Research Article

Received: 10 April, 2026
Accepted: 15 August, 2026
Published: 25 August, 2026

A Bibliometric Analysis of Planned Obsolescence Research

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Cite this article:

Akçay, V. H., & Ünlüönen, M. B. (2026). A Bibliometric Analysis of Planned Obsolescence Research. Revista Cultura Científica, (24): 1131–1146.

Abstract

Planned obsolescence has evolved into an interdisciplinary field of research associated with sustainability, consumer behavior, environmental impacts, technology, and circular economy policies. However, the literature appears to exhibit a theoretically fragmented structure, while the conceptual relationships among different research approaches remain insufficiently clarified. This study aims to reveal the conceptual positioning of the field by examining the intellectual and thematic structure of the planned obsolescence literature through bibliometric analyses. To this end, studies published in the Web of Science (WoS) database up to 2026 were analyzed. The data collection process was not limited solely to the concept of "planned obsolescence"; instead, a broader search strategy encompassing different forms of obsolescence was adopted. The study employs citation analysis, co-citation analysis, keyword co-occurrence analysis, and temporal trend analysis. The findings indicate that the literature has expanded considerably, particularly after 2010, shifting from discussions centered on economic models and product durability toward themes such as sustainability, circular economy, technological obsolescence, and consumer behavior. Co-citation analysis reveals two dominant theoretical orientations: an economic approach and a sustainability-oriented approach. Keyword analyses further demonstrate that themes such as technological obsolescence and consumer behavior constitute intersectional areas linking these orientations. The study concludes that planned obsolescence does not represent an independent and homogeneous field of research; rather, it reflects a multidimensional structure developing at the intersection of economic, technological, environmental, and consumer-oriented approaches. Accordingly, the study proposes a conceptual matrix that systematically positions the planned obsolescence literature on the basis of theoretical orientation and level of analysis.

Keywords: planned obsolescence, obsolescence, bibliometric analysis, sustainability, circular economy

1. INTRODUCTION

Rising global consumption patterns and the accelerating pace of technological renewal have significantly shortened product life cycles. This development has intensified academic interest in the concept of planned obsolescence in recent years. Planned obsolescence is commonly defined as the deliberate limitation of a product's lifespan by producers or the inducement of consumers toward earlier replacement decisions [1, 2]. From a historical perspective, the concept gained increasing visibility, particularly in the second half of the twentieth century, driven by the expansion of consumer culture and the acceleration of product replacement cycles [3, 4].

Planned obsolescence has evolved into an interdisciplinary field of research through its connections with sustainability, environmental impacts, ethics, consumer rights, and circular economy policies. At the same time, the concept is frequently discussed within the broader framework of obsolescence. In this context, obsolescence refers to forms of decline emerging through natural, technical, or usage-related processes, whereas planned obsolescence represents a specific form in which these processes are intentionally shaped by producers. As a result, the planned obsolescence literature exhibits substantial conceptual and thematic overlap with the broader obsolescence literature. This complexity necessitates a systematic evaluation of the field. In this regard, bibliometric analysis provides a useful approach for examining publication patterns, conceptual clusters, scientific collaboration networks, and the intellectual structure of multidisciplinary and rapidly expanding research domains [5].

Despite the rapid growth of the literature, planned obsolescence research remains theoretically fragmented. Economic, technological, sustainability-oriented, and consumer-focused studies frequently develop as separate lines of inquiry, making it difficult to clarify how these perspectives relate to one another and whether planned obsolescence should be understood as an independent field or as part of the broader phenomenon of obsolescence. This situation highlights the need for studies that move beyond descriptive mapping and contribute to a more integrated understanding of the field.

This study addresses this gap by examining the intellectual and thematic structure of the planned obsolescence literature through bibliometric analysis. It argues that the field is not organized around a single theoretical perspective but instead reflects the intersection of economic, technological, sustainability-oriented, and consumer-focused research streams. Accordingly, the study proposes a conceptual framework that clarifies the relationships among these streams and contributes to a reconsideration of the field's theoretical structure.

The literature was analyzed using the Web of Science (WoS) database, including studies published up to 2026. To capture the broader conceptual landscape of the field, the search strategy was not limited to the term "planned obsolescence" but also incorporated related forms of obsolescence. The remainder of the paper discusses the theoretical foundations of the field and presents the bibliometric findings through citation, co-citation, keyword co-occurrence, and temporal trend analyses.

2. CONCEPTUAL FRAMEWORK

2.1. HISTORICAL ROOTS AND ECONOMIC FOUNDATIONS

Although the concept of obsolescence predates planned obsolescence, its broader economic, social, and academic significance has largely evolved alongside the emergence of planned obsolescence [3, 4, 6, 7]. In this study, obsolescence refers to natural, technical, or time-related processes, whereas planned obsolescence denotes intentional and strategic interventions by producers. From this perspective, planned obsolescence can be understood as a specific and deliberate form of obsolescence.

Although the theoretical discussion of planned obsolescence began in the 1930s, its practical manifestations can be traced back to earlier periods. Examples include disposable shirt collars in the late 19th century and design and technological innovations in the automotive and lighting industries in the early 20th century, illustrating early forms of limiting product durability or reducing the value of existing products through technological change [4].

One of the most influential contributions to the conceptualization of the concept is Bernard London's [6] proposal during the Great Depression, which advocated shortening product lifespans as a public policy instrument to stimulate economic recovery. Similarly, the article "Outmoded Durability," published in Printers' Ink, emphasized the relationship between accelerated obsolescence, economic activity, and employment ([8], as cited in [3]). These early discussions framed planned obsolescence not only as a technical design choice but also as a macroeconomic mechanism.

At the firm level, early institutional examples include the limitation of light bulb lifespans by the Phoebus cartel [9] and production strategies aimed at reducing durability in synthetic materials [10]. These cases demonstrate the practical implementation of planned obsolescence as an economic instrument.

The concept gained widespread public recognition through Packard's [3] The Waste Makers, which critically examined the pressures of consumer culture and the mechanisms that encourage continuous product replacement. This perspective aligns with the Frankfurt School's culture industry approach [11], emphasizing the socially constructed nature of consump-

tion. In this context, products may be perceived as obsolete even before the end of their technical lifespan, a phenomenon reflected in the notion of the "throw-away society" [4].

The economic literature has addressed this multidimensional structure in a more systematic manner. Bulow [1] demonstrated that the time inconsistency problem in durable goods markets may lead firms to set product durability below the optimal level. Waldman [12] showed that the introduction of new products reduces the value of existing ones, thereby creating excessive incentives for firms to innovate. Orbach [13] further argues that firms in durable goods markets develop indirect obsolescence mechanisms through strategies such as restricting secondary markets, creating incompatibilities across products, and employing pricing strategies.

Taken together, this historical and theoretical background demonstrates that planned obsolescence is not merely a technical practice but a multidimensional phenomenon shaped by the interaction of economic dynamics, technological developments, consumer culture, and behavioral processes.

2.2. TYPES AND CLASSIFICATION APPROACHES

The literature does not treat obsolescence as a uniform phenomenon; rather, it has developed multiple classification approaches influenced by economic, technological, and cultural dynamics. Obsolescence is explained in terms of technical failure, producer strategies, and consumer perceptions. These perspectives do not exclude one another but operate at different analytical levels, indicating the multidimensional nature of the phenomenon.

Technological and functional approaches focus on product performance and durability [4, 14, 15], whereas economic and strategic approaches emphasize pricing strategies, product introduction timing, and market dynamics [1, 12, 13, 16, 17, 18, 19]. In turn, psychological approaches highlight the role of consumer perceptions, status, and symbolic consumption [3, 4, 14].

More recent studies emphasize the systemic dimension of obsolescence, particularly in digital contexts, focusing on issues such as software–hardware incompatibility, platform dependency, and update policies [7, 13, 20, 21, 22, 23, 24, 25].

These differing approaches highlight the multidimensional nature of obsolescence while also pointing to the absence of a unified and comprehensive classification framework in the literature. In this context, Granberg's [26] distinction between absolute and relative obsolescence provides a functional framework based on outcomes. Absolute obsolescence refers to situations in which a product becomes unusable due to technical reasons, whereas relative obsolescence arises when a product loses its use value in comparison with newer alternatives, although it is still technically functional.

Granberg's approach is valuable in demonstrating that obsolescence cannot be reduced solely to physical deterioration; however, it does not fully capture how producer strategies, market dynamics, and consumer evaluations shape the process. In this regard, Cooper's [14] classification of technological, economic, and psychological obsolescence offers a complementary perspective by emphasizing the evaluative criteria through which consumers perceive products as obsolete.

Taken together, these approaches confirm that obsolescence constitutes a multidimensional and interdisciplinary field of research. At the same time, the diversity of these perspectives underscores the need for a more systematic understanding of how the literature has evolved over time and how its conceptual structure has developed.

3. METHODOLOGY

3.1. DATA COLLECTION PROCEDURE

This study employs a bibliometric analysis to examine the planned obsolescence literature. Bibliometric analysis provides a systematic approach for analyzing large volumes of scholarly publications and enables the identification of research trends, structural characteristics, and the evolutionary trajectory of a given research field [5].

The dataset was constructed using the Web of Science (WoS) database. The selective coverage of WoS, which indexes high-impact and peer-reviewed journals, ensures a relatively homogeneous level of academic quality and reliability in the analyzed literature. Furthermore, the use of a single database enhances data consistency in bibliometric analysis.

During the data collection process, it was considered that planned obsolescence is often discussed within the broader conceptualization of obsolescence. Therefore, the search was not limited to the term "planned obsolescence." Instead, a broader keyword strategy was adopted, incorporating related terms such as "purposeful obsolescence," "incompatibility obsolescence," "technological obsolescence," "psychological obsolescence," "programmed obsolescence," "functional obsolescence," "systematic obsolescence," "stylistic obsolescence," and "product obsolescence," all of which were included in the search within the "topic" field. This approach enables a more comprehensive analysis of the position of planned obsolescence within the broader obsolescence literature.

The time span of the study was defined to cover all publications from the inception of the WoS database up to March 30, 2026. Given the highly interdisciplinary nature of the topic, no subject area restrictions were applied, and all categories were included in the search.

As a result of the search, a total of 778 publications meeting the specified criteria were initially identified. Non-research

document types such as film reviews, art exhibition reviews, letters, and poems were excluded from the dataset, as they are not suitable for bibliometric analysis. Although these documents may contain certain references to the concept of planned obsolescence, they do not produce systematic and comparable academic data consistent with the other publication types included in the analysis. Given their limited number (n = 4), their exclusion does not have a meaningful impact on the overall results of the study. Accordingly, the final dataset included in the analysis consists of 774 publications (see Figure 1).

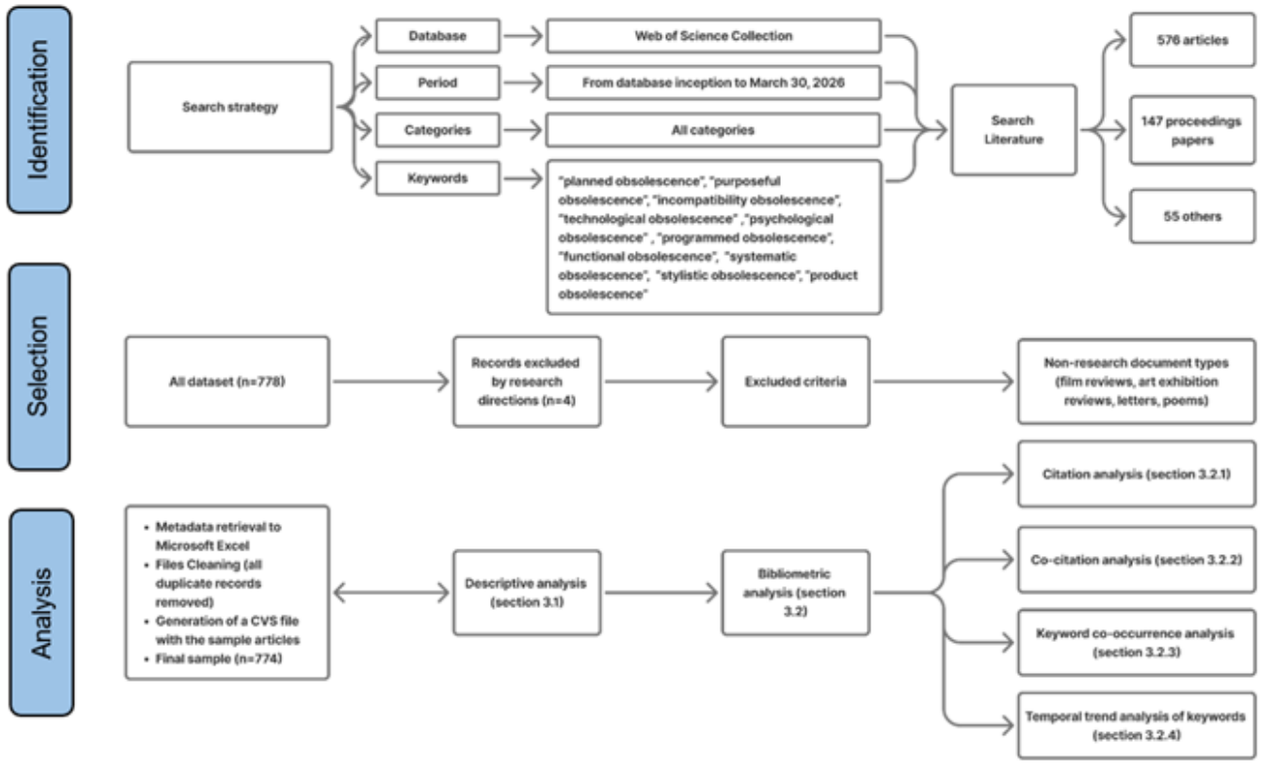

Figure 1. *Flowchart of the data collection, selection, and bibliometric analysis process*

Since the study adopts a comprehensive perspective aiming to capture the full scope of the literature, no restrictive filtering criteria were applied beyond database selection and keyword strategy. However, prior to analysis, the dataset was reviewed and cleaned, and inconsistencies in author names, institutional affiliations, and keywords were standardized to ensure data reliability.

3.2. DATA ANALYSIS

The data were analyzed through a two-stage process. In the first stage, descriptive analyses were conducted to provide an overview of the literature and examine the distribution of publications by year, country, and journal. In the second stage, bibliometric mapping techniques were employed to reveal the intellectual and thematic structure of the literature.

Bibliometric analyses were conducted using the VOSviewer software. The bibliographic data obtained from the Web of Science database were imported into the software and analyzed accordingly. Within this framework, citation analysis, co-citation analysis, and keyword co-occurrence analysis were performed, and the results were visualized using network mapping techniques.

Keyword analyses were based on the author keywords included in the dataset. Additionally, the temporal distribution of keywords was examined using the overlay visualization technique, enabling the identification of emerging trends within the literature.

Prior to analysis, the dataset was reviewed and cleaned. Variations in author names, institutional affiliations, and keywords were standardized, and conceptually similar terms were merged to enhance the consistency and reliability of the analysis.

4. FINDINGS

4.1. DESCRIPTIVE FINDINGS

4.1.1 General characteristics of the literature

The bibliometric analysis covers a total of 778 publications published between 1980 and March 30, 2026. These publications are distributed across 571 different sources, indicating that the literature spans a broad range of publication outlets.

The publications were produced by 1,662 authors from 885 institutions across 83 countries. This distribution reflects the international and multi-actor nature of the planned obsolescence literature. In addition, a total of 2,167 keywords were identified, indicating a high level of conceptual diversity within the field.

In terms of document types, the majority of publications are research articles (n = 576), followed by proceedings papers (n = 147) and review articles (n = 38). A smaller number of publications consist of book reviews (n = 13), early access articles (n = 13), and editorial materials (n = 13).

4.1.2 Distribution of publications over time

The distribution of publications over time reveals a clear upward trend in the literature (Figure 2). During the 1980s and 1990s, planned obsolescence research was represented by a relatively limited number of studies.

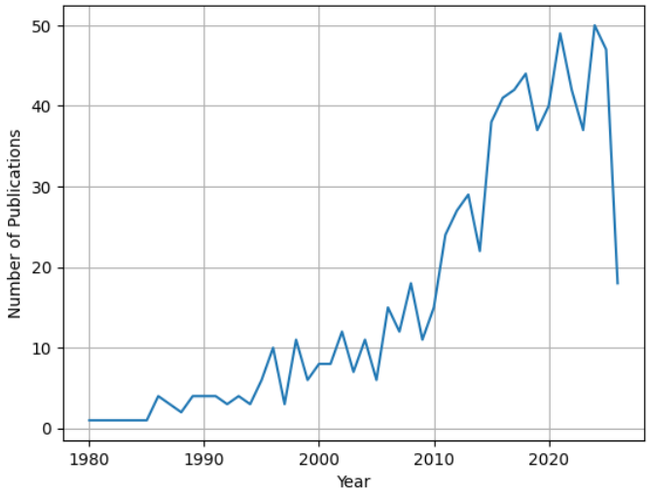

Figure 2. *Distribution of publications over time (1980–2026)*

Although a gradual increase was observed from the 2000s onward, the most substantial expansion occurred after 2010. In particular, publication output accelerated after 2015, indicating increased visibility of the field. This trend became even more pronounced in the 2020s, reaching its peak in 2024 with 50 publications. A high level of output was maintained in 2025 (n = 47), while the lower figure for 2026 reflects the dataset being limited to the first quarter of the year.

Overall, these findings indicate that the planned obsolescence literature has entered a phase of rapid growth over the past decade, evolving into a dynamic research field.

4.1.3 Distribution of publications by country

The distribution of publications by country indicates that the literature is concentrated in a limited number of countries. Although the analysis includes the full dataset, for the purposes of clarity and interpretation, Table 1 presents the ten most productive countries in the field.

The United States is the leading contributor (n = 205), followed by the United Kingdom (n = 64) and Italy (n = 50). Spain (n = 42) and Brazil (n = 41) also make notable contributions.

In terms of citation impact, the United States again holds a dominant position (n = 4,148), followed by the United Kingdom (n = 2,052). However, the findings reveal that productivity and impact do not always align. For example, the United Kingdom achieves high citation impact despite relatively lower output, whereas Italy shows higher productivity but comparatively lower citation levels.

Total Link Strength (TLS) values further indicate that the United States occupies a central position in collaboration and citation networks. The United Kingdom, France, and Germany also emerge as key actors in international collaboration

networks.

From a regional perspective, the findings indicate a strong concentration of publications in North America and Europe, while contributions from Asian countries also reflect the increasingly international character of the field.

Table 1. *Distribution of publications by country*

	Country	Documents	Citations	Total Link Strength
1	USA	205	4148	20182
2	England	64	2052	10156
3	Italy	50	275	2522
4	Spain	42	431	3307
5	Brazil	41	369	2865
6	France	35	721	7505
7	China	33	283	4694
8	Germany	32	451	6078
9	Canada	28	465	4074
10	Netherlands	26	756	3749

4.1.4 Most prominent journals

Although the dataset includes multiple document types, this analysis focuses on journal publications. To ensure clarity, Table 2 presents only journals with at least five publications.

Table 2. *Citation rankings of sources (minimum 5 publications)*

	Source	Documents	Citations	Total Link Strength
1	Journal of Cleaner Production	18	805	84
2	RAND Journal of Economics	12	983	179
3	Sustainability	11	115	10
4	European Journal of Operational Research	9	327	28
5	Resources, Conservation and Recycling	9	244	24
6	Product Lifetimes and the Environment	8	24	15
7	Marketing Science	7	394	57
8	Journal of Industrial Economics	6	205	58
9	Energies	5	82	12
10	Japanese Economic Review	5	8	50
11	Journal of Mechanical Design	5	137	1
12	International Journal of Industrial Organization	5	56	35

The literature is concentrated in a limited number of journals while being dispersed across a wide publication network. The highest number of publications appears in the Journal of Cleaner Production (n = 18), followed by the RAND Journal of Economics (n = 12) and Sustainability (n = 11).

The distribution indicates that both sustainability-oriented journals and economics and management journals play important roles, highlighting the interdisciplinary nature of the field. Citation analysis shows that productivity and impact are not always aligned. For instance, despite relatively fewer publications, the RAND Journal of Economics achieves high citation impact (n = 983), whereas some more productive journals exhibit lower citation levels.

Total Link Strength (TLS) values indicate that journals such as the Journal of Cleaner Production and the Journal of Industrial Economics occupy central positions within citation and collaboration networks.

4.2. SCIENCE MAPPING RESULTS

4.2.1 Citation analysis

Citation analysis by publication sources. Citation analysis was conducted using the full dataset. The distribution of citations across publication sources indicates that scholarly impact is concentrated in a limited number of journals (Table 2). The RAND Journal of Economics has the highest citation count (n = 983), followed by the Journal of Cleaner Production (n = 805). Memory Studies ranks third (n = 591), followed by the Quarterly Journal of Economics (n = 433), Marketing Science (n = 394), Technological Forecasting and Social Change (n = 393), and the European Journal of Operational Research (n = 327).

Importantly, citation rankings do not directly correspond to publication volume. Some journals achieve high citation impact despite a limited number of publications. For instance, Memory Studies (1 publication, 591 citations) and the

Quarterly Journal of Economics (2 publications, 433 citations) illustrate how individual studies can exert disproportionate influence. This pattern suggests that certain highly cited works are positioned within broader theoretical contexts rather than directly addressing planned obsolescence.

An examination of Total Link Strength (TLS) values further indicates that citation impact, publication volume, and structural centrality do not necessarily converge. The Quarterly Journal of Economics (TLS = 182) and the RAND Journal of Economics (TLS = 179) emerge as the most central sources within the network, while the Journal of Cleaner Production (TLS = 84) and the Journal of Industrial Economics (TLS = 58) also occupy influential positions. In contrast, some journals with relatively high publication output, such as Sustainability (TLS = 10) and Product Lifetimes and the Environment (TLS = 15), remain less central within the network structure. Similarly, Technological Forecasting and Social Change, despite receiving 393 citations, exhibits comparatively low network centrality (TLS = 10). Overall, the findings suggest that productivity, impact, and structural embeddedness represent distinct dimensions of influence within the literature.

Citation analysis by authors. The author-level citation analysis indicates that scholarly influence is concentrated around a limited number of authors (Table 3). Waldman (n = 909) stands out as the most influential author in terms of total citations.

Table 3. *Citation rankings of the top 15 authors*

	Author	Cluster	Document	Citation	Total Link Strength	Avg. Citation
1	Waldman, M.	24	11	909	425	82.6364
2	Baumers, M.	22	1	346	3	346
3	Brown, P.	22	1	346	3	346
4	Charnley, F.	22	1	346	3	346
5	Despeisse, M.	22	1	346	3	346
6	Ford, S. J.	22	1	346	3	346
7	Garmulewicz, A.	22	1	346	3	346
8	Knowles, S.	22	1	346	3	346
9	Minshall, T. H. W.	22	1	346	3	346
10	Mortara, L.	22	1	346	3	346
11	Reed-Tsochas, F. P.	22	1	346	3	346
12	Rowley, J.	22	1	346	3	346
13	Bulow, J.	14	1	309	196	309
14	Fudenberg, D.	1	2	265	93	132.5
15	Carlton, D. W.	1	1	263	8	263

Table 4. *Citation rankings of the top 10 publications*

	Document	Cluster	Citation
1	Connerton, P. (2008). Seven types of forgetting. Memory Studies, 1(1), 59–71.	157	591
2	Despeisse, M., Baumers, M., Brown, P., Charnley, F., Ford, S., Garmulewicz, A., Knowles, S., Minshall, T., Mortara, L., Reed-Tsochas, F., & Rowley, J. (2017). Unlocking value for a circular economy through 3D printing: A research agenda. Technological Forecasting and Social Change, 115, 75–84.	3	346
3	Bulow, J. (1986). An economic theory of planned obsolescence. The Quarterly Journal of Economics, 101(4), 729. https://doi.org/10.2307/1884176	16	309
4	Carlton, D. W., & Waldman, M. (2002). The strategic use of tying to preserve and create market power in evolving industries. The RAND Journal of Economics, 33(2), 194-220.	24	263
5	Junnila, S., Horvath, A., & Guggemos, A. A. (2006). Life-Cycle Assessment of office buildings in Europe and the United States. Journal of Infrastructure Systems, 12(1), 10–17.	390	251
6	Trimi, S., & Berbegal-Mirabent, J. (2012). Business model innovation in entrepreneurship. International Entrepreneurship and Management Journal, 8(4), 449–465.	360	222
7	Ozdamar Ertekin, Z., & Atik, D. (2015). Sustainable markets: Motivating factors, barriers, and remedies for mobilization of slow fashion. Journal of Macromarketing, 35(1), 53-69.	37	191
8	Waldman, M. (2003). Durable Goods Theory for Real world Markets. The Journal of Economic Perspectives, 17(1), 131–154.	25	189
9	Iacovidou, E., Hahladakis, J. N., & Purnell, P. (2021). A systems thinking approach to understanding the challenges of achieving the circular economy. Environmental Science and Pollution Research, 28(19), 24785–24806.	2	179
10	Fudenberg, D., & Tirole, J. (1998). Upgrades, tradeins, and buybacks. The RAND Journal of Economics, 29(2), 235-258. https://doi.org/10.2307/2555887	6	176

However, a notable pattern emerges: many authors achieve high citation counts based on a single publication. This should not be interpreted as individual influence alone, but rather as a consequence of highly cited multi-authored studies. The clustering of authors with identical citation counts within the same cluster (e.g., cluster 22) suggests that they share the impact generated by a single influential work.

At the same time, authors such as Waldman (cluster 24), Bulow (cluster 14), and Fudenberg (cluster 1) exhibit high citation impact while being located in different clusters. This dispersion indicates the presence of multiple intellectual focal points within the literature. The field is therefore not organized around a single dominant perspective but rather shaped by diverse theoretical approaches.

Total Link Strength (TLS) values reinforce this interpretation. Waldman (TLS = 425) is not only the most cited author but also the most central figure in the network. However, the mismatch between citation counts and link strength for some authors confirms that impact and structural centrality are distinct dimensions within the literature.

Citation analysis by publications. Citation analysis at the publication level reveals that impact is concentrated around a limited number of studies (Table 4). Although Connerton (2008) has the highest citation count (n = 591), its relationship to planned obsolescence is indirect. Moreover, the absence of direct link connections with other studies in the dataset (link = 0) indicates that this work is positioned outside the core network structure of the field. This finding further suggests that highly cited publications do not necessarily occupy central positions within the core structure of the literature. It is followed by Despeisse et al. (2017) (n = 346) and Bulow (1986) (n = 309), with Carlton (2002) and Junnila (2006) making additional influential contributions.

The distribution of highly cited publications across different clusters suggests that the literature is not structured around a single thematic core. Instead, it reflects contributions from multiple disciplines and diverse theoretical domains.

4.2.2 Co-citation analysis

Co-citation analysis was conducted to identify the intellectual structure of the literature. The results show that authors with high TLS values are grouped into distinct clusters (Table 5, Figure 3).

Table 5. *Authors with the highest Total Link Strength (TLS)*

	Author	Citation	Total Link Strength	Cluster
1	Waldman, M.	227	1514	2
2	Bulow, J.	167	1102	2
3	Cooper, T.	102	724	1
4	Swan, P. L.	74	597	2
5	Choi, J. P.	66	567	2
6	Coase, R. H.	64	539	2
7	Fudenberg, D.	47	447	2
8	Stokey, N. L.	37	329	2
9	Farrell, J.	36	300	2
10	Bond, E. W.	34	298	2
11	Van Nes, N.	32	291	1
12	Schmalensee, R.	32	278	2
13	Katz, M. L.	39	274	2
14	Fishman, A.	34	271	2
15	Bocken, N. M. P.	30	254	1
16	European Commission	38	241	1
17	Ellison, G.	28	235	2
18	Levinthal, D. A.	30	234	2
19	Mugge, R.	24	226	1
20	Bakker, C.	28	221	1

Waldman (TLS = 1,514) and Bulow (TLS = 1,102) emerge as the most central authors, followed by Cooper (TLS = 724), Swan (TLS = 597), and Choi (TLS = 567). These authors play a key role in shaping the intellectual structure by linking different strands of research.

The network structure reveals two dominant clusters. The first cluster (blue) is centered on Waldman and Bulow and represents an economic modeling perspective focused on durable goods and market dynamics. The second cluster (red), organized around Cooper and institutional sources such as the European Commission, reflects a sustainability-oriented perspective emphasizing circular economy and product lifetime.

The presence of connections between these clusters indicates that these perspectives are not entirely disconnected but

linked through conceptual relationships. However, the distribution of highly cited works across different clusters confirms that the literature is not grounded in a single theoretical framework.

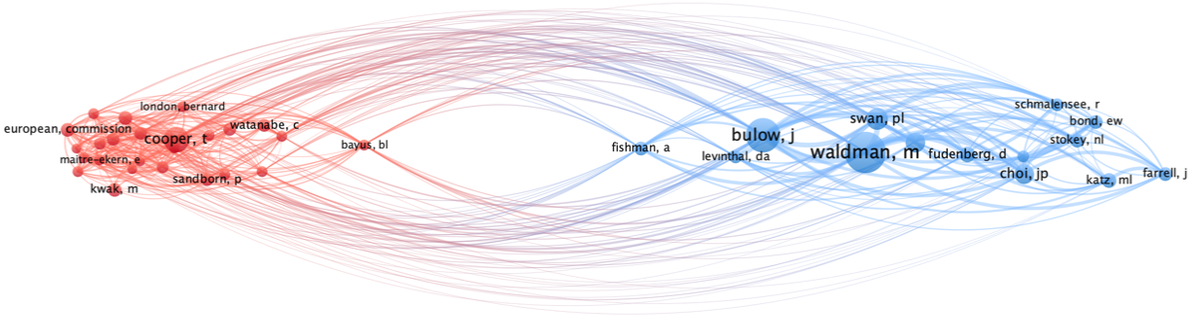

Figure 3. *Author co-citation network*

4.2.3 Keyword co-occurrence analysis

Keyword co-occurrence analysis was conducted to reveal the thematic structure and conceptual relationships within the literature. The results are visualized in Figure 4, and the most frequently used keywords with the highest Total Link Strength (TLS) are presented in Table 6. Keywords that remained isolated within the network structure and exhibited low link strength were excluded from the analysis.

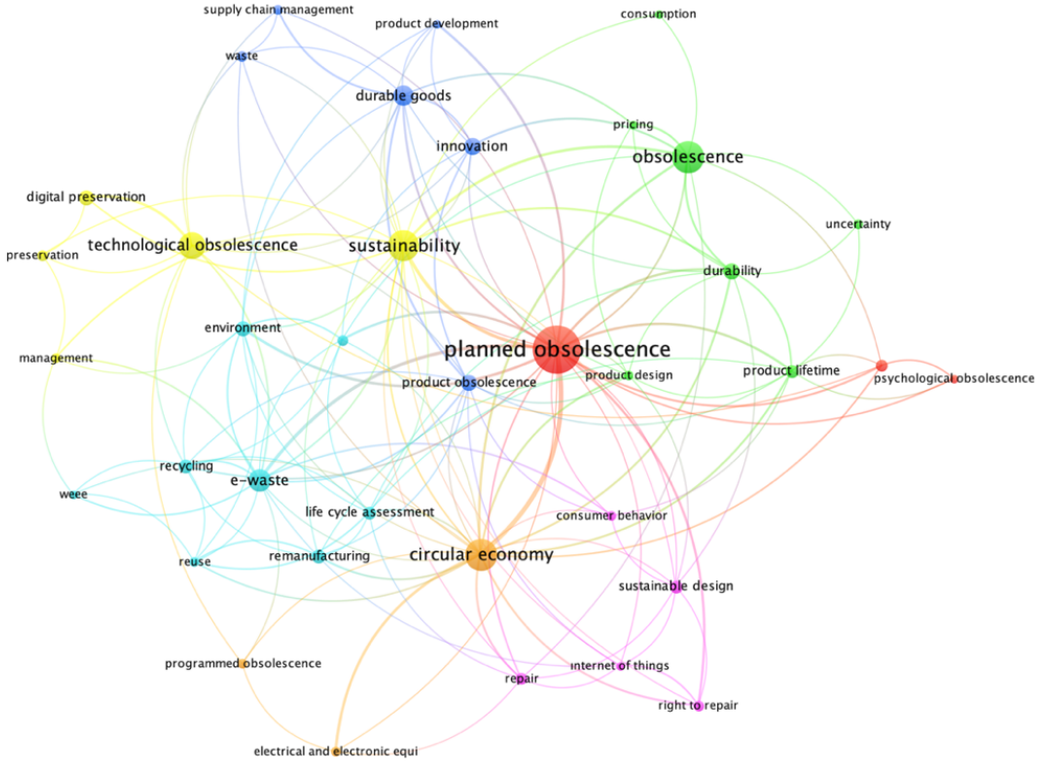

Figure 4. *Keyword co-occurrence network and clustering structure*

The findings indicate that planned obsolescence (f = 86) occupies a central position in the literature and establishes strong connections with other concepts. It is followed by circular economy (f = 43), obsolescence (f = 43), and sustainability (f = 40), indicating a strong integration with sustainability-oriented research.

The clustering structure reveals that the literature is organized around seven distinct thematic clusters. The first cluster focuses on environmental impacts and waste management (e.g., e-waste, recycling, remanufacturing, reuse, and life cycle assessment), highlighting the environmental consequences of planned obsolescence. The second cluster reflects product lifetime and economic perspectives (e.g., durability, pricing, uncertainty, and consumption), indicating a focus on economic decision-making processes. The third cluster is associated with production, innovation, and supply chain dynamics, linking planned obsolescence to production processes and innovation strategies.

The fourth cluster emphasizes sustainable design and consumer-related issues, including repair, the right to repair, and consumer behavior. The fifth cluster relates to technological obsolescence and digital contexts, highlighting the role of technological change and digital sustainability. The sixth cluster represents the conceptual core of the field, bringing together planned obsolescence, sustainable consumption, and psychological obsolescence. Finally, the seventh cluster highlights the circular economy and system-level approaches, reflecting policy-oriented and systemic perspectives.

Overall, the clustering structure demonstrates that the literature is not organized around a single thematic axis but rather reflects multiple conceptual and disciplinary focal points, confirming its multidimensional and interdisciplinary character.

Table 6. *Top keywords by frequency and Total Link Strength (TLS)*

	Keyword	Occurence	Total link strength	Cluster
1	Planned obsolescence	86	75	6
2	Circular economy	43	58	7
3	Obsolescence	43	25	2
4	Sustainability	40	37	5
5	Technological obsolescence	32	16	5
6	E-waste	23	28	1
7	Durable goods	19	20	3
8	Innovation	15	12	3
9	Durability	14	21	2
10	Product obsolescence	14	15	3
11	Digital preservation	12	8	5
12	Environment	12	18	1
13	Recycling	10	12	1
14	Remanufacturing	10	10	1
15	Life cycle assessment	9	12	1
16	Product lifetime	9	16	2
17	Sustainable design	9	9	4
18	Repair	8	11	4
19	Sustainable consumption	8	10	6
20	Preservation	7	4	5
21	Right to repair	7	11	4
22	Sustainable development	7	12	1
23	Waste	7	6	3
24	Consumer behavior	6	7	4
25	Electrical and electronic equipment	6	8	7
26	Management	6	7	5
27	Product design	6	11	2
28	Programmed obsolescence	6	4	7
29	Reuse	6	10	1
30	Supply chain management	6	6	3
31	Uncertainty	6	3	2
32	Consumption	5	2	2
33	Pricing	5	7	2
34	Product development	5	8	3
35	Psychological obsolescence	5	5	6
36	WEEE	5	6	1
37	Internet of things	5	8	4

4.2.4 Temporal trend analysis of keywords

Temporal trend analysis of keywords was conducted to reveal the conceptual evolution of the literature. The results are presented in Figure 5 using the overlay visualization technique, in which keywords are color-coded based on their average publication year. Blue and yellow tones represent earlier studies and more recent research trends, respectively.

An examination of the figure shows that concepts such as obsolescence, durable goods, and pricing were prominent in the early stages of the literature, indicating that initial studies were largely grounded in economic models and product lifetime–based approaches.

Over time, the literature expanded to incorporate concepts such as sustainability and technological obsolescence, reflecting a growing emphasis on environmental and technological dimensions. More recent trends highlight concepts

such as circular economy, repair, right to repair, consumer behavior, and internet of things, indicating a shift toward sustainability-oriented and consumer-centered perspectives.

Overall, the temporal distribution of keywords demonstrates that the literature on planned obsolescence has evolved from economically oriented approaches toward a multidimensional structure grounded in sustainability, circular economy, and consumer behavior. This transformation reflects the field's expansion across multiple conceptual dimensions and its increasing interdisciplinary character.

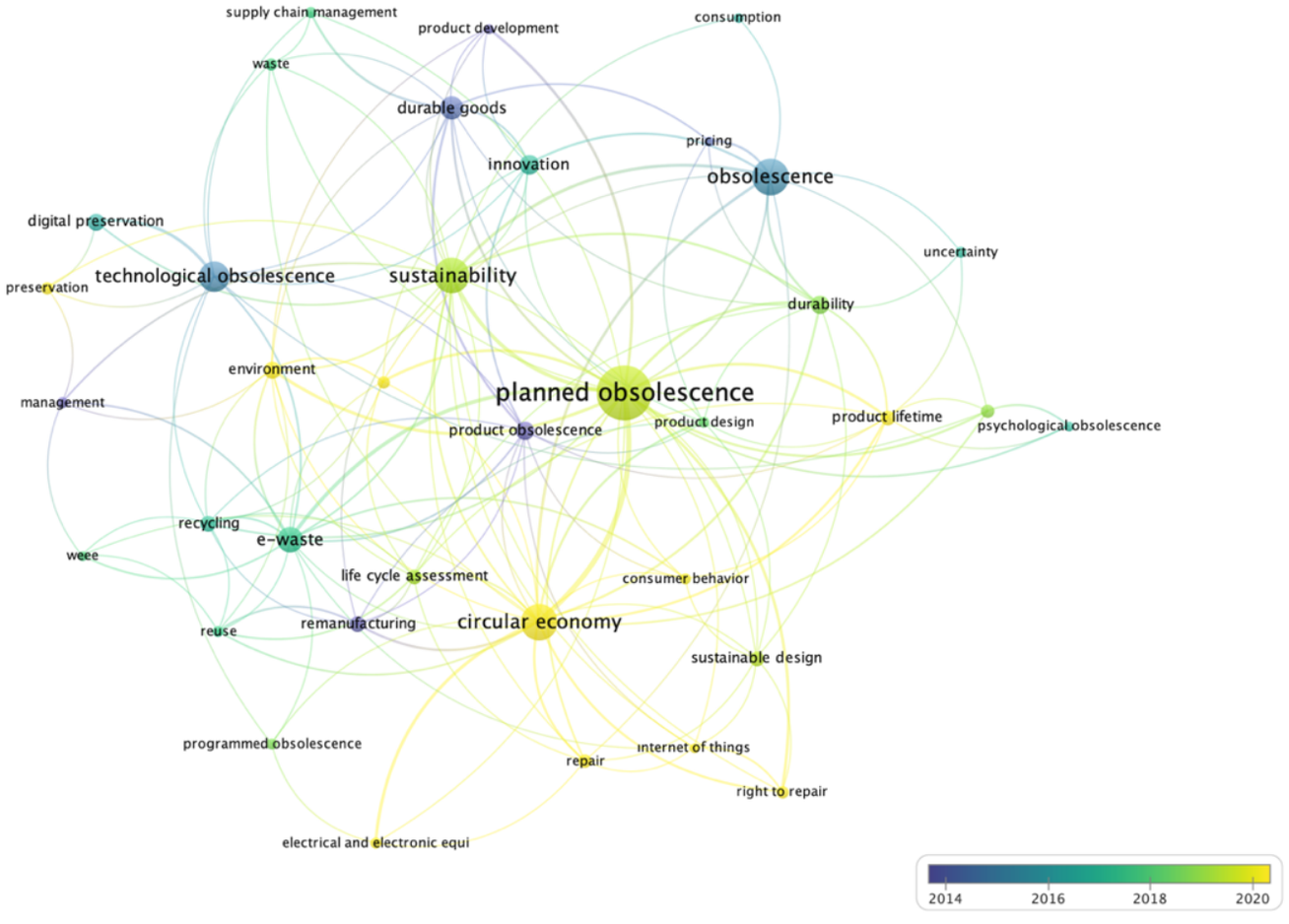

Figure 5. *Temporal trends of the keywords*

5. DISCUSSION AND CONCLUSIONS

This study examined the structure, development, and conceptual orientations of the planned obsolescence literature through bibliometric analyses. The findings reveal that the literature has expanded considerably, particularly after 2010, and has undergone a notable thematic transformation. While early studies focused primarily on economic models, product durability, and efficiency-related debates, more recent research has increasingly addressed sustainability, environmental impacts, technological obsolescence, consumer behavior, the circular economy, and the right to repair. The co-citation analysis further indicates that this transformation has largely developed around two major orientations within the literature: an economic approach and a sustainability-oriented approach.

Citation, co-citation, and keyword analyses collectively suggest that the literature is not organized around a single intellectual or thematic perspective. Highly cited studies are distributed across different disciplinary traditions, and several influential works address planned obsolescence indirectly through broader theoretical debates. At the same time, keyword clusters reveal the coexistence of economic, technological, environmental, and consumer-oriented themes. Taken together, these findings suggest that planned obsolescence is best understood as a research domain situated at the intersection of multiple dimensions of the broader phenomenon of obsolescence.

5.1. THEORETICAL IMPLICATIONS

The findings further demonstrate that the planned obsolescence literature is not grounded in a single theoretical framework, but rather develops around multiple yet interconnected approaches. This suggests that the field requires interpretation through diverse theoretical perspectives rather than through a unified conceptual lens.

The co-citation and keyword analyses indicate that the literature is primarily structured around economic and sustainability-oriented approaches. At the same time, themes such as technological obsolescence and consumer behavior appear to constitute intersectional areas linking these approaches. This pattern suggests that the field is characterized not by isolated lines of inquiry, but by a relational and multidimensional structure.

Moreover, the study positions planned obsolescence within the broader obsolescence literature. The findings demonstrate that planned obsolescence extends beyond producer-driven strategies and is increasingly discussed in relation to technological, psychological, and economic forms of obsolescence, as well as within the context of sustainability and environmental impacts. This highlights the extent to which the planned obsolescence literature is conceptually intertwined with broader debates on obsolescence.

Based on these findings, a conceptual positioning matrix is proposed in order to explain holistically the relationships between different theoretical orientations and levels of analysis within the planned obsolescence literature. Presented in Figure 6, this matrix systematically illustrates how the dominant research streams within the literature are clustered and through which intersectional areas they establish conceptual relationships with one another.

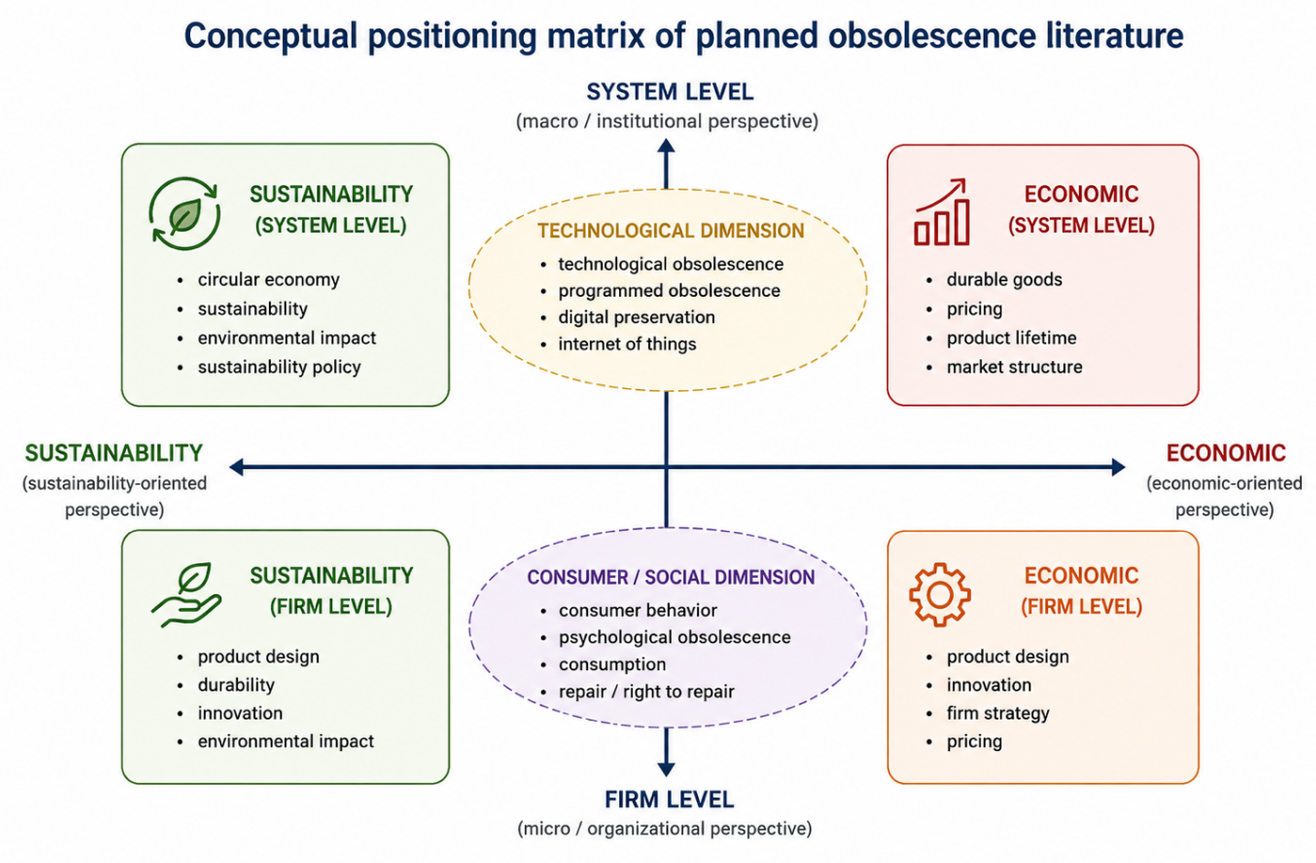

Figure 6. *Conceptual positioning of the planned obsolescence literature*

Note: The thematic areas presented in the matrix were interpreted by considering the theoretical relationships among the concepts identified through the keyword co-occurrence analysis and were positioned so as to represent the dominant research orientations within the literature.

The horizontal axis represents a continuum ranging from sustainability-oriented to economically oriented approaches. While the economic perspective is primarily associated with themes such as durable goods, pricing, product lifetime, and firm strategies, the sustainability-oriented perspective emphasizes the circular economy, environmental impacts, recycling, and sustainable production policies. The vertical axis reflects the level of analysis within the literature, distinguishing between firm-level studies focusing on product design, innovation, and managerial processes, and system-level studies addressing broader structures such as regulatory frameworks, market dynamics, and sustainability policies.

The intersection of these two axes reveals four major positioning areas within the literature. Economic approaches examine planned obsolescence through firm strategies, market structures, and competition-related issues, whereas sustainability-oriented approaches focus on product durability, circular economy practices, and sustainability policies at both firm and system levels.

The matrix also highlights technological obsolescence and consumer-related themes as intersectional domains that connect different theoretical orientations and levels of analysis. This suggests that planned obsolescence should be understood not as a purely economic or technical issue, but as a research domain shaped by the interaction of economic, technological, environmental, and consumer-oriented perspectives.

5.2. PRACTICAL IMPLICATIONS

The findings of the study demonstrate that planned obsolescence is not a phenomenon limited solely to firm strategies, but one that also generates important implications for policymakers, businesses, and consumers.

From a policy perspective, the growing prominence of themes such as sustainability, the circular economy, and the right to repair highlights the importance of regulatory frameworks aimed at extending product lifetimes and improving resource efficiency. In this context, policies should address not only producer behavior, but also the broader systemic factors influencing product life cycles. This suggests that planned obsolescence is shaped not merely by individual producer decisions, but also by wider regulatory and structural dynamics.

For businesses, the findings indicate the need to reconsider traditional product renewal-oriented business models. The increasing importance of product durability, reparability, and circular design approaches requires firms to adopt more sustainable innovation strategies. The findings further suggest that firms are facing a growing tension between short-term product renewal strategies and long-term sustainability expectations.

The increasing prominence of consumer-oriented studies within the literature further demonstrates that planned obsolescence research extends beyond producer strategies and technical product characteristics. In particular, the growing focus on consumer behavior, perceived obsolescence, and product replacement motivations indicates that consumers also play a decisive role in planned obsolescence debates. This suggests that planned obsolescence is associated not only with production processes, but also with consumption habits and broader social expectations.

5.3. LIMITATIONS AND FUTURE RESEARCH

This study has several limitations. First, the analysis is limited to the Web of Science database. Future studies may provide broader evaluations of the literature by incorporating additional databases.

Second, the study relies on bibliometric methods. Although these methods make the structural characteristics of the literature more visible, they provide only a limited representation of the substantive depth of individual studies. Future research could therefore benefit from supporting bibliometric findings with qualitative analyses or systematic reviews.

Third, the broad keyword strategy adopted in the study may have resulted in the inclusion of studies addressing planned obsolescence only indirectly. Future research may employ narrower and more focused keyword sets in order to concentrate on specific thematic areas.

Within the context of these limitations, several directions for future research can be proposed.

Studies focusing on the firm level may further investigate how product design, durability, and replacement strategies are shaped. In particular, the effects of design decisions such as modularity, reparability, and software update policies on firm performance and competitive advantage could be examined empirically.

Research focusing on policy and regulatory dimensions may investigate the market implications of right-to-repair initiatives, product lifetime standards, and circular economy policies. Comparative analyses of regulatory frameworks implemented across different countries may contribute to a better understanding of how such policies influence producer behavior and consumer welfare.

Studies adopting a consumer behavior perspective may explore perceived obsolescence, status consumption, and replacement motivations in greater depth. Comparative research conducted across different cultural contexts may further reveal how consumers' replacement decisions are shaped not only by functional considerations, but also by symbolic and social factors.

Within the context of digital obsolescence, elements such as software updates, platform dependency, and technological incompatibility warrant further investigation through multilevel research designs. Studies integrating firm strategies with regulatory policies may contribute to a more comprehensive understanding of the micro- and macro-level implications of digital obsolescence.

Finally, the conceptual positioning matrix proposed in this study provides a guiding framework for future research. In particular, integrating economic and sustainability-oriented approaches with firm- and system-level analyses may contribute to a more systematic explanation of the relationships among different research streams within the planned obsolescence

literature.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

In the course of preparing this manuscript, the authors employed ChatGPT to improve the linguistic quality and readability of the content. After utilizing this AI tool, the authors conducted comprehensive review and necessary revisions to ensure the accuracy, integrity, and scientific rigor of the manuscript. All authors bear full responsibility for the final content of the published work, including any errors or inconsistencies that may arise.

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