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Understanding Ecodesign from Practitioners' Perspectives: A Study with Designers and Managers in India

BAISHALEE SONOWAL

baishalee@iitg.ac.in

Indian Institute of Technology Guwahati

PANKAJ UPADHYAY

Indian Institute of Technology Guwahati

SHARMISTHA BANERJEE

Indian Institute of Technology Guwahati

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Abstract

Ecodesign research has predominantly focused on developing tools, frameworks, and models, rather than practitioner perspectives. This study investigates how designers and managers in India perceive ecodesign in practice. Semi-structured interviews were conducted with practitioners spanning seven market-leading home appliance companies in India, with experience across home appliances, consumer electronics, healthcare devices, automotive, and heavy machinery. Values coding was applied to identify and categorise participants' values, attitudes, and beliefs. They were compared against company sustainability initiatives published on company websites. Results reveal that practitioners believe they have limited influence in contributing to environmental sustainability, despite their companies prominently featuring sustainability initiatives. Practitioners perceive the product design and development process as complex and standardised, yet their personal values align with the company's sustainability goals. This highlights a gap between company sustainability commitments and design practice. This research outlines the practical implications and future research directions for enhancing the ecodesign implementation in India.

1. Introduction

Global sustainability targets can be achieved only through a fundamental change in how products are designed. The design phase of product development represents a critical intervention point for reducing environmental impact throughout its life cycle, from pre-production to end-of-life [1–3], making design decisions pivotal for cleaner consumption and production outcomes [4]. This positions ecodesign as a key strategy for industrial sustainability transformation.

Ecodesign, or Design for Environment (DfE), is a proactive approach to product development that considers the entire product's lifecycle during the design phase to minimise environmental impacts [5–8]. It encompasses design generation, design assessment, and design selection. Over the past three decades, researchers have developed numerous tools, techniques, methods, and frameworks to support ecodesign implementation, reflecting a growing recognition of design's potential to reduce environmental footprints. [9].

Despite this substantial body of research, a persistent gap exists between theoretical developments and practical implementation. Studies across geographies and industrial contexts have documented that ecodesign adoption remains limited in industrial practice [10–17]. There are several reasons for this. One key reason is that companies often struggle to translate available tools into operational design activities [6, 18]. The implementation deficit is not merely a knowledge transfer problem but a complex challenge involving organisational, behavioural, and contextual factors that remain insufficiently understood [11, 19, 20]. Additionally, the level of ecodesign implementation varies across countries due to differences in regulatory frameworks, market conditions, and institutional contexts [5, 21, 22]. Understanding this implementation gap requires attention not only to design tools and methods but to the corporate social

responsibility structures and employee-level mechanisms through which sustainability commitments are, or are not, translated into everyday design practice.

India presents a significant context for ecodesign research for several interconnected reasons. India's mandatory Corporate Social Responsibility (CSR) requirement is a distinctive feature [21, 23]. Furthermore, India faces substantial challenges in achieving the Sustainable Development Goals (SDGs), encompassing economic, social, and environmental aspects [24]. Notably, India is among the few countries that embed a commitment to environmental protection and improvement within its constitution [25]. The government also exerts pressure on companies to adopt environmental practices through laws and regulations, regulatory inspections, fines, and charges [26, 27]. However, the country still lags behind acceptable standards, largely due to implementation challenges, including weak enforcement mechanisms and prioritisation of short-term solutions over long-term environmental goals [26]. This combination of policy intent, regulatory features, and implementation challenges makes India a critical case for investigating practitioners' (employees involved in product design and development) ecodesign perspectives.

Understanding practitioner perspectives is essential for bridging the gap between ecodesign theory and practice. Employees who implement sustainability agendas bring their own values, attitudes, and beliefs to their work, shaping how environmental considerations are integrated into design activities [20]. These individual-level factors interact with organisational structures, processes, and norms to influence the extent to which companies adopt environmental management practices [27]. This study draws on the premise that effective ecodesign integration requires not only appropriate tools and organisational structures but also alignment between individual practitioner values and organisational sustainability goals. This relationship has received limited empirical attention in cleaner production research.

Although some studies have explored practitioners' perspectives (Table 1), this topic has not yet been examined within the Indian context. This study addresses the identified gaps with the following objectives:

(1) To investigate the values, attitudes, and beliefs of product designers and managers in India regarding ecodesign in practice;

(2) To compare practitioner perspectives with company-stated sustainability initiatives to identify potential disconnects between organisational rhetoric and design practice; and

(3) To identify directions for future research that could enhance ecodesign implementation in the Indian context.

This research makes three primary contributions to sustainability research and design practice. First, it extends the geographical scope of ecodesign practitioner studies to the Indian context, addressing a gap in the literature that has predominantly focused on Nordic [5], European [18, 20, 28, 29], and Malaysian [14] contexts. Second, by employing values coding methodology [30], it provides insight into the

underlying attitudes, beliefs, and values that shape practitioner behaviour and design practice—a dimension often overlooked in favour of barriers-and-drivers analyses. Third, by contrasting practitioner perspectives with company-stated initiatives, it reveals potential organisational disconnects that may impede ecodesign realisation, offering actionable insights for researchers and practitioners seeking to advance ecodesign practice. The study further advances SDG 12 (Responsible Consumption and Production) by investigating how sustainability can be more effectively integrated into the product design process — a critical leverage point for reducing the environmental footprint of manufactured goods.

The remainder of this paper is organised as follows: Section 2 reviews practitioner perspectives in ecodesign; Section 3 outlines the methodology; Section 4 presents the findings; Section 5 discusses implications, limitations, and future research; and Section 6 concludes with key contributions.

2. Literature review

To understand practitioner perceptions of ecodesign in real-world settings, a structured literature review was conducted using Scopus and the AI-based research tool Elicit. The search focused on three core themes: ecodesign approaches (“ecodesign”, “design for environment”, “green design”, “cradle-to-cradle”), practitioner perspectives, and product development. In Elicit, the phrase “perspectives about ecodesign” was used for the search. Publications were screened in two stages. First, titles and abstracts were reviewed to remove studies unrelated. Relevant studies addressing practitioner perspectives on ecodesign in practice were then examined in greater detail. Shortlisted studies are summarised in Table 1.

The review reveals that practitioner-focused ecodesign research has been conducted across multiple countries, where firms are working to reduce environmental impacts and integrate sustainability into business practices [5, 22]. The studies address several objectives. Collectively, they highlight both the growing global interest in implementing ecodesign and the need to understand how practitioners practice it.

These studies draw on practitioner perspectives from diverse sectors, including consumer products, appliances, energy, automotive, fashion, furniture, construction, metals and mining, and machinery [5, 14, 20, 28, 31, 32]. While some investigations analyse multiple sectors collectively, others focus on single-company case studies [18, 29]. Together, they provide insights into the drivers, barriers, adoption factors, and support tool requirements associated with ecodesign implementation. Several studies indicate that product development decisions are primarily driven by profit considerations, consumer demand, market forces, and internal organisational initiatives and values[5, 29, 32]. The adoption of ecodesign-related practices is largely influenced by legal and regulatory requirements [22], stakeholder pressure, and firm-specific characteristics [27]. However, despite these influences, ecodesign is not prioritised within product development practices [28, 29].

Although the literature recognises that ecodesign implementation is influenced by organisational, behavioural, and contextual factors, the interaction between individual-level factors such as practitioners' attitudes, values, and beliefs and organisational structures, processes, and norms remains insufficiently understood. Furthermore, most empirical studies have been conducted in Europe (mostly Nordic countries), Brazil, and Malaysia. Given that regulatory systems, industry practices, and market expectations vary geographically, practitioner perspectives are likely to differ accordingly.

In the Indian context, existing research has examined sustainability practices in relation to firm characteristics and stakeholder pressures based on managerial perceptions at the organisational level targeting red industries [27]. However, it doesn't address how these structures are experienced by practitioners within product design and development roles, as it is situated within an operations and organisational management perspective rather than a product design or development context. This creates a gap in understanding the human and contextual dimensions of ecodesign implementation in India. Addressing this gap requires examining how practitioners perceive, interpret and navigate ecodesign within their organisational contexts. This study addresses this gap by investigating the attitudes, values, and beliefs related to ecodesign among practitioners, primarily product designers and managers in India.

Table 1
Summary of practitioner-focused ecodesign studies

Sl. No.	Citation	Insight	Country	Industry
1	[5]	Examines the use of ecodesign from a company perspective, identifying the incentives, barriers, and organisational factors influencing its adoption.	Nordic Countries	Trucks, Building management automation, Time, sports and information boards, Van racking system, Parking ticket machines, Drying machines, Coffee machines, electrically powered warehouse trucks, Surface treatment material (paint), Lighting, Sanitary fittings/water taps, Textiles, Plumbing systems, Office Furniture
2	[20]	All four lenses (architect, catalyst, advocate, and prophet) are present in practice to varying degrees across organisations. Ecodesign integration is an organisational change process requiring attention to both systems and people.	Denmark, Norway	Medicare, Biotechnologies, Energy, Construction, Consumer products
3	[22]	Captured employee perceptions of ecodesign implementation, shaped by legal requirements and consumer pressure.	Brazil	Not mentioned
4	[32]	Designers, unlike sustainability specialists, decide based on user needs, resource constraints, and company values. Although they understand key factors, it is unclear how these are evaluated across design syages or at the end.	Not mentioned	Consumer Product, UX and UI, automotive and miscellaneous
5	[31]	There exists a divergence in perspectives between engineering designers and design researchers. The characteristics of environmentally conscious product development that are highly ranked highly by one group are given least preference by the other, and vice versa.	Not mentioned	Automotive, Electrical appliance
6	[28]	Examines how environmental considerations are integrated into product development based on employee perceptions. Micro-, meso-,	Finland	Metals or mining, Machinery, Electronic/Electrical, and Others

Sl. No.	Citation	Insight	Country	Industry
		and macro-level readiness shape ecodesign diffusion. Environmental considerations are not widely regarded as essential in product development.		
7	[29]	ISO 14001 as company guideline did not directly influence designers' day-to-day work, though awareness of such initiatives shapes views on DfE. While designers demonstrate general awareness of environmental issues, their understanding of broader global impacts remains limited.	Sweden	Transportation
8	[14]	Designers are aware of regulatory environmental requirements, but effective integration of DfE remains limited. DfE perceived primarily as an engineering task.	Malaysia	Industrial equipment, Electronics (large and small appliances), Automobile
9	[18]	Designers adopt ecodesign tools when they align with existing development practices and support both product-level assessment and design processes. Internal motivations outweigh innovation-driven goals	United Kingdom	Light manufacturing
10	[27]	Positive relationship exist between stakeholder pressure and the adoption of sustainable environmental management practices in Indian polluting industries, moderated by firm size, sector, and age.	India (Punjab)	Red-category industries (Manufacturing and Service sector)

3. Methodology

Qualitative interviews were employed as the primary data collection method. It enables open-ended, probing questions that provide detailed insights into participants' perceptions and experiences that other methods, such as fixed-response surveys, rarely capture [33–36]. The sampling procedure followed established qualitative sampling guidelines [37]. The target population includes professionals directly

involved in product design and development, including Product Designers, Design Engineers, Project Managers, R&D Engineers, Industrial Designers, and related roles. However, no reliable and up-to-date estimate of this population in India was found.

Purposive sampling was used to select participants with relevant experience [38]. Individuals were identified and contacted through LinkedIn. More than 200 individuals were approached, approximately 20% responded, and 14 agreed to participate in interviews. An iterative data collection and analysis process was used, allowing refinement of interview questions as new insights emerged and deeper exploration of participants' perspectives [39].

Interview questions were developed based on prior literature on practitioner perspectives and ecodesign practices [19, 20, 28, 32]. The questionnaire was piloted with two participants before data collection. Questions were broadly framed to allow participants to respond freely and elaborate on their experiences. Topics included whether environmental considerations are addressed during the design process, how they are incorporated, perceived barriers to and opportunities for their integration, and whether environmental issues are formally mandated within organisational practices.

Interviews were conducted online or by phone between 29 March and 23 June 2025, each lasting approximately 40 minutes. Participants were professionals currently working, or previously employed, in leading companies in consumer electronics, appliances, manufacturing, and design consultancy, including LG Electronics India, Havells India, Bajaj Electricals, Godrej & Boyce, Crompton Greaves Consumer Electricals, Whirlpool Corporation, IFB Industries, Safari Industries, John Deere India, Desmania Design, Anti Fragile Design, and Dream Sleep Healthcare. Table 2 summarises participant details.

Table 2
Participant Details

Participant No.	Designation & Details	Design Experience (Years)	Type of Products
P1	Assistant Manager (Design team)	8	Home appliances, e.g. refrigerator, microwave, washing machine, dishwasher
P2	Senior Industrial Designer (Customer Experience Design)	3.5	Fans, biodegradable packaging foam and incense sticks out of flowers from the river Ganga, stationery, edible cutlery, leather goods, furniture
P3	New Product Development Manager	10	Air Conditioner, air cooler, water heater, mixer grinder, oven, toaster, griller, microwave, personal grooming kits like trimmer, hair straightener, ceiling, table, pedestal & exhaust fan.
P4	Senior Manager	10	Premium line of products for India, e.g. air purifiers, small domestic appliances
P5	Senior Industrial Designer	2	Mechanical lock door handles, door handles, latches, mortise lock, digital products like digital locks and other accessories
P6	Associate Manager (R&D)	6	Electromechanical products - water heater appliance category, switchgears, water heaters, immersion rods, gas geysers
P7	Head of Design and Operations for all the verticals	15	Products spanning a diverse spectrum, ranging from small-scale consumer goods to large-scale automotive solutions, styling and cabin design for heavy machinery equipment, and fast-moving consumer goods
P8	CEO (Previously Senior Manager-Industrial Design)	19	Refrigerator products, filtration products like pitcher filters, countertop filters, and bathroom drinking water stations, wireless communication devices like home routers, indoor/outdoor access points & radios, diagnostic cardiology (Stress ECG), imaging (PET CT & MRI scanners) and cell processing and thawing instruments
P9	Senior Product Manager	18	Air conditioners
P10	Deputy Manager (Industrial Designer)	8	Fans, air conditioners, washing machine
P11	Associate Manager - Product Design	8 years	Medical equipment, technical graphics for tractors, agriculture and construction equipment, home appliances, fans, consumer electronics

Participant No.	Designation & Details	Design Experience (Years)	Type of Products
P12	Product Design Lead	3.5 years	Endoscopes, laparoscopes, endoscopy simulators, knee arthroplasty instruments, thermo-regulated beds, automation products.
P13	Freelancer (Previously Senior Industrial Designer)	6.5 years	Lifestyle products e.g. travel bags, consumer electronics e.g. earbuds, smart rings, smart watches, etc. and furniture
P14	Industrial Designer	16 years	Refrigerators, air purifiers, juicers

Interview data were analysed using values coding to interpret participants' values, attitudes, and beliefs. This method is appropriate for exploring intrapersonal and interpersonal experiences shaping actions and decision-making [30]. The unit of analysis was a contiguous stretch of speech in which a participant expressed a coherent view, attitude, or belief about ecodesign, sustainability, or their role in the design process. Values codes were distinguished from descriptive codes by focusing specifically on normative and evaluative statements, expressions of what participants considered important, desirable, or true, rather than factual descriptions of practice or workflow. The coding was conducted in two cycles [40]:

1. During the first cycle, inductive values coding to identify expressions of values, attitudes, and beliefs, with reflective memos recorded throughout to document interpretive decisions
2. In the second cycle, axial coding was done to group related codes into higher-level categories through constant comparison, within the research team, before finalisation

Coding was conducted progressively across interviews. While most codes were established by the tenth interview, occasional new codes continued to emerge in later interviews, suggesting partial saturation[41]. Table 3 illustrates a sample from the coding process.

Table 3
Sample from the Coding process

Participant No.	Verbatim	Code [Attitude(A)/ Belief(B)/ Value(V)]
P1	"…. you know that is not a design team's work, sustainability in design in my industry…"	A: role limitation
	"…. I am just creating the outer visuals of the let's say of a product. How can I mean, I think I don't have a huge role to play in the sustainability part…"	
	"…try to make or design products which are not using a lot of material…"	V: waste minimisation
P2	"...No forceful design, the care if it is needed then do, it if it is not, fine, yes…"	V: waste minimisation
	"…we can choose the material wisely."	V: material selection
	"..So in that you have to change the plastic as well. Plastic say plastic use karna padega to make it cheap otherwise log kharidenge……"	
P3	"..We can't bypass those factors because if we will, we will bypass those factors then any government agency or a third party ……. lab will pick up that product from market, and they will check at the as per their whatever the criteria they define…"	B: Regulations & regulatory compliance
	"……. government is already focusing on like energy conservation, … nowadays you know earlier we were using a induction motor ceiling fan, nowadays we are using a brushless DC motor ……"	
P4	"…..Sustainability should be an approach which should be governed from the ground up. As designers, you don't want to make sustainable products. You want the whole society could be sustainable…… That means from Ground Zero, everyone should think about it and then the push should be there……"	A: role limitation V: Awareness
	"….the sustainability point lies right beneath the line of a cost…."	B: Sustainability is secondary
	"……. I feel its pretty much greenwashing…… they would just keep talk about it"	A: Doubtful feeling
	"….. there are X number of factors when it comes to production…."	B: Sustainability is complicated
P5	"…..try to use of the material which is recycled like certain materials which are recycled like brass and all can be recycled…."	V: Recycling
P6	"…So The thing is the main decision making is done during the initial stage only….."	A: role limitation

Participant No.	Verbatim	Code [Attitude(A)/ Belief(B)/ Value(V)]
P7	"……So logistic is the biggest challenge right now. So if you are sending out let's say a flat back instead of a pack which is deflated or inflated, right, inflated back, that also causes a air volume to be transported, right. So one area of concern and one area of intervention which we can say is something which we talk about logistics, how we can optimise the logistics…."	B: Sustainability is complicated
P8	".....you know, the designer should be aware what is the latest material technology which we can implement....."	V: Awareness
	"…Another driving force is the government regulations that government also try to implement that....."	B: Regulations & regulatory compliance
P9	"….So everything is said by the government, you just follow the rules during the development process....." "…… here the Government of India is playing a very crucial role in it and they are doing a very fantastic job on that……"	B: Regulations & regulatory compliance
P10	"I feel that that is the major ……..is a pretty messy thing to deal with. I mean …… once the products life cycle is over, It is pretty hard to I mean decompose a plastic right……"	B : Sustainability is complicated
P11	"…It's a standard process. We, its already, you know, this is an established company. So, like you know, there has been processes that has been running for 15–20 years for now....."	B: Standard process
P12	".....So if let's say you know, people around are little bit concerned about the environment. So I think that would help if people themselves, if the senior people themselves promote it, that would be a good initiative....."	V : Awareness
P13	".....But at the end you will promote it as a eco-friendly and sell it at a premium. Not that the material comes at a lower rate, even the material is sold at a higher rate…."	V: Affordable sustainable products & materials
P14	".....brainwash that these companies are doing ….."	A: Doubtful feeling
	"…first awareness is very important, right. So if a designer at the school level is aware of these things then he can implement into the real scenario....."	V: Awareness

To enhance the credibility of the analysis, Intercoder Reliability (ICR) was assessed using two coders, both research scholars in design, with expertise in qualitative research and sustainability, respectively. Approximately 20% of the transcripts (3 interviews) were independently coded using the developed codebook. Thirty codes were evaluated, and percentage agreement was calculated using the formula:

(Number of Agreements / Total Number of Decisions) × 100, following established approaches for reliability assessment in qualitative research [42–44].

The interpretive nature of values coding requires acknowledgement of the researchers' positionality. The research team comprises three design academics, two of whom have prior industrial experience. This combination provided both practical familiarity and critical analytical distance.

As most participants (11 of 14) had experience with market-leading consumer electronics and appliance companies, sustainability initiatives from seven companies (Table 5) were reviewed after all interviews were completed, using systematic content analysis of their official websites. These companies were selected because participants had current or prior experience in at least one of them. The search strategy involved targeted navigation to dedicated sections labelled 'Sustainability', 'CSR', 'Environment', and 'Environmental, Social, and Governance' to extract formally communicated sustainability commitments or relevant initiatives. Sustainability initiatives were inductively classified into thematic categories based on the content, as reported in Table 5. These findings were then compared with themes emerging from the values coding to contextualise practitioners' perspectives within organisational practices. It is acknowledged that company websites represent curated public communications directed primarily at external stakeholders and may not fully reflect the organisation’s actual sustainability activities.

4. Results

4.1. *Attitudes*, beliefs and values *of designers implementing ecodesign*

Values coding revealed recurring patterns in participants’ attitudes, beliefs, and values, representing what they feel, consider true, and regard as important, respectively [30]. Table 4 summarises the codes identified by 5 or more (≥ 40%) participants.

The most prominent finding was a widespread attitude of role limitation, reported by 78.57% of participants. Practitioners perceived that they had limited power, influence, or control over environmental sustainability decisions within their organisations. This was followed by the belief that regulatory frameworks and organisational compliance requirements drive the integration of environmental considerations (71.43%). Participants frequently indicated that external mandates or company policies play a stronger role than individual initiative in shaping sustainability practices.

In terms of values, 64.29% of participants emphasized waste minimisation and material selection during product design and development. Half of the participants (50%) identified recycling and the need to raise awareness among designers and consumers as important. Figure 1 illustrates the distribution of participants across the identified attitudes, beliefs, and values.

Additional patterns emerged but were less prevalent. Four participants (28.57%) expressed a positive attitude toward incorporating environmental considerations and indicated a willingness to do so. Four believed that companies are primarily profit-driven, while three associated sustainability decisions with trade-offs. Three also highlighted the role of customers in shaping design priorities. Codes mentioned by fewer than three participants were treated as individual perspectives and are not emphasised.

Table 4
Code definition

Sl. No.	Attitude/ Belief/ Values	Code	Definition
1	Attitude	Role limitation	The participant feels that he or she has a limited role, power and control at work when it comes to influencing environmental sustainability.
2	Belief	Regulations & regulatory compliance	The participant believes that regulations, guidelines, compliance requirements, or similar initiatives from regulatory authorities such as the government or the company itself have the potential to influence the consideration of environmental sustainability in product design and development. [Regulations = mandatory legal requirements Guidelines = suggested best practices (often voluntary) Compliance requirements = the set of actions/processes needed to prove adherence to relevant regulations and/or guidelines]
3	Values	Waste minimisation	The participant considers it important to optimize material use, simplify design, and minimize waste.
4	Values	Material selection	The participant considers exploring, understanding and selecting appropriate materials important for environmentally sustainable product design and development
5	Values	Awareness	The participant considers awareness among designers and consumers about the environmental impact associated with a product and its lifecycle to be important
6	Values	Recycling	The participant considers recycling and the use of easily recyclable materials to be important.
7	Value	Affordable sustainable products & materials	The participant considers the availability and production of affordable sustainable products and materials to be important.
8	Belief	Sustainability is secondary	The participant believes considering environmental sustainability is secondary during product development. It comes after consideration of more important factors such as cost, functionality, market needs, manufacturing, durability & serviceability.
9	Attitude	Doubtful feeling	The participant feels doubtful about how environmental considerations are handled by the company, government, or themselves, and they do not know enough.
10	Belief	Sustainability is complicated	The participant believes that environmental sustainability is a complex and challenging subject to address in the industry due to numerous factors associated with product

Sl. No.	Attitude/ Belief/ Values	Code	Definition
			development (e.g. cost, materials and their properties, viability, durability, market and competition, logistics and supply chain, feasibility, manufacturing, end-of-life management, and production) and limited knowledge.
11	Belief	Standard process	The participant believes that the product development process in the industry is standardised and optimised, having been practised for a long time.

4.2. Methodological validation

ICR indicated substantial agreement between coders. Coder 1 recorded 23 agreements and 7 disagreements, yielding a percentage agreement of 76.67%. Coder 2 recorded 22 agreements and 8 disagreements, yielding 73.33%. The average percentage agreement across both coders was 75%, which exceeds the minimum threshold of 70% recommended for qualitative coding [30], indicating acceptable intercoder reliability.

4.3. Contrasting company environmental sustainability initiatives to designer perception

Across the companies analysed, their official websites reported:

- Corporate-level sustainability governance presented under structures such as ESG, CSR, Environment, Health, and Safety (EHS), or similar management systems. These sections reported sustainability assessments and social initiatives in education, livelihoods, sanitation, environmental conservation, and healthcare.
- Environmentally sustainable and energy-efficient product development, framed in relation to technological and product innovation.
- Circular economy initiatives, including waste management, e-waste collection, recycling, and Extended Producer Responsibility (EPR) programmes.
- Biodiversity-related initiatives (e.g. tree plantation and wildlife conservation).

Six of the seven companies reported wastewater treatment and conservation, and greenhouse gas reduction efforts, indicating attention to operational environmental performance. All reported initiatives provide the institutional context within which practitioners operate, offering a basis for comparison with interview findings. Table 5 summarises the initiatives identified across the 7 companies.

Table 5
Company Sustainability Themes Identified

Company	No. of Participants	Website Section / Framing	Themes Identified	Source
LG	1	ESG / Sustainability	Water resource management; chemical substance management; atmospheric pollutants management; biodiversity preservation initiatives; circularity; clean technology; carbon neutrality; sustainable living through products; ESG reporting with focus on recycling	[45, 46]
Havells India Ltd.	3	CSR	Sustainability vision (CO_2 reduction, environmental protection, quality of life, profitable solutions); radioactive-free and energy-efficient products; e-waste take-back and recycling; CSR initiatives (environment, health, education, sanitation, skill development, heritage conservation); impact assessment reporting; zero water discharge facilities	[47]
Bajaj Electricals Ltd.	1	CSR, ESG	Environmental sustainability initiatives (CO_2 reduction, tree plantation, urban afforestation, plastic waste upcycling); sustainable products; cookstove project; solar electrification; rainwater harvesting; renewable energy generation; zero liquid discharge; alignment with UN SDGs (3, 4, 5, 6, 7)	[48, 49]
Godrej Enterprises Ltd.	1	Good & Green	Tree plantation and biodiversity conservation; “Good & Green” products through technological innovation and consumer insights; net-zero mission; wastewater treatment; community-focused CSR (livelihoods, education, healthcare); responsible disposal of e-waste and packaging; recycling policies; sustainability reporting	[50]
Crompton Greaves Consumer Electricals Ltd.	2	CSR, EPR Policy	Energy-saving products; environmentally friendly materials; waste management; GHG emissions reduction and low-carbon products; energy efficiency targets; EPR for e-waste collection and recycling; biodiversity commitment; CSR initiatives (water conservation, skill development, community care); impact assessment reporting	[51]

Company	No. of Participants	Website Section / Framing	Themes Identified	Source
Whirlpool Corporation.	2	Our Impact	Net-zero initiatives in plants and operations; GHG and energy use reduction; renewable energy expansion; reforestation; electrification and fossil fuel substitution; carbon removal investments; wastewater treatment; sustainable products through product innovation; Environment, Health, Safety, and Security policy; zero waste to landfill	[52]
IFB Industries Ltd.	1	CSR Policies, E-waste	CSR policy; e-waste program; product lifecycle sustainability philosophy; preservation of the environment policy	[53, 54]

5. Discussion

5.1 Analysis of the attitudes, beliefs and values

The values coding of the interview data revealed a dominant attitude of role limitation, with many participants perceiving that they have limited power and control to influence environmental sustainability within their company. Although participants reported being able to propose design modifications, decisions regarding cost, material selection, manufacturing processes, and performance trade-offs were described as being made at higher organisational levels (Table 4). The belief that sustainability is secondary to cost, functionality, market demands, and manufacturing feasibility further contextualises role limitation. This suggests that practitioners experience sustainability decision-making as structurally positioned beyond their immediate sphere of influence, leading them to perceive their contributions as confined within predefined boundaries. These boundaries appear to be shaped by multiple factors, including design briefs defined by customer-facing or managerial teams, established product development procedures, and limited involvement in higher-level decision-making processes.

Such perceptions align with earlier findings that companies' primary motivations are rarely driven by environmental considerations alone but are often shaped by customer expectations, cost constraints, performance requirements and company initiatives and values [5, 28, 29, 32], and that ecodesign adoption is influenced by both regulatory frameworks and market pressures. [22]. This also supports prior research showing that organisational characteristics and structural factors influence the implementation of sustainability practices within firms, particularly in the Indian context [27]. These findings also resonate with engineering design research, which recognises that designers operate within sociotechnical systems that shape and constrain their decision-making [55–57]. The role boundaries practitioners describe, therefore, reflect the situated nature of design practice rather than individual

disposition. In such settings, environmental sustainability becomes one consideration among many competing priorities, potentially limiting practitioners' perceived agency.

Our results also indicate that participants value waste minimisation, material selection, and affordable, sustainable products and materials in the design and development process. Similar findings were reported in Malaysia [14], where engineering designers perceived DfE primarily in terms of product characteristics and material considerations. This suggests alignment between the two contexts. However, the Malaysian study also reported misconceptions among designers regarding DfE as an engineering design process. In our study, the industrial designers and managers believe that the product design and development process in their companies is standardised and driven by regulatory requirements.

The co-occurrence of role limitation with attitudes of doubt, alongside beliefs that product development processes are complex and standardised, suggests a lack of clarity about how to systematically integrate environmental sustainability into their roles. The emphasis on awareness (value) further supports a perceived need for knowledge, guidance, and practical direction. Previous literature stated that ecodesign techniques have not been widely adopted because such methods are often neither generic nor immediately applicable, requiring process-specific customisation [18]. This aligns with Stewart et al. (2018), who argue that ecodesign integration cannot be addressed through one-size-fits-all approaches but instead requires context-specific investigation that encourages companies to reflect on their particular conditions and challenges [20]. Local political, economic, and social conditions further reinforce the need for such context-sensitive approaches. Collectively, these findings indicate the absence of a clearly structured, step-by-step approach that connects sustainability objectives to day-to-day design tasks. Developing such approaches, aligned with the existing process, is likely to help translate organisational sustainability goals into actionable practices at the practitioner level.

In this study, 7 of 9 participants with 8 or more years of experience in managerial or related positions demonstrated the role-limited attitude. This suggests that perceptions of limited influence extend beyond junior roles and reflect broader organisational constraints.

5.2 Comparison of Practitioner Perspectives with Company Sustainability Initiatives

The analysis of sustainability initiatives reported on company websites shows that organisations publicly communicate structured commitments through ESG frameworks, CSR, circular economy programmes, and environmental performance measures. These initiatives suggest that all seven companies have formalised sustainability governance, report environmental targets, and have structured programmes at the corporate level. However, the contrast between these publicly stated commitments and practitioners' perceptions, such as role limitation, reveals a disconnect. Despite prominent corporate sustainability narratives, practitioners did not perceive environmental responsibility as part of their formal role, nor did they believe their day-to-day design tasks could meaningfully influence sustainability outcomes.

This finding aligns with Rodrigues et al. (2024), who show that CSR policies alone do not generate positive outcomes for employees. What matters is whether CSR is genuinely embedded in daily organisational activities and whether employees are involved in its design and implementation. When CSR is perceived as peripheral or symbolic, it does not translate into employee-level agency.[58]. Our study finds a parallel pattern: sustainability is communicated at the corporate level, yet practitioners experience it as disconnected from their design roles and responsibilities.

This suggests that the gap identified in this study is not unique to ecodesign. It reflects a broader pattern in which formal corporate sustainability commitments fail to reach the operational level unless actively embedded in roles, tasks, and decision-making structures. Research has shown that while companies increasingly formulate sustainability strategies, translating these into operational implementation within firms remains a persistent challenge shaped by organisational structures, internal processes, and leadership commitment [59]. In the Indian context specifically, where mandatory CSR requirements exist under Section 135 of the Companies Act 2013 [23], the presence of formal regulatory obligations does not guarantee that sustainability integration reaches the practitioner level within product design functions. Legislative CSR mandates, while necessary, are therefore insufficient on their own to generate practitioner-level environmental agency. This has direct implications for how sustainability governance frameworks are designed and operationalised in emerging economy contexts.

At the same time, practitioners' values — waste minimisation, material selection, awareness, and recycling — broadly align with the sustainability themes their organisations publicly communicate. This suggests the gap is not one of values misalignment but of organisational disconnection — sustainability is present at both the corporate communication level and the individual practitioner level, but there is no structural bridge connecting the two within design roles and processes.

In contrast, existing literature on ecodesign has several studies that have addressed approaches for integrating environmental sustainability considerations [9], which also align with these company initiatives. This indicates that the conditions for ecodesign integration are present — tools exist, companies communicate sustainability commitments, and practitioners hold relevant values — yet integration remains elusive. The missing element is not awareness or intent but the organisational structures that would connect these three ingredients within everyday design practice.

5.3 Practical Implications

The findings suggest that ecodesign implementation requires more than the availability of sustainability frameworks or policies. Organisations need to create clearer links between sustainability goals and practitioner roles by embedding environmental objectives into role definitions, design briefs, performance metrics, and decision-making processes. Training and cross-functional integration can further strengthen practitioners' ability to incorporate environmental considerations

Given that eco-design methods often require process-specific adaptation, organisations could benefit from developing customised approaches that fit their existing product development systems [18]. The

practitioner perspectives identified in this study can inform how tools and techniques are adapted in practice, knowing that sustainability practices are shaped by internal (organisational structures), external (market realities), and product-related factors [22, 27].

Strong top management support is critical. Findings indicate that even managerial or senior roles perceive limited influence over sustainability decisions, suggesting that environmental responsibility is not fully embedded within leadership priorities. Since strategic direction, resource allocation, and performance expectations are determined at senior levels, leadership commitment is necessary to integrate sustainability into core product development processes and legitimise environmental considerations in decision-making.

5.4 Future research directions

Future research should focus on developing prescriptive task flows that translate sustainability objectives into step-by-step actions within existing product development processes. Such task flows would provide practitioners with structured, actionable guidance for integrating sustainability into their existing design workflows, supporting more systematic ecodesign integration.

Further investigation is needed to understand why ecodesign methods are not consistently embedded in practice and to identify the barriers that hinder their effective use within organisational contexts. In particular, research should examine how political, economic, social, and industrial conditions in India shape the suitability and adaptability of existing ecodesign approaches [18].

The findings of this study pertain specifically to the Indian context. Comparative studies across countries with similar institutional and regulatory characteristics could illuminate how design practice and process expectations differ across contexts, and what aspects of ecodesign implementation require context-specific attention.

Additionally, data collection can be enhanced with a follow-up survey informed by the insights from this study, yielding results with greater statistical robustness. More targeted questions addressing the motivations, challenges, and limitations companies encounter when implementing ecodesign practices could be developed based on the present findings.

Another important direction is examining how managerial role limitation influences sustainability outcomes. As these groups play a central role in ensuring the efficient use of organisational resources [27], future research could investigate how top management support, organisational motivation, and stakeholder pressures can shape practitioner agency to improve the integration of ecodesign into product development.

Finally, future studies should analyse the role of political and regulatory support in shaping ecodesign adoption, particularly in emerging economies. Investigating how external institutional influences — policies, governance mechanisms, and regulatory pressures — shape organisational sustainability

practices will provide deeper insight into the conditions that enable or constrain practitioner-level action [60].

5.5 Limitations

The study has the following limitations:

1. The use of non-random sampling limits the generalisability of the findings.
2. The interviews were conducted between 29 March and 23 June 2025; therefore, the findings may not be generalisable to other time periods, geographical settings, or populations.
3. The results rely on participants' self-reported perspectives, assuming an accurate reflection of their views.
4. The study focuses primarily on practitioners from the household appliances sector. Thus, findings may differ in industries with distinct regulatory, technological, or organisational characteristics.
5. As is common in qualitative research, interpretations may be influenced by the researchers' perspectives despite efforts to follow systematic coding procedures.
6. Information drawn from publicly available company websites may reflect formal reporting rather than actual practices.

6. Conclusion

This study contributes to design research, ecodesign scholarship, and the field of green management by uncovering how product designers and managers in India perceive and engage with sustainability in practice — specifically their attitudes, beliefs, and values. By applying values coding methodology, the study captures the ethical, ideological, and evaluative dimensions of practitioners' perspectives, enabling a more interpretive and explanatory analysis than conventional barriers-and-drivers approaches [30, 40].

The dominant finding is a widespread attitude of role limitation, in which practitioners perceive sustainability decision-making as structurally positioned beyond their immediate sphere of influence, shaped by organisational hierarchies, standardised processes, and the belief that sustainability is secondary to cost, functionality, and market demands. At the same time, practitioners hold sustainability values like waste minimisation, material selection, recycling, and awareness, which broadly align with the sustainability commitments their organisations publicly communicate. The strong belief that regulations and formal guidelines are the primary driver of sustainability integration further suggests that ecodesign adoption is currently dependent on external institutional mechanisms rather than embedded practitioner agency. Together, these findings reveal that the challenge of ecodesign implementation lies not in a lack of environmental concern but in the absence of clearly defined, actionable sustainability responsibilities at the practitioner level.

By focusing on practitioner perspectives within the Indian context, this study illuminates the human and organisational dimensions that shape sustainability integration in design practice — dimensions that tools-focused and policy-focused ecodesign research has largely overlooked. The gap between

corporate sustainability commitments and practitioner-level agency cannot be addressed through tools and methods alone — it requires attention to how sustainability goals are embedded within design roles, processes, and decision-making structures. In the Indian context, specifically, where mandatory CSR requirements coexist with persistent implementation challenges, this study shows that legislative and organisational intent does not automatically translate into practitioner agency.

More broadly, this study suggests that advancing ecodesign requires a shift in how the field conceptualises the implementation challenge — from a tools and methods problem to an organisational and structural one. Understanding how individual values, role boundaries, and organisational structures interact is essential for developing context-sensitive approaches — including prescriptive task flows that connect sustainability objectives with everyday design practice — and for embedding ecodesign meaningfully within the conditions in which designers actually work.

Declarations

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Use of AI-Assisted Tools

During the preparation of this manuscript, the authors used ChatGPT and Grammarly to improve the readability, language, and grammar. Specifically, the tools were used to refine sentence structure and improve the clarity of academic prose. All research design, data collection, coding, analysis, interpretation of results, and intellectual content were conducted entirely by the authors. The authors reviewed, verified, and edited all AI-assisted outputs and take full responsibility for the accuracy and integrity of the final manuscript.

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Clinical trial number

Not applicable.

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Indian Institute of Technology (IIT), Guwahati (Reference Number: To be provided soon). The study was conducted in accordance with the National Ethical Guidelines for Biomedical and Health Research Involving Human Participants, India. Informed consent was obtained from all subjects involved in the study.

Name of the Approval Committee or the Internal Review Board (IRB): Institute Human Ethics Committee (IHEC), IIT Guwahati.

Consent to Publish

Not applicable

Data availability

The datasets analysed during the current study are not publicly available as the interview transcripts contain identifying information, including participant names and company affiliations, disclosed during introductions and conversations, which would compromise participant confidentiality if shared publicly. Data are available from the corresponding author on reasonable request.

Author Contribution

B.S. conceptualised and planned the study and conducted the investigation. B.S. curated the data with support from P.U. S.B. and P.U. provided supervision. All authors contributed to the preparation of the manuscript and reviewed and approved the final version

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Figures

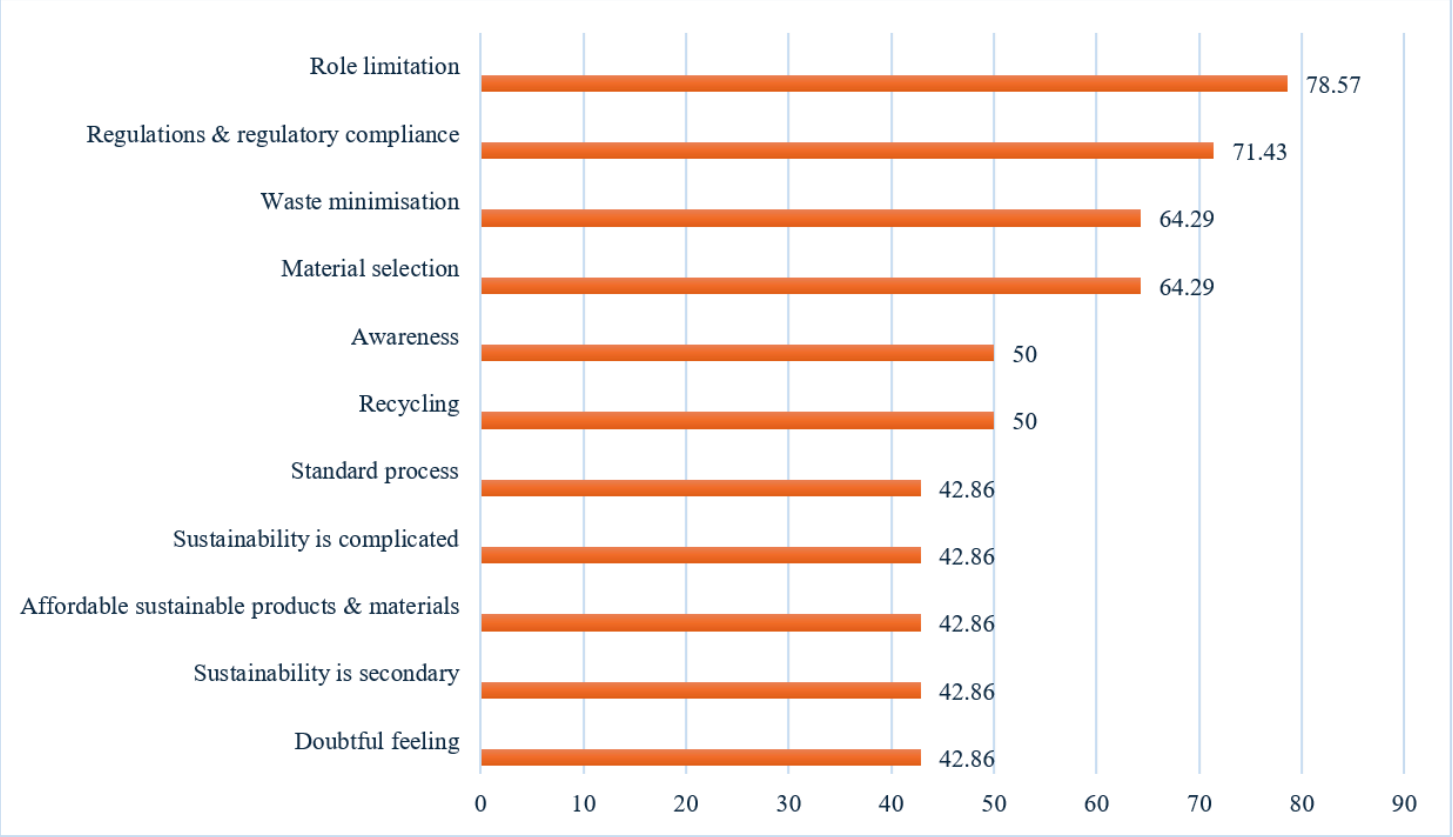


Figure 1

Codes and percentage of participants