Design-Durability: Insights from Product Case Analyses

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Abstract

Background Durability has been the key to creating long-lasting products that increase usage and functionality. The concept of design-durability expands traditional perspectives on product durability. Although this emerging concept was introduced in one of the studies, design-durability was not explained in terms of the key factors that influence and define it. As a result, this exploratory study aims to understand and define design-durability better by identifying factors that allow design features to transcend the constraints of single product lifespans and to adapt across generations.

Methods This study used a three-phase methodology: a literature review, product analysis, and content analysis. We extracted design-durability attributes by integrating theoretical insights with practical examples.

Results A total of 22 factors that contribute to and explain design-durability were identified. These factors include emotional and psychological durability, resilience, aesthetic continuity, and strategic adaptability, demonstrating a novel approach to sustainable product development.

Conclusions This study contributes to design-durability by identifying factors that were defined considering the designer's insights, which could further be extended in future research by exploring consumer perspectives and insights from various experts to enhance sustainable design practices.

Keywords Design-durability, Content Analysis, Design Continuity, Product Durability, Design Relevance

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Citation: Jetti, R., & Dhar, D. (2024). Design-Durability: Insights from Product Case Analyses. *Archives of Design Research, 37*(5), 131-172.

http://dx.doi.org/10.15187/adr.2024.11.37.5.131

Received : Aug. 20. 2024 ; **Reviewed :** Sep. 10. 2024 ; **Accepted :** Sep. 27. 2024
pISSN 1226-8046 **eISSN** 2288-2987

1. Introduction

In the dynamic realm of product design, conventional approaches have focused on physical durability as a measure of product excellence (Chapman, 2009, 2016). Over time, product durability has expanded to encompass emotional, psychological, and strategic dimensions (Chapman, 2009; Haines-Gadd, 2019; Haug, 2019; Razeghian & Weber, 2019). However, the primary goal remains to reduce the environmental impact by increasing a product's physical and usage lifespan, leading to a more sustainable product lifecycle. A more sophisticated and influential concept named design-durability (Jetti & Dhar, 2024) has emerged. This concept emphasises the lasting relevance of specific design features across product iterations, adapting to changing market conditions, consumer expectations, and technological advancements. Design-durability encourages designers to select product features strategically, allowing their use across various products and promoting sustainability by incorporating flexible, adaptable elements. Aligning with Farina et al.'s (2013) research on sustainable design, design-durability contributes to the circular economy by reducing the need for frequent redesigns, optimising resource use, and minimising environmental impacts. Unlike emotional and psychological durability (Chapman, 2009; Haug, 2019), which extends the current usage of a product by fostering user attachment, design-durability ensures the persistence of design elements even beyond the physical lifespan of a product. For example, modular components can be reused across systems to help companies reduce costs while improving quality and ensuring compatibility. This approach also supports strategic durability by embedding sustainability into broader business goals, allowing firms to adapt to market dynamics while prioritising long-term environmental responsibility.

Design-durability differs from physical durability, which focuses on a product's ability to resist environmental stresses, and from timeless or slow design, which emphasises the aesthetic and functional relevance of a product over time. Instead, design-durability ensures that specific features can persist across multiple product lifecycles. This user-centred, environmentally conscious approach promotes sustainable practices and reduces environmental impacts, fostering a shift in product design philosophy that aligns with long-term sustainability goals.

Design-durability aligns with user-centred design by ensuring adaptable, emotionally engaging features that remain relevant to evolving user needs. This supports long-term sustainability and encourages practices that maintain the relevance and usefulness of design in a changing market. Although current research has theoretically explored the concept of design-durability and offered some examples, the present literature has not adequately addressed practical implementation across various products, as the concept remains in its early development stages. This exploratory study aims to deepen the understanding of design-durability from designers' viewpoints, focusing on the factors that enable design features to transcend the limitations of single product lifespans and adapt through successive iterations. The primary research question is: "What factors enable design features to endure across diverse products and iterations?"

2. Methodology

To investigate the question, "What factors enable design features to endure across diverse products and iterations?" The study adopts a three-phase methodological approach (Figure 1), which closely resembles Kien et al. (2014). This study employed a comprehensive examination of existing literature and product analysis through focus groups. It aimed to explore the continuity of features and durability in product designs. Initially, a review was conducted to identify relevant literature on feature continuity and design-durability. The literature review was followed by a series of product analyses that were carried out with design experts. The approach was designed to integrate theoretical findings with practical insights, thereby enhancing the understanding of what contributes to the enduring nature of product designs.

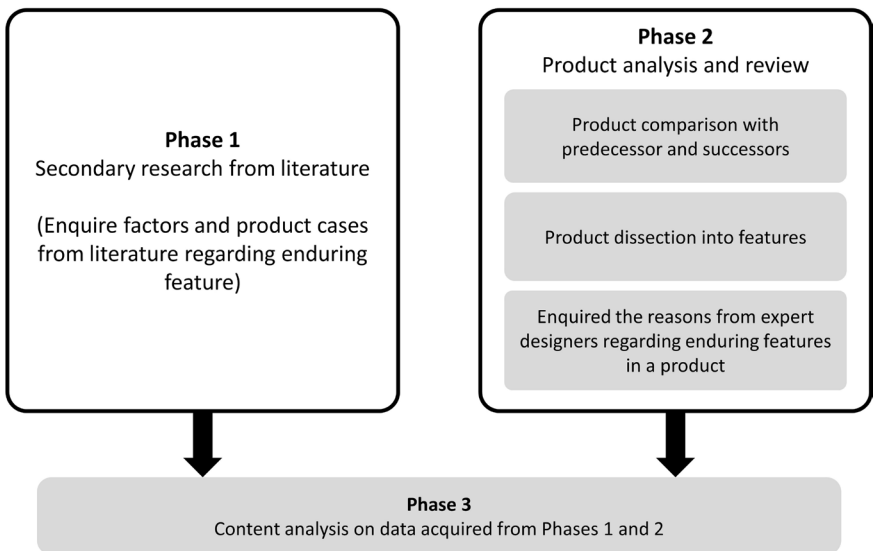

Figure 1 Overview of Study Methodology

2. 1. Phase 1: Review of Scholarly articles

In this phase, an exploratory systematic search was conducted using two online databases, Google Scholar and Scopus, employing keyword searches with Boolean operators. The search was carefully limited to disciplines relevant to the research objectives — Materials science, business and management, social sciences, economics, arts, multidisciplinary fields, decision sciences, and psychology — while excluding less relevant fields such as medical science, construction, and branches of engineering that are primarily focused on lifecycle analysis, production methods or material durability. However, design-related fields, including design engineering and craft, were included, as they meaningfully contribute to understanding feature continuity and design-durability.

The keyword strategy was designed to capture a broad range of durability-related concepts, including longer-lasting designs, durable design, and design-durability, as well as how specific design features have remained stable across product life cycles. Keywords such

as “feature continuity,” “feature longevity,” “feature consistency,” “feature adaptability,” “design continuity,” “design longevity,” “design consistency,” “design adaptability,” “timeless design,” and “product durability” were employed to identify relevant studies (Table 1). These terms cover both emotional and psychological durability, strategic approaches to sustainable design, and philosophies of resilience and timelessness, which are closely associated with design-durability (Jetti & Dhar, 2024).

While the keyword strategy was comprehensive, it also has its limitations. The emphasis on “feature” and “design” continuity, longevity, adaptability, and acceptance may have led to an emphasis on feature-centric studies, potentially overlooking broader aspects, such as emotional or psychological durability, which are crucial to product design. Furthermore, the absence of terms related to the circular economy, lifecycle assessments, or material durability may have omitted important systemic and technical perspectives. However, keywords like “product durability” ensured coverage of key dimensions, including physical, emotional, psychological, and strategic durability, circular economy, and product attachment.

To ensure methodological rigour, several criteria were applied to the article selection process. Articles were selected based on their novel theoretical contribution and robust research methods, particularly those that have employed empirical evidence, case studies, or innovative approaches to product durability. Only studies explicitly focused on durability — physical, emotional, psychological, or strategic—were included. Articles that lacked a strong connection to product design or durability were excluded from the final selection. Preference was given to studies that provided recent, innovative perspectives, ensuring that the review reflected contemporary trends and challenges in design-durability. Foundational or seminal works were included if they contributed significantly to the field’s theoretical foundations. Studies incorporating engineering, business, psychology, and sustainability perspectives to address product durability in design were prioritised.

This focused approach ensured that the literature reviewed was directly aligned with the research questions. Only English-language articles published between 2000 and 2024 were considered, as most significant research on obsolescence and product durability in design falls within this timeframe (Jetti & Dhar, 2024; Mesa et al., 2022).

This review phase is essential for analysing the literature and identifying significant trends and constructs contributing to the enduring nature of product designs. The findings aim to enrich theoretical frameworks and practical applications in product design.

The inclusion and exclusion criteria followed during the review are shown below:

a. Inclusion Criteria:
    - Relevance to design-durability was required, including aspects such as feature longevity, material resilience, emotional durability, or adaptability.
    - Only peer-reviewed academic articles or conference papers were included to ensure credibility.
    - Studies had to be in English and have full-text access to be considered.
    - Articles published between 2000 and 2024 were included to maintain contemporary relevance.

- Studies providing significant theoretical or empirical insights on design-durability were selected.

b. Exclusion Criteria:
   - Studies from unrelated fields, such as medical science, construction, and non-relevant engineering disciplines, were excluded.
   - Articles mentioning durability without linking it to product design or obsolescence were excluded.
   - Non-peer-reviewed publications, such as white papers, blogs, magazine articles, and thesis (Masters and PhD), were excluded.
   - Articles published before 2000 were excluded unless they were foundational or seminal works in design-durability.

Table 1 Search string used for the study

Search string
("product durability" AND "design")
(("feature continuity" OR "feature longevity" OR "feature adaptability" OR "feature acceptance" OR "design continuity" OR "design longevity" OR "design adaptability" OR "design acceptance") AND ("timeline" OR "sustainable design" OR "timeless"))

Two trained researchers independently reviewed 5,506 articles, removing duplicates to narrow the pool to 5,320. An initial title-based screening focused on articles strongly associated with product durability and design, reducing the selection to 1,173. These were then subjected to abstract review, and 146 articles were finalized for full-text analysis. Only peer-reviewed articles were considered during this process. Articles published in institutional sources, such as master's and PhD theses, were excluded. Articles unanimously deemed unsuitable by both reviewers were removed.

Further, 24 articles related to non-tangible studies, such as visual design, have been removed. From the remaining 122 articles, the literature was categorised into two groups: core articles and application-oriented articles. Of these, 97 articles focused on practical applications were excluded, leaving 25 core articles for content analysis. These core articles, which introduced new attributes and theoretical insights into product durability, provide the foundation for exploring the theoretical basis of design-durability. The distribution of the literature is shown in Table 2.

Table 2 Literature distribution across different concepts and strategies

Article theme	Core articles present	Application–based articles
Emotional durability	9	54
Timeless design	2	11
Ageless design	1	1
Slow design	1	5
Resilient design	1	5
Product attachment	4	6
Circular economy	1	7
Design consistency	3	2
Product DNA	1	0
Psychological durability	2	6

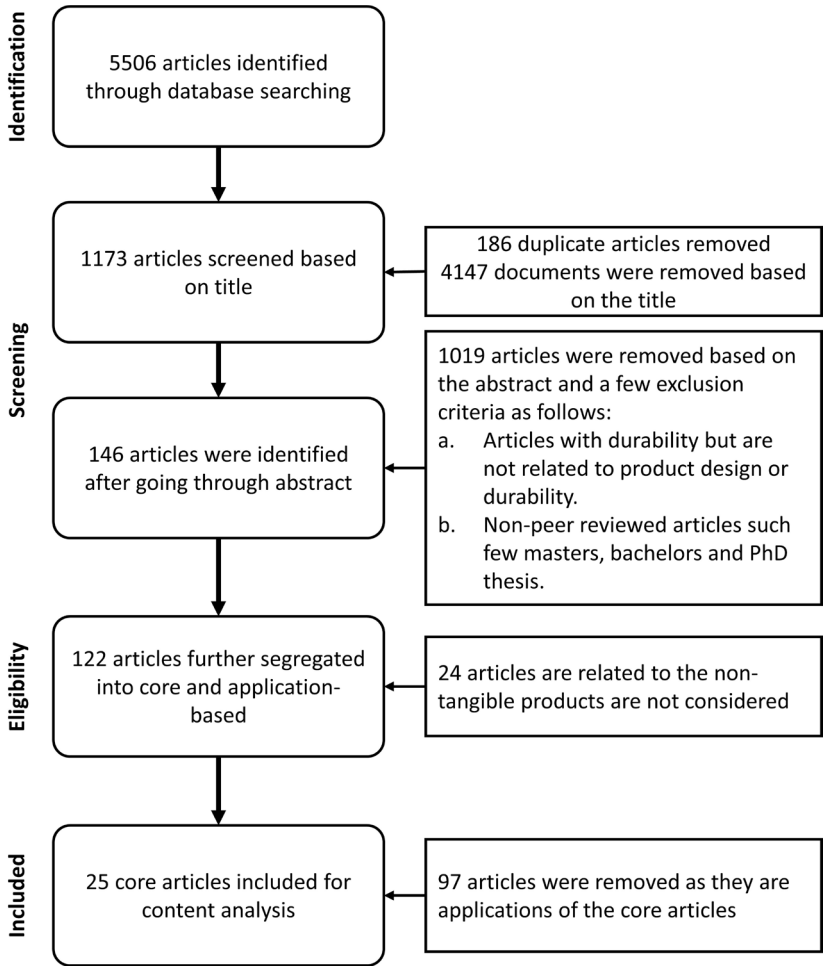

Figure 2 Literature review process

2. 2. Phase 2: Product Analysis and Review

In this phase, various product cases were examined to explore the reasons for the sustained market presence of specific designs. The approach combines two methodologies: comparing products with predecessors with successors and product dissection, as inspired by Aurisicchio et al. (2011) and Laursen & Barros (2022), respectively. Further, the reasons for the feature continuity were enquired using narrative-based enquiry with the participants.

To identify and analyse sustained features and designs, a total of 80 renowned products were initially selected from categories such as décor, transport, home, and kitchen appliances for their iconic or classic designs. The categories of décor, transport, home, and kitchen appliances were chosen because they feature both technologically advanced and classic, iconic products, which are also among the most frequently used in daily life. These products exemplify both functional durability and timeless appeal, making them ideal for studying design-durability. The selection of these products was carried out by the three members of the research team. They ensured that the products would be familiar and easily recognisable to participants. The profiles of the researchers involved are shown in Table 3. Researchers were selected for their expertise in the fields of product design and industrial design. Those

who participated in this stage were chosen for their proficiency in design practice and conducting experiments in research.

Table 3 Profiles of Design Researchers

Interview	Designation and Research Experience	Design Expertise	Research Domain
Researcher 1	PhD Scholar 5 years 5 months	Industrial Design, 6 years	Product durability
Researcher 2	PhD Scholar 5 years	Product Design, 12 years	Medical device design
Researcher 3	PhD Scholar 4 years	Product Design, 5 years	Design Ethics

The study filtered the initially selected 80 products to identify those that maintained stability and consistency of features despite technological changes. The objective is to identify models that have sustained and remained in production beyond the typical lifespan of their category. Models that have sustained this way can be considered more desirable than others. Literature defines these average lifespans as 15-20 years for electronics, 7-15 years for kitchen appliances, and 10-20 years for automobiles (Maulia & Halimatussadiah, 2018; Mendjargal et al., 2022; Terzi̇Oğlu, 2013). During product filtration, care was taken to ensure a balanced distribution across hedonic and utilitarian dimensions to prevent bias in participant responses. Hedonic products are highly associated with emotional and attachment aspects, and utilitarian products are heavily associated with functional aspects of the product only (Haug, 2019). This includes five utilitarian (Mosquito rackets, Vacuum cleaners, Wet mops, Lemon squeezers, and Safety razors), five hedonic (Coca-Cola, Chuck Taylor, Cars, Fountain pens, and Table lamps) and five mixed products (Motorbike, Hexa-Dumbbell, and Pencils, Door handle, and Safety Pin) that are the combination of hedonic and utilitarian. Finally, fifteen standout products were identified and placed on a timeline (Figure 3a, 3b, 3c), illustrating their historical context, innovation parallels, and feature evolution.

Product Reviewing

Following the selection of suitable products for the study, participants were tasked with identifying the enduring features, along with the reasons for their continued existence. A standardised protocol was provided to the participants via webmail to ensure consistency, and further clarification was provided through an audio call.

Participant selection

The study required insights from designers, as design-durability deals with enduring features and the design decisions that made them enduring. Twelve industrial designers, each with over five years of experience and a strong background in product design, were selected for the study, with the five-year experience criterion for expertise based on Eteläpelto's (2000) study. These experts, chosen for their innovative portfolios and diverse real-world product design experiences, are essential for addressing design-durability through their ability to apply practical, innovative solutions across various product categories. The group consisted of eight male and four female industrial design experts from India, each affiliated with fabrication units or design studios specialising in areas such as installations, automotive design, prototype manufacturing, electronics, and medical products. Table 4 details their expertise and backgrounds.

Table 4 Participants and their participatory stage

Interview	Products they worked with	Expertise and years of experience	Participated in the stage
Participant 1	Electric motorcycle, medical devices, Smartwatch	Automotive designer, five years	Feature and functional dissection and Interview
Participant 2	Inhalers, Vaporizer, Shaker, Camera lens attachment	Industrial designer, six years	Feature and functional dissection and Interview
Participant 3	Composter, Electric cigarette, Washing machine filter, Medical mask, Green gym	Industrial designer, six years	Feature and functional dissection
Participant 4	Jogger park seating, Vacuum cleaner, cloth lane design, Sink waste remover	Industrial designer, five years	Feature and functional dissection and Interview
Participant 5	The urinating device, Deodorizing kit	Industrial designer, Eight years	Feature and functional dissection and Interview
Participant 6	Hydration vest for hikers, Floor viper, Teapoy table	Industrial designer, five years	Feature and functional dissection and Interview
Participant 7	Ferro mania toy, Microscope toy, Hanging lamp, Jute jacket, Multi–utility Cardboard chair, Installation	Industrial designer, ten years	Feature and functional dissection and Interview
Participant 8	Customised motorcycles, Medical equipment for Endoscope and Duodenoscopy, Dome for mushroom cultivation	Industrial designer, seven years	Feature and functional dissection
Participant 9	Waste management kit for Scavenging employee, Cumin seeder, Polyhouse, Calves strengthening device	Industrial designer, eight years	Feature and functional dissection and Interview
Participant 10	Modular display devices, delivery van based on REVA electric car, Styling of various scooters, motor controller, Swing arm covers, Rain guard system for rubber plantations	Industrial designer, 15 years	Feature and functional dissection and Interview
Participant 11	Ergonomic neck rest, Blender, composter unit, Locomotive suspension seat	Industrial designer, six years	Feature and functional dissection
Participant 12	Dishwasher unit, Furniture design	Industrial designer, six years	Feature and functional dissection

Procedure and Protocol:

After attaining the final product collection, this segment involved a detailed dissection and analysis of the products across multiple levels to unearth the enduring features of selected products. Since the task is multi-faceted and time-consuming, the study was separated into three levels to accommodate participants' schedules.

The three levels of the study are as follows:

a. *Level 1*: Comparative Analysis
   Participants compared the product's origin model with its most enduring versions, as illustrated on a timeline in Figures 3a, 3b, and 3c. This step helped identify consistent features and factors that influence core functionalities and usage over time. Insights from this level informed the development of questions for Level 3's narrative-based inquiry.

Figure 3a Products considered for the study

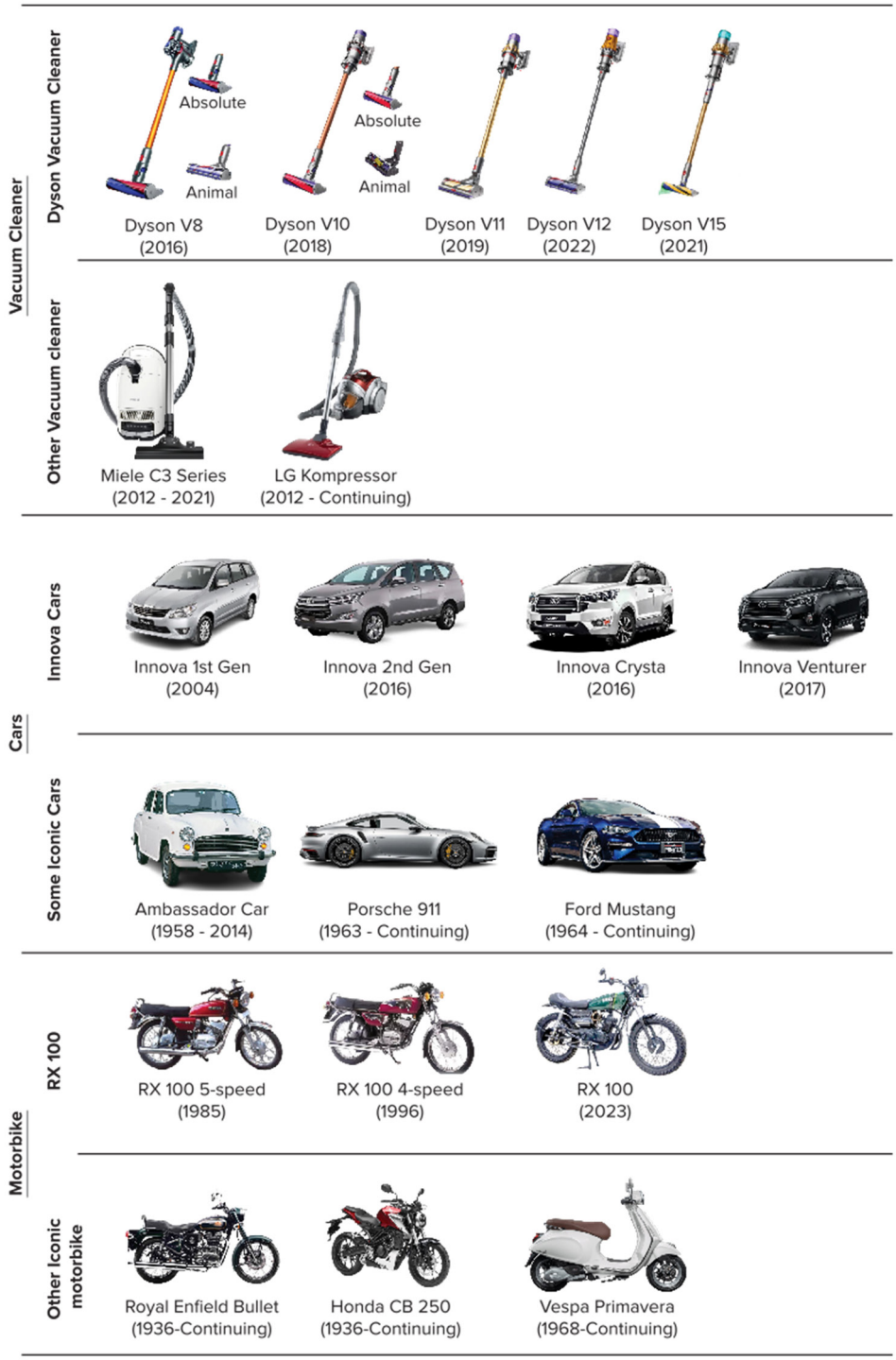

Figure 3b Products considered for the study

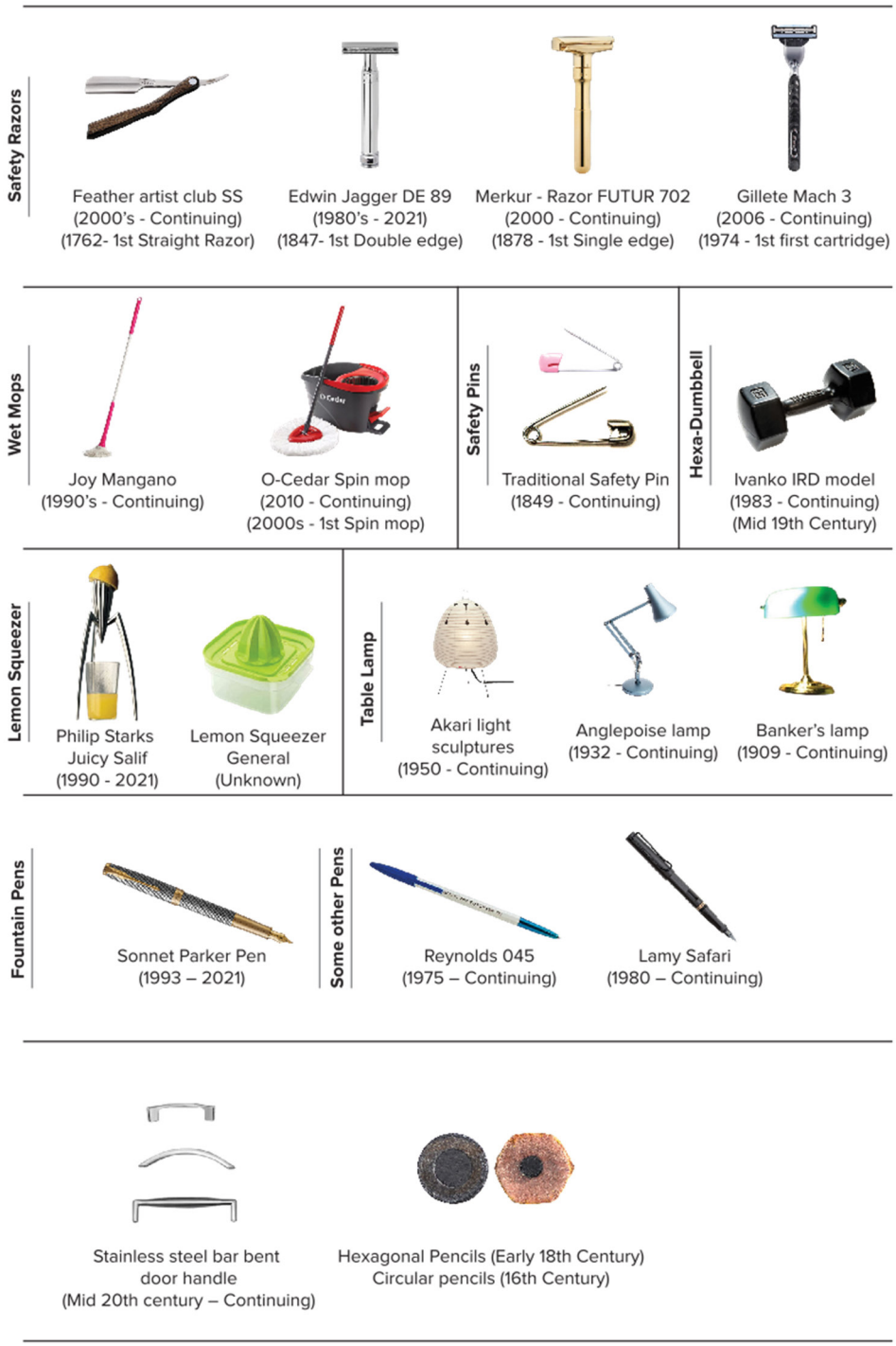

Figure 3c Products considered for the study

b. *Level 2*: Feature and Function Dissection

The most popular and lasting product models were analysed for their features and functions, as documented in Aurisicchio et al. (2011). For instance, the hexagonal shape of the hexa-dumbbell ensures stability, while the black colour conveys durability and

seriousness. Similarly, features and their corresponding functions were analysed. Participants followed a structured protocol (Table 5) to virtually dissect each product, with visual references provided (Figure 3a, 3b, 3c). The protocol outlined specific conditions and examples to guide the analysis of fifteen selected products.

As industrial and product designers, participants were familiar with iconic products and innovations, which reduced the need for physical samples. Due to geographical limitations across India, physical products could not be provided. The dissection task was completed online within three days, with an example shown in Figure 4. The three-day timeframe provided industrial designers ample time to thoroughly analyse various sensory and functional aspects of fifteen diverse products, ensuring detailed and well-considered evaluations. Due to the virtual nature of the setup, additional time was allotted to account for the absence of physical interaction with the products. When participants had difficulty envisioning certain stages, they were instructed to refer to images and videos of the products for better understanding.

Table 5 Protocol for Level 3

S.no	Protocol	Example
1	You see the product from a distance.	If the shape of a car's front headlights is aggressive, it seems more attention–seeking. The design is sharper and has thin lighting structures.
2	You see it from nearby.	A smoother form persuades you to touch and feel comfortable.
3	You see it while holding it in hand.	The peculiar freezing sensation of holding the Coke glass bottle makes it more enjoyable.
4	You see the product while it is packed.	Coke glass bottle demonstrates how the design supports rough transport conditions.
5	You are unboxing or opening the product.	Carbonated drinks need gas to stay fizzy and taste good. Coke glass bottles with tin caps are better at keeping the gas than other material bottles, even in varied climates.
6	You are using the product for the first time.	A pen with a rubbery grip communicates the gripping part to the user.
7	You are watching the product while it is being used.	A person wearing spectacles can make them appear more aggressive and not approachable.

c. *Level 3: Identifying product features and reasons for continuity*

At this stage, narrative-based inquiry was conducted with the same participants from Level 2, focusing on the longevity of product features and their underlying reasons. In this approach, participants were asked to share their experiences and insights, explaining why specific design elements have endured. Through interviews, participants reflect on their interactions with the products, offering narratives that help identify functional and emotional factors contributing to these features' longevity. This method provides a deeper understanding of the underlying reasons for feature continuity across product generations. This approach was modelled after the methodology of Haines-Gadd et al. (2018), where participants were engaged in both analytical and reflective processes. Narrative-based inquiry was only conducted on eight participants as data saturation in the interview data was observed, and no new insights on feature continuity emerged. Interviews lasted one to three hours, during which industrial designers were questioned about certain features' persistence. Images of product models assisted participants in discussing the reasons behind the enduring

design elements. A few participants presented their product dissections through sketches. Figure 4 is a compilation of various insights from several designers combined into one visual representation.

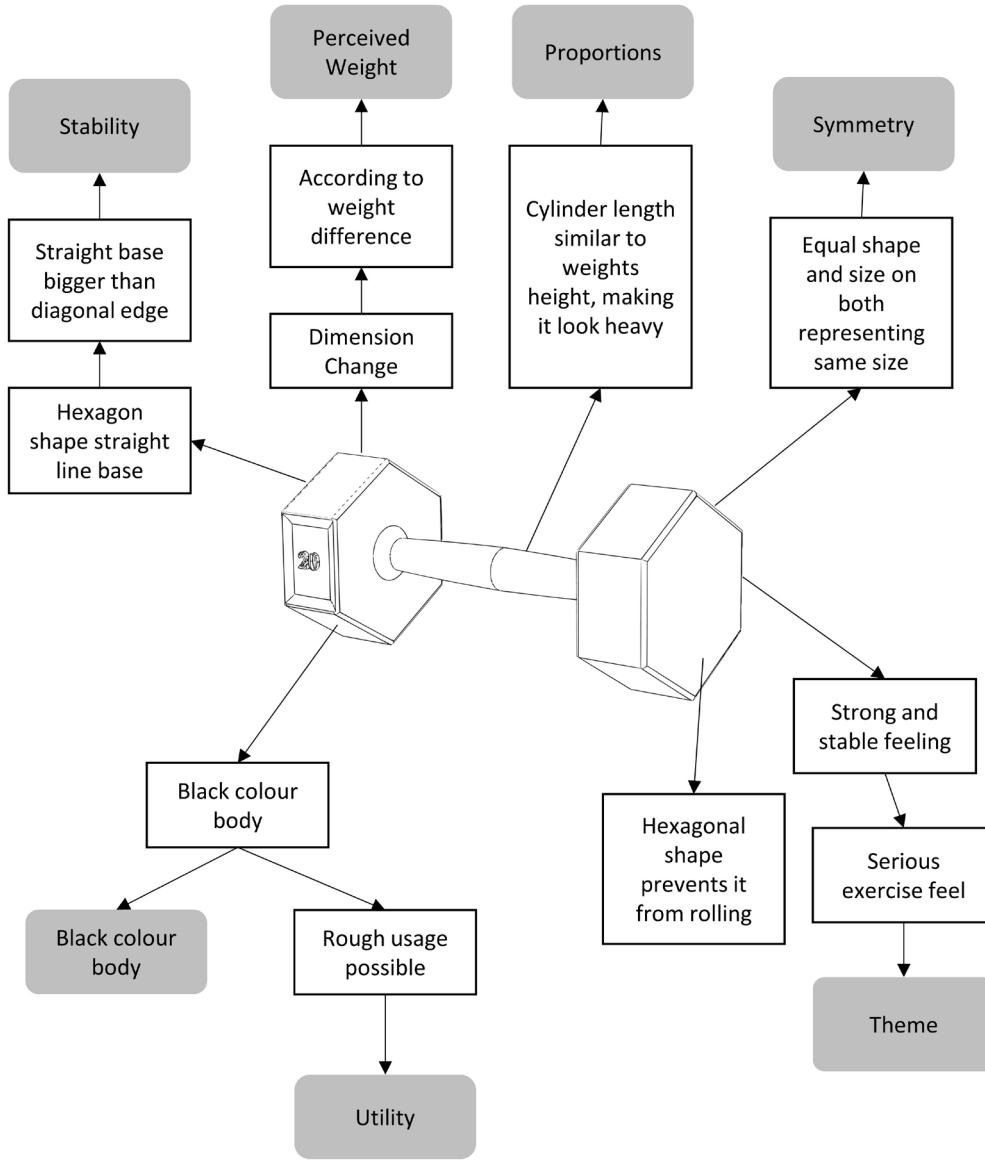

Figure 4 An Example of Product Dissection Performed by a Participant

Example of a product case: Dyson Vacuum cleaner over time

By comparing models, we can see how Dyson balances continuity and change to stay a market leader in making home appliances.

a. Iconic features that continued:
    - Cyclic suction technology was introduced in the 1990s; this core feature prevents suction loss and has been continuously refined.
    - A transparent dustbin is a consistent feature across models as it allows users to

monitor dust levels, enhancing functionality and user trust.
- Futuristic aesthetics such as bold, sleek designs with vibrant colours were used across Dyson's vacuum cleaners.

b. Iconic features that changed:
- Ball technology was introduced in the mid-2000s and helped improve manoeuvrability using a spherical pivot.
- Cordless models in the V-series introduced cordless vacuums, shifting towards portability and convenience.

2. 3. Content Analysis

Content analysis was applied to Phases 1 and 2 data, following a procedure adapted from past studies (Kraus & DuBois, 2017; Lettieri et al., 2009; Mayring, 2014; Nag et al., 2022; Xu & Zammit, 2020). This process involved two industrial designer researchers, both experienced in thematic coding, who thoroughly reviewed insights from the literature and product evaluations. The analysis focused on identifying design-durability attributes through a literature review and interviews. Initially, key attributes were derived from the literature, forming the basis for the initial coding scheme. In the second phase, the narrative-based inquiry data attained from product review and analysis was analysed through content analysis, generating new codes that provided further insights into product features and continuity. These new codes were integrated with the literature-based ones to create a comprehensive set of factors.

A hybrid approach was used, combining top-down (theory-driven) and bottom-up (data-driven) methods. The literature informed initial codes, while product review and analysis data revealed emergent themes. Thematic coding was applied to group similar features into broader categories. The example coding scheme is shown in Table 6. Although the literature could have influenced code identification, integrating both data sources provided a thorough exploration of factors driving design-durability.

Table 6 Content Analysis Example

Code	Axial Code	Content
Standardisation	Standardisation to lower production cost	The throat of Coke and many other products from Coca–Cola looks the same

3. Results and Discussion

Before presenting the combined results that illustrate design-durability attributes, results from the scholarly literature review and the product review are presented separately.

3. 1. Results from the Literature Review (Phase 1):

The concept of design-durability was defined in the literature to explain why certain features continue to exist across products and timelines (Jetti & Dhar, 2024). Though they defined the premise of design-durability with the existing concepts of durable designs and products,

their overlap still exists. Identifying these overlaps helped define key attributes of design-durability (Figure 5):

- Emotionally durable design focuses on creating products that form deep emotional connections with users. By encouraging attachment and meaningful engagement, the product's lifespan is prolonged, as users are less likely to dispose of it (Chapman, 2016; Haines-Gadd, 2019). This approach leads products to become iconic within a brand. This approach influences design-durability by ensuring the emotionally significant design elements are featured in new iterations. Both approaches reduce the ecological impact by minimising the frequency of product replacements and contributing to a more sustainable consumption model.
- Psychologically durable design enhances a product's perceived value through emotional attachment (Haug, 2019). This approach ensures that users continue to feel satisfied and connected to the product, increasing its functional and emotional lifespan. This aligns with design-durability by preserving iconic and sustaining features across iterations by ensuring a psychological connection that endures.
- Resilient design aims to create products that are adaptable, repairable, and upgradeable, defying functional and technological obsolescence (Haug, 2018). Emotional durability complements resilient design by promoting attachment. Together, resilient design and emotional durability complement design-durability by preserving adaptable and relevant design elements, allowing products to evolve while maintaining their core design ethos.
- Timeless design focuses on creating aesthetic and functional elements that stay relevant despite changing trends (Flood Heaton & McDonagh, 2017; Lobos, 2014). Design-durability supports timeless design by ensuring the core features of a product remain aesthetically and functionally meaningful across multiple product lifecycles, reducing the need for frequent replacements.
- Slow design promotes creating long-lasting, maintainable, and upgradeable products by enhancing emotional connection, reducing the need for replacements, and supporting sustainable consumption (Grosse-Hering et al., 2013). It combats functional and technological obsolescence by prioritising maintainability and upgradeability, ensuring products remain relevant and valuable over time. Design-durability complements slow design by preserving sustainable elements that evolve over time. These elements are carried into future products, countering social obsolescence and promoting durable, long-lasting designs across generations.
- Physical durability refers to a product's ability to withstand environmental and physical stresses, ensuring its intended functionality over time (Den Hollander et al., 2017), while design-durability ensures key design features persist as the product endures.
- Strategic durability aligns product longevity with corporate goals, particularly emphasising sustainability, market presence, and value generation for stakeholders (Razeghian & Weber, 2019). Design-durability complements strategic durability by ensuring that key design features adapt and evolve in line with strategic goals, enhancing the user experience over time while preserving the brand's core identity.
- Design DNA refers to the unique aesthetic and conceptual features that define a brand's identity, ensuring consistency while enabling innovation across product families (Eves & Hewitt, 2009; Rahim et al., 2015; Zhaolin Lu et al., 2009; Zuyao Zhang et al., 2009).

Design DNA ensures brand alignment, while design-durability preserves key design elements across product lifecycles, maintaining brand identity and user recognition as products evolve.

- Design continuity ensures the consistent application of core visual and functional elements across products, maintaining brand identity while enhancing user experience, customer recognition, and loyalty (Althuizen & Chen, 2022; Hsiang et al., 2011; Talke et al., 2017; Yu et al., 2022). In contrast, design-durability ensures that these design features are retained and remain relevant as products are updated or redesigned, supporting both innovation and heritage within product lines.

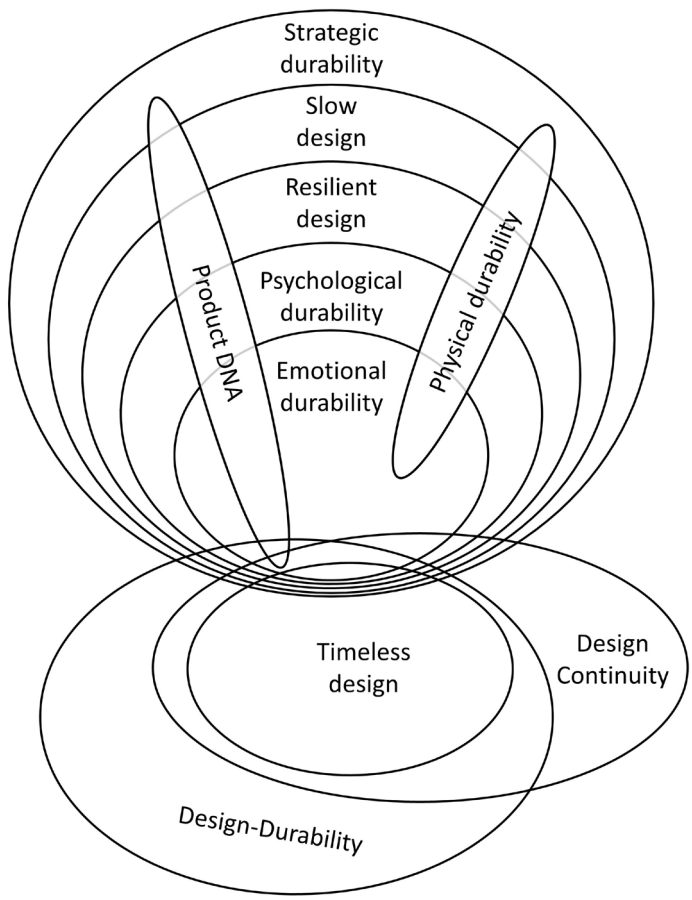

Figure 5 Overlap of Various Similar Concepts with Design–Durability

Upon reviewing the overlap of these various durability concepts, strategic durability emerges as the broadest. It aligns product longevity with corporate sustainability goals and includes slow design, emphasising maintainability and emotional connections. Slow design, as part of strategic durability, promotes sustainability and intersects with resilient design, psychological durability, emotional durability, and physical durability. Resilient design supports design-durability by preserving adaptability, repairability, and relevance, while psychological durability enhances emotional bonds and perceived product value. These bonds connect with emotional durability, resilient design, and slow design to extend product life.

Emotional durability builds strong user attachment, reducing the need for frequent replacements, and links with psychological durability, resilient design, and slow design. Physical durability focuses on withstanding physical wear and intersects with design continuity, timeless design, and slow design. Timeless design ensures long-term relevance and aligns with design-durability, design continuity, and emotional durability. Product DNA defines a brand's identity and overlaps with slow design, resilient design, psychological durability, and emotional durability to ensure consistency and long-term recognition. Finally, design continuity maintains consistent elements across products, fostering brand loyalty and recognition while supporting timeless design and design-durability.

The 117 factors from 25 core studies on durability, listed in Table 7, were sourced from the literature. However, further verification is needed to identify which attributes best align with design-durability. To address this, we advanced our study by comparing and integrating these factors with those extracted from product reviews, as detailed in the subsequent section. The comprehensive theoretical framework on durability concepts discussed earlier laid the groundwork for assessing the concept of design longevity. This evaluation led to the identification of 35 unique critical attributes. The process of selecting factors from Phase 1 is demonstrated through several examples, as depicted in Table 8.

Table 7 Factors defined from reviewing the literature

Factors extracted from the literature
Product attachment; reliability and robustness; repair and maintenance; upgradability; variability (Van Nes & Cramer, 2005)
Affect, lived experience and meaning; cultural philosophy and sustainable development; immateriality and irrationality (Borjesson, 2008)
Evoke enjoyment; memories (Schifferstein & Zwartkruis-Pelgrim, 2008)
Attachment; consciousness; detachment; narrative; surface; users are enchanted by the product (Chapman, 2009)
Group affiliation; memories; pleasure; self-expression (Mugge et al., 2010)
Aficionado-appeal; rarity (Jung et al., 2011)
Adapt to the user's identity; animacy; evoke memories; Involvement; rewarding (Van Krieken et al., 2012)
Engage; evolve; expand; participate; reflect; reveal; ritual (Grosse-Hering et al., 2013)
Brand design consistency; category design consistency (Sheng Goh et al., 2013)
Appearance; materials selection; product efficiency; user experience (Lobos, 2014)
Ability; memories; pleasure; reliability; usability (Page, 2014)
Aspiration; belonging; intimacy; memory; pleasure; self-image (Ko, 2017)
Cognitive economy; timelessness durability; visual simplicity (Flood Heaton & McDonagh, 2017)
Autonomy; environmental mastery; personal growth; positive relations with others; purpose in life; self-acceptance (Casais et al., 2018)
Color, form and material; design cues and language; explicit references; sensory elements; visual form and symmetry (Gonzalez et al., 2018)
Increasing sensory variety; aging well; maintenance quality; exclusivity; pre-purchase personalisation; making social connections (Haug, 2018)
Incorporating significant memories and associations (Orth & Thurgood, 2018)
Conversations; consciousness; evolvability; identity; Imagination; integrity; materiality; narratives; relationships (Haines-Gadd, 2019)
Ageing well; exclusivity; personality; personalisation; timelessness (Haug, 2019, p. 019)
Brand extension attitude; consumer-brand identification; perceived fit and tie; value congruity (Shokri & Alavi, 2019)
Adaptable to new functions; easy maintenance; flexible design; high durability; personalised; refurbished (Agost & Vergara, 2020)

Avoiding time markers; enduring icons; fulfilling deep human needs; neo-retro designs; quality and durability; simplicity (Ke & Yoon, 2020)
Supporting emotional value (Supporting product attachment, sustaining aesthetic value); supporting functional value (Stimulating product care and maintenance, Enabling upgradeability) (Van Den Berge et al., 2021)
Dual-extended resource base; social meaning; structural and visual elements; symbolic communication (Alam et al., 2023)
Artistic Innovation and cultural integration; cultural heritage and identity; ergonomic considerations; market demand orientation; socio-economic context; technological advancement (Ao et al., 2024)

Table 8 Content Analysis Example

Example factors	Whether factors relate to design-durability	Justification
Brand extension attitude	NO	This pertains to marketing strategies rather than the inherent durability of design.
Detachment	NO	Involves user disengagement in certain aspects, which is the opposite of what design-durability is trying to achieve
Cognitive economy	YES	Cognitive economy deals with the cognitive effort needed to use the product, so features made with adept cognitive economy make the features appreciated and accepted immediately.
Design Cues and Language	YES	Design cues and language enhance user understanding and interaction, reducing errors and increasing satisfaction, thereby extending product usability and lifespan.

3. 2. Results from Product reviewing (Phase 2)

During this phase, popular product models or icons were compared to their earlier versions to understand how their purposes have evolved over time and to what extent their design features have been maintained across generations. Similarly, unique and shared features contributing to their enduring presence were identified when competing products were compared. For instance, both Coke and Pepsi bottles feature logos on smooth surfaces, and their bottle openings are perceived as identical. The Pilot Vanishing Point fountain pen has sustained its popularity primarily due to its distinctive retractable nib mechanism.

Numerous products prominently exhibit mid-century modern, modern, art deco, industrial, futuristic, retro, and rustic styles. The study also offers insights into how design attributes—line, shape, form, texture, pattern, colour, space, and size—and design principles, including order, harmony, grouping, proximity, emphasis, balance, proportion, simplicity, symmetry, contrast, and rhythm, contribute to achieving product durability in the market. In phase 2, the narrative-based inquiry and product analysis yielded 253 axial codes.

3. 3. Combined results from Phase 1 and Phase 2

In Phase 3, the combined data from the literature review and product review analysis were examined. This mapping facilitated the identification of 22 factors related to design-durability, as illustrated in Figure 6.

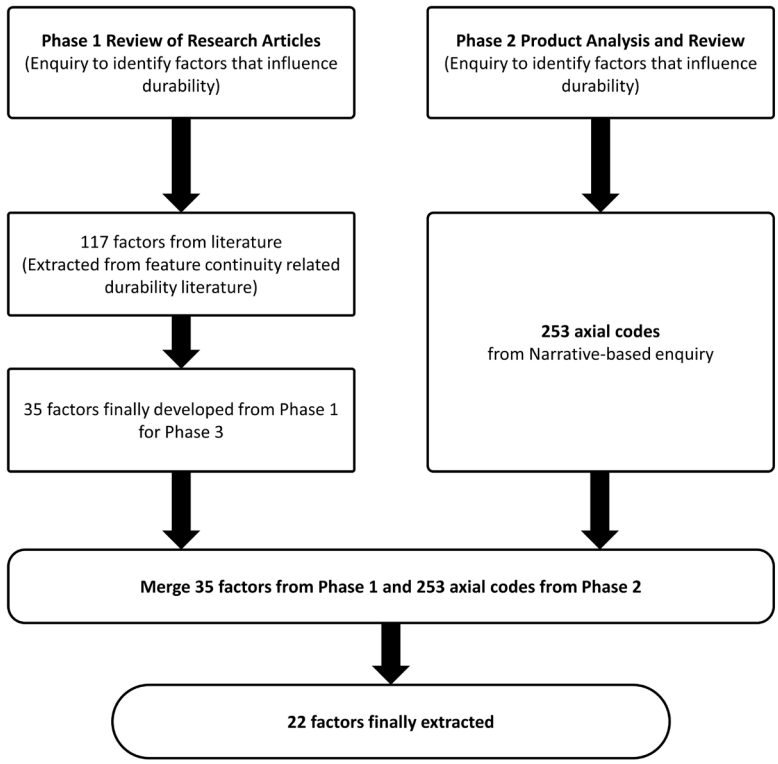

Figure 6 Map of Results Attained in Different Phases of Methodology

Example of content merging from Phases 1 and 2 to form factors based on their affinity and commonality (Clapp et al., 2023) as follows:

a. Step 1: Combine results from Phase 1
   Phase 1 emphasises timelessness, achieved through traditional, simple, and iconic designs that avoid specific time markers, ensuring long-lasting relevance.
b. Step 2: Combine results from Phase 2
   Phase 2 focuses on style consistency, using cohesive and symbolic design elements that ensure recognition and adaptability across different contexts.
c. Step 3: Combine results from Phase 1 and 2
   Style consistency does not completely align with timelessness. However, as product aesthetics evolve while retaining core elements, their combination forms a new concept. This integration allows products to adapt to changing contexts without losing their recognisable identity, resulting in a cohesive and enduring design. A new factor, aesthetic consistency, is created by merging Phase 1's timelessness with style consistency.

The identified 22 factors are outlined below, further elaborated through product cases from Phases 1 and 2 to highlight their practical application:

i. **Accessibility:** The extent to which a product can be effectively used by individuals with varied abilities is referred to as accessibility. It encompasses the development of designs that are widely usable by accommodating users with varying abilities. The spin mop

handle is designed to be lightweight and easy to grip and is an example of accessibility, making it suitable even for individuals with limited strength. The sub-factors that contributed to accessibility are shown in Table 9.

Table 9 Accessibility and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Accommodating various user segments	Accessibility
Phase 2	Visibility of the feature or product	
Phase 2	Commonly known shapes for better accessibility	
Phase 2	Flexible components used for Reachability	
Phase 2	Adjustability of product makes it more	

ii. **Aesthetic Continuity**: The ability of a product's aesthetics to remain consistent over time is referred to as aesthetic continuity. Using timeless styles or aesthetics with the ability to reintroduce a product in a different context successfully leads to a product's aesthetic continuity. Literature states that choosing an appropriate style and aesthetics true to the product's essence can result in timeless designs (Flood Heaton & McDonagh, 2017). According to Lobos' research, exceptionally beautiful, nostalgic, or simplistic designs lead to timelessness (Lobos, 2014). Porsche 911 is a notable example of a durable design that has survived the market since 1963 by staying true to its design language. The aesthetics of Chuck-Taylor all-star shoes were popular for basketball sports, and now the same shoes are used for casual wear.

Table 10 Aesthetic continuity and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 1	Using Traditional designs	Aesthetic continuity
Phase 1	Using Timeless designs	
Phase 1	Making simple products	
Phase 1	Designing Neo–Retro designs	
Phase 1	Using Enduring Icons in design	
Phase 1	Avoiding time markers while designing a product	
Phase 1	Using consistent Product style (Industrial, Simplistic, Minimalistic, Modernistic etc) across products	
Phase 1	Using timely styles that inform generation or timeline the product belongs to	
Phase 1	Using standard styles that informs the identity of a product type	
Phase 1	Using Iconic and Symbolic forms	

iii. **Affordance**: The cues an object or feature provides about possible usage and activities a user can achieve with them are called "affordances." These are relational properties between artefacts and users in a given environment. Literature categorised affordance into natural and perceived (Burlamaqui & Dong, 2015). Natural affordance refers to the cues a product's inherent features provide about its usage to the user. On the other hand, perceived affordance refers to the uses an individual can perceive based on prior experiences and cultural backgrounds. The Zap button in the mosquito bat is an example of natural affordance, as it only allows for pressing downwards and reverts

to its original position if not pressed. Many people perceive the fountain pen as a tool for precise and elegant writing; this is an example of perceived affordance.

Table 11 Affordance and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Provide cues that provide natural affordance	Affordance
Phase 2	Provide cues that provide perceived affordance	
Phase 2	Simplicity of form informs affordance	
Phase 2	Design Cues and Language	

iv. **Engaging Conversations**: Conversations are the interactions that happen between the product and the user. Designing feedback mechanisms in a product to make it responsive to the user and environment by improving its perceived dynamic nature can help achieve seamless conversations (Haines-Gadd et al., 2018). Table lamps adjusting their brightness according to the environment's light can be considered as an example of Conversations (Haines-Gadd, 2019).

Table 12 Engaging conversations and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Ergonomic conditions help provide natural and intuitive interactions	Engaging Conversations
Phase 2	Feedback enforces interactions in a product	
Phase 2	Human-like interaction or conscious interaction makes the interactions engaging	
Phase 2	Provide hidden features for surprising interaction	
Phase 2	Intrigue achieved by providing rare and least accessible product characteristics.	
Phase 1	Enhance consciousness of a product	
Phase 1	Enhancing relationships with product	
Phase 1	Product features that evoke enjoyment	
Phase 1	Make product features that provide pleasure	
Phase 1	Make products that can make a user participate in interaction	
Phase 1	Make the interaction more engaging	
Phase 1	Design rituals that make the interactions happen on regular basis	
Phase 1	User are enchanted	
Phase 1	Increasing Sensory Variety	
Phase 1	Sensory Elements	

v. **Evolvability**: Evolvability as a design factor is an amalgamation of adaptability and upgradability to change products according to the need (Haines-Gadd et al., 2018). Evolving photo display, a design concept proposed in Haines-Gadd's doctoral thesis, is an example of evolvability (Haines-Gadd, 2019). This design evolves with time and displays one's most preferred images.

Table 13 Evolvability and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Providing adaptable features to achieve optimised performance and actions	Evolvability
Phase 2	Adjustable product features to accommodate to different product contexts	
Phase 1	Providing features that are upgradeable	
Phase 1	Providing frame of the product architecture that can adapt to new features	
Phase 1	Personalised	
Phase 1	Personalisation	
Phase 1	Evolve	

vi. **Exclusivity:** Exclusivity refers to the degree of unique value a product can provide to the user. This characteristic can make an old technology and design appreciable even if new ones exist. Similarly, a product's exclusivity helps individuals attain status among others (Haug, 2019). Juicy Salif is an example identified among the lemon juicers whose form is differentiated from other juicers, making it exclusive.

Table 14 Exclusivity and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Incorporating valuable product attributes	Exclusivity
Phase 2	Restricted and limited product feature and usage makes the product to be rare	
Phase 2	Antique products are considered to be rare	
Phase 2	Providing unique product features	
Phase 1	Exclusivity	

vii. **Harmony:** Harmony is the phenomenon in which various elements in a design or product work cohesively and pleasingly together to achieve higher functional efficiency. (Kumar & Garg, 2010). The interaction among design elements, features, products, user's mental model and environment can lead to harmony. In this context, one example is how the distribution of Dyson vacuum cleaner suction units in combination, helps produce higher efficiency than its individual units. A pair of rubber-coated dumbbells make less noise when used together for certain exercises, making them less embarrassing to use in public. This dumbbell example illustrates how people, products, and the environment all work together harmoniously. Products in an environment that does not have harmony are not used for long. For example, table lamps which are used to create room ambience get replaced if they do not have harmony with other products in the room.

Table 15 Harmony and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Performance enhancement due to internal harmony	Harmony
Phase 2	Performance enhancement due to external harmony	
Phase 2	Providing non-dominating entities in a product	
Phase 2	Designing balanced product features	

viii. **Identity:** Identity refers to the characteristics and personality of a product that differentiates it from others. The expression, connectivity and self-discovery a product facilitates can make a user feel the product's identity (Haines-Gadd et al., 2018). Design that resonates with users can continue to exist for a longer time. Personal assistants are often made to have feminine personalities, as females are generally associated with integrity and pleasantness. Feminine personality in personal assistants is achieved by providing a soft voice and cute forms. Similarly, the concept of DNA, often used in companies to identify certain product features, is constant so that a customer can identify the brand identity and feel the brand value. The best example of this is the kidney front grilles provided in automobiles.

Table 16 Identity and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Incorporating features that inform brand identity	Identity
Phase 2	Design product attributes for product personality	
Phase 2	Incorporate distinguishable features that inform identity of a product	
Phase 2	Using typical product forms that represent a product category	
Phase 2	Embedding cultural symbols that inform identity	
Phase 1	Cultural Heritage	
Phase 1	Identity	
Phase 1	Self-expression	
Phase 1	Group affiliation	
Phase 1	Self-Image	
Phase 1	Belonging	
Phase 1	Making social connection	
Phase 1	Consumer-brand Identification	
Phase 1	Expand	
Phase 1	Aspiration	

ix. **Integrity:** The quality of design being honest and ethical is considered integrity. It refers to using coherent and consistent systems in a design. It involves upholding a product's intended purpose, functionality, and aesthetic appeal for its lifespan. Dyson vacuum cleaner, which became famous for its industrial style, not only causes aesthetic appeal but also helps achieve sturdy construction, making them last longer. This is an example of integrity in play.

Table 17 Integrity and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Complex interaction products are made to last longer	Integrity
Phase 2	Designing products to induce humble nature	
Phase 1	Reliability and Robustness	
Phase 1	High Durability	
Phase 1	Ageing well	
Phase 1	Quality and Durability	
Phase 1	Surface	

x. **Learnability**: Learnability refers to the ease with which an individual can acquire knowledge about using a product or feature efficiently and effectively without making mistakes(Nielson, 1993). Consistent, simplistic, intuitive designs, clear instructions, and familiar entities and metaphors increase product learnability. Making systems easier to learn can thus increase a product's appeal. Dyson vacuum cleaners with simple, easy-to-use interfaces and buttons are a great example of learnability.

Table 18 Learnability and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Provide simpler functionality and features to ease of learning	Learnability
Phase 2	Learnability for better feature usage	

xi. **Maintainability**: The product's ability to efficiently achieve resilience through care and repair is called maintainability. Maintenance as an entity includes cleanability and repairability (Joustra et al., 2021). Providing a washable and easily replaceable fabric lampshade in classic ceramic table lamps made them stay popular as a design. This table lamp example illustrates a classic example of maintainability, making the design last longer.

Table 19 Maintainability and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Make products features maintainable	Maintainability
Phase 2	Make products features cleanable	
Phase 2	Make products features repairable	
Phase 1	Repair and maintenance	
Phase 1	Easy Maintenance	
Phase 1	Maintenance quality	

xii. **Maturity**: A design or feature is considered mature when it is viewed as fully developed, achieved through iterative optimisation until it meets the highest standards required for a specific product category in a given context. This characteristic offers designers insights into optimised practices that can be adopted to create more effective designs tailored to specific contexts.

Maturity is achieved in two ways:

a. Feature optimisation: Providing the most optimal design feature from the potential solutions for a given context is referred to as feature optimisation. This process enhances product attributes to elevate user experience and value. An example is the addition of a rubber grip on pens to enhance usability.
b. Functional optimisation: This approach concentrates on enhancing the functional elements of a product to achieve superior performance within a specific context. For instance, razor blade angles have been progressively optimised to minimise skin damage. Similarly, the ink flow control mechanism in fountain pens is another example where optimisation has been applied to improve functionality.

Table 20 Maturity and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Providing Functional optimisation	Maturity
Phase 2	Providing Feature optimisation	

xiii. **Memorability:** A user's ability to recall a product or feature usage is memorability. Consistent, simple, intuitive design features help make designs memorable (Nielson, 1993). Similarly, providing clear instructions and using familiar entities and metaphors can also aid in achieving memorability. The iDrive system in BMW cars is an example of memorability usage in action. The iDrive system is always provided in the middle of the console and helps users easily operate it.

Table 21 Memorability and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Simpler features for memorability	Memorability
Phase 2	Placement and order of elements enable memorability	

xiv. **Narrative**: Narrative as an entity informs using shared stories as guidelines in creating features which remind the past product experience and make users experience nostalgia (Haines-Gadd et al., 2018). An example of a narrative is the Bajaj V15 bike, promoted as a piece of history using the material from INS Vikrant, the first aircraft carrier built in India.

Table 22 Narrative and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Metaphors and nostalgic features for incorporating story to a product	Narrative
Phase 1	Memories	
Phase 1	Intimacy	
Phase 1	Cultural Heritage	

xv. **Noticeability**: The ability of a feature to be seen or noticed is referred to as noticeability. This is accomplished by getting the user's attention in different ways. Product visibility is the most effective way to get users to notice a feature, among the other senses. Making features unique, recognisable and distinctive makes products visible. The zap button on the mosquito racquet stands out because of its contrasting colour is an example of noticeability. However, noticeability doesn't always mean making a product or feature stand out. If a product needs to be unnoticeable, it should have design entities that allow it to blend into the environment it is placed in. One example of unobtrusiveness is the form of personal assistants made with fabric-like materials and using neutral colours to blend with their surroundings. This makes people feel comfortable and safe to keep them around.

Table 23 Noticeability and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Distinctive product features for noticeability	Noticeability
Phase 2	Proportional variance for making a feature noticeable	
Phase 2	Conditions and environment enhanced visibility	
Phase 2	Visibility enabled through patterns	
Phase 2	Visibility enabled through textures	

xvi. **Portability**: Portability refers to the characteristics of a product that allow it to be moved from one location to another. Modularity, collapsibility, carriability, and transportability help achieve the portability of a product. A vacuum cleaner's detachable battery is an example of modularity. This allows users to charge batteries separately and conveniently. Similarly, in the case of a wet mop, storing the wringer by detaching it from the handle allows it to be stored in a compact space. Coke bottles are designed to be durable to withstand the rigours of transportation, demonstrating their transportability. Compact and lightweight safety razors are made to be carried in travel bags with ease, demonstrating carriability.

Table 24 Portability and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Designing products with compactness	Portability
Phase 2	Designing light–weighted product	
Phase 2	Designing products carriable	
Phase 2	Making products modularity	
Phase 2	Providing a movable mechanism in a product	

xvii. **Production quality**: Materials, manufacturing processes, surface treatments, and structural design all play an important role in increasing the lifespan of a product (Joustra et al., 2021). Users always prefer high-quality products when they choose a product. Material plays a prominent role in designing a product as it can also provide a multisensory experience and elicit pleasure. Celebrating imperfections as a concept has happened to be critically defined from the perspective of materials (Haines-Gadd et al., 2018). Also, according to the category, certain materials are used consistently across time in each product. Most double-edged safety razors are made from stainless steel, and cartridge-based safety razors are made from plastic. Similarly, the glass bottle of Coke preserves its taste, making the design continue longer. Anglepoise lamps are an example of production quality, with their structural strength and stable design being vital reasons for ensuring the design's continuity.

Table 25 Production quality and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Connection quality influences durability	Production quality
Phase 2	Product features customised for appropriate production quality.	
Phase 2	Making appropriate finish quality for required usage	
Phase 2	Environmental aggressions through appropriate structural quality	
Phase 2	Material selection considers aggressions and changes it can go through and helps make the product recyclable and renewable	
Phase 1	Material selection	

xviii. **Proficiency**: An individual's skill level in using a product to achieve a desirable outcome can be referred to as Proficiency (Brownell et al., 2021). Features optimised to proficiency level can increase the efficiency of product use, leading to design continuity. Defining the shape of a pencil is an example of Proficiency: Round pencils are meant for professionals and artists, hexagonals are for moderately skilled users, and triangular for novice users to make writing more comfortable.

Table 26 Proficiency and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Hidden features and operations providing minding expert users Proficiency	Proficiency

xix. **Protection**: This attribute refers to the product's ability to safeguard users or artefacts. Safety, privacy, and security are the three pathways to achieving protection. The curvy razor head, for example, is designed to move smoothly across the face, reducing the number of possible cuts. This design's safety gives users confidence in using these products. The microphone off button feature provided by Alexa is an example of security and privacy.

Table 27 Protection and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Standardised shapes, forms, material, textures for increasing safety	Protection
Phase 2	Material property, status quo of function, error prevention increases protection	
Phase 2	Enhancing security through detectability and privacy of a feature	

xx. **Redundancy**: Providing mechanisms that act as a backup in case of a failure is called redundancy. This can help keep the product running and increase design-durability (Joustra et al., 2021). Bikes are provided with reserve oil storage as they are meant for long drives compared to mopeds, which is an example of redundancy.

Table 28 Redundancy and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Backup mechanism for fail proof systems	Redundancy
Phase 2	Redundancy of features to tackle extreme scenarios	

xxi. **Standardisation**: This process establishes consensus on features and functionalities across industries, companies, and society, covering aspects such as design, materials, performance, and safety requirements. Standardization aids in integrating designs with other products and systems, thereby improving their viability.

Broadly, standardisation can be classified into four categories:

a. *Industry standardisation*: Industries apply design constraints to enhance product viability. For example, many soft drink companies adopt standardised bottle sizes to reduce manufacturing costs, which allows this feature to remain unchanged. Another instance is the industrial choice to maintain relevance through the inclusion of USB-C ports in most devices today.

b. *Regional standardisation*: This category encompasses socio-cultural norms and values, anthropometric data, and regional working standards. For instance, bike companies in India often release brightly coloured bikes (red, yellow) during peak wedding seasons. Similarly, devices manufactured in the US may not function in India due to differences in electrical frequencies, which can lead to product failure. Consequently, most products are tailored to align with the specific electrical frequencies in India.

c. *Regulation*: Local regulations vary by region. For instance, in India, it is mandatory for bike headlights to illuminate as soon as the vehicle is started. This requirement, enforced by the government, is known as the 'Daytime Running Light' feature.

d. *Design convention*: Design choices that are widely recognised and adhered to within a specific domain or industry are called Design conventions. They represent the common methodologies or standards that designers employ when developing a particular design. An example of a design convention is the similarity in interaction layouts across most TV remotes.

Table 29 Standardisation and their contributing sub-factors

Sub-factor from phase	Sub-Factor	Factor
Phase 2	Providing features that are industrially standardised	Standardisation
Phase 2	Providing features that are regionally standardised	
Phase 2	Providing features that follow regulations	
Phase 2	Providing conventional designs and features	
Phase 2	Socio-economic consideration	

xxii. **Versatility**: Versatility is defined as a product's ability to adapt to various situational requirements. Products achieve versatility by being multipurpose or multi-contextual features. Designs created with the ability to do more than one purpose are called Multipurpose designs. Personal assistants are examples of multipurpose devices because they can be used to search information online, as a smart home controller, and to set alarms and reminders. Designs created with the ability to fit varied contexts are called Multi-context designs. For instance, the Zaisu cushioned model became popular among Japanese users for being used in tatami rooms, which was not the context it was meant for.

Table 30 Versatility and their contributing sub–factors

Sub–factor from phase	Sub–Factor	Factor
Phase 2	Products made to accommodate multi–Context	Versatility
Phase 2	Products made to have multiple purposes	
Phase 1	Variability	
Phase 1	Flexible design	

Factors and Design attributes

Further, based on the nature of the identified factors and their relation to the designers' choices in making a feature enduring. The factors are segregated into six greater attributes of design defined by Ferrerira et al.(2016), as shown in Table 31. The design attributes that were considered for the study are elements of form, organisational principles, communication, function, human factors, and materialisation.

According to Ferrerira et al. (2016):

a. Form deals with visual and physical characteristics that help build an object.
b. Organisational principles include the entities that deal with compositional aspects, structure and spatial organisation.
c. Communication deals with entities that help one understand a feature or a product to convey meaning.
d. Function deals with the purpose of a feature, its usage, possibilities and limitations.
e. Human factors inform the subjective aspects of understanding, using and experiencing a product or a feature.
f. Materialisation informs the physical materialisation aspects such as manufacturing technologies, structures used and built quality.

When the identified factors were mapped, certain factors were observed to be associated with more than one attribute. For instance, Protection as a factor was mapped across both function and human factors. However, protection is regarded as an aspect of function, as it depends on the product's design rather than the user's capabilities or interactions. Standardisation and maturity, on the other hand, were commonly observed to be across all factors. These two factors contribute to industrial practices and the market acceptance of a feature over time. Thereby, they are categorised under a new segment named industrial relevance. All the factors identified for design-durability would support designers in identifying features that influence a product design's survival in the market. For example, aesthetic continuity highlights the most accepted styles of digital devices, which can be used to design a digital audio player. Saregama Carvaan, a digital audio device that succeeded by integrating nostalgic design (AM/FM radio style interface) into modern technology, is one such illustration.

Table 31 Attributes of Design–Durability and Elements of Design

Elements of Design	Attributes of Design–Durability
Communication	Noticeability, Affordance, Engaging Conversation
Form	Aesthetic Continuity
Function	Portability, Versatility, Protection, Maintainability
Human Factors	Accessibility, Learnability, Proficiency, Identity, Narrative, Evolvability, Exclusivity, Memorability
Materialisation	Production Quality, Redundancy, Integrity
Organisational principles	Harmony
Industrial Relevance	Standardisation, Maturity

Practical Implication:
The study on design-durability offers valuable insights for designers and manufacturers. It emphasises the creation of sustainable, emotionally resonant, and market-relevant products. Unlike user-centered design, which focuses on immediate user needs, design-durability takes a long-term approach. It ensures that product features remain desirable and functional across multiple iterations and contexts. It addresses emotional, psychological, and physical longevity. By promoting modularity and upgradability, design-durability allows products to evolve with technological advancements. This reduces the need for frequent replacements and supports sustainable consumption.

The study also presents a framework that links design-durability factors with design elements. It serves as a tool for novice designers to identify enduring features and build a repository of insights. The framework helps create adaptable and future-proof designs. These meet current needs while staying relevant over time. This approach complements user-centred design by extending product longevity and appeal across changing market demands. It fosters sustainability and responsible design practices.

4. Limitation and Future Scope

Though the identified factors in this study provide explanations to designers regarding the durability of a design, it does not discuss the practical applications of these factors. This could be a potential research topic that further develops the scope of the concept design-durability. Moreover, researchers can investigate the interrelations, impacts, and potential applications of factors to achieve design-durability. A key limitation is the lack of consumer perspective, and future research should explore how design-durability factors resonate with users, influencing product longevity and sustainable design. Additionally, the expert study with industrial designers limits this study to their perspective, which could be further enhanced by conducting studies with experts such as production engineers, maintenance engineers, logistics engineers, and marketing and sales managers for a more comprehensive understanding.

5. Conclusion

This study aimed to identify factors influencing a new concept known as design-durability using an exploratory research method. The study emphasises the importance of adaptability and strategic foresight in ensuring the relevance of design elements in various product settings. The study begins by reviewing the literature to identify product cases and factors associated with feature continuity. It was followed by additional tasks such as product analysis and interviews to learn how designers understand and apply the concept of durability. The study identified 22 factors that explain the concept of design-durability. Eleven of these factors were uniquely defined based on the product analysis. They are

aesthetic continuity, affordance, harmony, learnability, maturity, memorability, noticeability, proficiency, protection, versatility, and standardisation. The remaining identified factors were extracted from the existing literature on durable designs or products. This study aims to refine factors for practical application, assisting designers, manufacturers, and policymakers in their efforts to reduce environmental impacts and promote smarter, more sustainable design practices.

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Appendix:

Table A1. Factors extracted from Phase 2

Open code (Content from Phase-2)	Sub-factor	Factor
Handle length is limited to accommodate various people's ergonomic consideration	Accessibility through ergonomic consideration	Accessibility
Font in dumbbell informs and helps access the right product	Accessibility via visibility	Accessibility
Mosquito bat is easy to use and swing because of the form	Common knowledge for accessibility	Accessibility
The wet mop base is easily movable under the table as it has higher flexibility	Reachability via flexibility	Accessibility
Transparent body is used for the dust collection unit to show what's been sucked in and if anything, important exists	Accessibility via transparency	Accessibility
Detachable rechargeable battery can accommodate even smaller spaces and increase comfort	Accessibility via modularity	Accessibility
Simpler modes of use are provided in the vacuum cleaner for removing dust for better accessibility	Accessibility via complexity	Accessibility
The adjustable nature of the body of the table lamp makes it more accessible across the job space or table where it is placed in	Accessibility via adjustability	Accessibility
Dimensions of the door handle helps all people of demography reach it	Reachability via feature dimensions	Accessibility
Font size in the Coca-Cola makes product identifiable and accessible in the first glance even from far away	Form size defines noticeability and accessibility	Accessibility
Dyson vacuum cleaners suction units across models inform the technologically high level of products	Consistent Product style through shape	Aesthetic continuity
Neon colours used in Alexa can indicate the timeline of the product type	Timely style informing product generation	Aesthetic continuity
Roller is visible from transparent cover, which shows the functional entity	Technologically advanced product styles through transparency	Aesthetic continuity
Geometrical shape of table lamp makes it look simpler	Simplistic style via shape	Aesthetic continuity
Finite number of entities makes it feel more minimalistic	Minimalistic style via minimal entities	Aesthetic continuity
Body and shape when merged together in a table lamp, they will start to look simple and modernistic	Modernistic style via merging components	Aesthetic continuity
Squeezers usually are produced mostly in earthy colours like chrome, orange, yellow, green colours	Consistent colours usage across product type	Aesthetic continuity
Matte finish in cars informs futuristic nature compared to others	Finish of the product defines the timeline of the product	Aesthetic continuity
Octagon shape looking strong and stable and makes us feel it is serious to use	Form informs perceived strength and stability	Affordance

Straight base dimensions of dumbbell makes it feel bigger than diagonal edge	Dimensions inform visual perception	Affordance
Black colour body makes user perceive rough usage possibility	Colour informs product usage intent	Affordance
White colour in mosquito racket is used to indicate the non–functional components, instead of orange colour	Colour variance informs functional components	Affordance
Resemblance to tennis racquet shape for intuitive use	Form resemblance informs affordance	Affordance
Zap switch's in mosquito racquet its' restricted movements and freedom of motion defines the nature of the button	Freedom of movement informs affordance	Affordance
Activity frequency and type of work makes the switches in mosquito racquet is different from one another	Feature types informs activity affordance	Affordance
Lines over the torch provides help inform how the activity is done, as friction provided by them lets it know, the movement to be in forward and backward	Patterns inform usage	Affordance
Form of the mosquito racquet is mostly curvy in nature and making it look user friendly and very much like a bucket which makes it easier to buy for even new consumers	Form informs ease of use	Affordance
Certain surface transitions makes people know that product can be used roughly	Surface transition informs usage	Affordance
Colours are alternatively used to indicate important features in a product by lowering the colour variance	Grouping and colour combinations inform activity hierarchy	Affordance
Familiarity of the adjustable knob helps user achieve comfortable usage	Product familiarity informs usage	Affordance
The cap at the bottom of the tub functionality is easy to be recognized because of its placement	Feature placement in product informs activity	Affordance
Spin feature of the mop accommodated with the spin tub helps the new users know about rotational function even though it is unknown as it is similar to washing machine spin tub	Similarity informs activities	Affordance
The shape of Alexa doesn't have any wheels or something which makes it feel that it is a product that need to be kept in a place	Shape–based freedom of movement informs actions	Affordance
Texture being soft makes the product feel comfortable and touchable	Texture informs emotions	Affordance
Soft texture and that makes the surrounding nature makes us feel that sound system is three dimensional which can help keep it in centre of the hall	Texture informs functionality	Affordance
Crude nature of screw visibility makes us the surface is the bottom of the body	Features inform the product orientation	Affordance
The geometrical shape of the Dyson vacuum cleaners is used to make it look more standard and inform standard usage	Shapes inform standardised usage	Affordance
Colours are made different for different purpose and indicate functionally high– and low–level products	Colour variation informs functionality	Affordance
Red colour is commonly used for all the similarly functional features in the Dyson vacuum cleaner	Similar colour for functional similarity	Affordance
Uniquely shaped positive and negative form attributes inform users regarding the unique actions and compatible features	Form–specific compatibility informs activity	Affordance
Height of the table lamp helps us understand where to place it and how to place it	Product dimensions inform usage	Affordance
Images that are socially accepted helps users know where to keep it, as it is generic it can be placed in offices, bedroom, restaurants etc	Symbols and forms of product informs place it need to be placed	Affordance
Warm light instead of bright light is used to let people know when and how it can be used	Product feature type informs the place of use	Affordance
The pattern cover strip infront of the shoe sole makes the product to be used for rough usage such as sports which it is meant for	form features inform actions	Affordance
Lack of any door handle informs that the door can be pushed	Features inform activity	Affordance
Autonomous cars which are taxi uses forms which are boxy and like toasters making them feel safe	Product forms for emotional affordance	Affordance
Different parts in the pen are indicated with different colours	Colours inform part differentiation	Affordance
The material thickness of the metal makes it pressable	Dimensions of the product informs action	Affordance
Spin feature of the mop though being new feature to certain users it can be learnt and remembered easily due to its simplicity	Simplicity influences learnability and memorability	Learnability

Dyson's washing machine failed in the market as customers felt them too complex to use	Complexity of features makes it usage difficult	Affordance
Dyson Vacuum cleaner form is mostly symmetrical making us guess the other side of the body which lets us understand the body by understanding one side of the body	Symmetrical forms for simplicity	Learnability
Simple forms of the Chuck Taylor Allstar shoes makes them feel humble to users	Humble nature through simplicity	Integrity
Using safety pin doesn't require much of training for even first–time users	Complexity of the product informs need of learnability	Learnability
Logo being simply makes it more recognisable and noticeable	Memorability through simplicity	Memorability
Duplicate command can only be used effectively and efficiently by mastering the device	Complex products are made to last long	Integrity
Bottle is made with the broken glass and the renewing process is easier as this is a mix of least number of multiple materials	Material complexity to recycle and renew	Production quality
Hashed lines and its thickness are made in considering optimal damage to skin	Natural interaction through ergonomics	Conversation
Hashed lines placed with equal distance symmetric to centre making it easy to be held in both hands	Ergonomic consideration for better interaction	Conversation
Feedback from certain sounds gives insight to right practice	Feedback enforces interactions	Conversation
LED glow indicate changes from green to red this distinguishability makes it more status	Changing features inform feedback	Conversation
Intuitive interactions makes invest time in exploring through seamless interactions to let us explore the pure functionality	intuitive interactions helps achieve mastery	Conversation
Peculiar way of interacting and humanly sense of humar helps people interactProduct interactions are made to let users not feel lonely and lowered anxiety and increased comfort	Conscious interactions helps making better conversations	Conversation
Product interactions are made to let users not feel lonely and lowered anxiety and increased comfort	Intuitive and human like interactions for security and comfort	Conversation
Snapping sound mechanism fittings increases the interactions	Multisensorial feedback increases interactions	Conversation
Visible status of battery life helps users understand the performance by letting it know when to recharge	Status visibility for feedback for better usage pattern	Conversation
Personal assistants adopt to the context and user by understanding the user's preferences	Continuous adaptability for optimised actions	Evolvability
Product fittings are made to function in different contexts	Features that are adjustable with slight alteration can fit the product for different contexts	Evolvability
Lace profile in the shoes can be changed according to the requirement and style aspiration of the user	Features in the product that can be altered with user's aspiration makes the product evolve	Evolvability
Colours of the squeezer being silver and gold makes the product more valuable among other products in the market	Colour of the products informs value	Exclusivity
Shape of the Philip Stark's lemon juicer which is organic and more unique represents an art piece	Uniqueness through product shape	Exclusivity
Product's usage restrictions of not using it to juice lemon to prevent from losing gold plating makes them unique	Exclusivity through restrictions	Exclusivity
The limited amount of juicers available in the market makes them more exclusive and valuable	Exclusivity through rarity	Exclusivity
Older car forms are a status icon to owners as they are considered rare and unique	Antique products are exclusive	Exclusivity
Special packaging of the Parker pen can make the product special	Packaging can make products more valuable	Exclusivity
Metal pens are more luxurious considered to be the plastic ones	Material informs value	Exclusivity
Pens which are used rarely for special occasions makes them more valuable	Rarity through product usage frequency	Exclusivity
Harmony achieved among activity and proportions	Internal harmony among product features	Harmony
Balance is achieved as the base and top ring of the table lamp have the same material	Balance helps achieve harmony	Harmony
Non–dominating simple entities of the table lamp make the body harmonious	Simple non–dominating entities makes harmony	Harmony
Colour of the door handle always fits the door body which are natural coloured like metal and wood	Colours of feature provides harmony with the product	Harmony

Colours on the body of parker pen alternatively used creates balance	Balance through colour combinations	Harmony
Balance in the pen is achieved through balanced ratio proportions of cap and body	Balance of the product feature proportions create harmony	Harmony
rubber–coated dumbbells make less noise when used together for specific exercises, making them less embarrassing to use in public.	Harmony with the environment	Harmony
Specific colours in specific product type of wet mop helps to know the brand	Colours provide brand identity	Identity
Oddly cut shape lets us see what's to be identified in wet mop	Distinguishable feature informs identity	Identity
Proportions of the body makes it look cuter and accessible	Proportions informed personality	Identity
Usually the light halo structure makes it look like halo of angelic beings or soul full beings making it more safer	Metaphors forms indicating consciousness and personality	Identity
Light fluidly changes from white and blue along with the brightness makes it look alive in Alexa	Peculiar changeable features for informs life and personality	Identity
Dyson vacuum cleaner form makes us feel it's distinctive nature of it from other vacuum cleaners but still it lets us know that it is vacuum cleaner because of form typicalness	Typical forms to identify product category	Identity
Cyberpunk style is used to make vacuum cleaners of Dyson	Theme informs personality	Identity
Perceived functional superiority of dyson vacuum cleaners with futuristic technology from others	Identity through branding	Identity
Peculiar sounds produced in the Dyson vacuum cleaner makes it iconic and remembered the product for it	Branding created through sound	Identity
Sakura flowers and trees provides the cultural identity to the table lamp that is apt for a place	Embedding cultural symbols for identity	Identity
Distinctive form from common beverage bottles which can recognized even in the night times or even if its broken	Distinctive entities for brand identity	Identity
Coca–cola bottle form is directly inspired from the coffee fruit shape, making it a metaphorical representation that makes it more distinctive and directly relatable	Brand identity through distinctive relatable shapes	Identity
Unchangeable feature becomes strong design language provides the brand identity to the Coco–Cola	Design language and product DNA for brand identity	Identity
Bottle is advaterised to be faminine as it is made in the shape similar to females' waist	Product forms inform personality	Identity
The inspiration of the product form of lemon squeezer made by Philip is UFO to make it feel more out of the world feeling	Form informs identity	Identity
Kidney front grille in BMW is a consistent feature to provide brand identity	Consistent features in a brand creates brand value	Identity
Arrow heads of the pocket pens are iconic and creates brand identity as they are consistent across parker pens	Consistent features create brand identity	Identity
The character figurines on the pens indicate the pens to be used by kids	Identity through aesthetic style	Identity
Front headlights have become aggressive to easily attract the attention of users among other models	Product personality makes them more attention seeking	Identity
Knowing hidden and unknown functionality or feature in a product makes user feel surprising	Hidden features makes user surprised	Imagination
Form of vaccuum cleaner resemblance to sniper rifle intrigue the user for enhanced handing experience	Forms creates intriguing holding experience	Imagination
chromium steel usage in the safety razor represnts the durable nature of product and its humbleness	Material finish and colour induce humbleness	Integrity
Brand logo is made to be large enough to be noticed but kept inward of the shoes making it less noticeable informs humble functional nature	Branding and logo placement inform humble nature	Integrity
Minimal components in the product makes the product more humble	Minimalistic nature defines humble nature	Integrity
Simple forms of the Chuck Taylor Allstar shoes makes them feel humble to users	Humble nature through simplicity	Integrity
Efficient battery usage of the vacuum cleaner can be achieved through learning the function for a little amount of time	Learnability to use newer functionalities	Learnability
Consistent filter removal mechanism is same across all vacuum cleaners to lower new learning	Consistent features help learnability	Learnability
Dyson vacuum cleaners with simple, easy–to–use interfaces and buttons need less learnability	Complexity of the product informs need of learnability	Learnability

Shape and simplicity of the form complexity makes users feel better as they need less time to maintain the dumbbell	Maintenance through simplicity	Maintainability
Able to clean the handle of the dumbbell which is drenched in sweat of palms increases the life of product	maintenance through cleanability	Maintainability
If one in pair of dumbbell gets worn out, it can be replaced easily with other dumbbell	maintenance through spare part availability	Maintainability
The material of the table lamp and its smoothness makes the cleaning process easy and can be done regularly	material property informs maintenance	Maintainability
Form of the coke bottle is made in a way it is easily cleanable without much hassle	Form defines cleanability	Maintainability
Material used in the shoes makes user feel they can be washed in washing machine	Cleanability informed through material used	Maintainability
Transparent bodies of the pens inform the pen ink status and makes the user know when the product needs refill needs to be changed	Transparent bodies inform refilling	Maintainability
Standardised dimensions for optimised performance and practice	Functional optimisation through standardised forms	Maturity
Form evolves and gets optimised for the working contexts	Product form evolution for optimisation	Maturity
Gaps in the combed sticks is made to be same or similar and optimised across models to let har move freely between them	Optimised features used across models	Maturity
Designs of the shaving razors didn't change much and doesn't vary much as the designs are optimised for better functional effectiveness	Functional optimisation for design maturity	Maturity
Coke bottle are packed in a special container to make them be carried even in the harsh environments	Optimising forms to be carried in most standardised carriers safely	Maturity
Blade angles in the safety razors are made to made to reduce skin damage overtime	Optimised functional aspect of feature provides better performance	Maturity
Simpler designs are appreciated across times even among the competitors and the shape is not changed since the inception in Chuck Taylor All Star shoes	Timeless and simple designs for maturity	Maturity
The unchanged design of the Chuck Taylor All star form helps achieve optimisation in the manufacturability	Manufacturable optimisation is achieved through aesthetic optimisation	Maturity
Providing rubber grip in most of the pens for better usability	Compulsory features across various models for ages	Maturity
The curve of the juicers is made to be same across various models and to exist for a long time	Optimised designs to achieve performance makes the product mature	Maturity
Wipers of the cars are matured enough they didn't change much across modes	Matured features are consistent across time	Maturity
The car forms are standardised as they are optimised to fit the context and the car forms are changed by keeping the fixed dimensions	Optimisation of the dimensions to create standards	Maturity
The barrel in the fountain pens are optimised to provide long product usage	Feature optimisation for better performance	Maturity
The ink spill prevention from the nib of the pen makes the ball point pen more preferred than the ink ones because of the safety	Features optimised by making them safe to use are preferred among others	Maturity
shape of the product is made to suit a specific context	Design optimisation for specific context	Maturity
The iDrive system is always provided in the middle of the console and helps users easily operate it	Placement of feature defines memorability	Memorability
prints on Alexa is made to fit the demographics	Local metaphors to represent story or narration	Narrativity
People buy safety razors as they are the tools to define gentleman's nature	Iconic and symbolic nature of product make the product type continue across time	Aesthetic continuity
High school basketball player being the reason of the brand makes the product nostalgic in the high school context	Nostalgic products are specific to specific contexts	Narrativity
Letters are embossed on the surface by making a depression into the rubber surface of dumbbell cover, by understanding the surface abrasions into considerationsDifference in height of text and background makes dumbbell's text noticeable	Noticeability through distinctive features	Noticeability
Difference in height of text and background makes dumbbell's text noticeable	Noticeability through distinctive features	Noticeability
Actionable switches with differentiated background colour for visibility in mosquito racquet	Distinctive features lead to noticeability	Noticeability

Proportions of the wet mop features help attract customers attention	Feature proportions define noticeability	Noticeability
LED glow of the Alexa helps us locate it in the dark rooms	Feature visibility and distinguishability helps noticeability	Noticeability
Camouflaged patterns lowers the visibility of Alexa with respect to environment	Patterns for invisibility	Noticeability
Colours being only blackish and greyish they are get mixed with normal products in the surroundings, especially this is observed in Western nations as they are very generic is nature	colours for invisibility	Noticeability
Visibility of the bottle is evidently possible when the drink exists in the bottle and available in the bottle	Functional products identified through visibility	Noticeability
Font size of the logo is evidently big in the case of such products, as they make us know from far away whether we found what we are looking at in the first glance itself	Form dimensions defines noticeability and accessibility	Noticeability
Depressed smooth surface of the coke bottle makes the product visible for all	Surface texture of product can make the feature visible	Noticeability
Contrast in logo and background and the shoe colour makes the logo visible from a far range	Noticeability through contrast	Noticeability
Front headlights in cars have become aggressive to easily attract the attention of users among other models	Product personality makes them more attention seeking and attractive	Noticeability
Pens becomes more visible based on the package background	Visibility depends on background	Noticeability
Lines over the body reduces the need of grip feature to provide friction in mosquito racquet	Form features are optimised to provide better performance	Maturity
Torch material is made considering the direction of usage	Material selection for affordance	Affordance
The size of the personal assistant makes it look being in control	Product dimensions affect controllability	Maturity
Lines over the torch helps increase friction by lowering the material redundancy	Form features are optimised to provide better performance	Maturity
Floor cleaning liquid placement helps user keep all required apparatus at a place for comfort and ease of use	Accessibility in a product helps achieve better performance through reachability	Accessibility
Hashed lines and dotted patterns on handle help us place our hand on rod and fingers accordingly	Affordance through texture	Affordance
Bulge in the centre of the handle helps to held in centre of palm	Form proportions for better affordance	Affordance
gaps between the words and font are important for clear readability of letters in dumbbell	Performance through form characteristics	Learnability
Rounded form of the mosquito bat makes people comfortable to use	Forms informs usage likeability	Affordance
The racquets body is elongated to make users feel the wider space of actionable range	Dimensions induced utility	Affordance
Handle is diameter is good enough to be held easily in the hand efficiently	Ergonomic consideration for better performance	Accessibility
Rounded forms of the mosquito bat make it feel for smoother usage	Forms inform usage likeability	Affordance
Torch material is made considering the duration of usage	Material informs usage duration	Production quality
Torch material is made considering job space area requirement	Product material is defined based on the job space requirement	Versatility
Colours like green and pantoleen helps cover the coloured stains, which makes certain users feel less uncomfortable to touch the bucket	Colour influences performance	Aesthetic continuity
Bigger wheels always assure the first–time users about the evident comfort that can be achieved using this mop is mentioned	Product feature dimensions can afford assured actions to provide better performance	Affordance
Bigger wheels helps least water turbulance even on rougher surface	Proportions define performance	Harmony
Floor cleaning liquid keeping space provided in the body helps lower the number of actions increased when they have to bring cleaning liquid multiple times	Accessibility improves performance	Accessibility
Spin feature of the mop is usually controllable by the users according to the required wetness of the mop for the users	Controllability defines performance	Proficiency
Spinning method is used in the mop to help the users easily dry the mops by minimizing the activities	Merging of activities affects performance	Engaging conversations
The water stored in the buckets if used efficiently can help clean 4–5 rooms easily	Performance through product feature optimisation	Maturity

Fluctuating slightly when its searching for an answer (like how people make hand movement gestures while thinking)	Real life gestures are considered for operation status	Engaging conversations
Alexa device can be connected to multiple speakers at a time to make us experience the best user auditorial experiences which lets it to be used for longer period	Features for better performance	Maturity
Alexa devices optimisation can continue to next product which makes it more comfortable to use for a specific person	Personal history transfer makes the product more likeable	Evolvability; Proficiency
Cylindrical surface makes us feel there is a three dimensional hearing ability which makes it reliable	Form improved product performance	Affordance
ponger battery in product makes people to use product with convenience	Greater utility provides convenience	Versatility
Flexibility in the joint lets it to move in specified range of angles to let it move in users assumed and estimated directions	Controllability defines performance	Versatility
Dyson vacuum cleaners uses same suction technology in all models without changing it much and letting the supportive mechanisms alter, lets the people believe it is of higher functionality than others	Highly efficient technology enhances performance	Evolvability
Detachable battery can be recharged when there is less space availability helps increase	Job space requirement for performance	Portability
If any fitting or mechanism is assembled imperfectly then it shows where is the location that need to be taken care of	Status visibility for better performance	Protection
Energy saving trigger extends run time, preserves battery life depending on user usage efficiency	Proficient usage of functions increases performance	Proficiency
Angular handle designed ergonomically to help people hold vacuum cleaners with ease in not stressful postures	Performance through inducing ergonomics	Accessibility
Auto power usage according to floor, fitting, pressure required	Automated systems for versatile and optimised performance	Versatility
White translucent shade provides an understanding to support good sleep as the light emitted through the shade is less brighter lighting	Material property for performance that fit context	Harmony
Lighting position in table lamp creates focus on the sakura flower tree printed on the shade	Design elements for higher performance	Design cues and language
Colours of the handle in safety razor helps not register stains	Colours of products opted for greater convenience	Aesthetic continuity
Neck of the razor is made to provide convenience while pinch holding it	Design features developed to make performance	Accessibility
Ridge lines extracted from the cocoa beans help to be held in hand without slipping	Performance achieved from bioinspired design	Affordance
CO2 preservation and its impacts are considered while making the form features of the neck of the bottle	Optimised features are achieved among functional attributes to achieve apt performance	Maturity
Bulge and the curve of the coke makes the bottle be held in the hand comfortably	Form features are optimised to achieve comfortable holding performance	Accessibility
Glass material bottles of the coke is more preferrable as it is perveived to preserve the taste better compared to plastic bottled ones	Material of the product makes it perform better	Maturity
The body shape of the shoes makes them fixed tightly to the legs as it looks to be designed to fit and follow natural shape	Forms made to fit the body provides higher performance	Harmony
Thin ridges instead of big ones makes the juicer less effective than others	Dimensions of functional entities define performance	Maturity
Placement of the door handle helps increase the functional effectiveness	Placement of feature increases effectiveness	Harmony
For consistent product experience the steering is usually kept constant across all car models in a product category	Consistent features across models to provide consistent experience and performance	Standardisation
The pen width is always made to achieve highly efficient pinch grip	The product dimensions inform efficient product usage	Maturity
Pens dimensions are optimised to fit most people and provide better performance	Optimised dimensions for better performance	Maturity
Highest utility of the safety pin makes the form continue and be the same	Consistent form defines performance	Maturity
Mosquito bats size informs the portability	Product dimension influences portability	Portability
Wire not dangling in mosquito racquet provides info that it is portable	compact and individual components inform transportability	Portability

Even with essential parts integrated together the vacuum cleaner looks smaller compared to others making it look portable	Compact and light parts make product portable	Portability
Spherical form in dyson vacuum cleaner makes it look it can be rolled	Form of product informs the movability	Portability
Smaller size of table lamp helps us feel its portability and carriability	Small dimensions inform portable and carriable	Portability
Coke glass bottles production got lowered compared to plastic bottles by considering the convenience of user to personally carry them	Materials inform carriability	Portability
The top with ridges can be placed inverted into the bowl to let it carried easily	Collapsible product features for carriability	Portability
In case of emergencies the safety pin can always be found on body without much hassle, as in Indian scenario the safety pin is mostly kept on the people's bodies without a hassle	Carriability is one feature to keep form same	Portability
Unique pin mechanism that keep them together even when they are dropped	Component connection influences durability	Production quality
Iron pipe dimensions are usually similar across many brands as they are procured from outsourcing units, to lower the cost of scale	Standardisation defines production quality	Production quality
Duplicate command can only be used effectively and efficiently by mastering the device	Complex products are made to last long	Production quality
Chromium colours makes the product looks stronger among others	Colours indicate quality	Production quality
Full body soft texture clothing kind smoother material is used to help users feel comfortable	Material smoothness provides comfort	Production quality
The depression at the bottom of the bottle provides adequate strength to the bottle	Structural strength provided while manufacturing makes the product strong	Production quality
Bottle is made with the broken glass and the renewing process is easier as this is a mix of least number of multiple materials	Material complexity to recycle and renew	Production quality
Three legs for more structural strength in minimum structure informs the quality of the lemon juicer	Structure defined production quality	Production quality
Material of the grip feature in the product is made according to the contexts like washroom	Material selection for spaces	Production quality
form of the grip in the door is made according to the surrounding spaces	Form selection for spaces	Production quality
Duplicate command is one of the hidden feature that is embedded into the funtion keys, this can be only be achieved by continuous usage	Hidden product features build in for expert users	Proficiency
Optimised usage of product is achieved through proficient usage of product	Optimisation through proficiency	Proficiency
Razor design's continue across time because of its personal proficiency	Proficiency lets design continue	Proficiency
Most luxurious pens are available in cylindrical forms as they are made for most proficient ones	Shape of the design is influenced by proficiency	Proficiency
Same shape and size on both representing same weight makes it look safe to use without much damage if held in hand	Safety through standardised shapes	Protection
Flat surface to plane on surface and not roll is assumed helps people hold the dumbbell to do floor exercises	Safety through placement	Protection
Slippery of dumbbell handle due to its friction based texture handle	Safety through material	Protection
Torch is covered by fogged translucent surface to spread the light equally and not hurt the eyes	Material property provides protection	Protection
distinguishable status of feature indicating helps preserving its life, by not letting its battery worn out	functional status protects product	Protection
Curvy head of safety razors are made to smoothly move across the face, reducing the possible cuts	Features designed to prevent accidents	Protection
Alexa find the device even if we don't know where it is makes us feel confident	Detectability makes user feel secure	Protection
In most of the personal assistants the microphone switches off feature is provided with positively noticeable physical button	Security feature buttons are made physically tangible	Protection
Buy things online with just a command makes the buying process easier, and being it connected to amazon makes it more secure to order from the amazon instead of any other platforms	Product features for enhanced convenience and security	Protection

A slight textured bottom makes it not to slip on slight inclinations	Textures in product is designed to provide protection from falling	Protection
Straight shaving razors one side of the razor is covered on one side which prevents barber from getting injured	Safety through form features	Protection
Simplicity of the logo makes the logo difficult to counterfeit	Simplicity for protection	Protection
Sole of the shoes are designed for safety of the user	Safety through features	Protection
Rubber grip under the legs provides better grip and least damages the space it is placed in	Protection is considered while designing a feature	Protection
The screw mechanism is provided in the pen mechanism to fit each part makes it attached without accidentally dismantling	Mechanism type informs safety	Protection
Bikes provided with reserve fuel cabins makes the bikes which are made to work for long travels informs importance of back–up mechanism	Back–up mechanisms for fail proof systems	Redundancy
Can be charged using the USB cable from multiple sources helps user comfortably find alternatives to charge in regular	Redundancy helps versatile context needs	Redundancy
Daytime running light is made compulsory by the Indian government in two–wheelers	Regulation based product feature continues across models	Standardisation
most common power source of all the household equipment is used in the table lamp	Standardisation defines adaptability	Standardisation
Most standardised and common seen bulb holders are used in table lamps as each of them are interrelated	Compatible standardised product components sustain better across models	Standardisation
USB–C pins provision across various products like mosquito racquet, Personal assistants, and other inform the common industry standards to make a product	Industry standards through commonly provided features	Standardisation
Commonly used blades across all models and all companies of safety razor, which lets them continue for long in market	Large scale adaptation of feature become standard	Standardisation
Throat of the coke and other products looks same as the bulbs are outsourced	Standardisation to lower production cost	Standardisation
Car door handles are modified according to the demographics they are selling at	Demographic–specific product features for better understanding	Standardisation
Red and Yellow bikes are more popular and bought during marriages	Demographic–specific product colours	Standardisation
In a single car model itself based on the different demographics different clearances are provided	Demographic–specific product features for better understanding	Standardisation
The common wipers are most commonly used across the commonly available cars	Standardised features are commonly used across products and timelines	Standardisation
Autonomous cars are provided with the aesthetics and car forms that are similar to semantics of Volvo buses	Design conventions for similar products	Standardisation
Zaisu cushioned model became popular among Japanese users for being used in tatami rooms that was not meant for	Versatility through diverse contexts	Versatility
Blade adjustability are made according to competent cleaning depth needed in the context	Versatility through adjustable features	Versatility
The shoe colour is usually made to match with different attires of the user	Colours of the product informs versatility in contexts	Versatility
The height of the juicers is made to accommodate juicing from most of the citrus fruits	Versatility through product dimensions	Versatility
The top of the juicer can be placed on most kinds of bowls makes them more useful	Product features for versatility of context	Versatility