process between stakeholders in the building supply chain, but what are the impacts?
3. It is pivotal for suppliers to map out how influential stakeholders receive their environmental sustainability communications (Labarbera, 1982) to stay competitive and abide by demanding regulations.

Therefore, this study focuses on the building sector in Finland because the industry offers a distinctive perspective on the development of sustainability communication in the B2B context. By studying the formation and interpretation of sustainability communication between stakeholders in the Finnish B2B construction industry, the study can offer insights into how firms can develop more effective and credible sustainability communication messages. Many industries and markets will soon follow. Hence studying the development of environmental messages in this market will offer insights for practitioners in the building sector.

1.2 Theoretical Context

An important starting point for this study is to outline the theoretical context of environmental communication. While focusing on environmental communication, the study adopts the signaling theory to study environmental communication messages in smaller, distinct signals (Spence, 1973). The signaling theory studies signaling as a transactional communication, where the signaler obtains more information (about the truthfulness of the signal) that is unavailable to the receiver. Thus, the signaler is incentivized to be untruthful about the signal (Connelly et al., 2011).

When the signaling concept is applied to communication, consumers can determine quality differences among products or firms depending on signals (Connelly et al., 2011). Additionally, consumers can determine the firm value and form their perception of the firm's expertise and credibility using sustainability signals (Connelly et al., 2011). Smeltzer (2006) suggests that signals like product quality and sustainability impact

perception through psychological identification, self-verification, and feelings of mutuality. Therefore, this study uses the theory to extend the research on environmental communication by investigating how the signaling environment and signal attributes could impact the interpretation and trustworthiness of communication messages (Connelly et al., 2011).

Based on the theoretical context, the use of signaling theory to study environmental communication is relatively new and presents an opportunity for new insights and contributions to the field. Given the specific focus and context of the study, the signaling theory can provide a valuable framework for studying how architects, an influential stakeholder group in the building sectors, perceive environmental messages. Also, the study uses signaling theory to provide a framework for studying environmental communication between stakeholders and firms in the building sector. Finally, because this phenomenon is timely, the study could add significant managerial and theoretical contributions to the field.

1.3 Research Purpose & Questions

Following the presented research and theoretical context, the research purpose can be summarized in the following statement.

- **Research Purpose Statement:** This thesis aims to study the environmental communication process between stakeholders in the building sector using signaling theory as a framework.

Three main objectives guide the research. Firstly, the study contributes to the existing research on Corporate Social Responsibility (CSR) by expanding research on environmental communication. Secondly, the study presents the external factors impacting the communication of ecological messages between stakeholders in the building sector. Thirdly, the study advances the understanding and conceptualization of environmental signals.

The signaling theory proposes that communication is a transactional process in which the signaler aims to transmit signals that provide truthful information to the receiver, who, in turn, tries to interpret the signals to ascertain their credibility (Spence, 1973). Therefore, in environmental communication, the signals used by architects and building material suppliers could impact the interpretation and trustworthiness of environmental communication messages. Thus, the study is guided by two Research Questions (RQs):

- (RQ1): **How do architects interpret environmental communication signals?**
- (RQ2): **How do building material suppliers develop environmental communication signals?**

The two questions address construction industry practitioners and the signaling theory's theoretical context. RQ1 addresses the signaling theory's focus on the signaler's role in communication. At the same time, RQ2 investigates the role of the signaler (building material suppliers) in developing credible and effective environmental signals that can communicate their sustainability attributes to architects.

By incorporating concepts such as signaling, the research questions are grounded in the broader literature on communication, which provides a more theoretical lens through which to examine the role of sustainability signals in environmental communication.

1.4 Research Structure

The study is presented in five main chapters, each outlining a significant area of research.

The first chapter is an introductory chapter that is essential to the success of this thesis study. Chapter One introduces the research problem and study background and offers a precise rationale and inspiration for choosing the subject. The chapter presents the research problem and outlines the scope of the research by defining the empirical research on the central concept. The chapter ends with a clear research structure and justifies the adoption of signaling theory as a point of view to study the topic.

The second chapter introduces the theoretical framework and literature reviewed to explore the concepts in depth. The literature gap section peeks at the gap in current literature examining the relationship between CSR communication and B2B brand image as mandated by Bloom and Reve (1990), Vesal et al. (2021) and Avram & Kühne (2008). Marketing, ethics, and industrial marketing management journals carefully examined relevant titles to capture the latest knowledge and studies on brand signals, corporate image, and consumer trust. The second chapter also presents the literature gap in the subject area. It concludes with an illustration of the adopted research model, which will work as the basis for the study.

The third chapter presents the research strategy, approach, and data collection methodology. The chapter outlines and gives an overview of the research techniques and methods used to collect empirical data for the study. This detailed outline of selecting research strategy and methodology demonstrates the validity and reliability of the data collected. With that, the chapter builds the foundation for the trustworthiness of the results and findings detailed in chapter four. In addition, the presented strategy and data collection techniques offer future research clear steps on

how the study addresses the research questions and how to evaluate the data collection quality and accuracy. Finally, this chapter helps future researchers build upon and replicate the study to advance the field of knowledge.

Chapter four details the finding from analyzing collected data. An interpretative approach and thematic analysis were adopted to analyze the data collected from the semi-structured interviews with the architects and participating case organizations. The data was analyzed using O'Gorman and MacIntosh's (2015) six steps of thematic analysis, and the findings are summarized under each of the main preset and emerging themes. Results are presented in two sections, each organized in the order that corresponds to the research question at hand. The findings are detailed to follow the theoretical framework of pre-set themes and emerging themes from the data to tell a clear and cohesive story of the results.

The final chapter of this thesis presents the study's results and findings, which are analyzed through thematic analysis, interpretation, and analytic generalization. The chapter discusses the study's theoretical contribution and managerial implications and identifies its limitations and validity. It also outlines the precise evaluation criteria to ensure the study's transparency, validity, and reliability. The chapter concludes by providing directions for future studies to build on the findings and improve the understanding of the research topic.

It is also important to note that AI and language assistant programs were on the rise when this study was conducted. Therefore, it is important to note how those tools were utilized in this study. Grammarly and Chat GPT 4, AI and large language models, were used in this study to improve fluency and clarity of sentences and assist with text editing. The study also utilized Otter.ai to convert recorded audio from the interviews into written transcripts and locate keywords in the transcripts, which helped generate code and code frequency.

To summarize, Figure 1 offers an accessible overview of the research structure.

FIGURE 1 Research Structure Outline



02 Theoretical Framework

This chapter outlines this study's theoretical framework by introducing the adopted theory's research topic and reviewing existing literature on the subject and the chosen theory. The theoretical framework approaches the topic of environmental communication through the lens of signaling theory, developed by Michael Spence (1973). The signaling theory is selected as the primary approach to the topic because of its contribution to economics and the study of interdependent perception and persuasion in asymmetrical economic transnational environments (Rowe, 1999). In this study, the signaling theory is utilized to critically examine how environmental sustainability communication is initiated by B2B firms and then interpreted by targeted stakeholder groups in the B2B setting.

The chapter begins with the literature gap, then presents a detailed review of existing literature on the signaling theory, signal formation, signal reception, and signal characteristics. The fundamental theoretical concepts of signaling theory are used as the lens through which to observe and review influential concepts related to corporate reputation/image, corporate green perception, information asymmetry and effective communication between B2B firms and stakeholders. The chapter concludes with the adopted research framework for the study.

2.1 B2C VS B2B Sustainability Communication

The public expectations and demand for firms to be responsible have “modified and blurred the image of many companies, presenting a threat to the strategic positioning” of firms globally (Balmer et al., 2007, p. 173). The literature indicates that with the increased attention by stakeholders to a firm’s sustainability communication, B2B customers are also scrutinizing the nuances of environmental messages to validate honest suppliers (Kapitan et al., 2019). Esty and Winston (2009) have also pointed out that B2B firms are more challenged than Business-to-Consumer (B2C) firms because of the increased industry regulations, long-term supplier relationships and market maturity (Esty & Winston, 2009). The mentioned factors require communication practitioners to measure and articulate effective communication strategies to transmit a credible firm image to stakeholders.

Similarly, academic literature on the topic has also revealed that B2B stakeholders expect technical and more nuanced environmental messaging from suppliers (Esty & Winston, 2009). The authors found that B2B firms must tell sustainability stories with better signals to drive business results and gain customer trust (Esty & Winston, 2009). Especially as B2B customers quickly overlook suppliers solely based on confusing and

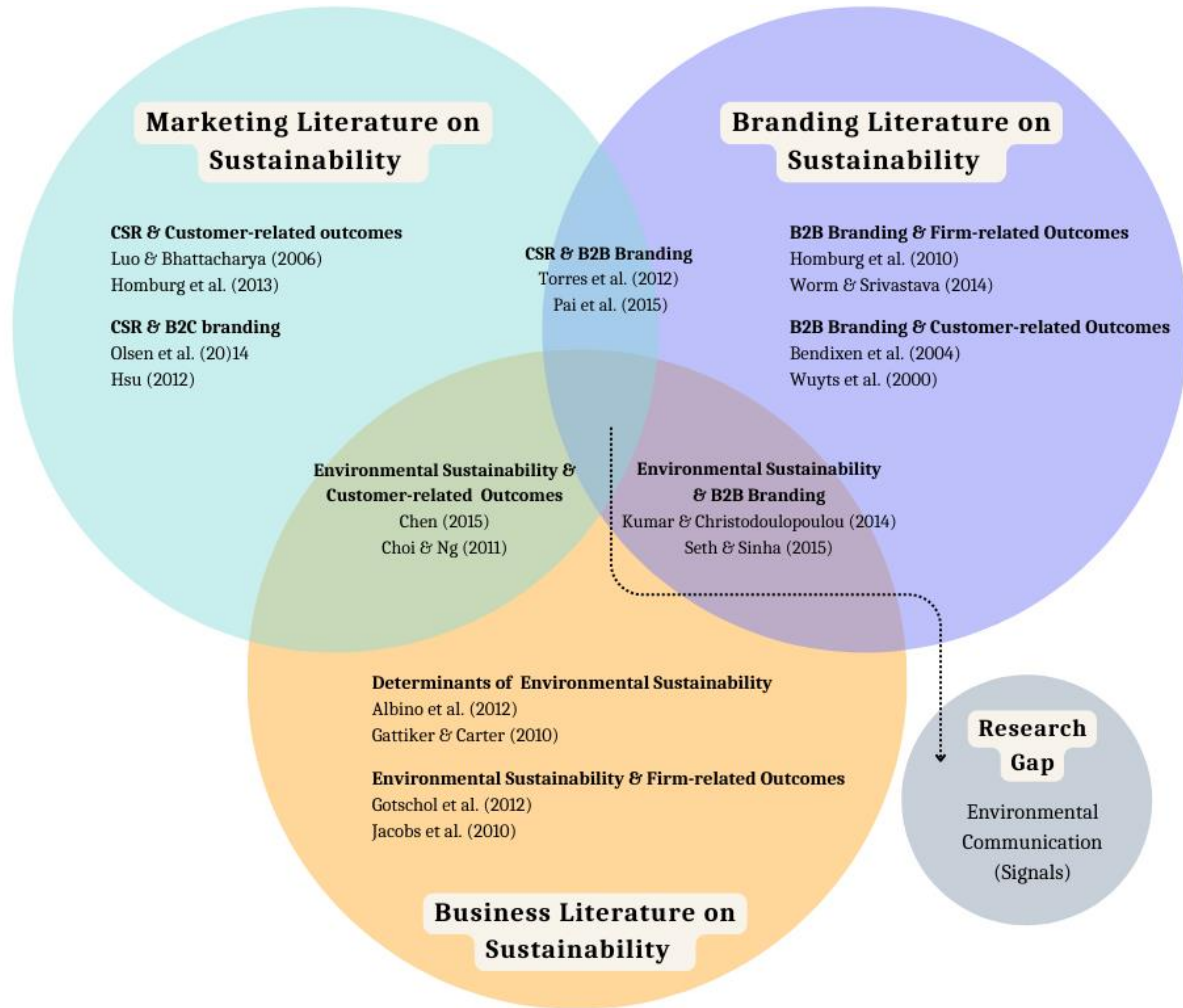
uncredible sustainability messages (Kapitan et al., 2019). Therefore, understanding what sustainability messages resonate with targeted stakeholders is integral to B2B firms' communication success. While there is a wealth of academic literature on “why” B2B communicates about sustainability, the author argues that the gap in the literature is in understanding “how” firms communicate with stakeholders (Contrafatto, 2014, as cited by Apostol et al., 2021, p.2). Luo and Bhattacharya (2006) discuss the need for future research to study the impact of CSR communication on firm value or firm value perception.

Although there is comprehensive literature on the effectiveness of B2C green communication on B2C corporate image and favoritism (Chen, 2010, 2015; Olsen et al., 2014), Vesal et al. (2021) highlight the need for research to investigate and explore the impact of green messages on B2B firm performance and perception. Vesal et al. (2021) studied the role of environmental sustainability signaling on brand value perception. The authors state that while literature has found positive connections between investing in sustainability branding and communication, more profound research is needed to “determine if environmental sustainability practices strengthen a firm perception and image (Vesal et al., 2021, p. 323).”

Ultimately, Vesal et al. (2021) study found a positive connection between customers' positive attitudes towards the brand with brand performance (Vesal et al., 2021). Vesal et al. (2021) conclude that future research should focus on how other environmental sustainability signals can impact brand perception, especially in markets where environmental sustainability is of growing concern.

Figure 2, presented by Vesal et al. (2021), illustrates the research gap in studying the impact of environmental sustainability signals on B2B brand image and customer decision-making. Moreover, Figure 2 indicates a need for further research to examine the relationship between environmental sustainability communication and customer-related outcomes (attitude, perception, and decision-making) in the B2B context, which is the focus of this study. Therefore, this study aims to study B2B environmental sustainability communication's impact on customer-related outcomes (perception and decision-making).

FIGURE 2 Vesal et al.(2021) Overview of Literature Gap in B2B vs. B2C Environmental Sustainability



Huang et al. (2022) observe that empirical articles investigating the connection between B2B firm perception and Corporate Social Responsibility (CSR) values tend only to explore one side of the relationship - the buyer or the supplier. The authors found this consistent with a literature review conducted by Gimenez and Sierra in 2013, which discovered that only a limited number of articles examined both sides of the B2B relationship. Similarly, Gimenez and Sierra (2013) found that only a few articles looked at both sides in the B2B context. Therefore, this study examines both perspectives from the firm and stakeholders.

2.1 Environmental Communication

Firms in the B2B sector have recognized the importance of sustainability communication; as a result, they have adopted different communication strategies and integration methods to enhance their sustainability position. Since sustainability

encompasses various aspects of social, environmental, and governance metrics (Bhattacharya et al., 2011), it is crucial to define the scope of the topic and outline other literature on the subject. The approach and definition of environmental communication have evolved through the years in the communication literature; the majority of the literature has looked at the concept as an arm of Corporate Social Responsibility (CSR) (Avram & Kühne, 2008; Bhattacharya et al., 2011; Signitzer & Prexl, 2007).

“Corporate Social responsibility is an integral part of corporate strategy and is concerned with the responsibility a firm takes for the social and environmental impacts of its actions and its responsiveness to the legitimate concerns and expectations of its stakeholders and broader society about these impacts (Moratis, 2018, p. 5).” While some firms approach sustainability communication as an initiative under corporate social responsibility (Bhattacharya, 2016), others drive their environmental communication from the firm’s ethical architecture and corporate ethical values (Heath, 2006). According to Mortais (2018), these different approaches to environmental and social impact communication lead to corporate hypocrisy and for sustainability messages to fall flat with stakeholders, or worse, be seen as greenwashing. Therefore, defining the scope and concept of environmental communication is essential to the study's success and understanding the differences between sustainability communication and responsibility.

Signitzer and Prexl (2007) look at corporate sustainability communication as one that integrates social justice and environmental issues concerning the firm and its relations to business success. Kearins et al. (2010) approach the topic from the perspective of business management as "corporate environmentalism," while Heath (Heath, 2006, p. 534) frames it as "ethical business values" under sustainable strategic management. While the topic is approached from varied perspectives in the reviewed literature, there is a consensus that it involves the integration of social justice and environmental issues in the firm's operations and communication with stakeholders. Terms like corporate sustainability communication (Coleman et al., 2011) and green communication (Branzei et al., 2004; Chen, 2010; Esty & Winston, 2009; Olsen et al., 2014) usually group different environmental values as sustainable communication.

To provide a clear overview of the concepts and definitions presented in the literature, **Table 1** summarizes the key points. This step was essential in narrowing down the scope and focus of this study, as the literature explored various viewpoints and definitions of environmental sustainability communication. **Table 1** lists important concepts such as sustainable strategic management, corporate sustainability communication, environmental communication, green brand image, corporate environmental responsibility, and corporate social responsibility initiatives.

TABLE 1 Overview of Environmental Sustainability Concepts in Literature

Definition
2000: Sustainable Strategic Management
<ul style="list-style-type: none"> Stead & Stead (2000) define the organization's strategic environmental sustainability in a three-phased framework. The first phase of the authors' framework includes pollution prevention and waste management. The second phase comprises product stewardship, in which the product life cycle is environmentally conscious, and three, the sustainability development of nations (Stead & Stead, 2000).
2007: Corporate Sustainability Communication (CSC)
<ul style="list-style-type: none"> The authors present the CSC concept as integrating social justice issues and environmental issues concerning the firm and their relations to the business success of the firm (Siginitzer & Prexl, 2007). The authors present CSR, sustainability management, stakeholder communication, and PR as topics that can be grouped under the concept of CSC.
2006-2007: Environmental Communication
<ul style="list-style-type: none"> "EnvCom is a policymaking and project management tool. A communication tool that bridges 'hard' technical know-how and 'soft' action-oriented practice. EnvCom efficiently uses well-established methods, instruments and techniques in development communication, social marketing, and public relations (Oepen, 2006, p. 12)." Lopez et al. (2007) definition of environmental communication includes all the communication around product energy consumption, energy waste, circularity, carbon emissions, and climate change (López et al., 2007).
2010: Green Brand Image
<ul style="list-style-type: none"> "A perception of a brand is linked to the firm's environmental commitment, performance and concerns (Chen, 2010, p. 309)."
2016: Corporate Environmental Responsibility
<ul style="list-style-type: none"> CER is a dependent variable of CSR that focuses on the organization's environmental performance and refrains from broader concepts like society, workforce, and governance. According to the authors, CER relies on the reported behavior of firms and imposes limitations on what environmental data is measured and the accuracy of reported data (Karassin & Bar-Haim, 2016).
2021: Corporate Social Responsibility Initiatives
<ul style="list-style-type: none"> Islam et al. (2021) group environmental sustainability communication from sustainable business, green energy and green HRM as criteria under CSR. The authors have characterized CSR as an all-encompassing concept encompassing an organization's social

and environmental concerns, including how it interacts with external stakeholders and its internal business operations. (Islam et al., 2021, p. 125),

López et al. (2007) define environmental communication as product energy consumption, waste, circularity, carbon emissions, and climate change. López et al. (2007) definition focuses on the messages about the product's environmental impact, which stakeholders in the building sector focus on when deciding on a building supplier. Therefore, the study adopts Lopez's (2007) definition because it encapsulates the main focus areas of environmental communication and analyzes environmental communication (EC) messages externally communicated by the firm around product energy consumption, circularity, carbon emissions, and climate impact.

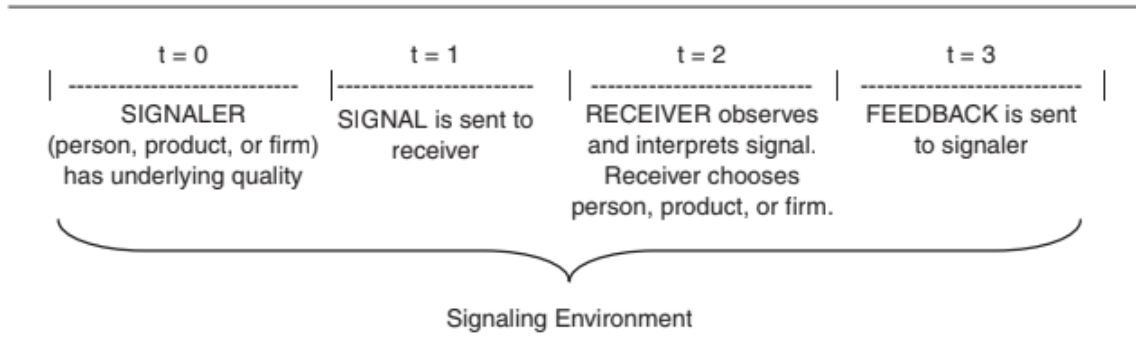
2.2 Signaling Theory: Overview

The signaling theory was developed by Michael Spence (1973) to present an approach to informational aspects of market structures that helped advance the field of organizational behavior and employee recruitment (Spence, 1973). Spence (1973) presents his theory that decisions made in market structures with information asymmetry are influenced by fixed attributes (indices) and modifiable attributes (signals). According to Spence, while controlled and manipulated, the signals are costly (Spence, 2002). The theory captures the informational aspects of market structure, studying how particular messages, referred to as signals, communicate information from one agent, the signaler, to another, the receiver (Spence, 2002). The context and signaling environment impact these key concepts and, ultimately, the relationship between the signaler and receiver (Spence, 1973).

The main concepts of the signaling theory are illustrated in Connelly et al. (2011) timeline in [Figure 3](#):

FIGURE 3 Connelly et al. (2011) Signaling Theory Concepts and Timeline

Signaling Timeline



Note: t = time.

Since this article, the signaling theory has been widely applied to further disciplines and research fields due to its viewpoint on the nature of information-seeking in transactional environments with information of asymmetry (Connelly et al., 2011). Additionally, the signaling theory has been studied in recruitment, human resource management, crisis communication and marketing, and entrepreneurship literature because it provides valuable insight into how signalers use signals to alleviate asymmetric information between them and the receiver (Connelly et al., 2011). Receivers use signals to evaluate the truthfulness of the signal and, consequently, the truthfulness of the sender (Smeltzer, 2006).

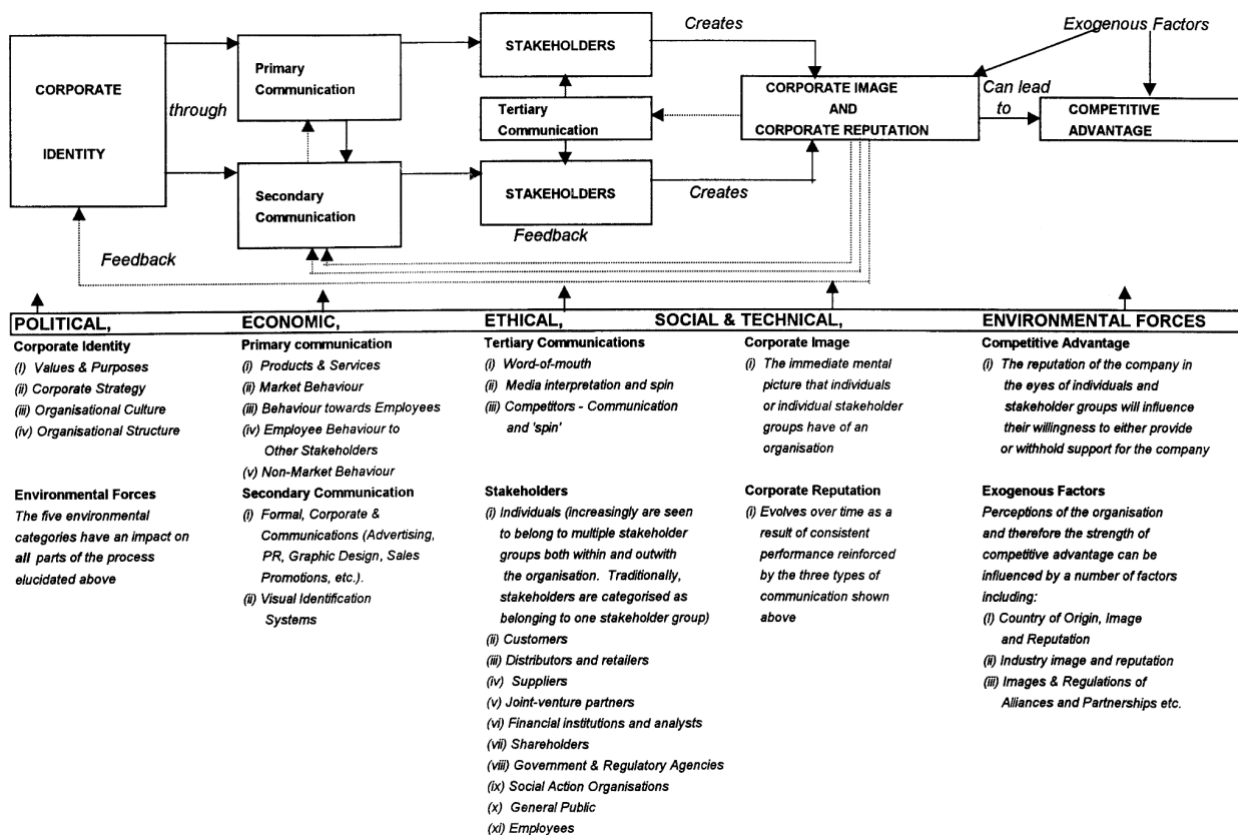
The theory has been widely applied in communication and marketing literature to study signal transmission and reception between firms and various stakeholders, including customers (Moore, 1992), investors (Porter, 1997), and product pricing (Prabhu & Stewart, 2001). The literature on theory explores using various signals to ultimately impact the targeted stakeholder group's attitude or behavior toward the firm (Connelly et al., 2011). In their review and assessment of the signaling theory, Connelly et al. (2011) review the foundation of the signaling theory, study the existing literature on the topic, and theoretical contributions when applied to economic and social phenomena. The theory's premise is illustrated through four key concepts (Karasek & Bryant, 2012):

- The receiver's reputation, signaling environment and sender impact the perceived quality of the signal.
- Signal costs and observability impact the receivers' perception of the signal and their attitude toward the sender.
- Signal cost impact only occurs when cost and productivity are negatively correlated.

- The receiver's interpretation of the signal depends on the receiver's knowledge and preference.

From a corporate communication perspective, the understanding of how external factors can impact the communication process is discussed by Balmer et al. (2007) in their model of ethical corporate communication. Like the signaling theory, Balmer and Gray (1999) present a communication process as a model impacted and affected by a set of external forces that impact (1) the perception of corporate messages and stakeholders and (2), consequently, the perceived corporate image and reputation. Illustrated in Figure 4, the authors note that the firm communities with stakeholders are part of a broader process controlled by communication factors.

FIGURE 4 Balmer and Gray's (1990) Strategic Corporate Communications Model



The signaling theory brings a new and vital lens to studying the concept because of its approach to information asymmetry between firms and stakeholders. Information asymmetry is an essential factor that is especially prominent in this era of digital communication and saturation of communication about corporate sustainability performance and impact in multiple business contexts. Therefore, this study adopts the signaling theory to expand on Balmer and Grey's ideas and model

and present new findings using the signaling theory factors and concepts to answer the research questions and fulfill the study objectives.

2.2 The Signaler: Signal Formation

Spence (1973) defines the signaler as the agent with the most visibility over signals, thus, the party with the most authority in the transactional relationship (Spence, 1973, 1978, 2002). The signaler's power over the flow and quality of information transactions puts the receiver at a disadvantage (Connelly et al., 2011). This intimate knowledge gives the signaler an authoritative perspective regarding the quality of the firm or product and, thus, the ability to manipulate the perception of their signals value (Connelly et al., 2011). This information asymmetry gives signaling firms the advantage of hiding, revealing, and manipulating signals to influence the receiver's attitude and decisions (Connelly et al., 2011).

Signalers have the position to attempt false signals when signaling benefits outweigh the costs of the signal and could result in favored attitudes towards the signaler at the receiver's expense (Connelly et al., 2011). The signaler deployed signaling strategically to win the receiver's favoritism against another competing alternative (Connelly et al., 2011). Because of the nature of the signaler and receiver's competing interests, a signaler with inferior quality characters has a high motive to "cheat and promote false signals" (Connelly et al., 2011, p. 50).

The quality of the signaler is one of the most important factors influencing how receivers interpret communicated signals (Connelly et al., 2011). The signaler's values and attributes impact the receiver's interpretation of signals (Zimmerman, 2008). Zimmerman (2008) found that firms use signals relevant to their strategic goals to indicate a more appealing product than competitors. In their evaluation of the signaling theory, Connelly et al. (2011, p.43) state that the signaler's quality is a belief obtained and perceived by the receiver. These qualities and attributes can also be considered the receiver's perception of the corporate image (Connelly et al., 2011).

Kreps and Wilson (1982) studied the signaler's quality as firm reputation, Lee (2001) as the firm website name and Certo (2003) as prestige. The signaler quality is "the underlying, unobservable ability of the signaler to fulfill the needs or demands of an outsider observing the signal" (Connelly et al., 2011, p. 43).

2.3 Signals: Observable and Costly Signals

The characteristic of markets with incomplete and asymmetrical information requires the signaler (supplier) with the most authority to use signals to transmit information to the receiver (stakeholder) (Spence, 1973, 1978, 2002). Spence (1973)

describes a signal as a carrier of information between two parties with different incentives (i.e., one wants to sell, and one wants to buy). Spence also distinguishes between signals (i.e., environmental product messages, higher education) and indices, which are fixed attributes of the signaler that cannot be altered or changed (for example, firm size or location).

In a competing marketplace, the equilibrium described by Spence (1973, 1978, 2002) is complex, as low-quality signalers are incentivized to misuse these contextual signals. The competing and imperfect nature of economic markets boosts the incentive of “high-quality product owners to distinguish themselves, and the incentive of the low-quality owners to imitate the signal to obscure the distinction is fairly clear” (Spence, 1973, p. 434).

Additionally, online communication's informational structure has impacted how agents form, transmit and interpret signals in the signaling environment (Spence, 1973, 1978, 2002). Spence's signaling theory (1973) and Burke and Stets's (1999) empirical articles on building trust share a commonality because Spence's (1973) signaling model relies on aspects of trust building like self-selection and self-verification (Burke & Stets, 1999). In other words, receivers look for and identify signals they can trust through models of self-verification and selection, then proceed to use these identified signals as contextual “screening devices” to decide (Spence, 2002, p. 436). In their review, Connelly et al. (2011, p. 44) note that the signaling theory focuses on deliberately communicating “positive information” to convey a specific product or firm attribute to a designated stakeholder group.

2.3.1 Signal Characteristics

The signaling theory proposes that signalers communicate their quality or intentions to others in situations where objective quality measures are difficult to assess; therefore, signal **observability** is an integral factor in determining the effectiveness and credibility of a signal as a means of communication (Spence, 1973).

Signal observability refers to the degree to which a receiver can detect or perceive a signal. Secondly, Spence (1973) emphasizes the importance of investing in signals that are **costly** to produce because they are perceived as indicators of high quality. In contrast, Bloom and Reve (1990) emphasize the importance of signal clarity in determining the effectiveness of the signal. Therefore, this study analyzes signal cost and observability as the two main factors that impact receivers' perception of environmental cues (Connelly et al., 2011; Spence, 1973). Table 2 outlines the key definitions of the signal characteristics and examples from the literature.

TABLE 2 Signal Observability and Cost Definitions and Examples

Definition	Examples
Characteristic: Signal Observability	
<p>Readily and apparent signals to receivers (Spence, 1973).</p> <p>The degree to which a receiver can detect or perceive a signal (Connelly et al., 2011).</p>	<p>Observable value signals (i.e., product price, carbon emissions, and energy consumption) sway customers (Bloom & Reve, 1990).</p>
Characteristic: Signal Cost	
<p>The cost to generate and transmit signals (i.e., time, money, effort and risk) (Spence, 1973).</p> <p>Costly signals require significant investment; thus, they are difficult or impossible for low-quality individuals (Bird & Smith, 2005).</p>	<p>Higher education cost (i.e., expensive college degree) signals better employee job fitness (Spence, 1973).</p> <p>ISO certificates signal better product or service performance (Connelly et al., 2011).</p>

Competing incentives between high-quality and low-quality firms and the shifting parameters of online signaling (Spence, 1973) resulted in B2B firms with quality products relying on signal characteristics to remain competitive. Therefore, high-quality firms need significant investments and resources to form and refine their communication strategies with observable and costly environmental signals to ensure effectiveness and desired outcome (Bloom & Reve, 1990). As illustrated in Table 2, signal observability is an important factor that impacts the effectiveness of transmitted signals (Bloom & Reve, 1990; Moore, 1992). Moore states that effective and observable signals contain detailed messages and not “subtle statements of intention” to be effective (Moore, 1992, p. 499). Thus, firms should develop observable, fit, clear and precise signals to maximize their impact (Connelly et al., 2011). Bloom and Reve (1990) discuss the need for honest and transparent self-assessment by B2B companies of their current and future signals to develop effective signaling strategies.

Secondly, the **signal cost** is a critical factor in signaling theory and plays an important role in determining the effectiveness and credibility of a signal. Connelly et al. (2011) define signal cost as an individual or organization's investment to produce a signal. The authors suggest costly signals or signals with cost attributes are considered more credible of the firm's quality or intent. Therefore, costly signals are perceived as

less likely to be imitated or manipulated by the signaler (Connelly et al., 2011). Spence (1973) also highlights the importance of signal cost, arguing that signals that are cheap or easy to produce may be less effective in signaling quality or intentions. Bird and Smith (2005) expand on this idea, defining costly signals as those that require significant investment or effort to produce and suggesting that individuals who can produce costly signals may be perceived as having desirable qualities or characteristics.

Bloom and Reve (1990) note that the cost of a signal influences its perceived credibility; therefore, signals that are cheap or easy to produce are less effective in communicating quality or intentions. Difficult or costly signals are assumed to be a more credible indicator of a firm's quality or intentions. In contrast, signals that are cheap or easy to produce may be less effective (Bloom & Reve, 1990). Connelly et al. (2011) argue that the cost of a signal impacts its effectiveness and credibility and note that the optimal level of investment in signaling depends on various factors, including the importance of the signal to firm competitiveness, the level of competition or noise in the signaling environment, and the receiver's ability to detect and interpret the signal.

2.3.2 Signals and Environmental Communication

Bloom and Reve (1990) were among the first scholars to apply signaling theory to the B2B market informational structure. The authors note that customers rely on easy and straightforward signals to form their perception of the firm values and product quality, especially when products are technical or offered services are intangible (Bloom & Reve, 1990). The authors define signals in the context of the economics of information as "controlled, easy-to-acquire informational cues that consumers use to form inferences about the quality or value of the product (Bloom & Reve, 1990, p. 59)." Furthermore, Bloom and Reve (1990, p. 59) emphasized the significant role of signals for "credence" products. In other words, B2B customers rely on signals to decide on products that require high trust before purchasing or recommending. The authors note that customers often feel incompetent in evaluating high-stake product or service decisions; therefore, they use signals to form better opinions about the product and streamline their decision-making (Bloom & Reve, 1990).

Mortais (2018) also applies the signaling theory to study CSR signals and their impact on corporate value perception. Mortais (2018) claims that due to the voluntary nature of CSR communication and the surge of public interest, firms utilize two types of signals to communicate about their environmental practices. The two types of signals are explicit signals, such as certificates and product declarations, and implicit

signals, including personal interactions, reputation, and past interactions with the firm. By leveraging both explicit and implicit signals, firms can enhance their credibility and foster more informed decision-making among customers, particularly in the case of high-stakes decisions related to credence products.

The study analyzes the firm's environmental message as environmental signals. Bloom and Reve (1990) present two important reasons to study communication messages as signals: (1) by dissecting communication strategies to signals, firms can better understand which signals are more effective with target stakeholders. Secondly, (2) by looking at communication as signals, firms can gain insights into all the factors impacting their communication message effectiveness and how stakeholders perceive their corporate identity.

2.4 The Receiver: Signal Interpretation and Attitude Change

Signaling theory suggests that individuals and organizations use signals to communicate their quality or intentions to others when objective quality measures are difficult to assess (Spence, 1973). Management researchers have partially attributed signaling effectiveness to the receiver's characteristics (Connelly et al., 2011; Pollock & Gulati, 2007). The process in which the receiver assesses and decodes the signal into "perceived meaning" defines the receiver's interpretation (Connelly et al., 2011, p. 53). According to the authors, receivers attend and interpret the same signal differently depending on what they seek, what they expect, and the context in which the signal is transmitted (Connelly et al., 2011). Therefore, the meaning of signals diverges from the original intent due to how receivers calibrate the signals (Branzei et al., 2004). Moreover, Moratis (2018) indicated that the receiver interacts with signals differently based on the signal's responsiveness to the receiver's concerns and expectations. Signals with a higher fit, consistency and frequency are relatively superior in performance and are easily observed by the receiver (Moratis, 2018).

Prabhu & Stewart (2001) suggest that the success of a firm signaling strategy is tied to the receiver's interpretation of signals considering the context of the signals. The authors discuss the need for research to examine how receivers develop "reputational beliefs about senders and what signaling strategies firms might employ to develop a particular reputation" (Prabhu & Stewart, 2001, p. 63). Connelly et al. (2011) suggest that the receiver's ability to interpret and understand a signal is influenced by the receiver's knowledge and experience and the information asymmetry between the sender and receiver. Spence (1973, 1978, 2002) notes that signals may serve as a means of reducing the information gap and providing credible information about the sender's

quality or intentions in situations where there is significant information asymmetry between the sender and receiver.

Bloom and Reve (1990) expand on this idea, suggesting that clear and precise signals may be more effective in reducing information asymmetry and enhancing the receiver's ability to interpret and understand the signal. Bird and Smith (2005) also note that the signaling environment can influence the receiver's interpretation of a signal, with factors such as cultural norms and expectations playing a role in shaping the receiver's perception of the signal.

Prabhu and Stewart (2001) extend the discussion to note that the receiver's perception of the signal can also be influenced by their social identity. The authors state that receivers view signals that align with their values as more effective than those that do not. Similarly, Branzei et al. (2004) suggest that the receiver's ability to interpret and understand signals is influenced by their cognitive capacity and motivation to process information.

Ehrhart and Ziegler (2005) also emphasize the importance of the signaling context, noting that the effectiveness of a signal may depend on factors such as the receiver's relationship with the sender and the receiver's perceived risk of their decisions. The receiver's relationship with the signal, information asymmetry, and signaling environment are all key factors in determining the effectiveness and legitimacy of the signal (Connelly et al., 2011). In the face of information asymmetry and the proliferation of environmental signals, high-quality firms ought to find effective ways to signal their ES with superior, clear and precise signals to reduce information asymmetry and attend to the receiver's interpretation process (Moratis, 2018). Understanding the receiver's social identity, cognitive capacity, expectation, and motivation to process the signal is critical for firms to aim to produce effective ES signals. The signaling environment, including factors such as the receiver's relationship with the sender and perceived risk, determines the signal's effectiveness and legitimacy.

2.5 Signaling Environment and Information Asymmetry

The literature on signaling environments and information asymmetry is an integral part of the theoretical background of this study, as these two concepts offer a unique understanding of the role of contextual information transactions in market environments (Spence, 1973). Understanding the environment in which signals are transmitted and interpreted offers a context and a framework for understanding how signalers and receivers share information (Connelly, 2011). Spence presented signaling

as the framework that holds the timeline of the signal transmission process (Spence, 1973).

Prabhu & Stewart (2001) refer to the signaling environment as contextual, which is the observable features of the signal sender or the environment in which signals are sent and received. Contextual environments include “firm size, location, product portfolio, changes in demand, and changes in the economy” (Prabhu & Stewart, 2001, p. 64). Mortais (2018) similarly notes that in a signaling environment, signals can be used to reduce information asymmetry and establish trust between the signaler and receiver.

2.5.1 B2B Signaling Environments

In crowded signaling environments, like B2B markets, where many signalers offer similar services or products, firms can use unique signals such as brand names, advertising, or product design to differentiate themselves and stand out in the market (Prabhu & Stewart, 2001; Mortais, 2018). Prabhu and Stewart (2001) argue that in a B2B signaling environment, firms use signals to convey calculated information to their targeted stakeholders to differentiate their products. According to Moratis (2018), information asymmetry arises in the firm-stakeholder relationship due to the nature of green signals' quality, context, and characteristics of how firms attribute meanings and firm characteristics to their green signals. Add to that the lowered cost of signals due to digital environments, making it even hard for buyers to decide on the quality of ‘costly signals’ (Spence, 2002, p. 454).

Prabhu & Stewart (2001) find that robust firms focus their signals on “internal rather than external or mixed factors,” so signals are aligned with the internal firm strategy rather than a response to external demands from stakeholders. Carter (2006) offers a slightly different perspective on signaling environments, focusing on the strategic behavior of firms in choosing which signals to use. The author shares that firms strategically choose costly signals to signal their firm’s quality and credibility (Carter, 2006). However, Carter (2006) notes that this strategy is occasionally effective, as it can be difficult to distinguish between genuine signals of quality and those used for strategic purposes. While observability and cost of signals could help reduce information asymmetries, factors such as the context (like the lowered cost of signals due to digital environments) are important to be studied to determine the effectiveness of the signals (Carter, 2006).

2.5.2 Information Asymmetry

In B2B markets, stakeholders are increasingly interested in learning about firms' CSR practices, including environmental practices, resulting in a proliferation of sustainability signals as an important competitive signal (Moratis, 2018). Connelly et al. (2011) propose that firms can use effective (observable and costly) strategic signaling to address information asymmetry between the firm and stakeholders. Nevertheless, the nature of environmental sustainability signals creates a higher information asymmetry in the firm-stakeholder relationship due to their quality, context, and how firms attribute meaning and characteristics to these signals (Moratis, 2018).

Moratis (2018) argue that the nature of environmental sustainability signals creates more heightened information asymmetry in the firm-stakeholder relationship because of their quality, context, and how firms attribute meaning and characteristics to these signals.

From a corporate communications perspective, Mortais (2018) and Balmer and Gray (1999) bring attention to the impact of external forces on the transmission and reception of corporate communication messages. Balmer and Gray (1999, p. 172) note that "ten environmental forces" are increasingly putting pressure on stakeholders to articulate their communication messages better and ensure accurate external communication with stakeholders about corporate identity and values. Therefore, firms can use primary communication tools (including products and services-related messages) and secondary communication (including online visual identity and website corporate-related messages) to convey corporate values (Balmer & Gray, 1999; Balmer et al., 2007). Relating this communication perspective to signaling, communication messages, in this case, are used to overcome information asymmetry and effectively transmit corporate values.

Balmer et al. (2007) expand on these thoughts concerning the communication of ethical corporate performance. The authors argue that ethical values (including economic, environmental, and social reasonability) should be a strategic and integrated part of the corporate identity and firm architecture (Balmer et al., 2007). Like Balmer et al. (2007), Spence (2002) signaling theory emphasizes the importance of utilizing effective clear and reliable signals to decrease information asymmetry between the signaler and receiver.

In the context of B2B communication, Mortais (2018) highlights that the information asymmetry between stakeholders is impacted by a firm's loose coupling of corporate messages about intention and performance. The author notes that in response to increasing pressure from stakeholders for firms to communicate their

“ethical considerations,” firms used blurry and confusing communication that does not declare messages about corporate intention from ones about corporate values. This confusion has led to high information asymmetry between firms and stakeholders. As firms hold all the power to reveal counsel messages about their responsibility, stakeholders are often confused and skeptical of all messages relating to corporate responsibility.

Table 3 outlines Mortais's (2018) two types of communication information asymmetry occurring between firms and the public regarding environmental communication:

TABLE 3 Information Asymmetry in B2B Signaling Environments

Definition	Examples
Within-Firm Information asymmetry (Unobservability of signals)	
“This type of information asymmetry concerns the inherent opacity of green signals quality and characteristics (Moratis, 2018, p. 5)”	Environmental messages are seen as vague by stakeholders; therefore, messages that are based on performance data are often ignored.
Between-Firm Information Asymmetries (Idiosyncrasy of signals)	
“This type of information asymmetry concerns the contested, multifaceted, and vague nature of green signals (Moratis, 2018, p. 5)”	Firms use green signals in a way that appeals to their corporate values, market demands, and stakeholders' needs.

The lowered cost of signals in digital environments has made it increasingly more work for buyers to evaluate the quality of 'costly signals' (Spence, 2002). Connelly et al. (2011) elaborate further that digital signaling has impacted the preceded quality of costly signaling; as a result, distorting the quality and observability of the signal. Online signaling environments (website and online media coverage) could act as contextual distortions and thus impact the perceived quality of the online signal (online press releases or company mission on the website) (Carter, 2006). In other words, if the same signal was transmitted via different media could have a different influence on the receiver.

Overall, the literature on signaling environments and information asymmetry provides important insights into how firms communicate and establish trust in highly competitive and asymmetrical information transaction markets like B2B. To develop the desired reputation from environmental sustainability efforts, firms must ensure

that stakeholders can observe, recognize and interpret their green signals (Connelly et al., 2011; Moratis, 2018) and utilize the 'context' in which they transmit their signals (Prabhu & Stewart, 2001).

2.6 Summary of the Theoretical Framework

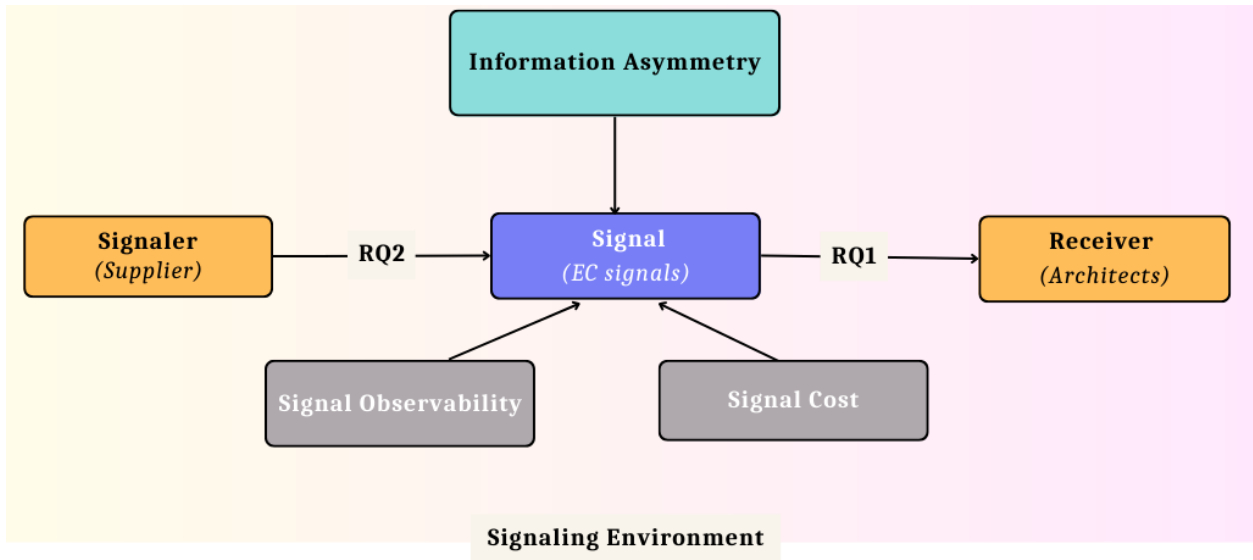
Studying the topic from a corporate communication perspective adds to the literature review a deeper understanding of how firms can communicate their impact from a strategic corporate point of view aligned with the firm's corporate identity and practices. Rather than afterthought initiatives that stakeholders could perceive as confusing or as a form of corporate greenwashing (Moratis, 2018). The increased public expectations for corporate sustainability have caused firms to drive their corporate environmental practices from a need to communicate with the public, leading many firms to adopt a "total communication" approach, where communication, corporate management and marketing are integrated (Balmer et al., 2007, p. 174). Thus, it is important to study how environmental messages are formed and perceived by stakeholders in the B2B context to offer practitioners an insight into what messages are seen as credible and resonate with those stakeholders.

This study focuses on the construction industry, one of the most relevant sectors for environmental communication and one of the most demanding for environmentally forward products, thus, commitment from the stakeholders in the sector. Therefore, this study will attempt to contribute to the corporate communication literature and explore the topic from both perspectives, the firm (building manufacturer) and the target stakeholder group (architects).

This study's theoretical framework is based on the signaling theory and its application to the B2B context. The signaling theory suggests that signals are not received at face value, and the quality of the signal impacts their strength, preconceptions about the sender, and the implications of the signaling environment through which the signal is transmitted (Spence, 1973). The quality of the signal, which includes its cost and observability, impacts the receiver's attitude toward the sender. Their knowledge and preference also influence the receiver's interpretation of the signal.

The proposed framework is an expansion of Connelly et al. (2011) signaling timeline and expanded on from the findings of the empirical literature for the study's specific context, as illustrated in [Figure 5](#). The proposed theoretical framework will guide the research design and analysis in investigating the effectiveness of sustainability signals in B2B relationships.

FIGURE 5 Study Theoretical Framework Model



RQ1

- **How do architects interpret environmental communication signals?**

RQ2

- **How do building material suppliers develop environmental communication signals?**

03 Data and Methodology

In this chapter, the research paradigm, methodology and data collection approaches, including sampling technique and overview, are thoroughly presented, and justified. This chapter is critical to the success of this thesis study for four main reasons (Adams et al., 2014) because it demonstrates the rigor and validity of the study and enables future researchers to trace the steps taken to address the research questions. Additionally, the chapter helps researchers verify and evaluate the study's data collection quality and accuracy (Adams et al., 2014).

Finally, the methodology chapter outlines the data collection and data analysis method, which as a result, helps future researchers to build upon and replicate the study advancing the field of knowledge (Eriksson & Kovalainen, 2008). The authors also note that presenting a clear and detailed research philosophy followed by the selected methodology indicates the effectiveness of this thesis paper and underlines the study's validity (Eriksson & Kovalainen, 2008).

3.1 Research Paradigms

The research problem and questions guided this study's philosophy to ensure the study scope is precise; thus, the study methodology is appropriate to the study scope (Eriksson & Kovalainen, 2008). The research ontological framework and philosophy inform the research design and better specify the reasoning behind choosing the research methodology and data collection (Eriksson & Kovalainen, 2008). Rashid et al. (2019) emphasize the necessity of stating the study's research philosophy because it provides a plan of action and approach to the methodology and data collection methods. It is essential to start with the study's assumption.

The Ontological research stand informs how the researcher approaches the topic and study (D O'Gorman & MacIntosh, 2015). This study follows a subjective ontological perspective, assuming that reality is based on what everyone perceives it to be (D O'Gorman & MacIntosh, 2015). Subjectivism accepts reality as personal experiences that "differ for each person and change over time (Eriksson & Kovalainen, 2008, p. 13)." The ontology formed the study's framework and informed its interpretative paradigm. The interpretive paradigm develops ideas from data induction and uses multiple methods to establish different voices of the studied concept. Therefore, it is appropriate to study the perception of signaling from different viewpoints (D O'Gorman & MacIntosh, 2015).

Eriksson and Kovalainen (2008) describe interpretive philosophy as one that studies the complexities of human sense-making in a real-life context. Interpretivism

examines reality as a construct of socially “shared meanings” and focuses on the contents of empirical data and the relationship between these constructs and their context (Eriksson & Kovalainen, 2008, p. 20). Therefore, this philosophy is perfect for answering the study’s questions about signaling and various perceptions of shared meanings between firms and architects. Another important reason is that interpretative philosophy considers meaning as a “result of human experiences” and the relationship between these experiences and the world (Rashid et al., 2019, p. 4).

The interpretive philosophy also informs how empirical data are collected and analyzed (Eriksson & Kovalainen, 2008). Consequently, it is important to note the philosophy before selecting the data collection and analysis methods. The interpretative looks for meaning in the content of the empirical data and the individually constructed reality based on shared meanings and experiences of languages (Eriksson & Kovalainen, 2008). Interpretivism focuses on small samples studied over time to induce meaning and analysis to find the “totality” of phenomena and understand the experiences rather than facts or simple elements (D O’Gorman & MacIntosh, 2015, p. 61). Highlighting the philosophy defines the scope of the study and demonstrates the limitation and close relationship between the researcher and the research field (Eriksson & Kovalainen, 2008).

This is integral to underline the study’s limitations, generalization opportunities of the analysis, and prospects for future research.

3.1.1 Qualitative Research Methodology

The study uses qualitative methodology to collect and analyze the primary data. The qualitative approach is discussed in this section, and the rationale for the selection is outlined.

The qualitative methodology yields valuable and revelatory data (D O’Gorman & MacIntosh, 2015). The qualitative method informed the collection and analysis of this study's primary and secondary data (Eriksson & Kovalainen, 2008). The data types are further detailed in the data collection section. The qualitative method offers broadened awareness of what beliefs and perceptions are behind behaviors (Eriksson & Kovalainen, 2008). This methodology helps researchers detect patterns, compare, and contrast groups and validate the theory (Adams et al., 2014). Hence, the qualitative methodology will help answer the stated literature gap and seek answers about the formation and interpretation of signals by contrasting viewpoints (Adams et al., 2014).

According to Eriksson & Kovalainen (2008), qualitative research is a research methodology that seeks to understand human experiences and behavior through subjective interpretations and meanings. This approach is beneficial for exploring

complex social and cultural phenomena, as it allows researchers to gain insights into people's perspectives, attitudes, and motivations (Hair & Page, 2015). The qualitative data approach suits this study's data collection because it examines why people behave in a certain way or respond to specific signals, which is appropriate to answer the primary and secondary research questions (Hair & Page, 2015).

Both the perspective of the case organization and individual perspectives are studied to deliver a complete understanding of the phenomena and answer the research questions (Eriksson & Kovalainen, 2008). In addition, research on perception and signaling (Sharma, 2017), and with that, the suitability of this method for the topic at hand. In this study, the qualitative methodology is adopted. Thus, data were collected with methods appropriate for qualitative studies - semi-structured expert interviews. The data collection and sampling overview are outlined in the following section.

3.2 Data Collection

This study's primary and secondary data collection methods reflect the qualitative methodology. Thus, preliminary data were collected through expert semi-structured interviews with a firm in the construction industry to study the formation of signals.

In addition, a contrasting group of architects was interviewed to study the interpretation of signals. Secondary data was also collected from the firm's website to understand how content is signaled, gather data about the case organization and further outline the context of the study. Secondary data is outlined in the case organization description and product environmental signaling section.

3.2.1 Case Organization Selection

According to Eriksson & Kovalainen, working with a case organization, especially in the business setting, offers holistic knowledge from analyzing the actual context of the case organization (Tellis, 1997, as cited in Eriksson & Kovalainen, 2008). The case organization offers this study a real context (Eriksson & Kovalainen, 2008) to investigate signaling phenomena.

This real-life context and setting are essential in interpreting intertwined attitudes, perceptions, actions, and events (Eriksson & Kovalainen, 2008). Rashid et al. (2019) also assert the importance of the case organization in providing a real-life setting for the study. Heras-Saizarbitoria et al. (2020) and Vesal et al. (2021) encourage further investigations of how environmentally certified B2B companies signal environmental values and the signal's impact on organizational outcomes.

3.2.2 Case Organization Description

Aisti is a Finnish startup that produces sustainable construction material products as a core value proposition. The start-up positions itself as an industry pioneer in designing and building construction materials that are safe and environmentally friendly (Allen, 2022). The case organization, Aisti, was founded in 2016 in Finland (Aisti, 2022). Aisti develops carbon-negative wood fiber-based acoustic tiles that are easy to recycle and plastic-free to bring sustainability to the construction industry (Aisti, 2022).

The organization concentrates its external and internal marketing and communication efforts on its green identity and value proposition (Aisti, 2022), evident in its digital media platforms and stakeholder marketing collateral (Aisti, 2022). The case company's mission and vision statements, detailed below, are communicated on the company's website (Aisti, 2022):

- *Mission statement: We aim to become the leading provider of exceptionally innovative construction materials and products that are safe and sound for people and the environment.*
- *Vision statement: We harness the power of nature to make natural, carbon-negative, and sustainable products for modern construction.*
- *Sustainability commitment statement: We are committed to preserving the well-being of our natural environment and fostering safe indoor climates through sound, ecological processes and products.*

Finnish media have also positioned the startup as a disruptive greener manufacturer with a negative carbon footprint (Allen, 2022). The company raised 1.6 million euros in its first round of funding, based on its green revolution of acoustic tiles material production (Allen, 2022). The case organization's direction, value proposition, and construction sector offer real context to study environmental signaling concerning the organizations' B2B signaling environment and targeted stakeholders (architects).

This context provides a rich setting to test the theory and seek answers to set research questions.

3.2.3 Semi-structured Interviews

The study's empirical data was collected using semi-structured interviews. Semi-structured interviews represent a valuable method for collecting data on the attitudes and behaviors of research participants (Hair & Page, 2015). Interviews are one of the most adopted qualitative data collection methods because interview provides rich and detailed data regarding complex phenomena (Hair & Page, 2015). Therefore, this

study adopted the method because it offers detailed insights into behaviors and the flexibility interviews offer in exploring research topics (Hair & Page, 2015).

This study uses in-depth semi-structured interviews. In-depth unstructured interviews are one of the methods to effectively gather insightful information on expert participants' feelings, thoughts, and perceptions (Hair & Page, 2015). Hence, semi-structured interviews were the chosen method to collect data for this study, and (Hair & Page, 2015) steps to ensure validity and effectiveness. The steps for conducting semi-structured interviews include developing interview questions and probes, selecting appropriate participants, and establishing rapport with interviewees (Hair & Page, 2015).

To ensure the availability and eligibility of participants, an interview protocol was developed to draft the interview questions. As the literature gap section mentioned, collecting data from two contrasting groups was imperative. One, understand the firm's perspective, which was achieved by selecting a case organization detailed above. Secondly, it was crucial also to understand the perspective of signaling interpretation by a targeted stakeholder group, architects. Architects were chosen because of their expert knowledge of building material products and their influence on the building supply chain. Architects usually influence the customers, developers, and buying decisions.

While time-consuming, conducting two-phased interviews was necessary to accurately answer the research question and achieve the study's objectives. Therefore, two interview protocols were developed - one for the case organization and a second protocol for architects. In addition, the semi-structured interview question relied on preset themes informed by the four main factors of the signaling theory. Developing an interview protocol based on the theory ensures the data collection's validity and reliability and the protocol's generalization for future research (D O'Gorman & MacIntosh, 2015).

The interview protocol followed five critical themes based on the theoretical background. Questions were developed for each theme (as presented in Tables 4 and 5). The interview protocol was tested with a volunteer participant before conducting the study interviews.

TABLE 4 Constructs Table and Development of Case Organization Interview Protocol

Themes	Interview Question
Receiver	Q1- Q11
Signals (observability and cost)	Q12-Q23

Signaling Environment	Q24-Q26
Signaler	Q27-Q29

TABLE 5 Constructs Table and Development of Architects Interview Protocol

Themes	Interview Question
Signaler	Q1-Q8
Signals (observability and cost)	Q9-Q23
Signaling Environment	Q24-Q32
Receiver	Q33-Q37

Appendix 1 (Aisti) and Appendix 2 (Architect) share the full list of interview protocols and questions. The interviews did not focus on explicit signals in order not to limit or force responses from the architects. Rather, the questions allowed participants to bring forward signals from memory and examples that resonated with them. This strategy in interviews allowed the participants to elaborate on how and why they focus on certain sustainability signals and identify the main signaling environment that could impact the interpretation of these signals.

3.3 Sampling Technique

Sampling is used to select a subset of individuals, cases, or data points from a larger population to study and make inferences about the larger population (Sharma, 2017). Choosing an appropriate sampling technique is essential to ensure the efficiency of this study’s data collection. Sampling is divided into two main categories: probability sampling and non-probability sampling (Sharma, 2017).

The first category, probability sampling, includes random, stratified, and cluster techniques (Sharma, 2017). These methods rely on a systematic approach to selecting the sample, such as randomly selecting individuals from the population or grouping individuals before selecting the sample.

The second category, non-probability sampling, involves selecting individuals based on the researcher's judgment, such as quota, snowball, and purposive sampling. Non-probability sampling is beneficial for exploratory research, where the goal is to expand the knowledge of a population or create new perspectives (Taherdoost, 2016).

Given available resources and time limitations, this study uses expert purposive sampling to select expert interviewees and case interviews to provide insights into the studied research question and population. This method helps study new research areas and gain information from experts in their respective fields (Etikan et al., 2015).

Purposive sampling is “non-probability sampling that relies on the researcher's judgment in selecting participants to gain insights that cannot be obtained through other means (Taherdoost, 2016, p. 23).”

3.3.1 Sample Overview

The semi-structured interviews were conducted over two months. Thirteen online interviews were conducted, each lasting between 30-60 minutes. All interviews were conducted using the same style and technique, utilizing probing methods to uncover hidden attitudes and behaviors (Hair & Page, 2015).

Respondents were asked to identify and expand on the sustainability signals they seek when evaluating building material suppliers. The strategy aimed to understand the phenomena at hand from two opposing points of view (case organization and target stakeholder) to find answers to the stated research questions. The interviews were divided into two groups:

Group 1 represents interviews conducted with senior managers of the case company to answer research question 2. Interviewees chosen from the case company were all decision-makers and contributors to the external environmental sustainability messages and signals communicated externally. Sample details are illustrated in [Table 6](#).

TABLE 6 Information Table of Interviewees with Case Organization - Aisti

Name	Job Title	Date	Time	Place
AF	Founder & COO	31.01.2023	34:00:00	Zoom
MP	Founder & CEO	06.02.2023	27:00:00	Zoom
PJ	Founder & CTO	06.02.2023	29:50:00	Zoom
HL	Brand Lead	10.02.2023	34:11:00	Zoom
Total	4		125:01:00	

Group 2 represents interviews conducted with architects from Nordic architectural firms that were among the customer target group for the case company. Only architectural firms that are Nordic based, with Nordic branches, or manage Nordic projects were contacted, a total of 50 firms were contacted via email, and nine interviews were confirmed from a predetermined seed list provided by the case company. Sample details are illustrated in [Table 7](#). The architects sampled were not familiar with the case organization or the product.

During the interview, the product was not specified, and no specific content was shown not to feed the interviews any perspective or impact their answers because of their relationship with the case organization.

TABLE 7 Information Table of Interviewees with Architects

Label	Job Title	Market	Gender	Date	Time	Place
R1	Architect	Finland	Female	04.01.2023	40:00:00	Zoom
R2	Architect	Sweden	Male	05.01.2023	45:59:00	Zoom
R3	Architect	Sweden	Female	06.01.2023	32:59:00	Zoom
R4	Architect	Sweden	Male	16.01.2023	37:39:00	Zoom
R5	Architect	Belgium	Female	17.01.2023	39:22:00	Zoom
R6	Architect	Denmark	Female	25.01.2023	30:44:00	Zoom
R7	Architect	Finland	Female	26.01.2023	36:26:00	Zoom
R8	Architect	Finland	Male	28.01.2023	44:46:00	Zoom
R9	Architect	Finland	Female	201.01.2023	46:28:00	Zoom
Total	9				354:23:00	

3.4 Data Analysis

Marketing and communication researchers are increasingly drawn to qualitative research methodologies because they provide meaningful insights from narratives (Nowell et al., 2017). Qualitative data typically come from interviews and interactions with real-world participants, which makes it essential for researchers to describe their data analysis methods in detail. D O’Gorman and MacIntosh (2015) suggest that rigorous data analysis processes are necessary for a qualitative methodology to yield valid and credible contributions to the field of study.

To ensure credibility, Nowell et al. (2017) emphasize the importance of documenting the precise methods used to analyze the collected data in qualitative research. Thus, the data analysis section is crucial for the success of this study for two reasons. Firstly, a thorough and detailed data analysis method is essential to gain the trust of the study readers. Secondly, data analysis can guide future researchers.

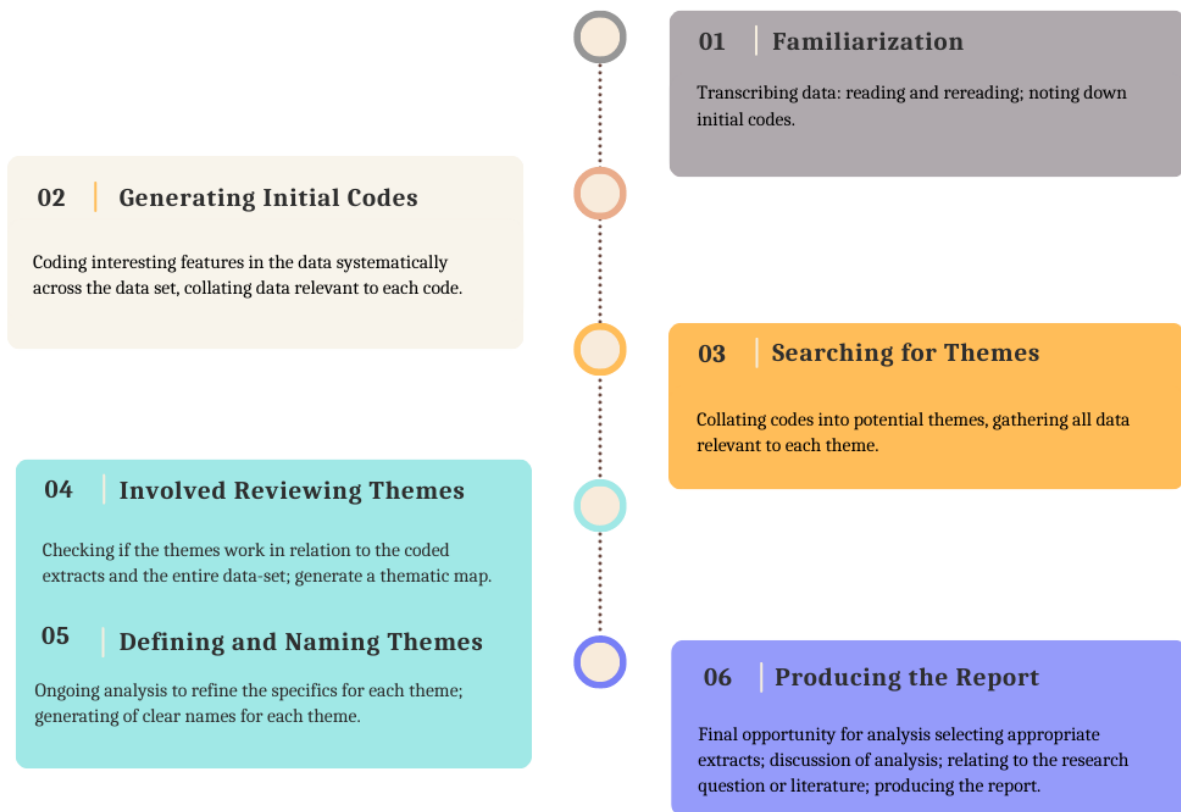
This study uses semi-structured interviews; thus, thematic analysis is appropriate and essential to draw credible results and conclusions from the collected data.

3.4.1 Thematic Analysis

The thematic analysis is a rudimentary method under the qualitative methodology (Nowell et al., 2017). The authors define thematic analysis as “a method for identifying, analyzing and reporting patterns(themes) within data (Braun & Clarke, 2006, p. 2)”. According to the author's thematic analysis, the analysis helps examine the different perspectives and narratives that emerge from collected data (Nowell et al., 2017). Additionally, thematic analysis is beneficial in analyzing large data sets like interview transcripts because it provides researchers with a systematic approach to finding key features and patterns (Nowell et al., 2017).

This study also adopted thematic analysis to produce a clear and organized final report. This study adopts Bruan and Clark’s (2006) thematic analysis technique to conduct the thematic analysis in a rigorous and clear procedure, as illustrated in Figure 6:

FIGURE 6 Braun and Clark (2005) Thematic Analysis Steps



D O’Gorman & MacIntosh (2015) describe thematic analysis as a six-step method to find, analyze and interpret themes within data. There are two ways to conduct the thematic analysis. One is through manual transcript writing, reading, and coding; the second is through computer packages to automate the thematic analysis for data sets of over 40 interviews (Adams et al., 2007). For this study, the analysis was conducted manually for the sample size of 13 interviews. A thorough and careful reading of written transcripts was followed to ensure that initial codes were 1). grounded in the original accounts, and 2). newly defined codes from emergent themes are recorded (Adams et al., 2007).

The transcript reading and note collection followed the six-step thematic analysis (Braun & Clarke, 2006). All thirteen interviews were recorded and transcribed manually to ensure data accuracy. The transcript development process involved several reads and manual notes and coding the interview transcripts (Adams et al., 2007). Based on the theoretical framework and literature review, themes were set

beforehand to structure the interview questions and develop the interview protocols for groups 1 and 2.

The coding phase started by organizing the transcripts to main points, attitudes, verbatim quotes, and other information in different colors. Otter.ai was used to locate and highlight keywords to generate codes and code frequency tables. Then, the Post-it notes were manually used to organize important codes from the transcript (Adams et al., 2007).

Finally, a cross-tabulation was formed to keep count of code frequency per participant (Adams et al., 2007). In this study, coding was performed for both initial and emerging themes (D O’Gorman & MacIntosh, 2015). The detailed findings of the thematic analysis are presented in the analysis and results chapter (Adams et al., 2014). A typical cross-tabulation is formed to showcase and summarize key codes under set themes to ensure coding accuracy (Adams et al., 2014).

The cross-tabulations are provided in the analysis chapter. Since there are two sets of samples, two typical cross-tabulations are provided for each group of interviews.

3.4.2 Interpretative Analysis

The study also utilizes interpretative methods to analyze the collected data (Spiggle, 1994). Interpretation allows researchers to adopt an intuitive and subjective approach to analyze the textual data and develop a synthetic and holistic finding (Spiggle, 1994). This complementary method is essential to this study because it allows for a deeper understanding of alternative perspectives and experiences by studying and analyzing the meaning customers attach to experiences, finding the patterns of behavior and how those connotations ultimately form customers' perceptions (Spiggle, 1994). Finally, interpretation decodes the meaning of lived experiences (Spiggle, 1994). This interpretative method was implemented in the analysis following Spiggle’s three-step process, identifying meanings, seeking patterns in meanings, and deciphering cultural or contextual codes from the patterns (1994). This approach was conducted following the data analysis using thematic analysis and implemented at the coding stage as a complementary approach to ensure codes were captured through an intuitive and holistic approach to the true individual experiences of study participants. It is also important to note the challenges of generalizations in qualitative research (Ritchie et al., 2013).

Generalizations of analysis usually refer to finding meanings beyond the context of the qualitative research and the context of the sample selection (Ritchie et al., 2013). Therefore, it was vital to ensure that the generalization of results was considered in the data analysis. Naturalistic generalization (Ritchie et al., 2013) of qualitative

methodology can be achieved with accurate descriptions of the participants' lived experiences with evidence (Smith, 2018). According to Smith (2018), adequate evidence of naturalistic generalizations could be through adding vivid interview inserts from interview participants, detailed analysis of the data collection and data analysis.

In conclusion, the interpretative technique was incorporated into the study's analysis to support the thematic analysis of the collected data and to offer a creative and intuitive comprehension of the central topic of the study (Spiggle, 1994).

04 Analysis and Results

This chapter details the analysis and findings following empirical data collection. The data is analyzed with an interpretative approach and thematic analysis. The analysis is done on the data collected from the semi-structured interviews with architects and expert spokespeople from the case organizations. The data was analyzed using O'Gorman and MacIntosh's (2015) six steps of thematic analysis, and the findings are summarized following preset and emerging themes.

Findings are presented in two sections, each organized in the order that corresponds to the research question at hand. The findings are detailed to follow the theoretical framework pre-set themes and emerging themes from the data to tell a clear and cohesive story of the findings. The analysis, like the data, is grouped into two main sections:

- Section 1 introduces the themes and analysis from thematically analyzing the semi-structured interviews of the case organization to seek answers for RQ2 regarding environmental sustainability signal formation.
- Section 2 presents the narratives that emerged from thematically analyzing the semi-structured interviews with architects to seek answers for RQ1 regarding environmental sustainability signal interpretation.

4.1 Phase 1: Signal Formation

The signal formation section presents the data findings and analysis of the interviews conducted with four interviewees from the case organization. The section will present the findings and analysis under four main themes from the data to answer the secondary research questions.

The section is outlined to follow the themes driven from the thematic framework and ordered to draw a cohesive and precise narrative of the data analysis outcomes. The cross-tabulations illustrated in [Table 8](#) present the frequency of views and attitudes discussed under each theme by the interviewees from the case organization.

The data collected in Table 8 were gathered by counting the number of times and frequency in which key codes were mentioned during the interviews to determine the strength of the code and, therefore, the theme driven from the theory. The unit of measurement is words mentioned during the interview's duration and about the theme discussed.

The taxonomy illustrated in the table shows the strongest and most discussed topics during the interviews (Adams et al., 2014).

TABLE 8 Cross-Tabulation of Codes Frequency By item and Respondent

Themes/Codes		Signaling: Signal Formation				
		<i>MP</i>	<i>P J</i>	<i>AF</i>	<i>HL</i>	Total
Signaler	<i>Size</i>	3	0	2	0	5
	<i>Corporate Identity</i>	6	0	5	10	21
Signal	<i>Circularity</i>	6	1 2	4	0	22
	<i>Product Sustainability</i>	11	1 9	6	0	36
	<i>Carbon Negativity</i>	8	6	4	1	19
	<i>Raw Materials</i>	5	2 4	0	1	30
	<i>Certificates</i>	1	6	11	0	18
Signaling Environment	<i>Competition</i>	3	7	6	0	16
	<i>Regulations Standards</i>	0	3	2	4	9
	<i>Online Signaling</i>	7	1	3	2	13
Receiver	<i>Expertise</i>	16	1 0	0	3	29

4.1.1 Signaler Characteristics and Signal Formation

The first theme was the necessity of observable and proactive signaling strategies. The proactive and transparent communication theme emerged from the interviews, as interviewees stated the important role of sending signals tailored to their customer's needs. The case organization spokespeople confirmed that architects look for precise, factual, and highly technical environmental signals to believe in the company's environmental claims.

Mp, Founder and CEO of the case organization, explained that they use precise and factual messages like defining the firm's raw materials recycling methods to support their environmental signals. MP mentioned that this detailing of messages is done for two main reasons: to offer quality messages to architects and to answer questions that architects seek from them.

Additionally, MP confirmed that their product offering and, as a result, their communication strategy emerged as a response to increased market demand for alternative ecological construction materials.

- Mp: "Our focus in communication came from the customer side...I think it came from the fact that no products in the market fulfilled these priorities. No real options would fulfill these environmental requirements of no plastic and carbon demands and the price."

- Mp: "For example, the recyclability messaging, we have two options for that, we can take the tiles back and use it as a raw material in our process, or we can utilize the recycling of cardboard, a recycling method that is already in place, which is why how it should be recycled by a process that is in place already. So we can elaborate on those resources or raw materials and prove our claims are true."

- Mp: "When we discuss with our interest groups, architects, construction companies, or any other player, we elaborate on what it means. So in some way, it proves that we are what we say we are because we elaborate on it. And our competitors cannot elaborate because they do not have a real solution."

PJ also emphasized the importance of showing accurate data behind its sustainability claims and described the firm's strategy to highlight its carbon-negative product as a core signal to reach architects on their website.

- PJ: "Well, CO2 emission is an essential thing at the moment, and at the moment, everybody knows that we have to do something with the construction sector to decrease the CO2 emissions, so that is why it (our messages about carbon negativity) resonates."

- PJ: "The first step is that our products should be sustainable, and we have to show it based on real data..... data related to the calculations that we should know about carbon ...everything behind our products."
- PJ: "We use calculations based on books and relevant and reliable ... that can be seen in, for example, public sources."
- PJ: "To reach architects with these messages, we use our web page, and I have received feedback that they are quite nice. At the moment, the most important points are very clear."

Both PJ and MP emphasized that communication between suppliers and customers in the building signals relies on explicit signals. In other words, confirming that B2B firms rely on environmental signals that are easy to observe on the website and pertain to high technical demands to build the desired trust with architects. By providing specific information and data to support their firms' environmental claims, they believed the firm could differentiate itself from competitors who make vague claims about sustainability without offering evidence.

The spokespeople believed this approach would likely be more effective in convincing architects of the company's commitment to sustainability, ultimately leading to a favorable green brand reputation. Another component of observability is using appropriate digital channels to transmit the right signals to the archives.

4.1.2 The Impact of Signaling Environment on Signal Formation

Architects and building material suppliers are under pressure from various regulations and certifications that guide building design and materials (Darko et al., 2017). As a result, architects are more receptive to messaging about carbon negativity and sustainable materials as they try to meet the requirements set by the regulations. PJ noted that Europe set a target for a 70% recycling rate of materials used in construction and demolition waste by 2020. PJ stated that the regulations and certifications demand influence architects' interests.

- PJ: "Architects look for as simple as (materials) can be for example, recycled materials, so architects would want to know if they plan or design with that material in the construction, they can take it off, and then recycle it easily. So, materials are mono materials, not hybrid materials that are quite challenging to recycle."
- PJ: Decarbonization of the construction sector "is maybe the sexy thing at the moment ... of course, there are people who also want to save the world, but most of them want the new trends communicating about their handprint somehow to be the most attractive with the newest solutions."

- PJ: "Well, our material is easily recyclable and carbon-negative messages are the main focus points. Of course, the third one is that the performance of our material is at the same level as the existing materials, and the price is at the same level. All those messages influence the architects' selection."

Furthermore, AF, Founder and COO confirmed that building material suppliers rely on environmental certificates and third-party assessments to ensure that their messages are seen as credible and valid by architects. AF also mentioned that the lack of environmental certificates impacts how architects receive their communication.

- AF "We focus on the full lifecycle of the building or the property. So, how the building is first developed, built, how it is used, and, finally, how it is demolished to minimize the emissions during the whole lifecycle, that is kind of the most critical view to sustainability in respect of, of construction, business, or industry."

- Mp: "Our carbon negativity messaging stands out to architects "because there is legislation coming and, in a place, where they have to look for these kinds of products, so I assume that it is their main value."

- HL: "In my opinion, all the architects that I have ever met, I think that they are continuously sleep seeking great materials to be used in the projects that increasingly are sustainable, as I said in the beginning, that it comes from the two perspectives, there is a law and regulations. And then there is their willingness to find good materials for the environment and people."

4.1.2.1 Online Signaling Implication on Signal Cost

Another important finding emerged under the signaling environment: the online context and channel in which the firm chooses to transmit its messages. Based on the interviews, B2B firms select channels best based on what they perceive as the channel most preferred by architects. In this case, all the case organization spokespeople confirmed that the website was the most preferred communication channel with this stakeholder group.

MP confirmed that its corporate website is critical for communicating the company's environmental signals to architects. MP, for instance, regards the website as the primary communication channel with architects looking for technical product information.

- Mp: "It has to be the website. It is the most used channel" by architects "to get technical information about something."

Therefore, weak environmental signals on the website could be interpreted as misleading, which can negatively impact the company's image. HL notes that architects have a heightened knowledge and awareness of environmental sustainability signals.

As a result, architects pay attention to the technical details provided on the website and are precise in their evaluations. Therefore, the firm focuses on crafting accurate and detailed signals on the website. This indicates HL saw the website as the main communication channel with architects.

- HL: "People (architects) notice that something is not right...and they notice these miscommunications very quickly."

4.1.3 Developing Credible and Factual Signals

Another theme emerged from the interviewee: the importance of focusing on the product's sustainability signaling in the case organization. The interviewees emphasized that the firm focuses on priority signals to demonstrate its expertise and credibility to architects.

According to PJ, the product environmental sustainability signals (carbon negativity, circularity and utilization of innovative raw materials) are the primary signals, followed by firm-related sustainability messages. Additionally, PJ stated that signals with real data and calculations related to carbon and other environmental factors about their products are the most fruitful messages to build credibility with architects and prove the case organization's sustainability claims.

- PJ: "The first step is that our products should be sustainable, and we have to show it based on real data..... data related to the calculations that we should know about carbon ...everything behind our products. The second step is to show that our company is sustainable, but the product should be the first focus."

- PJ: "One is that we mention that we are carbon negative, and then we show a calculation of how much we can bind gasses in our products. We also say that the product is a recyclable material. Those two things are the most critical points we emphasize."

The firm values the verification of its environmental signals; therefore, it adopts an internal process to govern the messages. This governing of messaging involves

multiple individuals with different perspectives reviewing the messages to ensure they are accurate and consistent with the company's values. AF emphasized the importance of asking how they can prove what they are saying and the need for a careful internal process of validating messages.

- AF: "We try to be right about what we say? It is no bullsh*t and no greenwashing. Especially compared to large companies, as a smaller company, I would say that we are more active."

- AF: "We often ask how to prove what we say. So, that is the key question: can we measure this thing? Can we find a reference for this claim? So, this is an internal process of validating the messages we send. It needs much care to ensure our messages are not biased...."

The company's focus on providing detailed and verifiable environmental information can be attributed to several factors. Firstly, with these detailed messages about the environmental sustainability of the products, the company demonstrates its commitment to environmental responsibility and shows that it is not merely engaging in greenwashing or making empty claims about its environmental impact. Therefore, the firm gains trust and differentiates its signals from competitors.

- Mp: "For example, regarding the recyclability messaging, we have two options for that, we can take the tiles back and use it as a raw material in our process, or we can utilize the recycling of cardboard, a recycling method is already in place, which is why how it should be recycled by a process that is in place already. So we can elaborate on those resources or raw materials and prove our claims are true."

Secondly, the case organization's focus on providing verifiable information is likely driven by the regulatory requirements and signaling environment in which it operates. Building material suppliers are increasingly subject to regulations and reporting requirements related to their environmental impact, and providing verifiable information is necessary to comply with these requirements (Darko et al., 2017).

Therefore, providing facts and checkable environmental signals is an important aspect of the firm's strategy and critical to establishing credibility with architects and regulators.

4.1.3.1 Costly Environmental Signals

The interviewees revealed challenges and costs for small B2B companies to communicate and implement environmental sustainability practices. The interviews suggest that the challenges and costs are influenced by limited resources, communication and resources needed to invest in customer communication and channel penetration. One major challenge is companies' limited resources to communicate and reach every architect, particularly with limited budgets.

As MP noted, the case organization needs more communication resources, making communicating with every player in the field challenging. The cost of communication, particularly with numerous architects and players in the field, requires significant resources.

- Mp: "There are no issues in how we communicate, we communicate it quite well, and the wording is clear. We do not have enough money to communicate with every player in the field."

Furthermore, as noted by PJ, effective environmental sustainability messages depend on the frequency and number of recurrences on channels. This repetition of messages is often costly.

- PJ: "I should say we have to repeat the message 100 times. One or two discussions are insufficient to get the message through, and we utilize different mediums to clarify things."

Another challenge in environmental sustainability practices is the need for more reliable communication standards or methods, as PJ noted.

- PJ: "I believe there are no reliable standards or methods to communicate (about environmental sustainability). If we, for example, calculate those EPD's of our products, the values heavily depend on the selections and our inputs and, at the moment, nobody checks those values. So, there could be situations in which some companies calculate, for example, CO2 emissions as in a standard system, but the reality can be something else."

The corporate values heavily depend on the selections and input of the case organization. This challenge is significant because the case organization needs reliable and accurate measures to communicate environmental sustainability practices effectively, other than EPD certificates, to reduce information asymmetry between the firm and architects.

¹ Environmental Product Declaration

Similarly, HL noted that the case organization is under stakeholder pressure to develop holistic sustainability strategies and communicate every detail of the firm's ESG² practices, which is both challenging and costly.

- HL: "Sustainability is a difficult matter in many companies, and this is not just in Aisti's case; it is a general issue. Sustainability is difficult for people to understand because it means that we have to change how we operate. And, we know people are not confident to change."

- HL: "So, in everything we do as a brand, we must think about a good way of communicating this very difficult topic. Because if we put sustainability at the brand core, then it has to go to everything that we do, we cannot say that we are sustainable in this part of the business, but in this part of the business, we are not."

4.1.3.2 Ambiguous Environmental Sustainability Messaging

When communicating about sustainability, AF noted that the firm faces a challenge in developing clear communication messages because of the unclear nature of the sustainability umbrella. AF commented that this is particularly significant for small companies that need more resources and standard certificates, impacting how architects receive their communication.

- AF: "We lack some standard certificates, like EPDs, because we do not have the products and resources yet. So it is certificates that we lack all kinds of, okay, so that is why we cannot communicate with them."

- AF "It is the first thing that they asked, whether this has an EPD, LCA³, or CE⁴ marking are standard ceiling requirements. These are important because they must design certified projects; you cannot do it without certified products. You need to have certificates for every product used in the building. So they cannot use this dark or unknown materials."

The interviewees confirm this vagueness in their answers and contribute to the industry's lack of standard evidence-based communication guidelines. According to AF, this vagueness obscures credible and false signals and, as a result, makes it hard for architects to recognize honest suppliers.

² Environmental, Social, and Governance Standards

³ Life Cycle Assessments for Building Materials

⁴ Conformité Européene

4.1.4 Summary of Signal Formation

This signal formation section of the analysis aimed to study the data collected from interviewing the spokespeople at the case organization who have formulated the firm's environmental sustainability signals. This section aimed to outline the analysis to understand how and what strategies impact the formation of signals internally. The section followed the key pre-set themes of the interview protocol to offer a clear and detailed analysis of the collected data. These themes included the signaler, signal, signaling environment, and receiver. The section also presents emerging themes from the data, like online signaling and online signaling environments.

Following the thematic analysis, the empirical data revealed that environmental signal-related costs impact signal formation. B2B building material suppliers communicate their environmental sustainability practices using reliable and accurate signals. The firm classified its environmental sustainability signals as clear, measurable, and technical. It is important to note that their definition is impacted by what they perceive as needed from architects.

Secondly, the analysis confirmed that environmental sustainability signaling requires significant resources investment due to the construction sector's high competitiveness and complicated signaling environments, particularly with numerous architects and competitors lacking standardized definitions of clear and reliable environmental data, regulations, and inconsistent competitor communication. As a result, companies depend on third-party qualifications to signal credibility. The need for certificates and third-party assessments is challenging for smaller building material suppliers and increases signaling costs.

In conclusion, these findings suggest that case organizations, especially SMEs, adopt a proactive signaling strategy to formulate and build their sustainability signals, which can reduce signaling costs.

4.2 Phase 2: Architects Expert Interviews - Signal Interpretation

After analyzing the data from the case organization, this analysis section will continue with the second group of interviews with architects. This section will focus on how architects interpret building material supplier environmental signals. Like section one discussing the formation of these signals, this section will also follow the thematic analysis of the data collected from the semi-structured interviews with nine architects representing architecture firms. The analysis in this section will follow the same key preset themes driven by the signaling theory and introduce the emerging themes found in the data.

The analysis of this section follows the theoretical framework and is presented coherently to offer valid and data-driven answers to the primary research question. RQ1: How do architects interpret these environmental communication signals? While the interview protocol followed pre-set themes, the narratives also included emerging themes from the collected data during the study. The theoretical framework presents key relationships between perceived signal and its environment, signal cost, signal observability and perception of the sender. These relationships present data analysis narratives.

The section is outlined to follow the themes driven from the thematic framework and ordered to draw a cohesive and precise narrative of the data analysis outcomes. Like Group 1, interviews with the architects were coded before analyzing the themes following Adams et al. (2014) tabulation steps and frequency of codes.

The cross-tabulations illustrated in Table 9 present the frequency of views and attitudes discussed under each theme by the architects. Similar to Table 8, the data collected in Table 9 was gathered by counting the number of times and frequency in which key codes were mentioned during the interviews to determine the strength of the code and, therefore, the theme driven from the theory. The unit of measurement is words mentioned during the interview's duration and concerning the theme discussed.

TABLE 9 Cross-Tabulation of Codes Frequency By item and Respondent

Themes/Codes		Signaling: Signal Interpretation									
		R1	R2	R3	R4	R5	R6	R7	R8	R9	Total
Signaler	Size	0	1	1	2	1	0	0	1	0	6
	Corporate Identity	2	3	2	4	3	1	8	4	1	28
Signal	Product Sustainability	7	0	15	4	1	9	15	17	6	74
	Circularity	9	4	4	1	12	4	0	4	11	49

	<i>Carbon Negativity</i>	6	15	3	13	19	7	0	12	14	89
	<i>Raw Materials</i>	14	3	2	10	26	5	4	7	11	82
	<i>Certificate</i>	1	12	3	15	6	0	6	11	8	62
	<i>Price</i>	2	4	1	0	1	0	1	0	5	14
	<i>Availability</i>	6	3	2	2	1	0	2	0	0	16
Signal ing Environment	<i>Competition</i>	0	2	1	3	4	8	1	10	6	35
	<i>Regulations</i>	1	5	3	2	2	0	2	0	1	16
	<i>Online Signaling</i>	1	5	2	3	1	5	2	6	4	29

4.2.1 The Impact of Signaling Environment on Signal Interpretation

As the study examines the formation and interpretation of environmental signals by stakeholders across the construction supply chain in the Nordics, it is critical to understand the implications of this external context on the signal formation and interpretation between stakeholders in the examined industry (Moratis, 2018).

4.2.1.1 High Regulations Impact on Information Asymmetry

Architects said that the heavy regulations have increased the supplier's competitiveness to signal environmental sustainability signals and increased the awareness and demand from buyers for these signals. Architects have stated that the regulations have been a positive moving force that impacts their decision-making and favoritism to ES signals.

- R5: “The height, the current heightened focus from authorities, in at least all the Nordic countries, about embodied carbon with legislation coming into a place where you have to declare and calculate your embodied carbon, which we did not have to do a few years ago. ”

- R5: “Choosing a sustainable supplier is related to our income possibilities because getting premises is hard and almost impossible unless the building is environmentally certified. Getting a loan is also more difficult and costly if the building is not environmentally certified. Alternatively, if you are using the Debt Capital Market for lending purposes...it is impossible to get Green Bonds without that information or sustainable suppliers. That is rapidly transforming to a voluntary market and almost compulsory because of the EU green taxonomy.”

- R7 “Investors are not ready to pay more and invest more (in sustainable materials). Still, they have to, they have to, and they cannot sell or rent if they do not care. So again, it is about money.....It is sad, but it is also good in this case.”

- R2 “We are seeing more and more regulation coming in certain markets, specifically in Denmark and London, so we look at carbon performance as a priority.”

- R2 “All the investors now have to meet certain criteria if they want to call a building sustainable, which most people want to do just to avoid the most blatant cases of greenwashing. So that is changing something.”

Also, architects stated that in the construction industry, asymmetry is controlled and regulated by governmental environmental regulations, policies, and regulations on the sector, making it easier for architects to filter signals based on fulfilling regulatory requirements.

- R4: “I think companies tend to put their money where their mouth is. They know that we are going to, we are going to look into that claim. If I talk to someone, they know that in five minutes, I will be on Google looking to see if they have this certification so that false claims would not get them very farto put makeup on something that is not working.”

Another reason contributing to the decreased information asymmetry is the adoption of signal credibility measurements to satisfy the regulations, which help architects quickly filter out products and evaluate the credibility of the environmental signal. Architects also revealed that the regulations had removed the skepticism barrier when measuring the credibility and seriousness of the green signal.

- R8: "Let us make the website green and say it is sustainable. They will never find out. You know, I do not think that this is what happens."

Architects saw the increased pressure and governmental regulations as a relief and a sign of increased signal quality and credibility because the regulatory requirements control information asymmetry. Some architects have also noted that they use the regulations as a framework to filter through crowded signals from suppliers.

- R1: "I want to find the information very quickly, so I skip all the intro and general company blah, blah, blah, because I get tired of it? I scroll quickly to check those answers and facts."
- R5: "So it is not enough with the corporate sustainability report, even if that is credible and using GRI, and maybe it is audited when it comes to construction material producers, the only thing that matters to us is a legit environmental product declaration."

4.2.1.2 Saturation of Environmental Communication

According to architects, the maturity of the market and increased competition between suppliers to be perceived as green; as a result, the more signals they see, the less they were willing to believe in corporate EC signals (Environmental statement, sustainability mission, ESG report, corporate press releases) as vague and unreliable.

- R1: "I skip the very general text. I am not so interested in the supplier's strategy and way of thinking, I want to know, what does it mean? I like to see the facts. Okay, what are their innovations related to this, what are they aiming at?"
- R3: "As architects, we care about environmental messages but need to see results from the material."

Most architects have stated that they skip and ignore any signals about the firm's corporate environmental sustainability and instead focus on signals that attain credible qualities. Architects referred to credible signals as factual signals that pose costly attributes of external third-party assessment. In other words, they found third-party assessment an indicator of a supplier's credibility.

- R5: "It is irrelevant to us if the company is climate neutral on the company level by compensating through CDMS⁵. They still produce things with a high embodied carbon

⁵ Clean Development Mechanism (emission-reduction mechanism)

because we are not calculating their like corporate carbon emissions. In total, we want to see each component. I think that would be good, but that is not good enough for us.”

- R4: “I mean, with this type of supplier, we go directly to the product, ask for the EPD, and compare. And then I would say that the price would be the differentiator to help us choose which one to use. We will not start at the company level.”
- R6: “The way suppliers use materials or maybe the way they identify themselves, and if they say that they are using recyclable materials and recycled materials ...it attracts me more and makes me trust them more.”

The reported saturation of EC signals has led architects to ignore signals about the company and evaluate the quality of the signal based on its costly qualities (attending certificates and third-party assessment) and signal strength in its responsiveness to changing regulations and market demands. This narrative is also present in architects' opinions on environmental sustainability signals related to the supplier's corporate social sustainability. Also, this could result from architects' belief that suppliers are highly motivated to falsify their signals.

4.2.1.3 Online Signaling Impact on Costly Signal Attributes

Following the pandemic, architects have also noted that they have become more reliant on online search engines such as Google to gather information about suppliers and materials. As a result, the perceived cost of the digital experience, including the accessibility and availability of EC messages on a company's website, has become a key factor in evaluating the quality and seriousness of EC signals.

- R4: “Now, especially after the pandemic, the website is the first way to go.”
- R8 “ I guess I will go first to the company's web pages. It is the place to find general information about the products.”
- R7: “ It is hard to find all the information you need online. Sometimes when I do not find the information, I try to find some sites where people chat, like chat groups, so you use your mind and try to find the truth there.”
- R2: “So there will be a bit of Google search. I am not sure that is the only way, but you eventually end up on a website.”
- R6: “Generally, you just Google because you search everywhere for the product.”

In other words, the saturation of the EC signals online has caused many to assign quality of costly signals to observable certificates, technical data, and clearly stated signals on the website in a phenomenon architects referred to as screening the company fluff. According to interviewed architects, they qualify costly signals based on how professional and clear the certified EC signals are presented on the website.

- R2: "There is more communication around these things by suppliers because it is increasingly the side of the argument everybody wants to be on. Increasingly, we must figure out which of the two does what it says on the tin. And, which of these is a little bit of a head in terms of their communication, compared to where the product can deliver."

- R8: "Of course, nowadays, you know, every company wants to make their products seem sustainable, so they find a way to calculate it. If it is plastic, then it is like recycled plastic, or, you know, if it is concrete, then they have compilations of the carbonization or, you know, some CO2 capturing or something. And if it is wood, they have the embodied carbon there."

- R8: "It is, of course, really great that sustainability has become mainstream. So it is nice that many companies are incorporating it in their speeches and websites and saying it is important. Still, at the same time, when everybody says that it is important, it is hard to distinguish."

- R1: "Website aesthetics are important. As an architect, I always like pictures. But, the clarity of information is far more important ...I want to find the information very quickly, so I skip all the intro and general company blah, blah, blah, because I get tired of it? I scroll quickly to check those answers and facts. If they satisfy me, I could scroll back to read more about a specific topic. If I find it, I try to find it quickly because my time is limited.

- R1: "Much investigation happens on the architect's end.....We rely on Google for information about new methods and innovations, so the better the manufacturers can inform us about those on their website, the better we can find them."

The architects drive quality attributes from how visual, technical, and clear the signal appears in its digital context. They also look at and attribute costly characteristics based on the perceived cost of the website design, development of clear signals and availability of technical information online.

- R2: "If you come to a website, which is just a landing page, with a couple of nice graphics, and then nothing else, it is hard to understand whether, you know, this product is serious..can this company supply and meet our demand? How mature is the product? And we see a lot of

that because many startups do many products. And so we see many flat landing pages with just one page and a few claims. Sometimes it has gone in a year and sometimes developed into something else.”

- R7: “The home page is very important if it is professionally done. It is the company's first impression, and it should be good. You will find the information and be convinced if the pages are professionally done.”

In conclusion, strict governmental regulatory policies and requirements governing suppliers and stakeholders across the construction have three layered impacts on how architects perceive credible environmental signals. Architects view the regulations as drivers for suppliers, developers, and investors to do good and increase market maturity, impacting their purchase decision-making. Also, architects use the standards and certificates as the only framework to identify and measure environmental sustainability signals credibility and quality. Therefore, environmental declarations and certificates reduce the inherently ambiguous nature of the EC messages.

Another important ramification of online signaling is its impact on architects' perceptions of costly signals and the shortening of the signaling process between suppliers and architects. As architects have stated, they tend to skip or underestimate signals about the supplier's corporate social responsibility or ESG reporting. This could be due to these signals' decreased cost and quality; therefore, they lose credibility with the architects. Thus, architects tend to skim suppliers' websites to observe signals they can attribute costly qualities, like certificates and assessments, case studies and customer testimonials. Finally, architects consider website design and content to ease another indicator of costly signals. More developed websites are more costly and are seen by architects as more professional and credible.

4.2.2 The Impact of Signal Cost and Observability on Signal Interpretation

The competitive nature of environmental signaling and the high saturation of environmental signals makes the signaling process between architects and suppliers even more challenging (Moratis, 2018).

During the interviews, architects have confirmed the impact of certain corporate communication messages on their attitude towards suppliers and products. Architects noted that they use indicators and wordings of particular and technical environmental messages. While architects confirmed that observability and cost of signals impact their decision, a third theme emerged from the findings.

- R1: "As architects, we strongly depend on the information the manufacturers have disclosed. Because there are so many materials, so many innovations are even happening. So we depend on what suppliers communicate and how they market and announce their innovations."

Most architects have stated that they have adopted their metrics to define the strength and quality of the signal. Branzei et al. (2004) mention this phenomenon in their study on signaling and point out that receivers tend to calibrate signals based on the messages and values necessary to them. In other words, how architects interpret and perceive the messages from the supplier changes the meaning of the initial communication based on their previous bias, intention, and values.

- R4: "Often, you need quick facts to determine if this material is right for me. We have many regulations and project-specific demands that we always have with us; when we search for a product in one project, it might be tough environmental demands, and in another project might be cost-efficient, often a mix of them. So when you start to look at materials, I mean, of course, step number one, what do we want? Looking for aesthetics, but then very soon, you need the quick info, the basics, often connected to cost on the economy and the environment."

This classification and marking of signals focused on what many architects considered factual signals that indicate somewhat objective data about the product's environmental performance and response to industry regulatory policies. Additionally, some architects emphasized that they utilize indicators or characteristics to classify trustworthy signals based on what they believe is demanded by other stakeholders on the chain and their market regulations.

- R8: "So if we talk about sustainability, circular economy, material health, these come from increased market demand and awareness."

- R2: "We look at the performance, specifically saying, how does this material/product help us meet any requirements around carbon? Building materials emit much carbon in their production, and the industry is increasingly working to bring that down."

According to some architects, messages with embodied carbon indicators and calculations are essential for credible sustainability signals because they are easier to find, verify, and report to clients.

- R1: "I usually have to understand, for example, the availability of materials, I have to understand the cost. Typically, for example, the CO₂ emissions for the material itself are quite easy to find, but the technical data of the material throughout its lifecycle is not easy to find... If the information I seek is unavailable, I abandon the material and supplier."

- R8: "Embodied CO2 is the most important indicator. It is the clearest, most tangible way to measure."

Some architects have stated that they use raw material circularity and the development of products from alternative renewable raw materials as another indicator of credible environmental signals.

- R5: "Regarding building and construction materials, we are looking for material with low-embodied carbon that is either renewable, reused, re-fabricated, or produced by recycled content. It is not enough only to provide low CO2 because we know of the problem with the loss and massive loss of biodiversity, and we all need to do everything we can to reduce our need for new and natural resources, so circularity is as vital as low embodied carbon for circular material recyclability.

- R9: "But if a supplier would go out of their way to recycle, that will increase the credibility because I am sure someone would like to buy a reused material for almost the same price as a new one.

While architects rely on messages about the circularity of raw material to indicate the credibility of suppliers' environmental claims, most have stated that the suppliers usually misdirect them with these indicators. This could result from the architect's lack of awareness of circularity, standardized regulations, and clarity from suppliers about their circularity measures.

- R3: "I would say the consistency of the whole process. If they can show me honestly that they thought about the material, its production, and how it can be reused. So you can see that it is like storytelling if someone only has focused on one little fraction of the story. And when you start digging a little, they cannot answer the rest of the chain and go around it. Well, you know, it is neither good nor innovative."

- R8: "I mean, just by using common sense, like, in most cases, you know, natural materials, you know, are you know, like organic materials, like wood, you know, it is more sustainable than steel."

- R1: "I need to understand the lifecycle of the material, and its full sustainable chain is always quite difficultyou can never get all that information. Is the company truly sustainable? Or are they spoiling some nature that has been unspoiled until now, or what is the transportation burden?"

Connelly et al. (2011) and Moratis (2018) found that signals must be observable and recognizable for the signaler to achieve the desired outcome from environmental sustainability to be seen by the receiver as quality signals. In the competitive and increasingly regulated construction market, architects said that they depend on factual, technical, and direct ES signals about the product to determine the accuracy and truthfulness of its environmental value promise.

- R1: "We are technically oriented and always have a task. And that is a technical task. It is aesthetic and technical, but we have to solve some problems the client gives us. So we always eagerly look for direct answersdirectly to the core. For example, in circularity and transparency information on the website, I look at how reliable the information on the website is and how widely the topic is covered."

Moore (1992) argues that the signal's effectiveness depends on the details it contains. In other words, the effectiveness of ES signals depends on the technical and clear messages to answer the receiver's demands, which is what the architects have stated. According to the architects, content with subtle corporate fluff is seen as attractive and insincere, and many look for technical details and facts in their environmental sustainability signals.

- R8: "Finding that sort of objective information, like comparable information, to say if this material is more sustainable than this one ..."

- R4: "Often, you need certain, like quick facts, to determine if this material is right for me.... When you start to look at materialsvery soon, you need the quick info, the basics, often connected to a cost for the economy and the environment."

- R4: "I look for anecdotal proof of products. If I log on to a website for timber frames and see a picture of two children, I will look for another company. I want to see the product. I want to see what you do, not the storytelling .. that is not interesting. I would perhaps be suspicious then think, why are they not showing their product here?"

The reliance on the supplier's willingness to share truthful environmental messages about their product causes a challenge for architects to determine the credibility of these messages. Thus, they rely on the signal cost to assign quality characteristics to it. Bloom and Reve (1990) have argued that these self-assessment signals influence the receiver's interpretation of the signal's honesty. This is evident as architects seek assessments of environmental signals through these certificates.

- R3: "To assess the supplier's credibility, the most basic way is to check all their certifications and if they can fulfill the construction sector regulations internationally."
- R5: "It is not just enough with the corporate sustainability report, even if that is credible and audited using GRI⁶. Regarding construction material producers, the only thing that matters to us is a legit environmental product declaration."

Architects have said that they use third-party verification signals to determine the credibility and truthfulness of the product's environmental signals. Architects mentioned that certificates provide credible and reliable sources to verify the signal's credibility. In addition, these certificates and standards allow them to compare materials based only on environmental impact and value.

- R1: "I do not want to know if the supplier wants to be good and sustainable. I am looking for answers, materials, and products, so I am looking for EPDs and HPDs. I could return to the company's information at some point, but it is not where I start."
- R2: "I also look at what I could call material transparency. So is there what is called an EPD backing up their claims of performance? Or do we just have some nice claims? EPDs are something we could call material transparency in general. While environmental materials can be pricey, we argue that this can help meet the requirements we are looking at from the client side, does the material meet carbon emission requirements and transparency..... do we have EPDs declared, and are the claims backed up?"
- R2: "In general, EPDs are interesting because if a company has gone to the effort to get an EPD, that means they are quite serious about it, it means the material has been around for longer. So it also indicates maturity and seriousness."
- R3: "I look for the certifications. Because if you do not have a reputation, you can show me that you (material) have passed this test. If you have this CE certification, then yes, I believe you, but if you are, I do not know if I have never heard of you, and you tell me, but I'm doing the test now. Maybe your material is incredible, but I, as an architect, cannot trust that to make a building I'm responsible for."
- R5: "Without an EPD (environmental product declaration), no communication is worth it."
- R4: "We look for specific certifications to rule some (suppliers) out and go forward with a few more. That is like when I had my first Google search. Yes, we are like, I want to use this, I

⁶ Global Reporting Initiative (Global Sustainability Standard)

want an acoustic ceiling that has this dampening effect. That is where I start. And then I make sure of what they need to have.”

4.2.3 The Impact of Signaler Characteristics on Signal Interpretation

More than half of the architects have stated that their perception of the sender’s reputation, size and relations impacts how they determine the credibility of EC messages.

Most architects attributed the firm’s size (small and startup companies) to a firm’s commitment to being more sustainable and more innovative in its sustainable product offering. These are all critical factors in their decision-making process.

- R1 “Manufacturers with several decades of bringing something new and known for reliable and quality R&D with an established reputation could be more convincing. However, I am also very interested in finding new products from new startups. So I do not think it matters so much in this context and this field because it is full of innovations and products.”

- R2 “Another part of the risk aspect is, well, what is the supply look like? If we want to do this, we do quite big buildings. If we want to specify or, in the end, we do not get to specify, we specify specifications, and then the procurement side takes over, and we can say you should talk to these guys. However, they will then look at the scalability and if this is a new material, can the production facility meet our demand.”

Furthermore, most architects noted that they view smaller suppliers and startups as more trustworthy regarding their sustainability efforts and product offering. The media attention impacted this socially constructed perception of the signaler in the architect's mind. Media favoritism was also something the case organization mentioned, previously mentioned by interviewees from the case organization data.

- R3: “When you have a startup that put some work into it, well, they can tell you from the beginning, how it started, why they do it like that, where they are going, what they are going for, what innovation or they are working out to make it better, and that you can listen to.”

- R1: “Manufacturers with several decades of bringing something new and known for reliable and quality R&D with an established reputation could be more convincing, but I am also very interested in finding new products by new startups. So I do not think it matters so much in this context and this field because it is full of innovations and products.”

- R6: “Many huge companies, like IKEA, claim to be sustainable but are not sustainable. We do not know how many routes were used to transport their products, how much plastic is

used and where the material is sourced.”

Architects have emphasized the importance of the close relationship between suppliers. They believe that their personal connections with suppliers influence their perception of their credibility, reliability, and expertise. Although architects may use digital means to gather information about suppliers, some still rely on interpersonal cues to assess the quality of their work.

- R2: “Some of these new products do not have EPDs yet, then you spend time with the supplier, engage with them, and see the production facility and have them tell you their story face to face. So you build up a little bit of a relationship and retake something, not just a fluffy claim on a website but your finding. So I think those supply visits are probably not a bad way of building credibility, right?”

- R4: “A bit of a habit, if you have heard of them before or they are a large company. I mean, you tend to start where you are familiar with places you are familiar with. But I would say that if I can get some sort of, I need the facts. Fast.”

- R4: “I love to talk to people, so when we go out to fairs, exhibitions, or gatherings, you meet someone (supplier), so when I have any questions I will call that guy and see if he can help me. I tend to favor that. And then, you often find a good reference project that this particular company has made. And, I mean, you look at a picture and see, I want something that goes in that direction. And that might lead me to contact a company I have not heard about before.”

- R7: “I go to the internet and look for all the available information. Then next, I ask friends if they have any experience using the product or with the supplier, and then I normally contact the company.”

4.2.4 Signals and Decision-making

Architects use EC signals to decide on material suppliers. Most architects mentioned that increasing regulations and awareness of environmental signals have reduced barriers to choosing eco-friendly products, but not all architects prioritize them.

- R2 “Investors are willing to spend the extra money now to develop something that they believe is a competitive and viable product in five to 10 years, so there is a sort of developer-driven interest in meeting environmental parameters.”

- R8: "It is tough to be very objective about it (environmental sustainability), so I have to admit that in the end, it is subjective ...more like a gut feeling type of thing to evaluate, which would be, which would be the most sustainable choice?"

- R9: "But if a supplier would go out of their way to recycle, that will increase the credibility because I am sure someone would like to buy a reused ... for almost the same price as a new one. Just knowing that it was low carbon, even if the reused material cost a couple more than a new one, we have clients that opt for this."

- R4: "I would say that every client of ours has the ambition to build sustainably. What varies is how far they have come. However, some clients are very far ahead. They want to fulfill environmental requirements because it is a business for them. This trend is growing, which causes our clients to choose more sustainable products and solutions."

Nonetheless, Architects consider product performance, cost, and availability as priority factors when recommending building materials to their clients, even though environmental communication signals are important for meeting regulations.

- R1: "It can be that we, as an architect, might find the environmental information attractive, but finally, the final decision will be made very much based on the cost and availability."

- R2: "So it is not just environmental claims, of course, I guess you have to think about it like this when we want to specify a certain material. Price is one point, everybody is looking at the price, and we want something that performs better."

According to some architects, when choosing building products, they focus more on factors like cost and availability rather than environmental signals (ES), as the latter are now considered industry standards due to regulations. Architects generally begin by evaluating products based on environmental performance, cost, and availability, all of which are standardized under environmental regulations, as stated by other architects.

- R6 "We (architects) are small pieces in a huge industry. It is hard to influence the processes, so when we design something, it depends on the costs developers want."

4.2.5 Summary of Signal Interpretation

The section on signal interpretation examines the data gathered from interviews with architects and analyzes it thematically. The analysis helps to understand how

signals from suppliers regarding their environmental and sustainability practices are perceived and interpreted by architects based on factors such as the signal itself, the environment in which it is given, and the signaler's characteristics.

Architects have emphasized the crucial role that signaling environments play in interpreting signals. Therefore, impacts the level of information asymmetry between architects and suppliers. According to architects, the signaling environment included online signaling, regulations, and saturation of environmental communication. The signaling environment nature of online signaling. The highly regulated signaling market environments have influenced the level of attention devoted to environmental signals by architects and suppliers and the saturation of environmental signals from competing suppliers. Consequently, architects view regulations as decreasing information asymmetry between themselves and suppliers, ultimately affecting their decision-making process and decreasing the time spent on signaling interpretation.

The regulated signaling environment has significantly impacted the perceptions of quality and observable signals held by architects. Consequently, architects have developed a heightened expectation for clear and detailed environmental sustainability signaling from suppliers regarding their products. In addition, architects have established their own calibration standards to align their product choices with regulatory requirements. These calibration standards focus on key indicators such as producing energy efficiency, net product emissions, and the circularity of natural materials. The absence of these indicators is enough for architects to discredit and deem signals unreliable. Overall, the regulations have played a crucial role in shaping architects' perceptions of quality and sustainability.

Online signaling has significantly influenced the evaluation and preservation of signals by architects. Architects viewed online communication as less costly and less credible. Thus, architects tend to rely on third-party assessments rather than information provided on suppliers' websites to assess the credibility of EC signals.

Also, architects have become increasingly skeptical of corporate signals about sustainability, as they believe such signals are easy to obtain and lack authenticity. Furthermore, the results shed light on the impact of environmental sustainability signaling on architects' attitudes towards suppliers and decision-making. In conclusion, the results underscore the importance of understanding the nuances of environmental communication and call for greater attention to be paid to the authenticity and credibility of signals in the field.

4.3 Overview of the Results: Bridging the Communication Process

This section presents an overview of the analysis and results from the two primary data sets. The section will compare the findings from both analysis phases to bring necessary conclusions for the study.

The analysis presented in this section compares the findings of both signal formation from the firm’s perspective to the signal interpretation processes from the architects’ perspective. Thus, the comparison brings the finding closer and presents an overview of the signaling process between suppliers and architects.

4.3.1. Signaling Environments

The interviews confirmed that the signaling environment impacts the interpretation between firms and stakeholders in the building sector, are regulations, online information seeking and saturation of environmental communication signals. These three factors impact the level of information asymmetry between architects and suppliers and, as a result, the signal.

The findings indicated that the signaling environment impacts and influences signal interpretation and formation. Also, the findings confirmed that the saturation of environmental signaling had led the case organization to rely on costly third-party assessments and certificates to signal its environmental commitment effectively. Another significant finding was the challenge of the case organization to invest more time and resources to measure, govern and report on their environmental impact. The increased signaling costs of environmental messages could prevent many quality firms from achieving competitiveness.

Table 10 compares the findings related to the signaling environment from architects and the case organization.

TABLE 10 Comparison of Architects & Supplier Views on Signaling Environments

A. Architects	Signaling Environment	B. Case Organization
Architects mentioned that the regulations in the construction sector added pressure on firms to report more accurately about their environmental impact.	Environmental regulations reduced information asymmetry.	The case organization interviewees mentioned that the regulations increased the pressure on them to communicate about their corporate

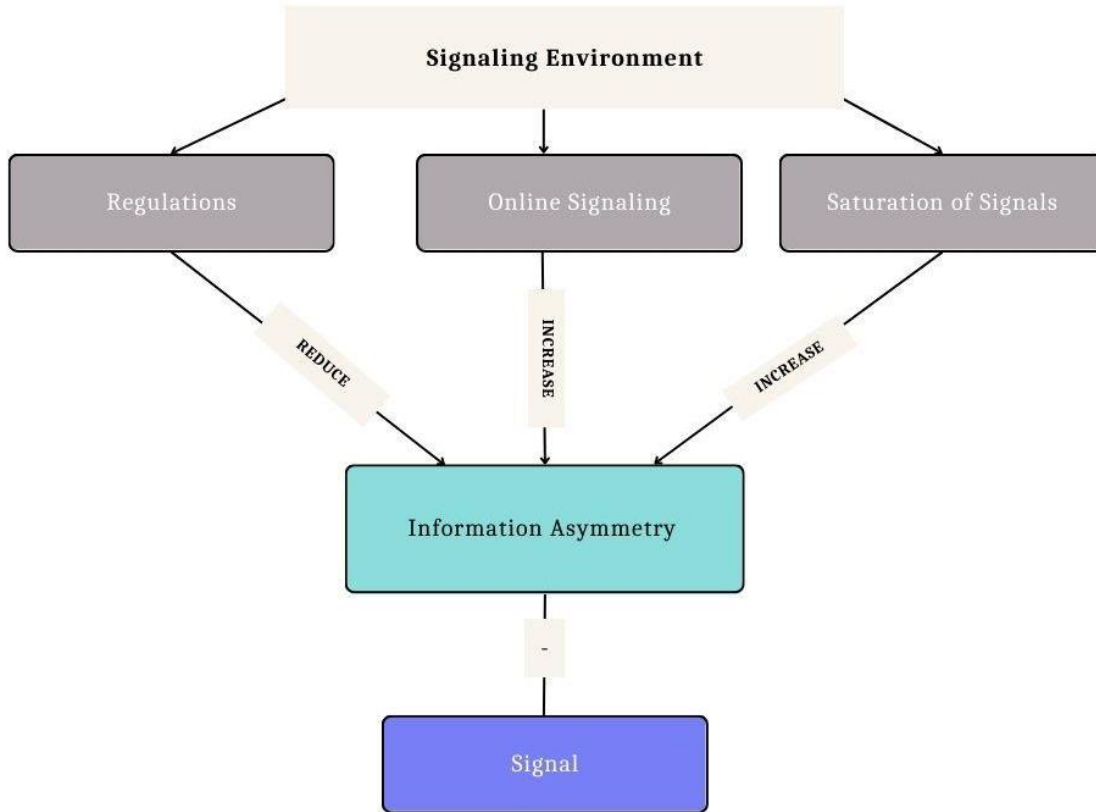
<p>Architects mentioned that firms could not get away with false or greenwashing messages due to regulatory demands.</p>		<p>sustainability practices and product environmental values to remain competitive.</p>
<p>Architects mentioned that they rely upon messages that answer regulatory demands when they seek environmental sustainability signals.</p>	<p>Environmental regulations reduced signals observability.</p>	<p>The case organization mentioned using varied tactics and communication messages to assert its sustainability position, like sustainability reporting and product environmental messages.</p>
<p>Additionally, the regulations have set a governing standard of how architects filter through honest and fake environmental signals.</p>	<p>Environmental regulations increased signal costs.</p>	
<p>Architects mentioned that due to competing environmental communication, they have become more skeptical of environmental signals.</p> <p>This intense pressure has also increased environmental signaling saturation and, with it, the suspicion about the credibility of signals.</p>	<p>Signal Saturation increased information asymmetry.</p>	<p>The case organization has had to increase the frequency of its signals and channel penetration to ensure signal observability.</p>

<p>Said saturation of environmental sustainability signals has increased architects' skepticism of environmental signals, creating the need for certification and assessment as stand-alone cues of reliable firm signaling.</p>	<p>Signal Saturation reduced signal observability.</p>	<p>The case organization has to invest more resources and time to increase the frequency of communication and communication channels means increased costs for the case organization.</p>
<p>Architects now rely on certification and assessment as stand-alone cues of reliable and honest signals.</p>	<p>Signal Saturation Increased signal costs.</p>	<p>The intense competition of EC signals has increased signaling costs in the case organization.</p> <p>The case organization is looking to invest in obtaining third-party verifications and certificates to appear more credible and gain architects' trust.</p>
<p>There are many company websites to navigate and choose from all with some sort of sustainability page, green leaves or a sustainability proposition which poses a challenge for architects when choosing materials.</p>	<p>Online Signaling increased information asymmetry.</p>	<p>The case organization mentioned that the company website and social media are the platforms they invest in the most to communicate with architects.</p>
<p>Architects mentioned that they consider the homepage accessibility, clarity, and user experience when deciding whether a signal is trustworthy.</p>	<p>Online Signaling reduced signal observability.</p>	<p>The case organization confirmed that the nature of online signaling had increased the cost of creating observable and highly factual signals.</p>

<p>Architects confirmed that because communication is easy online and always available, serious companies must confirm their commitment by obtaining certificates that are easy to find on their website.</p>	<p style="text-align: center;">Online Signaling increased signal costs.</p>	<p>Therefore, the case organization increased its investment in communication to ensure their signals are more visible, factual, and frequent.</p> <p>The costs of ensuring their signals are observed online are challenging, so companies must invest in website accessibility and content.</p>
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Based on the findings outlined in Table 10, the result highlights the major signaling environment factors that impact information asymmetry between architects and building material suppliers. The result is illustrated in [Figure 9](#) below.

FIGURE 9 Signaling Environment Implication on Information Asymmetry Between Suppliers & Architects

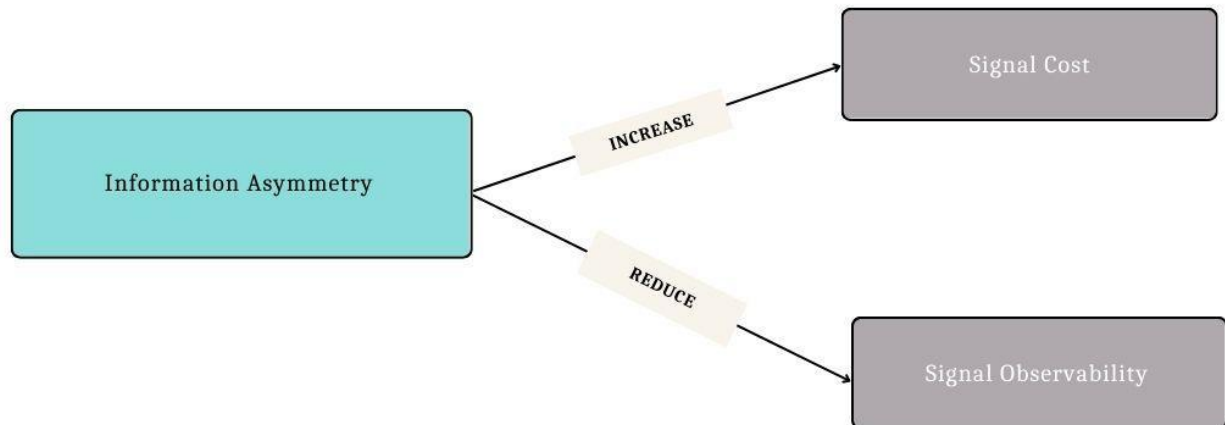


Also, the data in Table 10 confirmed that Information asymmetry affects signal cost and observability, affecting signal effectiveness. This supports Spence's (1973) theory that suppliers must develop more effective signaling strategies when there is higher information asymmetry in sharing. Also, the results summarized in Table 10 revealed that information asymmetry decreases signal observability and increases EC signal between architects and the case organization. As a result, suppliers must accurately comprehend and effectively utilize signaling ecosystems, including digital communication channels and the overall market information structure, to successfully transmit their environmental messaging.

Although competitive information structures and high regulations pose significant challenges and costs for environmental signals, suppliers can leverage digital channels to focus on observable signals to differentiate their communication strategies. Additionally, the increased skepticism of corporate messaging suggests that suppliers may propose environmental product signals on the company's homepage to

achieve greater credibility. Figure 10 illustrates the relationship between information asymmetry and signal cost and observability.

FIGURE 10 Information Asymmetry Implication on Signal Observability & Cost



4.3.2 Signals Cost and Observability: Effective and Credible Signaling

To gain a better understanding of how signals are formed and interpreted, this study explored the interplay between three key factors: (1) the characteristics of the signaler that affect signal formation, (2) the cost and observability of the signal, and (3) the characteristics of the receiver that impact signal interpretation. These factors were found to be consequential, as theorized in the signaling theory. Additionally, the study revealed the influence of both implicit and explicit characteristics of the signaler (case organization) on signal effectiveness.

Spence (2002) posited that the quality of the signaler affects how signals are formed and transmitted externally, while the receiver's perception of the signaler's quality and characteristics shapes their interpretation of signals.

Summary of Results on Signaler Characteristics

The case organization interviews confirmed that the signaler characteristics (like firm size and resources) impact how the firm articulates its environmental communication messages. On the other hand, interviews by architects also discuss that the personal and intimate nature of the B2B relationship affects the receiver's

perception of the firm and signals. Table 11 compares the case organization and architects' findings regarding the role of signaler quality and characteristics.

TABLE 11 Signaler Characteristics Implication on Signal Interpretation & Formation

A. Architects	B. Case Organization
<p>The perception of the firm size and reputation influences architects' perception of the credibility of environmental signals. Architects, for example, perceived small suppliers as more credible than large global companies.</p> <p>The study found no significant relationship between the architect's perception of corporate signals and their perception of environmental signals.</p> <p>Architects have stated that they tend to disregard corporate environmental messaging because they are seen as biased and unreliable.</p> <p>The signaler's constructed qualities, such as characteristics and company size, influence environmental signals' perceived credibility and truthfulness.</p> <p>Architects highly value personal and intimate relationships with suppliers, and these relationships impact their perception of environmental signals.</p>	<p>The case organization strongly emphasized its corporate image through environmental messages about the products because product-related environmental messages impact its reputation among architects and, eventually, competitiveness.</p> <p>The case organization recognized that subtle explicit signals about the firm's size, market share, and founders' reputation could influence how architects perceive their environmental signals.</p> <p>Hence, the case organization paired their environmental communication with those of entrepreneurship to appear more credible.</p>

Overall, interviews with architects brought attention to how the supplier's corporate environmental messages impact how they perceived the EC signals. Based on the findings, architects relied on their relationships with suppliers to determine the credibility of messages rather than corporate identity and messaging. While it could be argued that representative reputation is part of the firm's reputation, the lines were blurry and vague. Therefore, suppliers could invest in offline environmental signaling

at fairs and exhibitions to establish the desired reputation and strengthen their signal observability with architects.

Summary of Results on Signal Observability & Cost

Secondly, the study confirmed that EC signal costs and observability impacted the architect’s perception and credibility of the case organization. The findings demonstrated the positive relationships between signal observability and credibility. The more observable and factual the EC signal, the better architects perceived it and thus improved the signal's credibility. As mentioned in the section about signaling environments, signal observability is influenced by factors like market demands, a saturation of environmental signals, and regulatory requirements. However, there are also other attributes that impact signal observability and cost based on the interviews.

Table 12 compares the insights regarding signal observability and cost from the architects and the case organization.

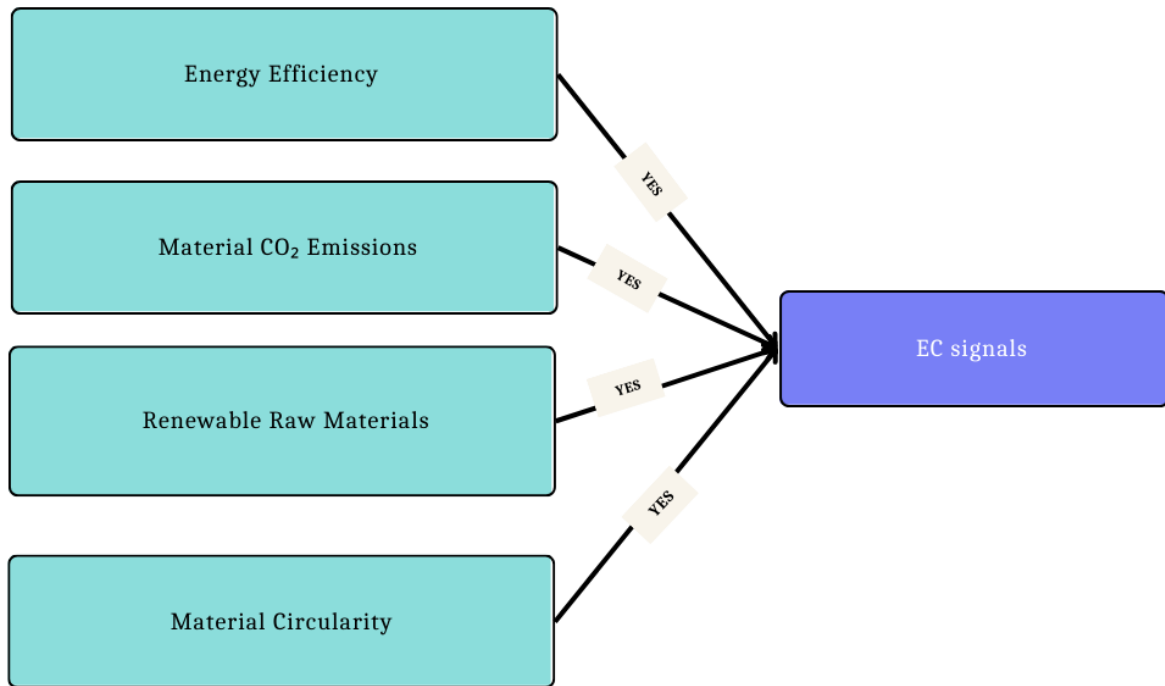
TABLE 12 Signal Observability & Cost Impact on Signal Formation & Interpretation

A. Architects	B. Case Organization
Signal Observability	
<p>Architects confirmed their need for observable environmental messages.</p> <p>Due to firms' high level of environmental communication, architects developed priority calibration indicators to filter through messages. Architects filter through corporate “fluff” communication using measurable environmental signals.</p> <p>These messages are all related to the product's environmental impacts and are easily verifiable.</p> <p>Architects look for four detailed and highly technical messaging: carbon emissions, product lifecycle,</p>	<p>From the case organization perspective, the firm depends on comprehensive and verifiable environmental signals to establish credibility with architects.</p> <p>The case organization focused on three key communication messages to build a superior sustainability position. These messages focused on three main signals: negative carbon Footprint, the circularity of raw materials, the novelty of natural raw materials and product recyclability.</p> <p>The case organization noted a lack of standardization in sustainability communication; therefore, developing observable signals required resources and investment.</p>

<p>renewability of raw materials, and energy efficiency.</p> <p>The environmental declaration and third-party certificates reduce the inherently ambiguous nature of the EC signal.</p>	
<p>Signal Cost</p>	
<p>Architects use certificates and environmental product declarations to validate signals' credibility and trustworthiness and alleviate information asymmetry.</p>	<p>There is increasing pressure on the case organization to communicate about their corporate sustainability measurement and practices in every aspect of business operation, which is costly.</p> <p>The case organization noted that communicating and implementing environmental sustainability is costly.</p> <p>These challenges impact smaller suppliers due to the limited resources, communication, and resources needed to invest in customer communication and channel penetration.</p> <p>Ultimately, the cost of environmental communication messaging presented a challenge for the case organization because of the effort, resources and need to report on many environmental aspects of their product to achieve the required visibility.</p>

Based on the insights shared in the table, it is evident that architects rely on four verbal signals to identify the credibility of a supplier's environmental signals. These message classifications impact whether architects notice or ignore EC messages. The calibration messages the architects use to observe EC signals are illustrated in [Figure 7](#). Therefore, it is crucial to understand how architects classify or assign quality characteristics to signals to gain deeper insights into how architects observe and decipher these signals.

FIGURE 7 Product Environmental Signals Calibration by Architects



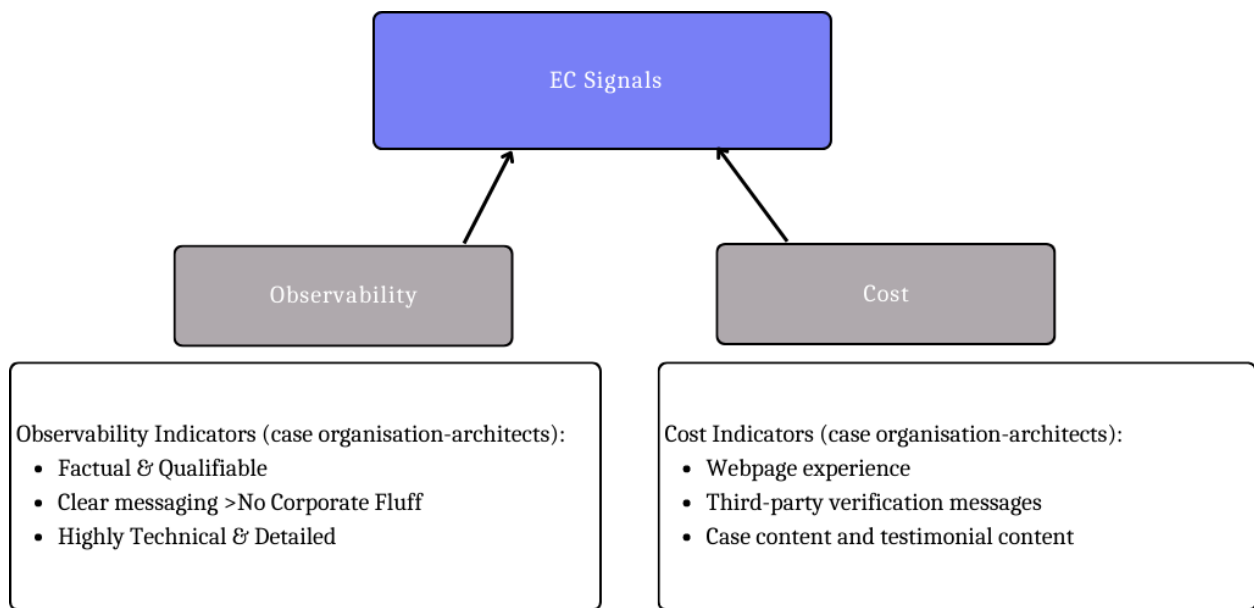
Finally, the receiver's attitude and expertise impacted signal credibility and observability. Since receivers rely on signals when the signaler's intentions and messages are hard to discern (Spence, 1973), communication in competitive markets depends on the attitude and expertise of the receiver. This study found that architects' expectations and attitudes toward environmental signals impacted their awareness and evaluation level. For example, architects with more experience and knowledge in sustainability may emphasize signals related to environmental performance.

Another aspect of signal credibility is the quality of costly signals. The finding confirmed the positive relationship between sustainability message costly qualities and its credibility with architects. The finding revealed that the quality of costly signals impacts signal credibility and observability. Consequently, these costly qualities eliminate information asymmetry between architects and suppliers. The nature of online signaling reduces the cost of suppliers communicating with architects, therefore reducing the apparent quality of the online content.

Architects mentioned relying on third-party certificates, assessments, and case studies to indicate credible signals. While the supplier argues that these certificates use biased metrics that depend on the firm's selection and input. Architects see these certificates as reliable and accurate measures of a supplier's signals. Thus, these certifiable environmental standards play an important role in environmental communication because they eliminate information asymmetries between suppliers and customers.

Architects have stated that these certificates indicate seriousness and maturity as they equate the cost (time, resources, and expertise) the company puts into obtaining these certificates with credibility. Also, third party certificates provide a credible signal to stakeholders about the supplier's overall environmental responsibility. Based on the analysis, the finding regarding the relationship between the signal cost and observability can be summarized and illustrated in Figure 8 below.

FIGURE 8 Signals Observability & Cost Implication on Signal Strength



05 Discussion

The discussion chapter presents the findings of this study by reflecting on the study results in two sections. One is about the theoretical contribution the findings bring to the existing literature on signaling theory and corporate communication. Followed by the practical managerial implications of these findings.

The chapter then evaluates the study, presented in the validity and limitation section. The future research sections also present possible avenues of future research for researchers wanting to replicate or expand on this study. These two sections determine the quality and limitations of the study findings and verify the trustworthiness of the results and limitations of the study (Eriksson & Kovalainen, 2008). Finally, the chapter concludes with concluding remarks to summarize the study.

5.1 Theoretical Contribution

In this study, environmental sustainability communication is examined through the lens of the signaling theory.

The study considers the important role of the signaling environment and information asymmetry in the communication process between B2B firms and stakeholders. Information asymmetry was studied from a communication perspective and defined as the unbalanced access to environmental information between the firm and stakeholders, which results from the competing incentives between the two communicating groups (Spence, 2002). The nature of readily available and cheaper cost of online communication coupled with stakeholders' increased demands for access to corporate sustainability performance has increased the level of information asymmetry and "blurred boundaries between internal and external aspects of firms (Balmer et al., 2007, p. 174)."

The necessity of the study was also presented in the academic literature, as researchers state a literature gap in the study of B2B sustainability communication and its impact on perceived company image and reputation (Heras-Saizarbitoria et al., 2020; Huang et al., 2022; Vesal et al., 2021). Another challenge contributing to this paradox of communication vs. persuasion is the inherently vague nature of environmental communication (Moratis, 2018). Based on the reiterated literature gap and industry problems mentioned above, this study explored the factors influencing the success of environmental communication messages and presented a model of the communication process between suppliers and architects from the findings. The paper combined signaling theory literature and qualitative research methodology to document and follow the signaling process between building material suppliers and

architects in the Nordics. The communications messages were studied as signals. Also, the relationship between building material suppliers and architects was studied as the relationship between signaler and receiver. Specifically, the research examined the impact and influence of signaling environments and signal attributes (observability and cost) on architects' interpretation and perception of the firm.

Balmer and Gray's (1999) strategic corporate communication model is similar to Spence's (1973) signaling theory, where a corporate value is transmitted between two groups through communication tools and impacted by external factors. These factors and forces impact both the communication process, communication messages and, consequently, stakeholders' perception of the corporate and product values (Balmer & Gray, 1999). The study used the signaling theory to examine the role of market information structure and information asymmetry on signal perception and formation (Spence, 1973).

The construction market had a complex and dynamic misinformation structure that was highly regulated, reducing the impact of information asymmetry between architects and suppliers (Darko et al., 2017). This study collected primary data from nine architects and four spokespeople from a Finnish building material supplier to obtain contextual and current insights into the signaling formation and interpretation process between the two groups. The data was then analyzed, and the results were presented following the thematic analysis and interpretation methods.

The findings have showcased the communication process between suppliers and architects and the implications of environmental messaging on company image and product value perception. Also, the study discovers that the cost and observability of environmental signals have significantly impacted message interpretations and firm perception. Notably, the findings have shed light on the integral role of third-party certificates in establishing credibility and expertise for the firm. Secondly, the study found a negative relationship between high-level information asymmetry between the firm and stakeholders and signal effectivity. In other words, environmental signals are more likely to be ineffective in environments with a high information asymmetry (for example, lack of regulations or awareness from stakeholders).

The findings confirmed the need for practitioners to understand the receiver's priorities and expertise and align their signaling strategy and messaging choices accordingly. Thus, communication managers should invest in one-on-one research with stakeholder groups to understand the level of information asymmetry before developing the firm's corporate communication strategy.

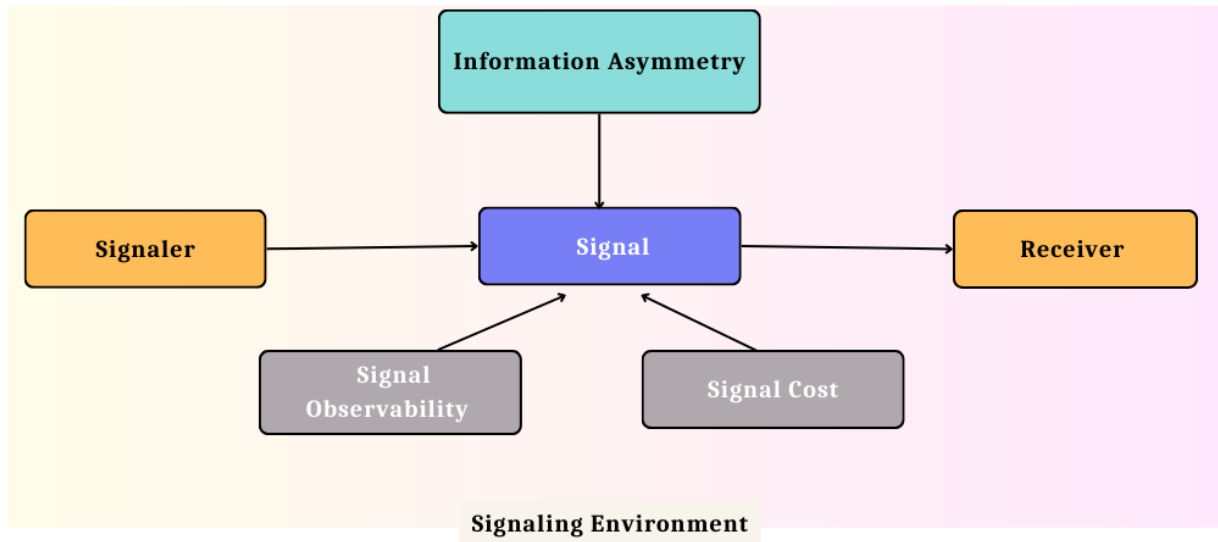
5.1.1 Assessment of The Signaling Theory

The signaling theory added value to the study of the corporate communication process between architects and building material suppliers and the success of this study for three main reasons. Firstly, the theory proposed a distinct approach that looks at the impact of signaling environments on communication message perception, which offers valuable insights into understanding the relationship between context and message interpretation. Secondly, the theory presented a fresh take on environmental sustainability communication by studying how the characteristics of the signaler, receiver and external signaling environments impact signals interpretation. Thirdly, the theory brings attention to the characteristics of communication messages beyond the attributes of language and visuals through perceived signal observability and cost attributes. Studying the signaling cost and observability adds a new perspective to the research on how environmental messages are interpreted and perceived. Therefore, the theory offered a unique and distinct approach to studying corporate communication by dissecting environmental communication into signals— one which includes and allows room for the contextuality of communication (environment and subjective experiences).

The theoretical contribution of this study started from the literature review presented in the theoretical framework chapter. Additionally, the conceptualized and developed framework for this study is another contribution to the literature on signaling that future studies can implement.

The framework presented in [Figure 11](#) presents the relationship between information asymmetry and signal strength in a model that presents the signaling process between the signaler and receiver. The framework adopts Spence's (Spence, 1973) theory constructs and Connelly's (2011) signaling timeline to propose a relationship framework between the constructs. For example, the model can be used in corporate communication to study the relationship between corporate identity, corporate messages and corporate reputation.

FIGURE11 Signaling Framework for Communication Signals



The developed model used in this study can examine other communication signals like corporate values, spokesperson profiling, or messages about specific products or services. The model can also study other signals impacting the firm's perception, like content marketing, corporate branding and social media advertising.

5.1.2 Addressing the Research Questions

The study highlighted the importance of environmental signals in establishing firm credibility in the B2B context. The findings also contributed to understanding the challenges and costs faced by suppliers in implementing environmental sustainability practices and the need for reliable communication standards. The findings suggest that while Spence's (1973) signaling theory provided a valuable framework for understanding signaling in environmental sustainability, it is essential to consider additional factors, such as the receiver's perspective and market maturity, when designing and evaluating signaling strategies.

Overall, the findings confirmed Spence's hypothesis (1973) that signal attributes (cost and observability) and signaling environments impact signal credibility. [Table 13](#) below presents the findings concerning the research questions to summarize the theoretical contribution of the study.

TABLE 13 Outline of Study RQs & Answers

Primary RQ1	Answer
<p>RQ1 How do architects interpret environmental communication signals?</p>	<p>Environmental messages are interpreted by architects based on their observability and costly attributes.</p> <p>Signal interpretation is impacted by the context in which signals are observed, like communication medium, market information structure and information asymmetry between architects and suppliers.</p> <p>Online signaling has increased the saturation and competitiveness of environmental communication and eased the cost of signaling those messages. However, the decreased barrier of online signaling made it more challenging for architects to dedicate quality and truthful signals from false signals (Spence, 2001).</p> <p>Due to the high nature of regulations in the construction industry, architects rely on certificates to evaluate the credibility of environmental communication messages.</p> <p>The signaling environment and regulations have led Architects to create indicators to filter through fluffy and accurate environmental messages. These indicators included four detailed and highly technical messages about the product's environmental impacts: carbon emissions, product lifecycle, renewability of raw materials, and energy efficiency.</p>
Secondary RQ2	Answer
	<p>Suppliers form signals based on their perception of the market and stakeholders' needs. Particularly small companies, like the case organization, who have developed their product portfolio based</p>

<p>RQ2 How do building material suppliers develop environmental communication signals?</p>	<p>on the demand for environmental products.</p> <p>Suppliers utilize a proactive EC strategy depending on the firm's corporate strategy, commitment to the environmental cause, and product competitiveness.</p> <p>While online signaling has reduced the cost of signal transmission, the pressure of delivering observable and accurate environmental messages has increased suppliers' costs.</p> <p>Small suppliers utilize their company size and entrepreneurship states to make their EC signals more observable and credible. Using media-buy-in and media coverage to increase the observability of their EC signals.</p>
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By answering the two research questions, the three study objectives are met, as outlined below:

- **Research Objectives**

- First Objective: The study aims to contribute to the existing research on Corporate Social responsibility (CSR) by expanding research on sustainability communication.
- Second Objective: The study seeks to present the external factors impacting the communication of environmental messages between stakeholders.
- Third Objective: The study aims to advance the understanding and conceptualizing of sustainability signals, building on prior literature.

- **Meeting Research Objectives:**

- The study reviewed the literature on CSR and presented an overview of sustainability communication definitions.
- The study clearly defined environmental communication and distinguished environmental and CSR sustainability communication.
- The study reviewed the literature gap in B2B environmental communication.

- The study utilized the signaling theory to study external factors impacting the communication process and focused on signaling environments and information asymmetry relationship with signal persuasion.
- The study identified and analyzed the attributes of effective signals by investigating how stakeholders interpret and respond to environmental signals.
- The study explored the role of information asymmetry in shaping the effectiveness of sustainability signals.
- The study findings presented new insights into the impact of signaling environments on the interpretation of signals and perception formation from a communication perspective.
- Overall, the study objectives were met via the literature review presented, discussed analysis, and reflected on findings.

5.2 Managerial Contribution

The study offers several practical contributions for communication practitioners to develop persuasive and effective sustainability communication strategies. These strategies could utilize signaling concepts to ensure the development of visible, credible and influential environmental messages.

Firstly, practitioners must understand the role of context and environment in the effectiveness of their signals. The signaling environments directly (Connelly et al., 2011) influence suppliers' and architects' information asymmetry status. A better understanding of the information structure of the firm and targeted stakeholder group could be achieved with market research and tailored stakeholder survives. It is also essential to determine what environmental messages are required at each stage of the decision-making journey.

This dynamic understanding of the environment will help practitioners devise appropriate communication strategies based on the architect's journey and stage of interest in the firm. As a result of this mapping, practitioners could increase signal observability and decrease the cost of frequent signals. Another aspect of information asymmetry that was touched upon in this study is within-firm signaling asymmetry which could lead firms to communicate confusing and contradicting sustainability messages about the firm's environmental values and practices. Therefore, practitioners must invest time in internally reducing asymmetry before developing external communication programs.

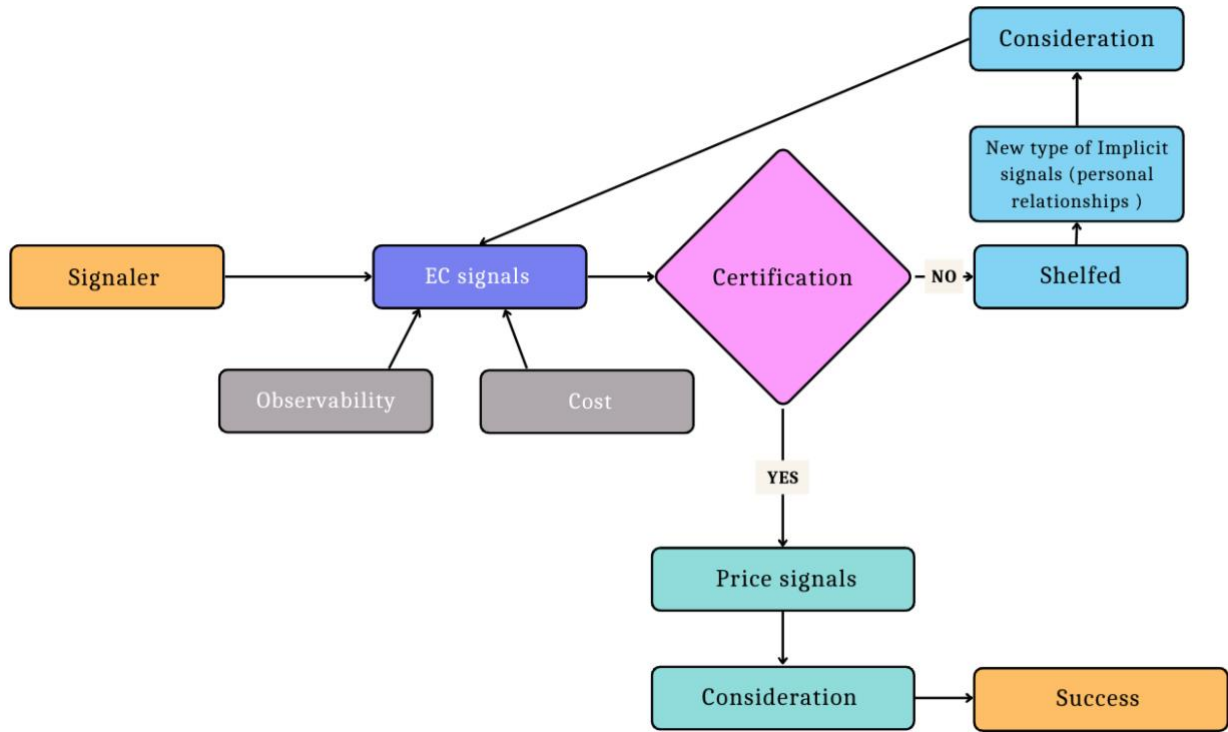
Secondly, the findings demonstrate the integral role of knowing what to signal and when. Firms developing effective sustainability communication strategies should

focus on environmental product messages, ensuring those are visible, credible, and supported. For example, practitioners could develop verifiable and factual environmental signals about their product's carbon footprint and footprint and link them to product circularity. These detailed and transparent communication messages about the product impact could establish credibility with architects. Based on the finding, architects seek product environmental signals first and perceive them as the most credible signals to assess the credibility of a supplier's sustainability communication. Thus, firms looking to establish their sustainability position should focus on building communication around accurate data and calculations of their environmental messages. These messages should include and focus on four critical themes:

1. Product Carbon Footprint and Handprint
2. Product lifecycle and circularity
3. Utilization of renewable raw materials
4. Energy efficiency materials

Even if the product's environmental impact may not be as competitive as its competitors, suppliers must prioritize honest and transparent communication to build awareness around its impact. The finding does not imply the dismissal of corporate sustainability messaging altogether but instead emphasizes the significant role of product-related signals in the eyes of architects. Therefore, firms should build a distinct signaling strategy around product-related environmental signals that complements corporate sustainability messaging. From the presented result, [Figure 12](#) illustrates an overview of the signaling process from the architect's perspective.

FIGURE12 Signaling Process between Suppliers & Architects



The figure highlights the importance of signal observability and costs in determining the credibility of the signal. The figure also emphasizes the role of architects in the signaling process, as they play a critical role in assessing the environmental sustainability signals of the product. The process flow highlights the iterative nature of the signaling process, as signals go through multiple cycles of assessment and consideration by architects.

Thirdly, firms need to consider the impact of signal cost on their signaling strategy development. Small B2B firms face challenges and costs in communicating and implementing environmental sustainability practices due to limited resources, communication, and resources needed to invest in customer communication and channel penetration. Therefore, firms should find more reliable communication standards for environmental sustainability signals that reduce information asymmetry between the firm and architects. A communication standard is achieved via designing internal measures to communicate environmental sustainability practices, other than EPD certificates, based on factual data that cannot be manipulated.

Finally, the final pieces are the receiver's awareness and involvement in the communication process. The findings confirm the need for practitioners to understand the receiver's priorities and expertise and align their signaling strategy and messaging

choices accordingly. The results indicate that the firm's understanding of the receiver's priorities only sometimes aligns with how receivers calibrate signals and look for them. Therefore, firms must invest in developing an intimate relationship with the receiver to better understand their priorities and tailor their signaling strategy accordingly.

The managerial contributions of this thesis highlight the importance of developing verifiable environmental signals, considering the impact of signal cost on signaling strategy development, and aligning the signaling strategy with the receiver's priorities and expertise. These contributions can enhance the credibility and trustworthiness of firms' environmental signals, reduce information asymmetry between the firm and architects, and enhance firms' competitiveness in the market. This section presents the key findings from the study, highlighting the importance of product-related sustainability signals and firm-related sustainability messages. It also emphasizes the need for reliable and accurate measures to communicate environmental sustainability practices to reduce information asymmetry between the firm and stakeholders.

In summary, firms looking to communicate their corporate values and identity strategically could follow these seven steps:

- (1) devise holistic company sustainability messaging and philosophy.
- (2) devise and align internal communication environmental strategies to ensure consistency and reduce within-firm information asymmetry.
- (3) careful consideration of market information structure and signaling environments.
- (4) careful consideration of stakeholders' attention and expertise.
- (5) devise credible and factual environmental messages.
- (6) utilize third-party verification to achieve observability and qualities of a costly signal.
- (7) careful consideration of in-person signaling and feedback channels with stakeholders.

5.3 Study Evaluation

According to Eriksson and Kovalainen (2008), researchers justify and evaluate the study's trustworthiness to gain the readers' trust in a scientific research process. The authors state that the evaluation of the study should be continuously followed throughout the study and not at the end, which is the case in this study and is compatible with the selected research methodology. Rose and Johnson (2020) suggest that a researcher should deeply understand the literature, employ appropriate data collection and analysis techniques, and link the empirical data to broader theoretical

explorations to ensure the trustworthiness of qualitative methodology. Adams et al. (2014) also emphasize the importance of evaluating validity, reliability, and generalizability.

The interpretive epistemological approach chosen for this study was deemed appropriate for several reasons. The interpretive approach is used to find meaning from extensive data (D O’Gorman & MacIntosh, 2015) by examining reality from multiple perspectives (D O’Gorman & MacIntosh, 2015). Also, the interpretive approach drives conclusions by studying reality as it exists to individuals living it rather than imposing a preconceived hypothesis (Eriksson & Kovalainen, 2008). Therefore, the interpretive epistemological approach and methodology were adequately implemented in this study to explore the phenomena of ES communication signaling in the construction industry through the lens of signaling theory.

5.3.2 Study Validity and Reliability

Testing and measuring the quality and trustworthiness of the study are essential to ensure the quality of “data, research design methods, and the overall accuracy of the study results (Adams et al., 2014, p. 245).” According to Adams et al. (2014), there are three measurement criteria and tests to determine the quality of the study at hand:

- Reliability of study.
- Validity of study.
- Generalization of study.

These evaluation measures assess whether the study results are reliable, valid and can be generalized to other industries, settings, or contexts and identify areas for future research and improve the quality of future studies. Adam et al. (2014) quality measures and tests are mapped out and answered in [Table 14](#) to accurately evaluate the quality and trustworthiness of this study.

TABLE 14 Study Quality Measurement & Test (Adam et al., 2014)

Tests	Answers
Reliability: The consistency of measurement and instruments studied.	
Can this study be repeated?	<p>Rose and Johnson (2020) saw measuring the repeatability of qualitative analysis as irrelevant due to the contextual and interpretive nature of qualitative methods.</p> <p>The reliability of this study was ensured by following a rigorous overarching research design based on analytical</p>

<p>between the cause and observed outcome?</p>	<p>explained in more detail in the theoretical contribution section.</p> <p>Yes, there is a relationship between the research questions and the outcome result. The causation was explained in detail in both the analysis section and theoretical contributions.</p> <p>Yes, the relationship between the sender and receiver's interpretation is outlined in the results. This relationship is specific to the study setting and outcome and could vary depending on the setting.</p>
<p>Generalization: The applicability of findings to future research.</p>	
<p>Was the research based on a theory that could be applied to explain other phenomena?</p>	<p>The signaling theory was the basis for interpreting the research problem and has been widely used to explain other phenomena (Connelly et al., 2011).</p>

The selected research philosophy and methodology were justified, outlined throughout the study, and evaluated in this section. The study follows a systematic research design informed by the presented research paradigm, methodology and analysis (Rose & Johnson, 2020). Therefore, based on the above evaluation of the study's validity and reliability, it is fair to conclude that the study extends the understanding of environmental communication in a trustworthy manner.

5.3.3 Study Limitations

This study's design is outlined and justified to ensure its credibility and reliability; however, some limitations must be acknowledged and outlined for future research considerations. Firstly, the qualitative methodology and thematic analysis of the data collected are often challenged in academic research by subjective interpretation (Eriksson & Kovalainen, 2008). Subjectivism could also relate to the interviewer's skill, expertise, and established relationship with the interviewees (Rose & Johnson, 2020). While adequate measures have been adopted, like setting interview protocols based on the adopted thematic framework, it is important to note the limitation of qualitative research methodology and its implication on the study's findings. Therefore, the

study's findings could be regarded as extended insights into the topic rather than measurable facts (Eriksson & Kovalainen, 2008).

Given this study's time and resource restrictions, the data gathered for this research was limited to 13 interviews, therefore limiting the research to a small sample size to gather the data. Consequently, a larger sample size could present more insights and add depth to the findings presented in this study. Though the study has presented saturated findings that exhibit promise in generalizability, the current amount of empirical data could be considered preliminary to confirm finding generalizations.

Another limitation of the sampling selection is the implication of the sampling technique on the results. This study focused on the expert sampling of architects from firms operating in the Nordic countries; hence the results reflect only the opinions of this specific sample, nationality and expertise. The environment, market and level of regulations related to the study topic impact these opinions. As a result, the same study could garner different results when applied to different settings, contexts, and individuals.

5.4 Directions for Future Studies

Extending on the literature on signaling theory and addressing the literature gap on environmental suitability communication and brand perception in the B2B context, this study made a valuable contribution to the field of corporate communication. Nevertheless, further research is necessary to ensure the credibility of the findings and insights on the topic. This study focused on the communication process between suppliers and architects, shedding light on the communication process between the firm and this influential stakeholder group. Future researchers could build on these insights by examining sustainability signaling in SME firms with other stakeholder groups, such as investors and the public, to determine the impact of these signals on company perception and performance. Additionally, investigating the relationship between other CSR signals and firm performance and reputation would be an important area for future study.

To further expand on the future research possibilities in this area, the analysis methods used in this study involved gathering the opinions of field experts. Future research could employ content analysis to identify patterns and themes from the content of case companies to complement this approach. This alternative research methodology could provide more in-depth insights and data. Another possible avenue for future research is to use a case strategy to analyze the signaling of three different organizations, focusing on understanding the relationship between the receiver's reputation, size, and market position in the signaling process. Adopting different

research methodologies and analysis methods could provide a more comprehensive and nuanced understanding of this topic.

This study applied the signaling theory to investigate the environmental signaling process among B2B stakeholders in the construction industry. The findings shed light on the implications of this communication on company buyers' perceptions and relationships with buyers, providing valuable insights into a highly regulated and environmentally saturated industry. Future research could build on these insights by exploring the signaling of environmental messaging in environments with non-existing environmental regulations. Studying the signals and signaling environments in different information market structures or markets where product environmental competitiveness is underdeveloped would be an exciting area of inquiry. For example, the study could be replicated in the technology or pharmaceutical industries. Such research would deepen our understanding of the role of environmental signaling in different contexts and provide new opportunities for companies to differentiate themselves through sustainability efforts.

5.5 Concluding Remarks

Due to the complexity of information structure in the construction sector and the increasing demand from stakeholders (regulators, builders, customers and architects) for firms (building material suppliers) for firms to do right by the climate (Vesal et al., 2021), communication practitioners are tasked to cut through the noise with credible and effective environmental communication.

While B2B firms have increasingly invested in reporting and communicating about the firms and product environmental sustainability, many fail to achieve any positive impact from sustainability communications (McKinsey & Co, 2021; RepRank, 2022). Additionally, the saturation of sustainability communication and the availability of online information has led stakeholders to dismiss and disregard building material suppliers quickly if they suspect their environmental sustainability communication is false (Kapitan et al., 2019).

The building industry, in particular, is expected to decarbonize its supply chain in the next decade, putting extra pressure on firms to communicate their environmental impact and initiatives effectively. Given the research and theoretical context, this research studies the environmental sustainability communication process between suppliers and stakeholder groups in the building sector. The study aims to understand and expand on the research of how firms can utilize and craft credible and effective environmental communication to achieve favorable brand perception and please demanding stakeholders (Esty & Winston, 2009; Islam et al., 2021).

The study presented a theoretical contribution to the signaling theory timeline and practical managerial implications for developing effective environmental communication messaging. Future research could employ alternative methodologies and explore environmental signaling in different contexts and settings to further build on these insights and provide new opportunities for companies to differentiate themselves through sustainability efforts.

The finding of this study is beneficial for firms to develop integrated communication of their environmental impact that resonates with their stakeholders and builds desired corporate reputation. By carefully assessing utilizing and stakeholders' expectations and utilizing third-party certificates and partnerships, firms can reinforce their corporate values and enhance their reputation as responsible and sustainable businesses. Finally, the paper provides valuable insights that can help companies in the construction industry differentiate themselves through their sustainability communication and contribute to sustainable development by motivating stakeholders to change their perceptions of sustainable practices.

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Appendix 1 Interview Protocol for Case Organisation (Aisti)

Warm-up (5 minutes)

Explain the interview and interview protocol duration and bring awareness to the privacy notice in the reminder email.

Themes	Questions
Sender	<ol style="list-style-type: none"> 1. Would you describe Aisti as a sustainable company? Why? 2. In what ways do you act sustainably? 3. What is the role of sustainability at Aisti?
Receiver	<ol style="list-style-type: none"> 1. To whom does Aisti communicate about its sustainability? 2. Why is it important to communicate sustainability to architects? 3. Does this communication resonate with all receivers, or are there differences? Why so? 4. Is communicating sustainable value/sustainability benefits to outsiders difficult or easy to do why? 5. How do you prove the credibility of your sustainability values? 6. Are there “inner” challenges regarding communicating/signaling sustainable value/benefits? 7. Which sustainability initiative is the easiest/hardest to communicate: economic, environmental, or social? 8. Describe some challenges you face when communicating environmental values/initiatives? 9. Do you measure the level of success regarding signaling sustainability value, how? 10. Do you have feedback channels open with this target group? 11. Why, if not? What are these channels, if yes?
Signals	<ol style="list-style-type: none"> 1. What do you communicate/signal about sustainability? 2. What number of values/messages do you focus on when communicating to architectures? Why are these signals important?

	<ol style="list-style-type: none"> 3. If you would order the values you communicate to architects based on importance, where does sustainability stand in the company's messages to architects? 4. Why do you rank sustainability (as number x) in the company's messages to architects? 5. What sustainability messages do you think you are not communicating right? Why so? 6. Are there any environmental sustainability messages you do not communicate externally? If yes, what? 7. What communication actions does Aisti conduct to be seen as sustainable? Bias answer 8. How would you evaluate Aisti's environmental communication actions compared to competitors? 9. How do you communicate about your sustainability to architects? What kind of content do you use?
<p>Signaling Environme nts</p>	<ol style="list-style-type: none"> 1. Are you familiar with the term greenwashing? What does that mean to you? 2. Explain to them the term meaning if they do not know. Then ask, how do you approach greenwashing in your company? 1. Is this phenomenon present in the construction industry? 2. What would make a customer describe a competing company of greenwashing? 3. What marketing measures do you take to ensure you do not greenwash your claims? 4. What are the main platforms used to communicate Aisti's sustainable value to architects, and how actively are they used? 5. Are there any underlying (intangible) environmental values you find challenging to communicate? How do you communicate about those?

Appendix 2 Interview Protocol for Architects

Warm-up (5 minutes)

Explain the interview and interview protocol duration and bring awareness to the privacy notice attached to the reminder email.

Themes	Questions
Signaler	<ol style="list-style-type: none"> 1. What are the most important values you look for in suppliers/companies you work with? Why do these values matter to your work? 2. Refer back to the values they mention, How does x indicate credibility in your point of view? 3. What makes a supplier credible in your point of view? 4. Does a supplier's environmental sustainability efforts impact its credibility? Why? 5. How do you define sustainable suppliers? What makes a supplier "sustainable" or "green" in your point of view? 6. Between a supplier that claims "green" value and one that does not, which one would you choose, and why? 7. What do you dislike about suppliers that claim they are "green"? 8. Does the company's size impact how you see its sustainability efforts?
Signals	<ol style="list-style-type: none"> 1. What are the most important "sustainability" messages you look for in suppliers? 2. Between the three content options below (show sustainability content options of three suppliers), which sustainability content stands out the most to you? 3. Why? 4. Can you differentiate between truthful "green" content and not truthful? 5. How do you differentiate between truthful "green" content and not truthful? 6. When assessing a company's environmental marketing messages, what stands out most?

	<ol style="list-style-type: none"> 7. Can you give me examples of environmental messages that you look for? Why do you look for them? 8. What do you consider unimportant/unappealing sustainability content that you do not like to see? 9. There are many platforms to receive information on nowadays, which ones do you consider most important when assessing sustainability messages? 10. Where do you look for environmental sustainability information about a product? Why? 11. What kind of content do you think indicates a company's commitment to sustainability? 12. Why do you think (content) indicates a company's commitment to sustainability? 13. Which platform do you go to first to learn about the company's sustainability? 14. What do you look for first when you are on the website? 15. Why do you look for (example mentioned) information on the website?
<p>Signaling Environme nts</p>	<ol style="list-style-type: none"> 1. How important is environmental sustainability in your sector? Why? 2. Does that impact your consideration when looking for suppliers? 3. Are there many suppliers that are sustainable in the sector? Does that impact the credibility of the sustainability messages? 4. Are you familiar with greenwashing? Is greenwashing phenomena present in the construction sector? 5. What does that mean to you? 6. Explain to them the term meaning if they do not know. Then ask, what indicates greenwashing in your opinion? 7. Is this phenomenon present in the construction industry? 8. Have you described a company in the industry of greenwashing? Why 9. What made you think of a supplier as being dishonest about their environmental claims?
<p>Receiver</p>	<ol style="list-style-type: none"> 1. How do you make a final recommendation decision for a supplier? 2. Why do you recommend a supplier? 3. What motivates you to recommend a supplier to a colleague?

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| | <ol style="list-style-type: none">4. What red flags will drive you away from suppliers?5. Have you ever given feedback to a company about its sustainability message? |
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