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# Effects of Circular Design Attributes on Consumers' Purchase Intention toward Sustainable Clothing—An Integrated Review of Durability, Repairability, Recyclability, Material Traceability, and Consumer Value

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**----------ABSTRACT----------**
*Circular garments on the market are commonly described through brief claims such as recycled content, long wear life, repair services, or take-back schemes. Consumers, however, compare complete garments, so price, fit, handle, care requirements, and service conditions enter the decision at the same time.This review primarily examines studies on circular design and sustainable clothing consumption published between 2010 and July 2026, supplemented by foundational studies on perceived value and planned behavior. Choice-based conjoint analyses, surveys, experiments, interviews, and living-lab studies show that durability is readily interpreted as dependable quality, a longer period of use, and lower replacement expenditure. Repairability becomes a credible purchase reason only when service locations, costs, waiting times, spare parts, and warranty conditions are clearly stated. Recycled content and recyclability depend on material verification and usable collection routes; their influence declines when consumers remain uncertain about price, fit, comfort, or style. Digital product passports can add material-origin and service records, although dense information also raises reading effort. Emotional longevity, adjustable fit, and participatory design further indicate that frequent wear and long-term retention are themselves forms of circular value. The review integrates functional, economic, environmental, emotional, and symbolic value and examines how trust and risk reshape the pathways between design attributes and behavior. Future work should use identifiable garment prototypes, realistic prices, and post-purchase use records, while measuring purchasing, wearing, repairing, reselling, and returning as separate outcomes.*

***KEY WORDS:*** *Circular fashion, sustainable clothing, durability, repairability, recyclability, traceability, purchase intention, consumer value.*

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## I. INTRODUCTION

The environmental effects of clothing do not begin in the store, nor do they end automatically when a consumer discards a garment. Raw-material production, spinning, dyeing and finishing, garment manufacture, transport, laundering, repair, resale, collection, and recycling form an interconnected sequence. Circular-economy research usually groups resource strategies into reducing inputs, extending the period during which value is retained, and closing material loops [1-3]. Applied to clothing, this approach must also address a frequently overlooked issue: a garment can remain physically sound without continuing to be worn. Changes in body size, style preference, wearing occasion, or care burden may remove clothing from daily use long before physical failure occurs.

Brands often compress complex circular systems into a few labels, such as recycled fiber, modular construction, repair service, take-back program, or digital traceability. These messages vary greatly in how easily they can be understood. A recycled percentage can be printed directly on a hangtag, whereas disassembly and recovery require additional explanation. The benefits of durability are close to the present purchase, while end-of-life recycling may be years away and depends on local facilities. In a choice-based conjoint experiment in Australia, Klemm and Kaufman found that durability generated relatively high utility among the circular attributes tested, although price still dominated the overall choice [4]. Consumers therefore tend to read circular design first through everyday use value; environmental commitments are more likely to affect selection when they are linked to concrete product benefits.

Research on sustainable clothing consumption has discussed environmental concern, ethical attitudes, knowledge, social norms, price sensitivity, and the intention-behavior gap [5,6]. These studies do not always reveal which design consumers are evaluating. Some surveys refer only to sustainable clothing without

specifying material percentages, repair services, or recovery conditions. Other design studies explain disassembly, life extension, and material circulation in detail but rarely observe how shoppers interpret these arrangements at the point of purchase [7,8]. An explanation of purchase intention therefore needs to consider the garment itself, the evidence supplied with it, the supporting service, and the value judgments formed during comparison.

This review addresses four questions. Where do circular attributes sit within materials, components, garments, information, and services? Through which judgments of value, trust, and risk do consumers interpret them? Why do favorable attitudes weaken during price comparison, actual purchasing, or later use? How can research measures retain specific design meaning instead of returning to broad environmental attitudes? The main focus is on garments, textile products, and related services that consumers can encounter and use; general circular product-design studies are included where they help define a mechanism.

## II. REVIEW SCOPE AND ANALYTICAL APPROACH

Circular fashion includes material selection, structural design, commercial services, and post-purchase handling. A focus on purchase intention alone omits repair, resale, rental, return, and recycling, even though these activities determine whether a garment remains in use and whether material value is retained. The review therefore covers circular product design, garment durability, repairability, recyclability, recycled content, emotional longevity, material traceability, rental, second-hand circulation, and consumer purchase judgments.

The reviewed studies differ in both objects and methods. Design papers usually describe material combinations, joining methods, disassembly, and life extension. Consumer studies rely more often on surveys, conjoint analysis, experiments, or interviews. Living-lab and service studies allow participants to engage directly with repair, customization, rental, and return. Read together, these sources reveal recurring time gaps between what is technically feasible, what consumers can understand, and what firms can continue to provide.

Garment categories, sample composition, attribute wording, and outcome variables are not consistent enough for direct data pooling. No aggregate effect size is calculated here. The literature is organized by design attribute, life-cycle position, product or service context, consumer judgment, and behavioral outcome, with attention to mechanisms that recur across studies, the conditions under which they apply, and the circumstances in which they fail [9].

Materials and construction establish a garment's circular potential. Information and services determine whether that potential can be recognized and used, after which value, trust, and risk enter the evaluation. Figure 1 separates this process into four levels—design attributes, life-cycle position, consumer evaluation, and behavioral outcomes—so that transmission and feedback across the levels can be examined [7-9].

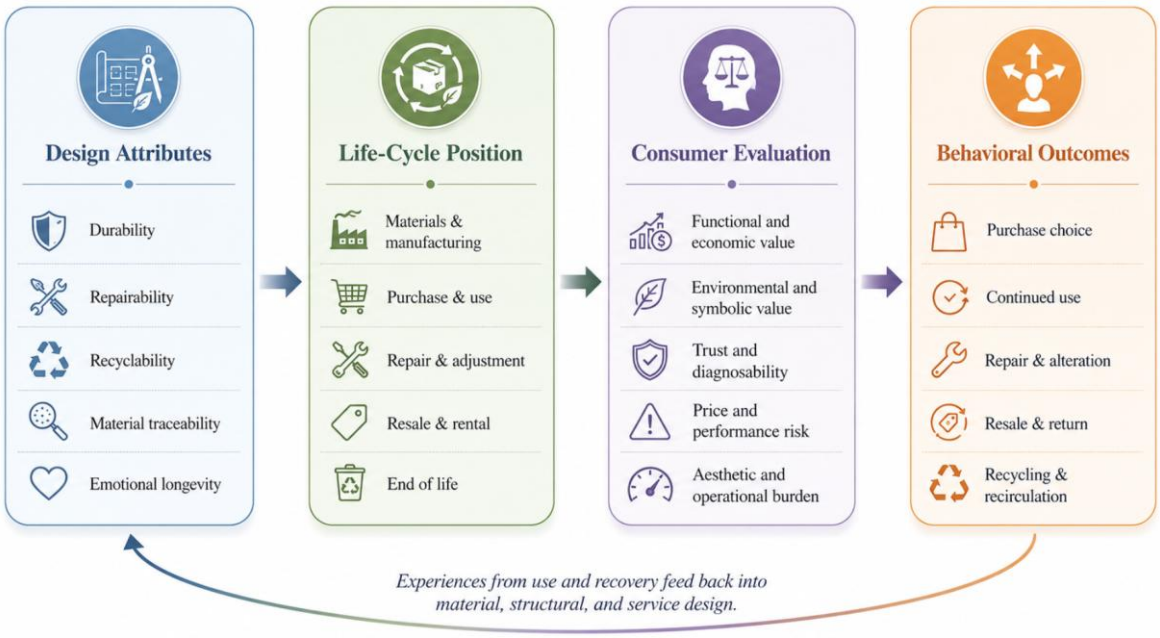


**Figure 1 Analytical levels linking circular design attributes, the life cycle, and consumer behavior [7-9]**

The pathway in Figure 1 does not end in a one-way movement toward purchase. Design choices first enter production, use, repair, and end-of-life stages, where consumers translate them into quality, expenditure, environmental meaning, or operating burden. Purchase intention is an intermediate outcome. The presence of a repair point, the credibility of a second-hand platform, and the availability of a collection route continue to

shape later behavior. Separating technical conditions, consumer evaluation, and behavioral outcomes helps retain differences among product categories and service settings [7-9].

Many circular properties cannot be judged from appearance alone. Consumers need tests, warranties, material percentages, repair access, or return routes to compare them. Table 1 therefore brings together durability, repairability, adaptability, recycled inputs, recyclability, traceability, emotional longevity, and service integration and relates each attribute to design indicators, visible evidence, and resource functions [10-14].

| Attribute | Design-level indicator | Consumer-visible evidence | Primary circular function |
|---|---|---|---|
| Durability | Abrasion, seam, and colorfastness performance; dimensional stability; replaceable high-wear parts; construction compatible with routine care | Performance warranty, test results, reinforcement details, and cost-per-wear information | Slow replacement and maintain product utility |
| Repairability | Accessible seams and fasteners; standardized components; repair allowance; removable decoration; available spare parts | Repairability rating, repair manual, visible construction, service location, and supplied repair kit | Extend use and postpone disposal |
| Adaptability/modularity | Adjustable fit; reversible or reconfigurable panels; replaceable modules; allowance for size change | Demonstration, configurator, component diagram, and alteration options | Respond to changing needs and strengthen emotional attachment |
| Recycled content | Verified fiber source; quality control of secondary feedstock; controlled blend ratio | Certified percentage, material origin, and evidence of equivalent performance | Substitute secondary materials for virgin input |
| Recyclability | Mono-material or separable construction; compatible dyes and finishes; identification of contaminating components | End-of-life route, separation instructions, and collection eligibility | Close the material loop where infrastructure exists |
| Material traceability | Chain-of-custody data; product identity code; composition and chemical records | QR code, digital product passport, and verified supply and life-cycle information | Reduce information asymmetry and support sorting, repair, and recycling |
| Emotional longevity | Distinctive yet lasting aesthetics; personalization; narrative quality; acceptance of natural wear | Customization, origin story, repair history, and owner interaction | Increase retention through attachment and identity value |
| Service integration | Take-back, resale, rental, repair, refurbishment, warranty, and care support | Published service terms, price, turnaround time, and return channels | Connect product design with repeated use and value recovery |

**Table 1 Circular apparel attributes, design indicators, and consumer-visible cues [10-14]**

The attributes in Table 1 do not serve the same resource strategy. Durability, repair, adaptability, and emotional longevity primarily delay a garment's departure from use. Recycled content reduces virgin input, while recyclability concerns end-of-life processing. Traceability and services connect different stages. The table also exposes a practical issue: performance created in design usually becomes visible only through warranties, repair terms, material-origin information, or recovery records. Without such evidence, consumers have difficulty converting a technical advantage into comparable product value.

## III. CIRCULAR DESIGN ATTRIBUTES IN APPAREL

### A. Durability and the Practical Meaning of a Long-Life Garment

Resistance to abrasion and laundering shows that a garment is less likely to fail physically, but it does not establish that the garment will be worn for a long time. Continued fit, acceptable appearance, manageable care, and stable use occasions also determine clothing life [10-13]. Seams, colorfastness, dimensional stability, pilling resistance, and zipper reliability support the question of whether a garment can still be worn. Handle, silhouette, and compatibility with everyday situations shape whether the wearer still wants to use it. A lifetime estimate based only on mechanical performance can therefore mistake long-term storage for effective use.

In the conjoint experiment by Klemm and Kaufman, durability was valued more highly than recyclability, repairability, and recycled content, while price remained the strongest constraint [4]. Consumers may connect durability directly with quality, fewer replacements, and lower long-term cost. Schiaroli et al. likewise found in their review of fashion consumption research that quality, comfort, and style frequently sit closer to actual decisions than abstract environmental attitudes [5]. Durability information should therefore specify reinforcement at stress points, stable fit, tolerance of normal care, warranty length, and repair support. Online reviews are also more useful when they discuss materials, function, style, and price together [15].

A long service life does not automatically produce an environmental benefit. When a high-quality coat is added to an already full wardrobe instead of replacing another purchase, transport, laundering, and rebound consumption can weaken the gain from life extension [16]. Evaluation should therefore record active wearing time, annual wear frequency, purchase frequency, and the number of new garments actually displaced, in addition to laboratory lifetime.

**B. Repairability, Replaceable Components, and Service Accessibility**

Garment failure often begins in one area. A zipper, elastic component, cuff, or lining may fail while the main fabric remains usable, yet the whole garment may be discarded because repair is difficult. Openable linings, standard fasteners, replaceable elastic, modular cuffs, and clear component identification reduce disassembly and reassembly effort. Construction also has to suit the category. Outdoor jackets contain waterproof zippers and laminated layers, uniforms and workwear face frequent abrasion, and children's clothing must accommodate growth and safety requirements. A repairability score without information on tools, spare parts, and service access describes only theoretical repairability.

After damage occurs, consumers weigh repair cost, travel distance, waiting time, post-repair appearance, and the price of a replacement. A purchase-stage promise that repair is available may signal brand responsibility, but delivery requires a stated location, price, turnaround time, component-supply period, and warranty boundary. European experiments on textile repair services found that emotions associated with loss or waste can influence evaluations, while actual repair still depends on accessible service capacity [17]. Long delays, uncertain quotations, or an outcome that differs from expectation can erode the trust created at purchase.

**C. Recyclability, Recycled Content, and Material Identifiability**

The label recycled polyester identifies an input source; it does not mean that the finished garment can become fiber again after use. Elastane, coatings, laminated membranes, adhesives, prints, metal trims, and functional finishes all increase separation difficulty, and some reduce the purity of recovered material. Recyclability should therefore be assessed at whole-garment level, including material combinations, joining methods, contamination risks, and currently available processing routes [3,7,8,10,11,16,18].

Park and Lin's comparison of recycled and upcycled fashion shows that the attitude-behavior relationship differs between the two product groups [19]. A recycled percentage can also prompt questions about handle, durability, cleanliness, and claim credibility. Garment position changes the judgment as well. Outerwear has limited skin contact and may permit greater acceptance of unfamiliar materials, whereas next-to-skin clothing places greater weight on softness, safety, and hygiene [20]. Acceptance of recycled materials should therefore be measured within a specified product category.

Whether recycling actually occurs cannot be known until a garment reaches end of life. Distance to collection points, geographic coverage, sorting capacity, and processing facilities all affect the outcome. Consumers need a clear material label, return location, and stated destination before they have an executable route. Conjoint analysis can measure preference for a recyclable attribute [4], but it cannot replace an actual return years later. Mono-material construction may simplify sorting while reducing stretch, drape, moisture and heat regulation, or protective performance. Product information should disclose these trade-offs and state which constructions the current recovery system accepts.

**D. Traceability Information, Digital Product Passports, and Trust**

A QR code can bring together fiber composition, suppliers, care, repair, and recycling information, but it can also direct consumers to a long and poorly organized page. A digital product passport is not limited to the first purchase. Repairers need component information, second-hand transactions need authenticity and condition records, and recyclers need composition and chemical data. Becchi et al. found that digital labels could strengthen consumer confidence and some willingness to pay, although price and aesthetics continued to shape attractiveness directly [21].

Trust in a material-origin claim depends on whether the evidence matches the promise. Green perceived value can influence purchase intention through green trust, while perceived risk weakens this effect [22]. Greenwashing concerns likewise reduce intention and behavior [6]. The first information layer should answer questions directly related to choice: what the material is, what supports the durability claim, how repair works, and where the garment can be returned. Supplier, chemical, and verification records can appear in a deeper layer. Test data, corporate targets, and estimated results should be labeled separately so that unlike forms of information are not blended together.

**E. Emotional Longevity, Fit Adaptation, and Participatory Design**

Emotional longevity asks why clothing is retained. Repeated repairs, wearing memories, identity expression, and personal participation can keep an older garment in daily life. Research on emotional durability

therefore includes attachment, agency, and narrative value within product longevity [13]. Clothing also has a direct relationship with the body and public appearance, so body change, fit, and shifting occasions continually reshape this attachment.

Adjustable waists, alteration allowances, reversible wear, replaceable decoration, and modular panels can help a garment respond to changes in body size or use. Long-term use has no single visual language. Some wearers prefer quiet basic pieces; others retain garments because of cultural meaning, personal experience, or transformable construction. When modules are numerous, operation is difficult, or accessories remain unused, the extra material may add burden and structural flexibility may not lead to more wear.

The Circular Shirt Builder living lab allowed 19 participants to assemble modular shirts themselves. The study recorded learning, creative expression, agency, and reflection on later care and repair [23]. This participatory method turns circularity into an operational experience, although current evidence does not show whether the effect persists at retail scale. Emotional attachment is also difficult to predict from a single survey. Wardrobe diaries, repair records, resale histories, and longitudinal follow-up are more suitable sources. Studies should record wear frequency, expected retention, and disposal plans alongside purchase intention.

Circular attributes become observable at different points in the life cycle. Materials and construction are fixed before purchase. Repair, adaptation, and emotional attachment can be observed only through use, while recycling still depends on end-of-life facilities. Figure 2 arranges the relevant elements across material selection, garment structure, use, life extension, recirculation, and end of life to show where information and services have to connect [7,8,10-14,16,18].


**Figure 2 Circular apparel attributes across material selection, garment structure, use, life extension, recirculation, and end of life [7,8,10-14,16,18]**

Figure 2 separates durability, fit, and aesthetics, which are close to purchase, from repair, rental, and resale, which can be verified only after purchase. Material recycling occurs at the end of the cycle and is more strongly constrained by collection coverage and treatment capacity. Traceability runs through the entire process: it explains materials and performance during purchase, supplies component information during repair, preserves condition records during resale, and supports identification during sorting. The feedback arrows are equally important. Repair histories can increase second-hand credibility, while available recycling technology feeds back into fiber, trim, and joining decisions.

## IV. CONSUMER DECISION MECHANISMS

### A. Functional and Economic Value

When consumers encounter a garment, price, color, silhouette, handle, brand, size, and care requirements appear together; circular attributes form only part of the comparison. Durability, repair, or recycling information is quickly displaced by other cues when it cannot be translated into quality, cost, or convenience.

The PERVAL scale separates perceived value into functional quality, value for money, emotional value, and social value [24]. Circular clothing can activate several dimensions. Durability concerns quality and cost per wear; repair services reduce future replacement risk; recycled materials carry environmental meaning; upcycling creates distinctiveness; and take-back schemes reduce disposal effort. A product page that says only eco-friendly, without explaining what the buyer receives, cannot easily compete with price, style, and comfort.

Long-term economy and the present budget operate on different time scales. A coat may have a low cost over five years and still exceed the budget at checkout. Cost per wear can make the economic meaning of durability more concrete, but the wear frequency and lifetime used in the calculation should be disclosed. Repair coverage lowers uncertainty about future failure, while rental and resale convert a one-time ownership expense into access, liquidity, or residual value [25-28].

Environmental attributes may also trigger doubts about performance. Luchs et al. describe this as the sustainability liability: when strength or function is highly important, ethical attributes can be read as evidence of compromised performance [29]. Recycled fibers, bio-based materials, detachable connections, and modular components therefore need evidence on comfort, care, protection, durability, and appearance to counter this inference.

### B. Environmental Value, Identity, and Social Meaning

Environmental concern can increase purchase propensity, but it rarely determines clothing choice by itself. After reviewing 217 studies of fashion consumption, Schiaroli et al. found recurring barriers involving price, skepticism, limited knowledge, stereotypes, availability, and action cost; quality, comfort, style, technology, and service were more closely tied to everyday decisions [5]. A large Italian survey further showed that environmental concern and perceived value positively affected purchase intention and willingness to pay a premium, while the effects of direct and indirect experience varied across material types [30].

Studies of green clothing in Germany and elsewhere further show that price, habit, retail channels, and knowledge sources can interrupt the conversion of attitude into purchase [31-35]. Environmental value usually works in combination with dependable product value.

Clothing also communicates identity in public. A sustainable choice may signal restraint, expertise, or creativity, yet observers may also interpret it as a style compromise, lower status, or a cleanliness risk. McNeill and Moore documented tensions among fashion motivation, convenience, and sustainability values [36]. Lundblad and Davies likewise showed through qualitative work that sustainable consumers draw on different values and purchase motives [37].

The same material can be evaluated differently across garment categories. Jackets are visible but have limited skin contact, making unfamiliar materials easier to accept. Underwear places softness, hygiene, and safety much higher in the judgment.Schiaroli et al. found that material type, garment visibility, and level of skin contact altered purchase intention and its determinants [20]. A single generic description across categories can conceal these differences.

Social influence comes from peers, reviews, social-media figures, brands, repair communities, and second-hand platforms. Shrivastava et al. used Instagram micro-celebrities to explain adoption of online clothing rental [38]. Huang et al. found that reviews discussing material, function, style, and price in concrete terms had greater diagnosticity [15]. These channels can make circular services familiar, while exaggerated promotion or weak evidence can intensify suspicion of greenwashing.

### C. Trust, Diagnosticity, and Perceived Risk

Consumers cannot directly observe a recycled-material chain or know whether a brand will still provide spare parts several years later. Recyclability claims may even depend on collection facilities outside a firm's control. Distance in time and distance from information jointly increase the cost of trust. Vehmas et al. found that consumers responded more favorably to circular-fashion communication when it was clear, verifiable, and connected with quality judgment [39].

Information diagnosticity describes how well information helps a consumer judge a product. Test results, reviews, warranty terms, material passports, certification, and physical demonstrations may all increase diagnosticity. Huang et al. found that perceived diagnosticity mediated the link between online reviews and sustainable clothing purchase intention, while prior knowledge altered the evaluation process [15]. Too little evidence makes a claim unconvincing; excessive complexity can exceed the consumer's capacity to process it.

Risks associated with circular clothing include performance, financial, aesthetic, hygiene, and operating costs. Strength, colorfastness, comfort, and care belong to performance judgments. A price premium and uncertain lifetime create financial risk, while style, fit, and social evaluation shape aesthetic risk. Second-hand clothing, rental, and recycled materials may also raise cleanliness concerns; repair, search, and return consume time. Rausch and Kopplin found that greenwashing concerns and aesthetic risk weakened both intention and actual behavior [6].

Each claim requires a different kind of evidence. Durability can be supported by tests and warranties. Repairability requires service capacity, spare-part availability, and prices. Recycled content relies on chain-of-custody records. Recyclability needs a locally usable end-of-life route. A digital passport also depends on data maintenance, verification, and interface readability. One broad certification cannot cover all of these questions.

**D. Attitude, Perceived Behavioral Control, and Purchase Intention**

Consumers who support circular fashion may still withdraw because the price is high, products are difficult to find, information is unclear, or maintenance requirements are complex. The theory of planned behavior treats attitude, subjective norm, and perceived behavioral control as antecedents of behavioral intention [40]. Sustainable-clothing studies generally confirm a role for attitude, yet availability, knowledge, price, and product risk narrow the space through which attitude becomes purchase [6,30-35,41].

Durability and aesthetics influence attitude. Peer use and credible reviews create normative cues. Repair locations, clear instructions, nearby return points, and complete size availability shape perceived control. Some technical solutions require consumers to learn disassembly, care, or return procedures. When this operating burden is high, a favorable attitude may still fail to produce action.

Post-purchase care, repair, resale, return, and recycling are separate tasks, each requiring ability, time, and service opportunity. A garment may be bought because of a recycling promise and later enter household waste when no nearby collection point exists. Research should measure purchase, extended use, repair, resale, and return intentions separately. Combining them into one circular behavior indicator hides the barriers specific to each stage.

Design attributes do not move directly into purchase intention. Consumers first judge whether the benefit is clear, the evidence credible, the risk acceptable, and the action convenient. Figure 3 places explanatory variables that recur in the literature between design cues and behavioral outcomes. The arrows identify testable relationships; they do not imply that any one study has validated the entire causal chain [4,6,15,22,24,29,40-42].

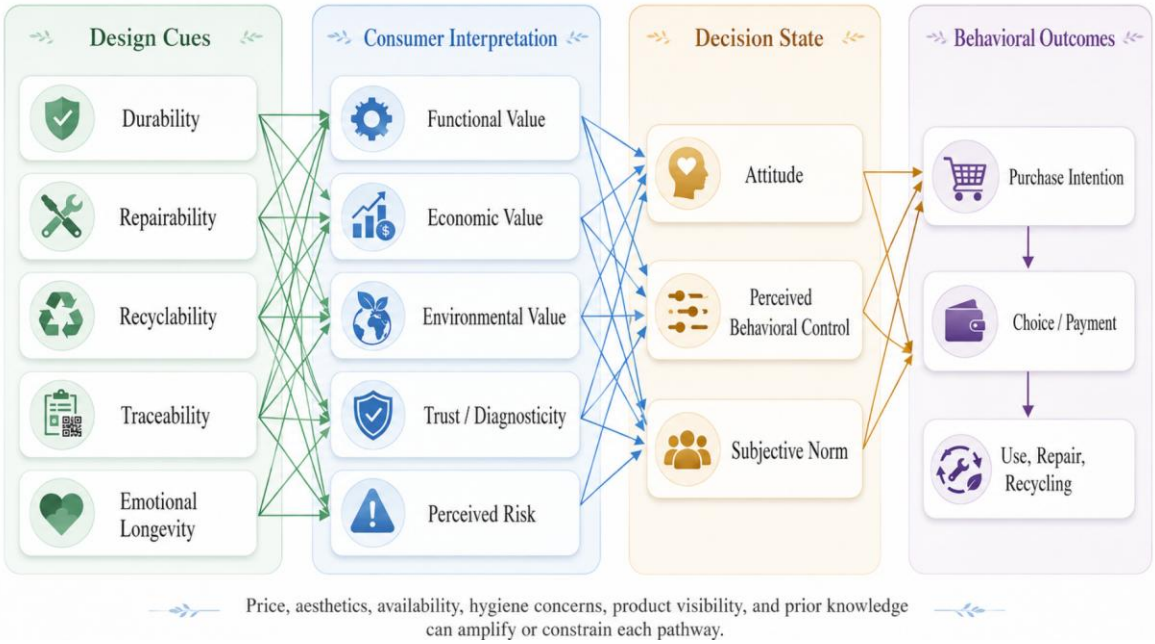


**Figure 3 Integrated pathways through which circular design cues influence purchase intention and post-purchase behavior [4,6,15,22,24,29,40-42]**

In Figure 3, durability, repairability, recyclability, traceability, and emotional longevity first enter functional, economic, environmental, emotional, and social evaluations, accompanied by price, performance, aesthetic, hygiene, and greenwashing risks. Material origin, durability promises, and recovery destinations cannot be fully observed at purchase, placing trust and diagnosticity in a central position. Attitude, subjective

norm, and perceived behavioral control carry these judgments forward. Service distance, return routes, size availability, and operating complexity have especially direct effects on control. Wearing, repair, resale, and recycling remain separate at the end of the model rather than being compressed into a single purchase intention.

Different methods capture different cross-sections of consumer decision-making. Table 2 selects empirical studies that directly examine product attributes, service conditions, or information interventions and compares their samples, methods, settings, and principal findings across conjoint analysis, surveys, experiments, interviews, and living labs [4,6,15,17,19-21,23,25-28,30-39].

| Study | Context and method | Attribute or intervention | Main evidence related to purchase or circular behavior |
|---|---|---|---|
| Klemm and Kaufman (2024) [4] | Australia; choice-based conjoint analysis; n=774 | Durability, recyclability, repairability, recycled content, and price | Durability had the highest utility among the circular attributes tested; price remained the main determinant of overall choice. |
| Rausch and Kopplin (2021) [6] | Survey and behavioral model; n=464 | Sustainable clothing, greenwashing concerns, and aesthetic risk | Attitude strongly supported intention; greenwashing concerns and aesthetic risk weakened intention and behavior. |
| Schiaroli et al. (2025) [20] | Italy; survey; n=768; garment/material contexts | Bio-based and recycled materials; jackets and underwear | Material and product context affected purchase intention; visibility, skin contact, and material type changed the relative importance of its determinants. |
| Huang et al. (2024) [15] | Text mining and survey | Online reviews discussing ecology, fashion, function, and price | Perceived diagnosticity mediated the effect; prior sustainability knowledge moderated evaluation. |
| Dangelico et al. (2022) [30] | Italy; large consumer survey; n=2694 | Sustainable fashion products and antecedents | Environmental concern and perceived value positively influenced purchase intention and willingness to pay a premium, while the effects of direct and indirect experience varied across eco-materials. |
| Vehmas et al. (2018) [39] | Consumer study of circular-fashion communication | Circular materials, life cycle, and communication | Consumers required understandable information and linked circularity with quality and trust. |
| Park and Lin (2020) [19] | Comparison of recycled and upcycled fashion | Product type and attitude-behavior gap | The two product groups formed different value and risk patterns and should be examined by category. |
| Shrivastava et al. (2021) [38] | Online clothing rental and social-media influence | Rental accessibility and Instagram micro-celebrities | Digital social influence and platform acceptance supported adoption of circular-fashion services. |
| McNeill and Moore (2015) [36] | Qualitative consumer research | Fast-fashion motives and sustainability concern | Fashion identity, convenience, and price competed with ethical intention. |
| Wiederhold and Martinez (2018) [31] | German consumers of green apparel | Ethical attitude-behavior gap | Knowledge, price, availability, and habit interrupted favorable ethical attitudes. |
| Jacobs et al. (2018) [32] | Extension of the value-attitude-behavior hierarchy | Sustainable clothing purchase | Values and attitudes did not automatically become purchases; product and contextual barriers remained. |
| Armstrong et al. (2015) [25] | Finland; perceptions of clothing product-service systems | Rental, swapping, redesign, and repair | Acceptance differed across service models; convenience, ownership preference, and trust shaped responses. |
| Lang and Armstrong (2018) [26] | Female consumers; rental and swapping | Fashion leadership, need for uniqueness, and materialism | Personal motives influenced adoption of collaborative clothing consumption. |

| | | | |
|---|---|---|---|
| Becker-Leifhold (2018) [27] | Collaborative fashion consumption; TPB perspective | Access-based clothing models | Values influenced collaborative consumption through attitudes and planned-behavior pathways. |
| Machado et al. (2019) [28] | Second-hand fashion market | Reuse and second-hand purchase | Economic, environmental, and hedonic motives interacted with risk and condition judgments. |
| O'Nascimento et al. (2026) [23] | Living lab; 19 participants | Modular shirt configurator and participatory customization | Participation encouraged agency, learning, attachment, creativity, and reflection on future care and repair. |
| Bettiga et al. (2025) [17] | Laboratory experiment and consumer survey | Textile repair services and emotional framing | Emotion influenced repair intention and service evaluation, while accessible repair capacity remained a prerequisite. |
| Becchi et al. (2026) [21] | Producer multi-criteria analysis and consumer survey; n=415 | Digital product passport and traceability | DPP information increased confidence and willingness to pay; price and aesthetics still mattered. |

**Table 2 Representative empirical evidence on circular and sustainable clothing decisions [4,6,15,17,19-21,23,25-28,30-39]**

Table 2 shows that surveys and structural models still account for a large share of the evidence, while studies of real choice, repair services, participatory configuration, and digital product passports remain limited. Conjoint analysis places circular attributes in direct competition with price and shows that durability receives comparatively strong support, although price is still the primary constraint [4]. Repair and passport studies expose the conditions under which promises are delivered, since service accessibility and information credibility directly change evaluations [17,21]. Recycled, upcycled, rental, and second-hand clothing create different value-risk combinations and should not be merged into one category. Across studies, recurring barriers include aesthetics, premiums, availability, hygiene, and greenwashing. More stable supports include quality evidence, knowledge, diagnostic information, social influence, and operational services.

## V. ATTRIBUTE-LEVEL EVIDENCE AND TRADE-OFFS

### A. Why Durability Often Outweighs Abstract Circular Claims

Choice-based conjoint tasks require respondents to trade price against several attributes within the same option and therefore come closer to shopping decisions than an isolated question about support for sustainable clothing. In the Australian experiment, durability ranked ahead of recyclability, repairability, and recycled content among the circular attributes tested [4]. This result does not indicate disregard for the environment. It shows that durability connects more readily with immediate product value.

The advantage of durability may arise from three intuitive judgments. It signals reliable quality, a longer period of use permits a replacement-cost calculation, and the resource logic of wearing more and buying less is easy to grasp. Recycled content and recyclability require knowledge of materials and infrastructure, while repairability asks consumers to imagine future failure, repair expense, and contact with a service provider.

This ranking is likely to vary with product category, climate, income, premium, fashion involvement, brand, and visibility and should not be generalized to every market. Outerwear and workwear may place greater weight on abrasion resistance and lifetime, while next-to-skin clothing gives priority to softness, hygiene, and material safety. Future choice experiments should repeat the comparison across countries and categories and use realistic prices, images, garment samples, or tactile materials.

### B. Repairability Creates Value Only When the Service Is Concrete

The phrase repairable leaves many questions unanswered: who performs the repair, which failures are covered, how much it costs, how long it takes, how many years parts remain available, and whether the appearance of the repair can be selected. Without this information, a repair claim is easily interpreted as future uncertainty.

Repairability should be presented as a complete service offer. Accessibility of the construction, nearby service locations, price ceilings, turnaround time, warranty coverage, and the duration of parts supply all shape perceived future risk and control. Emotional framing can attract attention, but operational capacity still determines whether repair is completed [17]. Repair maps, case examples, prices, and service records provide stronger evidence than a brief promotional claim.

Post-repair appearance is also part of the outcome. Invisible repair seeks to restore the original look, while visible mending preserves the history of use and creates a new aesthetic. Formal wear, outdoor clothing,

and individualized garments do not share the same acceptance threshold. Research should record completion of the repair and acceptance of its appearance as separate outcomes.

**C. Recycled Content and Recyclability Need Explicit Boundaries**

A recycled percentage on a hangtag appears precise, although its meaning can vary widely. Feedstock may come from pre-consumer or post-consumer waste, from bottles or discarded textiles, and from mechanical or chemical processing. These sources and routes differ in retained resource value, quality, and future recyclability. A claim should therefore state its measurement basis and system boundary.

Recyclability is equally dependent on applicable conditions. A garment that can be treated in a laboratory may have no receiving facility where the consumer lives. Collection coverage, accepted material composition, disassembly requirements, and the actual processor jointly determine whether a recovery route exists. Brands operating take-back programs should also disclose the final destinations of returned garments.

Recycled and bio-based materials can trigger a stereotype of weaker performance. Product-specific evidence on comfort, durability, care, and safety can reduce this risk [20,29]. Once basic wear performance is demonstrated, environmental value can function as an additional benefit instead of carrying the entire burden of persuasion.

**D. Traceability Can Reduce Doubt and Increase Cognitive Burden**

Digital information can fill gaps created by an invisible supply chain, but consumer attention is limited. Many people value the possibility of checking a claim without reading every field. A digital passport should therefore distinguish a front page from deeper records. The front page supports choice and action, while detailed pages serve verification, repair, resale, and recycling.

In research on digital product passports, fashion products with digital labels received greater confidence and some additional willingness to pay; price and aesthetics still had direct effects [21]. Traceability therefore reduces uncertainty but does not replace judgments of appearance, fit, function, and budget.

Data quality, long-term preservation, and interoperability remain weak points. If a passport disappears when a brand closes, the record can no longer support second-hand trade or recycling. Future studies could use clicks, dwell time, and actual service events to distinguish fields used in decisions from those that merely provide reassurance or create information overload.

The attributes consumers notice most easily are not always those with the greatest capacity to retain resource value. Figure 4 positions the principal attributes in a two-dimensional space of salience in purchase decisions and potential for retaining resource value, using the relative direction of current evidence. These locations support mechanism comparison and are not pooled statistical effect sizes [4,7,8,10-14,16-18,21,23,25-28,39].

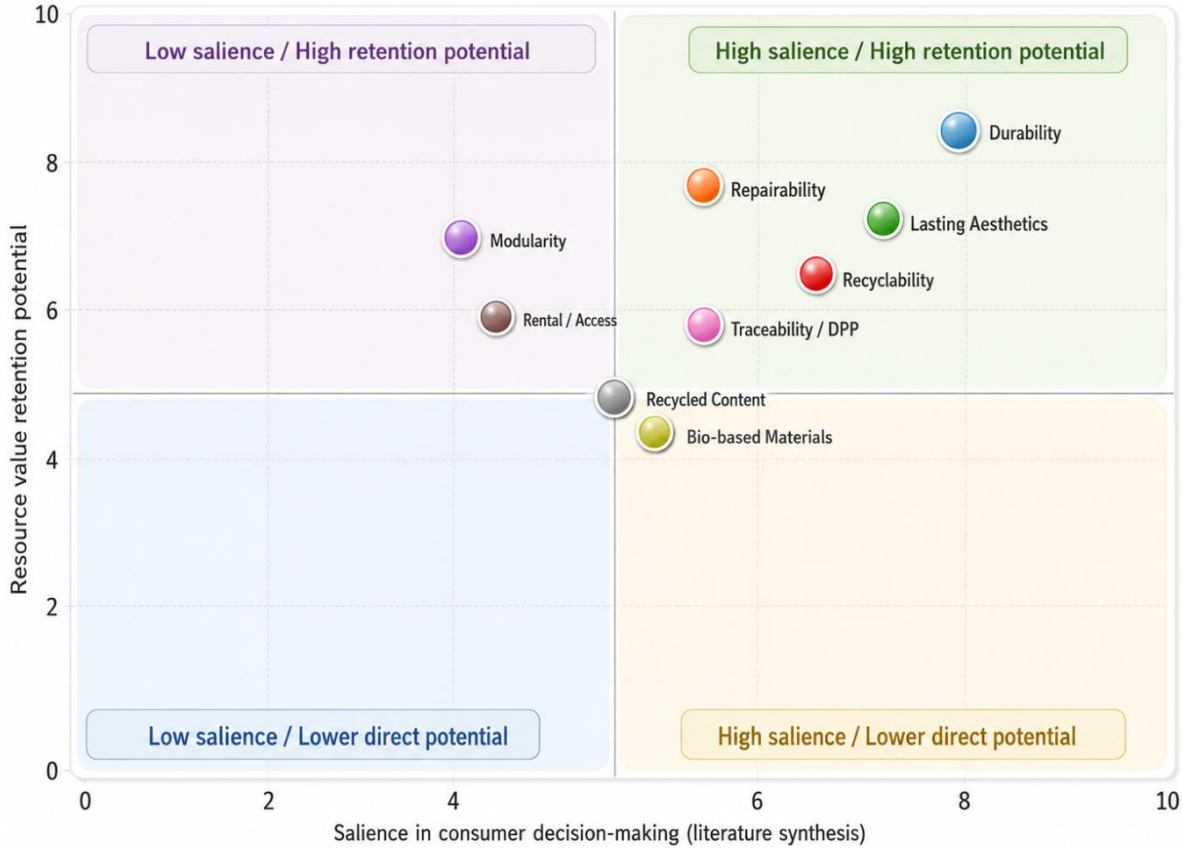


**Figure 4 Qualitative positioning of circular design attributes by consumer salience and resource-value retention potential [4,7,8,10-14,16-18,21,23,25-28,39]**

The upper-right region of Figure 4 contains durability, repairability, lasting aesthetics, and recyclability. These attributes combine relatively high resource potential with some consumer visibility, although each is constrained differently. Repair depends on a service network, lasting aesthetics varies with personal preference, and recyclability depends on processing facilities. Modularity has strong resource potential but may receive little attention at purchase because it requires explanation and learning. Recycled content, traceability, and digital product passports occupy the middle area; their value depends on clear accounts of origin, percentage, and data meaning. Rental and access-based models may raise utilization, yet ownership preference, hygiene, and convenience continue to affect acceptance. The upper-left region reminds designers that attributes with high potential but low visibility need physical experience, service commitments, and verifiable evidence.

The same attribute can generate opposite evaluations under different category, price, and service conditions. Table 3 follows the consumer judgment process and sets out the mechanisms, boundary conditions, common failure points, and evidence needs associated with circular cues. It helps identify where technical feasibility is interrupted by practical conditions [4-6,15,17,19-30,39-42].

| Circular cue | Possible mechanism | Boundary condition | Common failure point | Evidence required |
|---|---|---|---|---|
| Durability | Quality inference; cost per wear; fewer replacement difficulties | Category, price time scale, and expected wear frequency | No test evidence, or durability does not displace a new purchase | Standardized performance, warranty, and use assumptions |
| Repairability | Perceived control; lower future risk; brand relationship | Repair price, location, skill, turnaround time, and post-repair appearance | Service remains promotional or parts are unavailable | Repair map, service terms, and parts-supply period |
| Recycled content | Environmental value; innovation; identity expression | Feedstock origin, performance, skin contact, and premium | The percentage is unclear or is mistaken for complete circularity | Chain of custody, feedstock definition, and equivalent performance |
| Recyclability | End-of-life responsibility; material management | Collection and processing infrastructure | A technical route exists but consumers cannot use it | Accepted composition, return route, and recovery-destination report |

| | | | | |
|---|---|---|---|---|
| Traceability/DPP | Trust; diagnosticity; reduced information asymmetry | Data relevance, knowledge, verification, and interface burden | Dense, unverified information increases doubt or fatigue | Layered information, third-party verification, and persistent records |
| Emotional longevity | Attachment; identity; narrative value | Personal relevance and changes in body shape or aesthetics | Novelty fades or personalization limits resale | Longitudinal use, alteration options, and repair history |
| Rental/resale | Access, lower ownership burden, and residual value | Hygiene, condition, logistics, and ownership preference | Convenience and trust are weaker than direct purchase of a new product | Condition standard, proof of cleaning, simple return, and transparent pricing |

**Table 3 Mechanisms, boundary conditions, and failure points in circular apparel decisions [4-6,15,17,19-30,39-42]**

Table 3 locates the problem at the point of implementation. Durability requires standardized tests and evidence that it displaces new purchasing. Repairability is limited by parts, price, distance, and post-repair appearance. Recyclability has practical meaning only when it connects to a usable collection route. An unclear recycled percentage may be read as proof that the entire garment already forms a closed loop. A digital passport containing extensive but unverified data can increase skepticism and fatigue. Emotional longevity, rental, and resale are more sensitive to personal relevance, condition, hygiene, and ownership preference. Evidence cannot be applied generically: performance, service, material chains, and end destinations require separate proof.

## VI. FROM PURCHASE INTENTION TO USE, REPAIR, AND RETURN

Positive survey responses are often weakened step by step when consumers reach fitting and checkout, where price, handle, size, style, and uncertainty become immediate. The intention-behavior gap is not a single jump. It consists of smaller gaps across attention, understanding, trust, comparison, purchase, repeated wear, repair, resale, and return.

Environmental benefits usually appear in the future, while a premium is paid in the present; price therefore remains a persistent barrier [4-6,31,32,36]. Limited budget and low willingness to pay are different constraints. A consumer may value durability and still be unable to afford the more expensive option. Experiments using only a small hypothetical premium are likely to overstate demand. Transaction records, field experiments, and choices made at real prices capture budget constraints more accurately.

Style and fit determine whether a garment enters the consideration set. Consumers with favorable environmental attitudes may still reject products that do not meet aesthetic or size expectations [5,6,36]. Modular connections, reinforcement zones, recycled-material textures, and visible mending all change appearance. Research stimuli should display these details realistically; written descriptions can provide support but cannot replace the visual and tactile evidence.

Service availability directly affects perceived behavioral control. The absence of a nearby repair point, no collection channel in the region, or a complicated rental-return process transfers the work of the circular system to the consumer. Convenience should be treated as part of design, and product attributes and service routes should be tested within the same experiment. Social norms, habits, and the choice environment can also alter the effect of an intervention [42].

Many studies do not record the consumer's existing wardrobe or purchase frequency. Frequent shoppers may add sustainable garments without reducing the total number they own. Wardrobe saturation, replacement intention, expected wear frequency, and the destination of displaced garments help distinguish replacement purchases from cumulative purchases. Their environmental implications differ substantially.

Moving from a sustainable attitude to retained resource value requires product comparison, purchase, wear, repair, and a destination decision. Figure 5 uses a narrowing funnel to show these points and places enabling factors and causes of loss on either side [4-6,17,21-23,25-29,31,32,36,37,41,42].

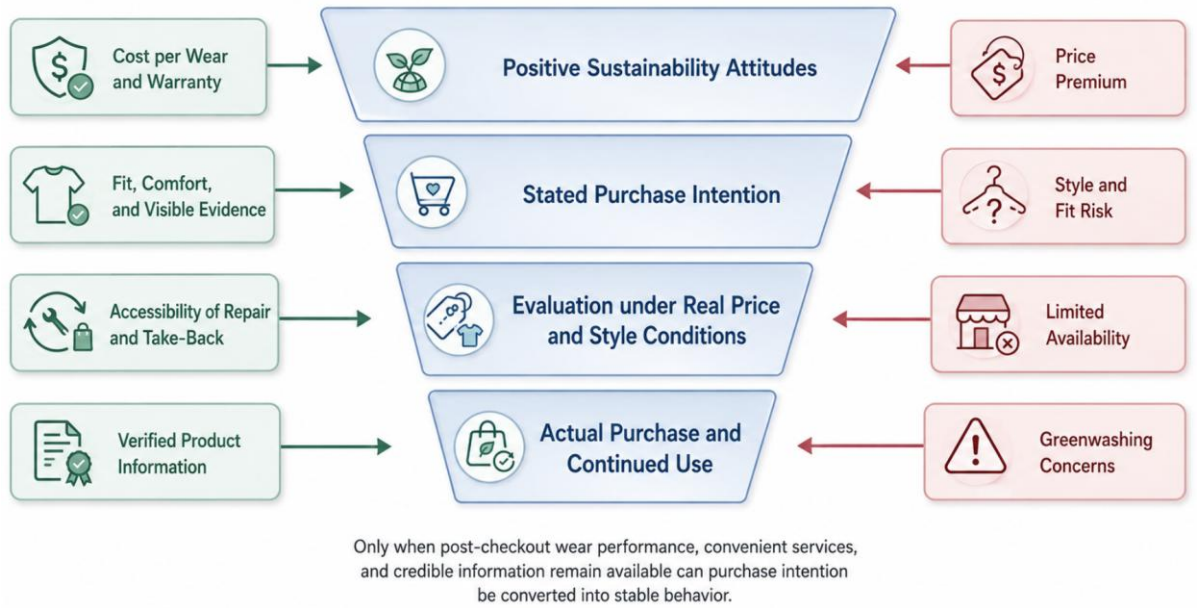


**Figure 5 The intention-behavior gap and intervention points for circular apparel [4-6,17,21-23,25-29,31,32,36,37,41,42]**

The top of Figure 5 represents broad favorable attitudes. By the time consumers state a purchase intention, price, style, and fit have already excluded some options. Actual transactions are further affected by product availability, service distance, operating burden, and greenwashing concerns. Cost-per-wear information, evidence on fit and comfort, convenient repair, and clear labels act at different points in the funnel. The final stage combines actual purchase with continued use to emphasize that checkout is not the endpoint. Wear frequency, repair, resale, and recycling determine whether product and material value is retained.

## VII. INTEGRATED FRAMEWORK AND RESEARCH AGENDA

Product-design research explains how clothing can be kept in use, disassembled, repaired, and recirculated. Consumer research explains value, trust, attitude, perceived control, and risk. The two bodies of evidence remain only partially connected. This review treats circular attributes as product cues created by design, supported by evidence, and interpreted by consumers. Their effects depend on the product category, service capability, and conditions for action.

Research variables need to return to observable design. Sustainable material, circular design, and eco-friendly clothing cover too many features to identify which one produces an effect. Experiments should specify material composition, joining methods, and service content and should display the evidence that consumers can actually obtain in the market. Durability can be represented through tests and warranties. Repairability can be represented through component access, price, and distance. Recyclability requires both material composition and a local return route.

Trade-offs among multiple attributes deserve direct study. Mono-material construction can reduce stretch, detachable modules add fasteners, recycled fibers may change handle and cost, and reinforcement can add weight. Conjoint analysis can estimate how consumers treat these combinations, but text-only scenarios remain abstract. Images, garment prototypes, tactile materials, and try-on sessions offer a closer representation of real purchasing.

Purchase intention records an early stage, so observation should continue after purchase. Follow-up data can include wear frequency, care, repair, resale, return, and retention. With privacy consent, a digital product identity can connect service events and transfers of ownership. Wardrobe research can also establish whether a circular product displaces a conventional purchase or becomes an additional item.

Consumer segmentation should not rely only on age and gender. Income, climate, product category, fashion involvement, repair skills, sustainability knowledge, and cultural norms can all alter a pathway. Knowledge improves comprehension and may also lead consumers to scrutinize weak claims more severely [15]. Fashion leadership may encourage rental or upcycling through a desire for uniqueness [26], while also increasing purchase frequency. Segmentation variables should be tied to the mechanism under examination.

Willingness to pay, stated preference, page clicks, actual purchase, repeated use, and repair events are different outcomes. A paper should identify the stage measured and should not interpret intention as an

environmental effect that has already occurred. Circular contribution depends on how long product utility is retained and whether new production and purchase are reduced.

Broad sustainable-clothing scales cannot distinguish durability, repair, recycling, and traceability. Table 4 converts the more stable mechanisms into working definitions, candidate measurement statements, and contextual control variables for surveys, choice experiments, and product-stimulus studies [4-6,15,17,20-24,29,30,40-42].

| Construct | Working definition | Candidate measurement statement | Suggested outcome or control variable |
|---|---|---|---|
| Perceived durability | Expectation that function and appearance will remain after normal wear and care | This garment is likely to remain usable after repeated wear and care. | Expected years of use, warranty, category, and wear frequency |
| Perceived repairability | Judgment of the difficulty and feasibility of restoring function | Major damaged components can be repaired without excessive time or expense. | Repair price, distance, skill, and component availability |
| Perceived recyclability | Belief that the material can enter an accessible recovery route | A practical collection and recycling route is available for this garment. | Local facilities, material composition, and return intention |
| Traceability-information diagnosticity | Extent to which product information supports judgment and action | This information helps me evaluate its environmental and functional claims. | Prior knowledge, information volume, and verification source |
| Functional value | Expected performance, comfort, fit, and quality | The circular features will not reduce the wear performance I require. | Garment type, visibility, and skin contact |
| Economic value | Perceived benefit relative to purchase and future costs | The expected lifetime and service support justify this price. | Income, budget, cost per wear, and residual value |
| Environmental value | Judgment that resource inputs and waste will be reduced | This design may keep materials in a useful cycle. | Environmental concern and claim specificity |
| Green trust | Belief that claims and services will be delivered | The evidence supporting the circular claim is reliable. | Brand familiarity, certification, and greenwashing concern |
| Aesthetic and hygiene risk | Concern about style, fit, cleanliness, or social acceptance | This circular feature may make the garment unsuitable for me. | Product visibility and second-hand/rental context |
| Perceived behavioral control | Judgment of one's ability to purchase, maintain, repair, and return | I can use the services needed to keep this garment in circulation. | Availability, service distance, time, and skill |
| Purchase intention | Likelihood of choosing the specified garment under realistic conditions | At the stated price, I would choose this garment. | Actual price, competing products, and transaction tracking |
| Circular-use intention | Likelihood of long-term use, repair, resale, or return | Use, repair, resale, and return should be measured with separate items. | Longitudinal behavior, event records, and wardrobe displacement |

**Table 4 Construct definitions and candidate measurement directions for circular apparel research [4-6,15,17,20-24,29,30,40-42]**

Table 4 separates recognition of a design attribute from evaluation of that attribute. Perceived durability, repairability, recyclability, and information diagnosticity test whether respondents identify the feature. Functional, economic, and environmental value record expected benefits. Green trust, perceived risk, and perceived behavioral control capture credibility and feasibility. Purchase intention and circular-use intention are measured separately to distinguish one purchase from later wear, repair, or return. Price, category, skin contact, service distance, and prior knowledge are contextual variables. The proposed statements still require pretesting for a specified product, language, and sample.

## VIII. DESIGN AND COMMUNICATION IMPLICATIONS

There is no context-free optimum between a mono-material shell jacket and an elastic blend. If a limited amount of stretch improves fit retention and substantially increases wear frequency, a less recyclable blend may achieve a longer active life. Design records should document trade-offs among performance, use, and recycling compatibility and should continue to seek detachable connections or compatible treatment routes.

Durability evidence should vary by category. Outerwear can report abrasion resistance, seam strength, hydrostatic pressure, zipper reliability, and colorfastness. Knitwear places more emphasis on pilling, dimensional stability, and recovery. Children's clothing also needs information on size adjustment and

replacement of high-wear parts. Expected use, test conditions, and warranty coverage allow more informed judgment than a broad claim of long-lasting quality.

Repairability should enter the design process before the prototype is finalized. Failure-mode analysis can identify the components most likely to limit service life and guide the placement of openings, seam allowances, standard fasteners, spare parts, and repair instructions. Service price, turnaround time, and logistics need parallel planning. Repairable construction does not create practical value when consumers cannot reach the service.

Product communication should separate recycled content from recyclability. The first describes the source of the input; the second describes a possible destination after use. Material composition, verification method, and operational route should each be explicit. Where local infrastructure is limited, communication can give priority to durability, repair, resale, and existing take-back programs and avoid unsupported closed-loop claims.

Digital product passports are suited to layered presentation. The first page can answer questions about composition, durability evidence, repair access, and return procedures. Deeper pages can preserve supplier, chemical, certification, and life-cycle records. With user consent, repair, resale, and condition changes can be added to the history for later owners, repairers, and recyclers.

Aesthetic quality continues to determine whether circular clothing is worn. Replaceable modules can offer moderate variation, visible mending can retain traces of care, reversible construction expands styling options, and recycled-material texture can become part of the design language. Circular attributes need to be integrated with silhouette, color, and detail. As an added label alone, they are unlikely to support long-term use.

Circular strategies move from prototype to use only when product construction, purchase-stage evidence, and later services remain connected. Table 5 aligns attribute goals with product decisions, evidence at purchase, system conditions, and consumer outcomes and can be used to locate the stage at which a claim loses support [4,7,8,10-18,20-23,25-30,39,41,42].

| Attribute goal | Product decision | Evidence at purchase | Service or system requirement | Consumer outcome to be tested |
|---|---|---|---|---|
| Extend active life | Reinforce failure points; maintain fit and appearance; simplify care | Test results, warranty, and use context | Care guidance, quality support, and spare parts | Choice, expected use, actual retention, and displacement of new purchases |
| Executable repair | Accessible connections and replaceable high-wear components | Repair diagram, indicative price, and time | Spare parts, trained service, logistics, and appearance options | Perceived control, repair intention, and completed repair |
| Material circulation | Compatible materials and separable components | Composition diagram and accepted route | Collection, sorting, and verified processors | Return intention, actual return, and final destination |
| Credible recycled input | Verified feedstock origin and performance control | Recycled percentage, origin, and certification boundary | Chain of custody and quality assurance | Trust, performance expectation, and willingness to pay |
| Adaptive use | Adjustable fit, reversible wear, or modular construction | Demonstration and configuration options | Alteration, replacement modules, and instructions | Attachment, multiple use, wear frequency, and retention |
| Life-cycle transparency | Persistent identity and layered information | QR/DPP summary and verification | Data maintenance, transfer, and access governance | Diagnosticity, trust, information use, and decision time |
| Circular access model | Design suited to multiple users and restoration of condition | Clear price, cleaning, condition, and return terms | Inspection, cleaning, refurbishment, and logistics | Adoption, satisfaction, repeated use, and substitution for ownership |

**Table 5 Coordination of circular attributes with product design, evidence, and service provision [4,7,8,10-18,20-23,25-30,39,41,42]**

Every row in Table 5 contains both physical design and system provision. Life extension and repair depend on reliable construction, accessible components, warranties, spare parts, and a repair network. Material circulation requires compatible composition and collection, sorting, and processing capacity. A digital identity with no continuing maintenance or ownership-transfer mechanism cannot effectively support second-hand trade and recycling. Adaptive construction and access-based models depend more heavily on experience and operations, and labels alone cannot demonstrate their value. Outcome measures must also fit the goal: durability calls for retention and displacement of new purchases, repair requires records of completed events, and recycling requires tracking of actual returns and final destinations.

## IX. CONCLUSION

In everyday shopping, consumers continue to evaluate circular clothing through quality, price, fit, comfort, aesthetics, convenience, and trust. Durability has a direct relationship with fewer replacements and is relatively easy to understand. Repairability requires clear prices, accessible service, and long-term spare-part support. Recycled content and recyclability need explicit material boundaries and usable routes. Traceability can reduce uncertainty, while a poorly organized interface increases reading burden. When circular advantages are invisible at purchase or unusable afterward, the product is unlikely to move from a niche option into the mainstream market.

Purchase intention describes a preference at one point in time. Wear frequency, care, repair, resale, return, and displacement of new purchasing determine whether product and material use is actually extended. Research should employ identifiable garment prototypes, realistic prices, and category-appropriate performance information and should continue observation after purchase. Conjoint analysis, field experiments, product prototypes, digital service records, and wardrobe studies can reveal trade-offs that general surveys often miss.

A credible circular claim must be grounded simultaneously in the garment, verifiable evidence, and a usable service or recovery system. When these three elements remain connected, consumers are more likely to understand circularity as quality, convenience, and everyday value and to carry that understanding into wearing, repair, and return.

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