

Towards a Unified Model of Planned Obsolescence and Innovation Adoption in Consumer Behavior: A Literature Review and Conceptual Proposition using the Stimulus-Organism-Response Framework

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Abstract

This study investigates the controversial practice of planned obsolescence in the electronics industry. The study explores how frequent new model releases affect smartphone pricing and consumer loyalty, along with factors influencing smartphone upgrades such as perceived necessity, technological advancements, and pricing incentives. The research aims to understand consumer perspectives on planned obsolescence using Venkatesh's decision-making theory in dynamic purchase conditions. Key questions include defining planned obsolescence, dissecting the innovation and consumer behavior model, and examining how these concepts relate to purchasing the next smartphone version. The literature review covers 23 planned obsolescence references (1993-2022) and 21 innovation adoption references (1943-2021). It touches on various aspects of planned obsolescence. The study advocates for consumer awareness, sustainable practices by producers, and a balanced business model that serves all interests while protecting the environment. A legal framework supporting a circular economy is highlighted as essential in combating planned obsolescence.

Keywords

Planned Obsolescence, Innovation Adoption, Stimulus Organism Response, Unifying, UTAUT.

Introduction

Smartphone batteries deteriorate over time, and manufacturers often separate the sale of hardware from accessories, such as chargers, to prevent easy replacement. New product launches often lack notable features, despite introducing fancier models. Manufacturers also focus on software and operating systems, providing support for distributors and consumers in patching and updating. However, support is limited to certain years and more directed towards highly sold products. New phone models typically receive only a few software updates before becoming “no longer supported,” with larger manufacturers offering the best-case scenario. This strategy is particularly effective

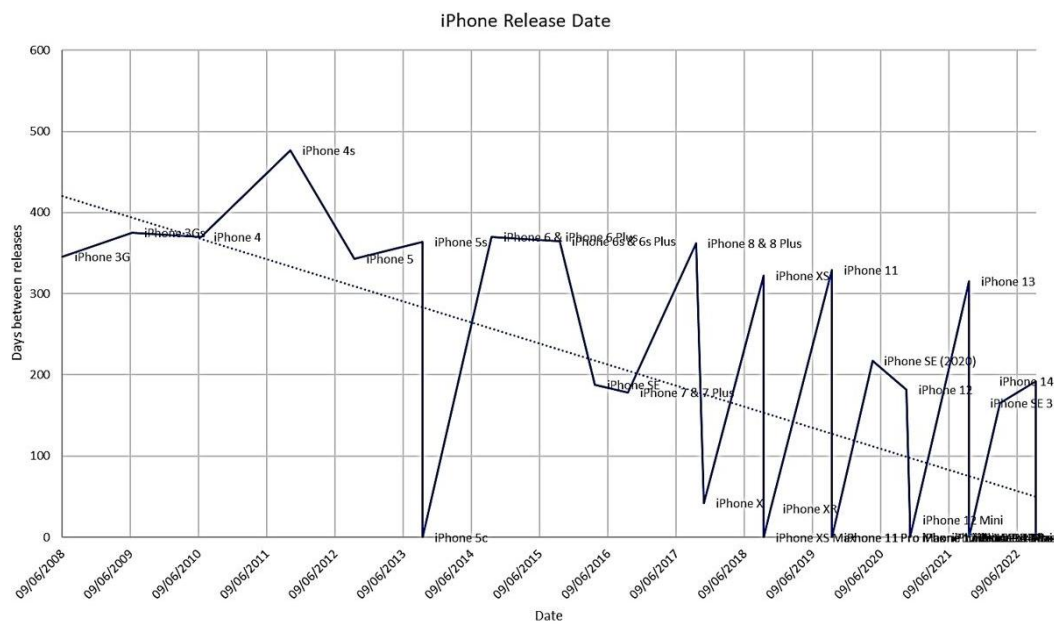
for more expensive phones, while smaller and less expensive phones receive very few upgrades. Figure 1 shows the tracking of a new model launched by the top two smartphone manufacturers, Apple, and Samsung. Figure 1a shows the track record of the new iPhone model at the time it was released, while Figure 1b is for the Samsung Galaxy A series. Both companies are constantly producing models that are commonly regarded as superior to the prior item. Because there is a newer and better version with all the newest technology, this renders the earlier version outdated.

Note the steepness of the trendline in both graphs in Figure 1. If the steepness of the trendline indicates the use of planned obsolescence in products, then Apple uses it more aggressively for the iPhone than Samsung for the Galaxy A.

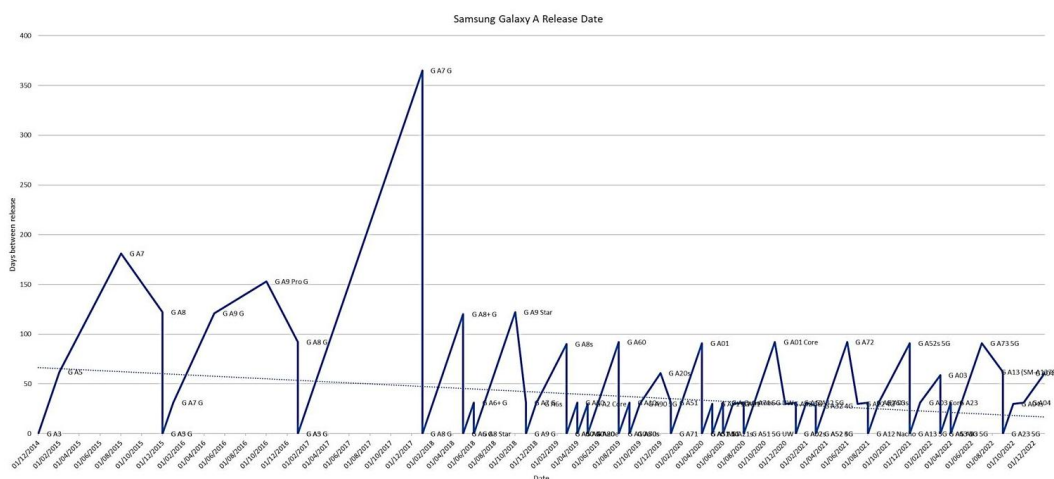
Apple has faced accusations of using a planned obsolescence strategy for its iPhone products, leading to a public apology in December 2017. Critics argue that Apple intentionally designs software updates that slow down older devices, making them less functional and less desirable to consumers. The iPhone 7

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(a) iPhone from Apple



(b) Samsung products Galaxy A series

Fig. 1. Tracking of new product release for, (a) iPhone from Apple, and (b) Samsung products Galaxy A series

and 7 Plus were designed without a headphone jack, and the iPhone X introduced a new facial recognition feature that made certain features less user-friendly. A study by Greenpeace revealed that the average smartphone lifespan has decreased from 4.7 years in 2014 to 2.7 years in 2020, with 80% of the environmental impact occurring during production. A survey by the Consumer Reports National Research Center found that 8 out of 10 smartphone users upgrade due to outdated features, faster phones, better cameras, or longer battery life. Samsung faced criticism for its use of planned obsolescence in 2017 and a class-action lawsuit in the US.

The regularly successive launches of new models have also impacted smartphone prices. Prior to launching a new model, consumers are invited to participate in what is called a “pre-launch offering.” In the pre-launch, a limited number of new models are set aside for the most loyal customers’ disposition. They can have the product while the product itself is not on the market yet. It triggers the social discrepancy among loyalists and less loyalists to the brand. The strategy commonly worked. Apparently, the manufacturers play around with the depreciation of the new model months after it launches. A sketch from GSM Arena shows how prices dropped over the months following the first introduction of the product to the market.

Planned obsolescence is a business strategy in which a product is designed and manufactured with a limited lifespan or with features that become obsolete quickly, resulting in the need for consumers to purchase a new version of the product. This strategy can increase sales and profits for companies, as consumers are more likely to purchase newer versions of products that they perceive as outdated or no longer functional. The decision to purchase a new version of a product is often influenced by a variety of factors, including the perceived need for the new features or improved performance, the desire to stay current with the latest technology, and the availability of affordable pricing or promotional offers. Companies often use marketing techniques to encourage consumers to upgrade to the latest version of their products, such as advertising the new features or offering trade-in programs for older models. However, the practice of planned obsolescence has been criticized for its negative impact on the environment and consumer finances. By creating products with a limited lifespan, companies contribute to the growing problem of electronic waste and promote a culture of disposable consumerism. Additionally, consumers may feel pressured to continually upgrade their products, even if their current version is still functional, leading to unnecessary spending and financial strain. Overall, the relationship between planned obsolescence and the decision to purchase a new version of a product is complex and influenced by a variety of factors. While the practice can benefit Planned obsolescence, the practice of intentionally designing products with a limited lifespan, has become a controversial topic in the electronics industry.

This study intends to enlighten the controversy from user or customer perspectives by using the decision factors that Venkatesh's theory offers (Venkatesh et al., 2016). It is expected to answer whether Venkatesh theory can be extended to the condition where customers' purchase conditions are dynamic and where the incentive for this dynamism is planned by the manufacturer. It will contribute to the theoretical basis of the purchase decision that has to be made in a market where information is unlimited but burdensome and influencers are the main drivers in such an overwhelming market. It leads to the following research questions: 1) What components constitute the construct of planned obsolescence? 2) What components constitute the construct of 'innovation, diffusion of innovation, and consumer behavior model?' and 3) How are these two constructs unified to describe the intention to buy the next version of a product in the smartphone market?

Literature review

The literature review consists of two critical theories: planned obsolescence theory and innovation adoption theory. This study reviews 23 references on planned obsolescence theory dated from 1993 to 2022 and 21 references on innovation adoption theory dated from 1943 to 2021. They are depicted in the following subparagraphs:

Theory of planned obsolescence

Twenty-three references are examined to describe the theory of planned obsolescence. The list of references is tabulated in Table 1. The list is not exhaustive, but it covers the entirety of the materials needed to answer the research questions. The articles explore various topics related to consumer protection, planned obsolescence, engineering, product design, environmental technology, sanitary engineering, waste management, and marketing strategies. It also discusses the impact of planned obsolescence on consumer behavior, demand, and sustainable development. The article also examines smartphone obsolescence, repairability, and big data analysis.

The text explores business ethics, consumer behavior in the cellular phone market, product obsolescence, sustainability, emerging markets, innovation, marketing, consumer psychology, social change, and information economics.

Multiple definitions are derived from the articles; however, the general agreement on the definition of all the articles is: "*Planned obsolescence is a deliberate design strategy involves intentionally making products or services obsolete or unusable, affecting consumer purchase decisions and societal impact. This strategy can be used to stimulate demand for new products or to reduce the value of older products, resulting in an obsolescence effect on past sales.*" The keywords are "design strategy", "obsolete", "consumer purchase decision", and "societal impact".

Theoretically, planned obsolescence covers multiple aspects. Those are the social practice aspect, the marketing aspect, the environmental aspect, business ethics, the circular economy aspect, and the planning aspect of planned obsolescence.

Social practice aspect

Waldman (1993) presents a new perspective on planned obsolescence, arguing that consumers may have imperfect information about product durability or

quality. The author develops a model of a monopolist selling a durable good to consumers uncertain about its durability, showing that the monopolist may reduce the product's durability to signal its high quality and increase profits. [Maycroft \(2009\)](#) identifies three main types of planned obsolescence: technological, stylistic, and superfluous. Technological obsolescence involves the use of fragile components that cause products to malfunction or become obsolete, while stylistic obsolescence appeals to changing tastes and preferences. Superfluous obsolescence involves the overelaboration of products with unnecessary features or functions, requiring additional consumption of goods and services to maintain them. The author discusses the social and environmental impacts of planned obsolescence, such as consumer dissatisfaction, increased costs, resource depletion, pollution, and waste disposal problems. The author calls for more awareness and resistance to planned obsolescence and suggests alternatives like product durability, repairability, adaptability, and recyclability. [Cooper \(2004\)](#) argues that product obsolescence is a result of complex interactions between consumers, producers, and society. The author calls for more research on consumer attitudes and behaviors towards product life spans and collaboration between stakeholders to promote sustainable consumption patterns. [Karakuş Umar & Beyaz \(2021\)](#) examine planned obsolescence, the deliberate design of products with a limited lifespan or functionality, and its effects on consumers and society. They argue that planned obsolescence can be a trap set for consumers or a strategy for social development. They suggest consumers should be aware of their rights and responsibilities, and producers should adopt sustainable practices.

Marketing aspect

The most addressed aspect of planned obsolescence is marketing. [Utaka \(2000\)](#) investigates the marketing activities of a durable goods monopolist that have an obsolescence effect on products sold in the past. The study uses a two-period model and assumes that the monopolist can stimulate consumer demand for second-period products through marketing activities. [Cooper \(2004\)](#) explores product obsolescence, focusing on household appliances and their environmental and social implications. Data from surveys and focus groups on the UK reveals consumer attitudes and behaviors toward appliance life spans, with factors such as cost, quality, performance, convenience, fashion, and social norms influencing decisions. [Iizuka \(2007\)](#) examines the decision to introduce new products by durable goods producers, also known as planned obsolescence.

The study finds that publishers revise editions more frequently when competition from used textbooks increases, suggesting the presence of planned obsolescence. Other factors, such as technological change and product differentiation, also influence the introduction of new products. [Soto Pineda & Prada Salmoral \(2017\)](#) discuss planned obsolescence, a business strategy that makes products or services outdated or unusable after a certain period. They argue that this practice violates loyalty, good faith, consumer rights, and competition laws. They propose solutions such as increasing transparency, enhancing reparability, extending warranties, and promoting sustainability. [Margarita & Vargas \(2017\)](#) review the origins and impacts of planned obsolescence, arguing that it stimulates innovation and creates jobs but also has negative effects like increased waste, pollution, poverty, and consumer dissatisfaction. They call for a better business model that balances producer and consumer interests while protecting the environment. [Niklewicz-Pijaczyńska et al. \(2021\)](#) discuss planned product aging (PPA), which can be beneficial for sustainable development by stimulating innovation, reducing environmental impacts, and increasing social welfare. They propose a framework to evaluate PPA's effects on economic, environmental, social, and institutional dimensions and present examples from various sectors. They conclude that PPA can be a viable strategy for sustainable development but requires careful analysis and implementation to avoid negative consequences.

Environmental aspect

Planned obsolescence has an impact on the environment. [Cooper \(2004\)](#) suggests that consumers can help reduce appliance waste by choosing durable products, using them efficiently, and repairing them when possible. [Rivera & Lallmahomed \(2016\)](#) explore the environmental implications of planned obsolescence (PO) and product lifetime, highlighting the importance of considering these factors in sustainable engineering. [Malinauskaite & Erdem \(2021\)](#) argue that current EU legal measures are insufficient to address planned obsolescence, arguing that a holistic approach considering demand, supply, and environmental aspects is needed. They propose an EU measure that outlaws planned obsolescence in the context of the circular economy, extending warranties, enhancing consumer rights, imposing fines, and sanctions, and promoting eco-design and reparability. The article concludes that planned obsolescence is not inevitable and a legal framework supporting a circular economy can help prevent it.

Business ethics

Giaretta (2005) explores the link between product innovation and business ethics in the context of global competition. The author proposes an ethical model based on slowness, which promotes creativity, quality, customer satisfaction, and social and environmental responsibility. Giaretta (2005) provides examples of companies that have adopted slowness as a strategic value, achieving market success. Maycroft (2009) discusses the negative social and environmental consequences of planned obsolescence, including reduced consumer choice, increased costs, waste generation, and resource depletion. The author suggests ways to challenge planned obsolescence and promote sustainable consumption patterns.

Circular economy aspect

Wieser (2016) discusses the concept of planned obsolescence and its implications for a circular economy, which is an economic system that aims to minimize waste and maximize resource efficiency. The author argues that planned obsolescence is not only a strategy to increase profits and stimulate consumption but also a response to changing consumer preferences, technological innovations, and environmental regulations. The author also identifies some of the challenges and opportunities for extending product lifespans and promoting a circular economy, such as the need for better information, incentives, standards, and regulations, as well as the potential for innovation, collaboration, and social change. The author concludes that planned obsolescence is not inevitable but rather a result of complex interactions between producers, consumers, and institutions, and that a circular economy requires a systemic and holistic approach that considers the environmental, social, and economic impacts of product design and use.

Customer perspective aspect

The study by Fels et al. (2016) found that technical failures, outdated design, changing customer needs, and new technologies are the most common reasons for product obsolescence. Echegaray (2016) found that urban Brazilians perceive and cope with product obsolescence in electronics, which affects sustainability and e-waste management. Consumers do not expect their devices to last long but are not very dissatisfied with their shortened lifespan. Due to psychological obsolescence and the loss of symbolic appeal, they replace their equipment before it breaks down. Monteiro (2018) investigated how planned obsolescence affects consumer purchase decisions, focusing on the

effects of three cognitive biases: the bandwagon effect, optimism bias, and present bias. Kuppelwieser et al., (2019) examined how customers perceive and react to planned obsolescence, a marketing strategy that aims to reduce the value of older products and encourage customers to buy newer ones. The results showed that planned obsolescence negatively affects customers' value perception and willingness to pay for both product categories. The study concludes that planned obsolescence is a risky marketing strategy that can backfire on companies by harming customers' value perception and willingness to pay. Maulia & Halimatussadiah (2018) and Sjöstrand et al. (2022)) conducted studies on the factors influencing the lifespan of cellular phones in Indonesia and Sweden. They used a survey of 1,030 respondents to analyze consumer behavior and preferences in the cellular phone market. The results showed that the average lifespan of cellular phones in Indonesia is 2.5 years, which is shorter than the global average of 4.7 years. The main reasons for changing phones are functional obsolescence and psychological obsolescence. Subjective considerations such as social status and fashion trends also significantly reduce the phone's lifespan. Most consumers do not recycle or donate their old phones, either keeping them at home or selling them to informal collectors. The authors concluded that obsolescence is not only an issue for manufacturers but also a responsibility for consumers. They suggested policy recommendations to promote sustainable consumption and production of cellular phones, such as providing incentives for recycling, raising environmental awareness, and encouraging ethical and green marketing. The study concluded that planned obsolescence in smartphones challenged sustainable consumers' identity and values, suggesting manufacturers and policymakers should consider their needs and preferences and promote more sustainable alternatives.

Planning aspect of planned obsolescence

In many respects, planned obsolescence is the producer's initiative. Zolghadri et al. (2018) developed a Bayesian model to predict product obsolescence using historical data and expert knowledge. They applied the model to an aircraft component case study and demonstrated its usefulness for decision making and risk management. Gecit (2020) analyzed the term planned obsolescence, a strategy of intentionally making products with a limited lifespan to boost demand and consumption. They identified 28 keywords related to planned obsolescence and grouped them into five clusters: durability, sustainability, waste, product perishability, and consumer culture/environmental aware-

Table 1
List of examined references

No	Year of Publication	Author	Article Category Includes
1	1993	Waldman, M. (1993)	Economics; Industrial Organization; Product Design; Consumer Behavior; Information; Economics
2	2000	Utaka, A. (2000)	Durable goods monopoly; Marketing activities – obsolescence effect; Consumer demand – product innovation
3	2004	Cooper T. (2004)	Product obsolescence – Psychological aspects; Consumer behavior – Consumer satisfaction – Product obsolescence
4	2005	Giaretta, Elena (2005)	Business Ethics; Product Innovation; Sustainable; Development
5	2007	Izuka, T. (2007)	Planned obsolescence – consumer behavior and demand; Durable goods and their pricing strategies; Product innovation – market competition & entry
6	2009	Maycroft, N. (2009)	Environmental; Sociology; Planned obsolescence – consumer culture; Planned obsolescence – environmental issues; Planned obsolescence – product design; Planned obsolescence – social change
7	2016	Wieser, H. (2016)	Environmental technology; Sanitary engineering; Waste management and disposal
8	2016	Fels & Schmitt (2016)	Product obsolescence; Social media analysis; Customer perception; Product life cycle
9	2016	Echegaray, F. (2016)	Consumer behavior-product obsolescence; Product obsolescence – sustainability; Product obsolescence – emerging markets; Product obsolescence – innovation
10	2016	Rivera & Lallmahomed (2016)	Planned obsolescence; Product lifetime; Environmental impact; Sustainable engineering
11	2017	Soto Pineda, & Prada Sal moral (2017)	Law; Consumer protection; Planned obsolescence; Sustainability
12	2017	Margarita & Vargas (2017)	Marketing strategies – consumer behavior; Scholarly communication – digital humanities; Legal aspects-environmental impacts
13	2018	Monteiro (2018)	Marketing; Consumer behavior; Planned obsolescence; Cognitive biases

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No	Year of Publication	Author	Article Category Includes
14	2018	Kuppelwiesera, et al. (2018)	Consumer behavior – attitudes toward planned obsolescence; The environmental and social impacts of planned obsolescence; The ethical and legal implications of planned obsolescence; The marketing strategies and innovation opportunities of planned obsolescence
15	2018	Zolghadri et al. (2018)	Obsolescence management
16	2018	Maulia & Halimatussadiah (2018)	Consumer behavior in the cellular phone market; Product obsolescence and lifespan of cellular phones; Panel regression and Common Effect Model (CEM) for data analysis Indonesia as a case study of a developing country
17	2020	Gecit (2020)	Circular economy; Sustainable consumption; Consumer behavior; Product life cycle; Environmental impact;
18	2021	Niklewicz-Pijaczynska et al. (2021)	Engineering; Product design; Planned obsolescence; Sustainability
19	2021	Karakus & Beyaz(2021)	Industrial Management; Business ethics – consumer behavior; Product design – innovation; Sustainability – circular economy; Marketing- consumer psychology; Social change – development
20	2021	Makov, & Fitzpatrick (2021)	Smartphone obsolescence – consumer behavior; Smartphone repairability-consumers perceive and value repair options; Big data analysis-a large dataset of iPhone benchmarking test scores and online search trends to examine smartphone performance and consumer interest in repair
21	2022	Sjostrand et al., (2022)	Business and Management; Consumer Behavior; Sustainability; Planned Obsolescence; Smartphones
22	2022	Liu & Zhao (2022)	Obsolescence management
23	2021	Malinaauskalite & Erdem (2021)	Planned Obsolescence in Legal and Economy

ness. Makov & Fitzpatrick (2021) investigated factors influencing smartphone lifespans and consumer interest in repair using a big-data approach. They found that the objective performance of smartphones does not

deteriorate rapidly over time, but the testing frequency varies substantially. The authors suggest that sustainability advocates should focus on the performance of devices over time instead of their rapid decline. They

conclude that non-technical aspects play a critical role in determining smartphone lifespans and that novel datasets can improve our understanding of issues such as planned obsolescence and repair.

Karakuş Umar & Beyaz (2021) conducted interviews with 21 experts from various fields to understand the perspectives on planned obsolescence. They found two main approaches: one viewed it as a necessary and ethical concept for social, economic, technological, and ecological development, benefiting consumers through innovation, lower prices, and higher quality products and services. The other criticized it as harmful and unethical, exploiting consumers, wasting resources, polluting the environment, and encouraging crime. The authors concluded that planned obsolescence is a complex and controversial concept with both positive and negative impacts on society. They suggest further research to understand its effects on stakeholders and develop appropriate regulations and policies. Liu & Zhao, (2022) proposed a novel method for forecasting product obsolescence using an improved radial basis function neural network. They applied their method to real-world cases and found it to have higher accuracy and better generalization ability compared to other methods.

Theory of innovation, diffusion of innovation, and consumers behavior model

This section discusses innovation theory and its relationship to consumer behavior. This section explores the concepts of diffusion of innovation theory, technology management, and technological innovation. It discusses the role of social psychology, cognitive psychology, and applied psychology in understanding and implementing disruptive technologies. It also discusses the importance of information systems theory and the UTAUT2 model in assessing and managing obsolescence risks, implementing ERP systems, and understanding consumer behavior in information systems. The following is the grouping of the articles in Table 2 into four critical aspects of innovation and obsolescence: Innovation: disruptive innovation, diffusion of innovation, innovation and perceived obsolescence, and innovation adoption model.

Innovation: disruptive innovation

In his 1997 paper “The Innovator’s Dilemma When New Technologies Cause Great Firms to Fail,” Clayton M. Christensen established the idea of disruptive innovation and its consequences for corporate strategy (Christensen, 1997). The essay makes the case that established businesses frequently struggle to adapt to disruptive innovations, which are new technology or

business models that first target a niche market but ultimately displace established market leaders. Disruptive innovations can present chances for new entrants or challengers since they are challenging for established organizations to understand, value, and invest in. The definition, applicability, dynamics, and ethical implications of the paper have drawn criticism. Some scholars have questioned the generalizability of disruptive innovations and the validity and reliability of the criteria used to categorize advances as sustaining or disruptive.

Diffusion of innovation

In their 1943 study on the diffusion of hybrid seed corn in Iowan villages, Ryan and Gross discovered an S-shaped curve in adoption rates that was impacted by elements such as comparative advantage, compatibility, complexity, trialability, and observability. In his 1986 article, Eveland argues that technology is a dynamic process involving numerous actors, settings, and interactions. He then examines the difficulties in transferring and adopting new technologies in businesses, urges enterprises to take a more comprehensive approach to comprehending and managing technological innovation, and advocates for increased study and interaction between academics and practitioners (Ryan & Gross, 1943). The chasm notion, first proposed by Schirtzinger, describes the challenge of bringing high-tech products from early adopters to mainstream consumers. The dissemination of innovations is covered by Rogers Everett (1995), who focuses on diffusion’s components, the history of diffusion research, criticisms, the genesis of innovations, and the innovation-decision process.

Innovation and perceived obsolescence

Ajzen & Fishbein (2000) re-examine the reasoned action perspective, which assumes that people’s attitudes are based on their beliefs and guide their behavior. The authors argue that this perspective can account for both reasoned and automatic processes in attitude formation and expression. They discuss how the number and types of beliefs that influence attitudes depend on the motivation, ability, and context of the person. They also show how the reasoned action perspective is compatible with evidence for automatic activation of attitudes and behaviors and how attitudes can vary with the context in which they are expressed. They conclude by discussing the implications of their perspective for the attitude-behavior relationship and the role of habit in human behavior. Perceived obsolescence is when a person is persuaded into replacing an item before the old one has lost its functionality.

To summarize Ajzen and Fishbein's discussion of the attitude-behavior relation, which is the link between what people think and feel about something and what they do about it, the relationship to perceived obsolescence is that people's attitudes, norms, and perceived control can influence their intentions to buy new products, even if the old ones are still functional.

Ferlie et al. (2001) explore the diffusion and adoption of evidence-based medicine (EBM) in clinical practice, focusing on four clinical areas: acute myocardial infarction, glue ear, low back pain, and duodenal ulcer. They identify factors influencing EBM uptake, such as evidence nature, adopter characteristics, opinion leaders, organizational culture, and the external environment. Challenges include the gap between research and practice, the variability of clinical practice, resistance to change, and ethical and political implications. The article has an implication for perceived obsolescence in healthcare, where EBM can create pressure for healthcare professionals to adopt new practices and discard old ones, even when the evidence is not conclusive or relevant. External factors, such as political agendas, economic interests, and professional power, may not reflect the best interests of patients or practitioners. The authors highlight the complexity and diversity of organizational behavior and studies in health care, calling for more critical and reflexive approaches to EBM and organizational change. Kim (2021) develops a mathematical model of consumer demand, where firms aim to maximize their profit from consumers who enjoy network benefits from updated products, but also incur switching costs when they upgrade. The author shows that perceived obsolescence can be an effective strategy for firms, but it also has some drawbacks and limitations. For example, perceived obsolescence can increase the market share and profit of the firm, but it can also reduce consumer welfare and social welfare. Moreover, perceived obsolescence can be effective depending on the characteristics of the product, the market, and the consumers. The author provides some criteria and examples to help firms decide whether perceived obsolescence is a viable strategy for them. Alalwan et al. (2015) can be suggested to relate to the obsolescence of internet banking in Jordan in the following ways: The authors find that hedonic motivation, habit, self-efficacy, and trust have significant effects on the behavioral intention to use internet banking, along with the traditional Technology Acceptance Model (TAM) variables of perceived usefulness and perceived ease of use. The authors suggest that internet banking providers in Jordan should focus on enhancing the hedonic aspects of internet banking, such as enjoyment, fun, and pleasure, as well as fostering the habit of using internet banking among

consumers. The author also recommends that internet banking providers should increase the level of trust and self-efficacy among consumers by providing security features, privacy policies, customer support, and user-friendly interfaces. The authors imply that internet banking in Jordan is not obsolete but rather has the potential for growth and improvement if the factors affecting consumer adoption are addressed properly. The article by Alalwan et al. (2015) is relevant to the topic of the obsolescence of internet banking in Jordan, as it provides insights into the current state and prospects of internet banking in the country. It also contributes to the literature on internet banking adoption by extending the TAM model with additional variables that reflect the specific context of Jordan.

Brock et al. (2019) discuss obsolescence in system design, which refers to the loss of utility or value of a system due to changes in technology, environment, or user needs. They propose a framework based on three dimensions: type, timing, and impact. The authors provide a case study of a satellite system to illustrate how obsolescence can be analyzed and mitigated using their framework. They identify sources and drivers of obsolescence, such as technology evolution, launch delays, and changing user demands, and use value-centric design (VCD) tools to model and analyze the effects on the system's value. In short, Brock et al. (2019) contribute to the literature on obsolescence in system design by providing a comprehensive and systematic approach for addressing obsolescence issues throughout the system lifecycle.

The parallelism between perceived obsolescence and new technology can be drawn from the work of Li, (2020). Li explores the adoption of blockchain technologies, which offer data integrity, security, decentralization, and reliability, in various industries. However, rapid market innovation and competition may hinder widespread adoption. Factors influencing adoption include perceived usefulness, ease of use, cost, trust, social influence, and facilitating conditions. If the hypotheses to test these relationships and test the impact of these factors on blockchain adoption intention fail, due to the failure of those perceived factors, then the adoption fails as well.

Innovation adoption model

Studies by Venkatesh et al. (2012, 2016) focused on consumer acceptance and use of information technology, suggested a unified theory of acceptance and use of technology (UTAUT) model that can help researchers and practitioners understand the factors that influence users' decisions to adopt or reject these technologies these technologies, as well as their post-adoption be-

Table 2
The list of references used

No	Year of Publication	Author	Article Category Includes
1	1943	Ryan and Gross (1943)	Sociology; Diffusion of innovations theory
2	1986	Eveland (1986)	Technology Management; Technological Innovation; Diffusion and Implementation of Technology
3	1989	Schirtzinger (1989)	Innovation adoption; Technology Marketing; Market segmentation; Product lifecycle; Business strategy
4	1995	Rogers (1995)	Sociology; Psychology; Economics; Business
5	1997	Christensen (1997)	Disruptive technologies
6	2000	Ajzen and Fishbein (2000)	Social psychology; Cognitive psychology; Applied psychology
7	2001	Ferlie et al. (2001)	Evidence-based medicine; Organisational change; Health care.
8	2003	Rogers (2003)	Innovation studies; Technology adoption; Social change; Social networks; Diffusion processes
9	2004	Greenhalgh et al. (2004)	Innovation; Health service
10	2008	van Raaij and Schepers (2008)	Educational technology
11	2012	Venkatesh, Thong, and Xu (2012)	Information system; UTAUT model
12	2013	Baker (2013)	Obsolescence risk assessment; Obsolescence forecasting; Obsolescence management strategy selection; Obsolescence management implementation
13	2014	Hwang (2014)	ERP systems adoption
14	2015	Alalwan et al. (2015)	Internet banking
15	2015	Marchek (2015)	Information Technology Management; Technology Innovation – Obsolescence.
16	2016	Venkatesh, Thong, and Xu (2016)	Information systems theory; UTAUT2 model
17	2019	Brock et al. (2019)	Obsolescence in system design

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No	Year of Publication	Author	Article Category Includes
18	2020	Permana and Indrawati (2020)	Continuance intention of customers
19	2020	Li (2020)	Information systems; Management science; Computer science and engineering
20	2021	Tamilmani, Rana, and Dwivedi (2021)	Information systems; Technology adoption; Consumer behavior; Meta-analysis UTAUT2 model
21	2021	Kim (2021)	Mathematical model of Perceived Obsolescence

haviors and outcomes. They proposed an extension of UTAUT to UTAUT2, which includes three new constructs: hedonic motivation, price value, and habit. They also examined how age, gender, and experience moderate these constructs' effects on behavioral intention and technology use. UTAUT2 explains more variance in behavioral intention and technology use than UTAUT, with significant moderating effects of individual differences. Hedonic motivation refers to the intrinsic enjoyment or pleasure derived from using a technology. The authors argue that hedonic motivation may play a significant role in influencing users' perceptions of obsolescence, as users may seek new technologies that offer more fun, excitement, or novelty than their current ones. The article also suggests that hedonic motivation may interact with other determinants of UTAUT, such as performance expectancy, effort expectancy, social influence, and facilitating conditions, to affect user acceptance and use of technology. The article relates to perceived obsolescence by discussing how UTAUT can be applied to study the adoption and use of emerging technologies that may create a sense of obsolescence among users, by incorporating hedonic motivation as a determinant of user intention and behaviors that may influence users' perceptions of obsolescence, and by comparing UTAUT with other models and theories of technology acceptance and use that may also address the issue of perceived obsolescence. [Permana & Indrawati \(2020\)](#) modified the UTAUT2 model to include lifestyle compatibility and trust as factors influencing mobile payment service continuance intention in Indonesia. The modified model had better explanatory power than the original model, with lifestyle compatibility and trust being significant predictors of continuance intention. The authors suggest future research should compare the modified UTAUT2 model with other frameworks to assess its validity and generalizability. [Tamilmani et](#)

[al. \(2021\)](#) examine the factors that influence consumer acceptance and use of information technology using UTAUT2 as a framework. One of the factors is hedonic motivation, which is the fun or pleasure derived from using a technology. This factor may hypothetically relate to perceived obsolescence, as consumers may seek new technologies that offer more enjoyment or satisfaction than their existing ones. However, the authors do not explicitly mention perceived obsolescence as a concept or a variable in their analysis.

Method: Stimulus-Organism-Response (S-O-R) approach

A psychological theory called stimulus response theory explains how the interactions between stimuli and responses can affect learning and behavior. A stimulus is anything that can trigger a reaction, such as a sound, a smell, or a touch. A response is the reaction that follows the stimulus, such as a movement, a feeling, or a thought. According to stimulus response theory, the strength of the connection between a stimulus and a response depends on several factors, such as the frequency, intensity, and timing of the stimulus, and the consequences of the response. Some responses are innate, meaning they are not learned but rather reflexive or instinctive. For instance, when we touch something hot, we immediately remove our hands. This is an innate response to a painful stimulus. Other responses are learned, meaning they are acquired through experience and practice. Stimulus-response theory has been applied to various fields of psychology, such as behaviorism, learning theory, and cognitive psychology. It has also been used to explain various phenomena, such as habits, phobias, addictions, and emotions. Stimulus-response theory can help us understand how we learn from our environment and how we can change our behaviors by manipulating the stimuli and responses that influence us.

The stimulus-organism-response (S-O-R) model is a development of the stimulus-response theory and is a psychological framework that explains how stimuli, organism variables, and responses affect behaviors. Stimuli are living things' dynamic perceptions of their surroundings, which they then translate into receptive fields, neuronal rings, or abstractions. Adaptive prediction is made easier by the dynamic element known as the mediator between inputs and reactions. According to the theory of dynamical systems, an organism's behavior and interactions with its surroundings define a state in its trajectory. Responses in a system can be straightforward abstractions or complex descriptions that include readjustment, recalibration, and adaptation to changing stimulus parameters, leading to new system states that reflect into the environment (Young, 2016). The diagram of S-O-R is depicted in Figure 2. Figure 2 shows the S-O-R causal psychological model. This figure presents an expanded S-R (stimulus-response) model of behavior that includes organismic (person, O) mediational components. The model is referred to as the S-O-R one, with added sub-components expanding the O portion (S-O-R model).

The S-O-R framework has been discussed in several cases. Jacoby, (2002) presents an integrative stimulus-organism-response framework for consumer consumer behavior modeling, incorporating evolutionary psychology, cognitive neuroscience, and behavioral genetics. The framework acknowledges environmental and situational factors as stimuli, as well as the diversity and complexity of consumer responses. Islam & Rahman (2017) explore the influence of online brand communities (OBCs) on customer engagement (CE) using the stimulus-organism-response (SOR) paradigm. Wu & Li (2018) study explores the impact of social commerce marketing mix on customer value and loyalty using the SOR framework. Cho et al. (2019) found that all four stimuli positively affect users' pleasure, leading

to product attachment. Kim et al. (2020) found that authentic VR experiences significantly impact cognitive and affective responses, and attachment to VR influences visit intention. Zhu et al. (2019) found that website quality, trust, and e-service quality positively affect satisfaction and perceived value, which in turn affects repurchase intention. Zhao et al. (2020) propose a stimulus-organism-response model for massive open online course (MOOC) users, suggesting that providers should improve the technological environment and enhance the virtual experience to retain and attract users.

Materials & Methods

The literature review synthesizes 23 references on planned obsolescence theory and 21 references on innovation adoption theory, spanning from 1993 to 2022 and 1943 to 2021, respectively. The review encompasses various facets of planned obsolescence, including social practices, marketing strategies, environmental impacts, business ethics, circular economy considerations, and planning aspects. It underscores the multi-dimensional nature of planned obsolescence, shedding light on its effects on consumer behavior, sustainability, and societal development.

Results

Application of S-O-R framework to unification of planned obsolescence with innovation adoption toward consumer behavior conceptual model

Addressing research question 1, the theoretical review above reveals six elements that can be used to explain planned obsolescence: social practice aspect, marketing aspect, environmental aspect, business ethics aspect, circular economy aspect, and planning aspect. Aspects of social practice: This refers to how customers view and use things, as well as how their routines and tastes evolve over time. To maintain their social position or to stay up with fashion trends, some customers would prefer to purchase new things, but others could place a higher value on practicality and longevity. Aspects of marketing include how manufacturers market and advertise their goods as well as how they affect consumer demand and expectations. To emphasize the advantages of new features or upgrades, for instance, or to evoke a sense of urgency or scarcity, certain producers may employ persuasive approaches. Environmental aspect: This refers to how products affect

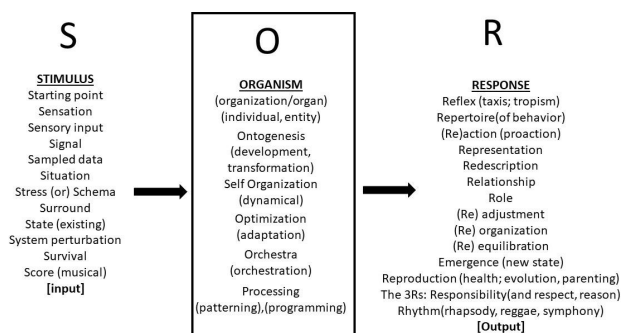


Fig. 2. The S-O-R causal psychological model (Source: Young, (2016), p705, without extension parts)

the natural environment and how they contribute to resource depletion, waste generation, pollution, and climate change. For example, some products may require a lot of energy and materials to produce or may be difficult to recycle or dispose of safely. Aspects of business ethics: How producers treat the rights and interests of customers, employees, communities, and other stakeholders is referred to here. For instance, some manufacturers might use dishonest or unfair tactics, such as concealing flaws, cutting back on warranties, or restricting repairs. Aspect of the circular economy: This refers to how products can be created and managed to reduce their negative effects on the environment and increase resource efficiency. Some items, for instance, can be modified to be more robust, repairable, reusable, and recyclable, or they can be incorporated into a service or sharing system. Aspect of planning: This relates to the way manufacturers plan and carry out their product development and innovation plans. For instance, some manufacturers might have a long-term perspective that considers the requirements and values of both the present and the future, while others might be more concerned with immediate profits and market share.

Those six aspects are the main objectives of planning the product's life cycle. In the case of a smart phone, the six aspects play the role of external stimulus. Arriving at the consumers, those external stimulants will be perceived as novelty or innovation by the consumers. A smart phone recognizes the following perceived factors: Psychological (Psy), whose components are ergonomic (Er), sensory quality (SQ), and changing need (CN), technological (Tech), and functionality (Func), and economics (Econ), which manifest as working cost (Wc), wear-out (Wo), or physical wear-out (Pwo), External stimulus and perceived obsolescence (because

consumers perceive that new innovation is entering the market) act as stimuli in the S–O–R framework.

In response to research question number 2, the theoretical evaluation of innovation, diffusion of innovation, and consumers' behavior model reveal four components of the construct: disruptive innovation, diffusion of innovation, innovation and perceived obsolescence, and innovation adoption model. These four elements affect how innovations are developed, embraced, and replaced in the marketplace. A disruptive innovation is one that first establishes a new market or value network, then subverts an existing one by dislodging well-established goods or services. A theory called diffusion of innovation describes how, why, and how quickly new concepts and innovations spread throughout social systems.

When buyers are convinced to replace a product before it has lost its usefulness because it has become outmoded or less desirable, this is known as perceived obsolescence. A paradigm called the innovation adoption model explains how various adopter types—including innovators, early adopters, the early majority, the late majority, and laggards—respond to innovative goods and services depending on their individual traits and preferences. The relationship between the four components is depicted in Figure 3. Disruptive innovation has a causal effect on perceived obsolescence, which in turn causes the diffusion of innovation using mechanisms of adoption. The mechanism of adoption passes through two affects: cognitive and affective which interact with one another (Blair, et al., 2007; Cegala, 1984).

With references used for Figure 3 (Permana & Indrawati, 2020; Tamilmani et al., 2021; Venkatesh et al., 2012, 2016) it further divided into Cognitive affect: Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), Price Value (PV), Perceived Value (PR), Self-Efficacy (SE), and Personal Innovativeness (PI), Affective affect: Hedonic Motivation (HM), Trust (T), Habit (H), Attitude (A), Enjoyment (E), and Emotional Involvement (EI).

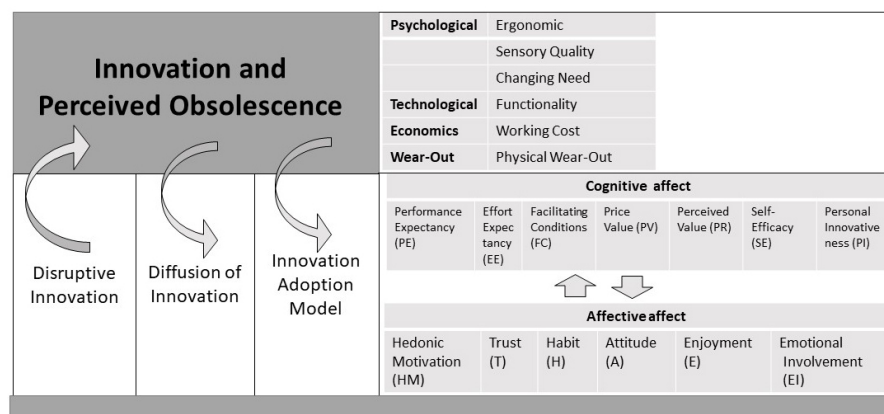


Fig. 3. Diagram describing the causal relationship between disruptive innovation, dissemination of innovation, innovation and perceived obsolescence, and innovation adoption model

Perceived Risk (PR), Self-efficacy (Se), Personal Innovativeness (PI); and Affective affect (Kim et al., 2020; Permana & Indrawati, 2020; Tamilmani et al., 2021; Venkatesh et al., 2012, 2016) Hedonic Motivation (HM), Trust (T), Habit (H), Attitude (A), Enjoyment (E), Emotional Involvement (EI).

Discussion

Figure 4 proposes conceptual model unifying planned obsolescence and innovation adoption toward consumer behavior. Planned Obsolescence and innovation adoption describe the intention to buy the next version of a product in the smartphone market. Consumer perceptions form when manufacturers stimulate consumers with new product versions. During perception, two processes will occur: an affective process and a cognitive process. These two processes will determine whether consumers will buy the next product or not.

The effects of perceived obsolescence as stimulant to use new products are translated in Figure 2 as “processing”. It has two forms: cognitive and affective.

An adoption model defines decision process, the model in Figure 4 can be regarded as exhaustive. The cognitive and affective components are empirically confirmed (Kim et al., 2020; Permana & Indrawati,

2020; Tamilmani et al., 2021; Venkatesh et al., 2012, 2016). This process describes how the two constructs unify to describe the intention to buy the next version of a product in the smartphone market as raised by research question number 3.

How the model in Figure 4 operates is explained by the following case: Planned Obsolescence and Innovation Adoption in iPhone Cases. Apple’s product releases often introduce design changes. Marketing campaigns highlight the aesthetic appeal and functionality of new cases, triggering Fear of Missing Out (FOMO) and evoking emotions like excitement or exclusivity. It is causing consumers to consider upgrading their cases (Stimulant). The affective process involves consumers assessing—hedonic motivation, habit, attitude, enjoyment, and emotional involvement—new features like protection, grip, and wireless charging compatibility and comparing them to their existing case. The cognitive process weighs the cost of the new case against perceived benefits and the remaining lifespan of their current case—innovation adoption (Organism). If the emotional appeal and perceived value outweigh the cost, consumers might upgrade their case, while if the existing case remains functional, they might maintain it (Response).

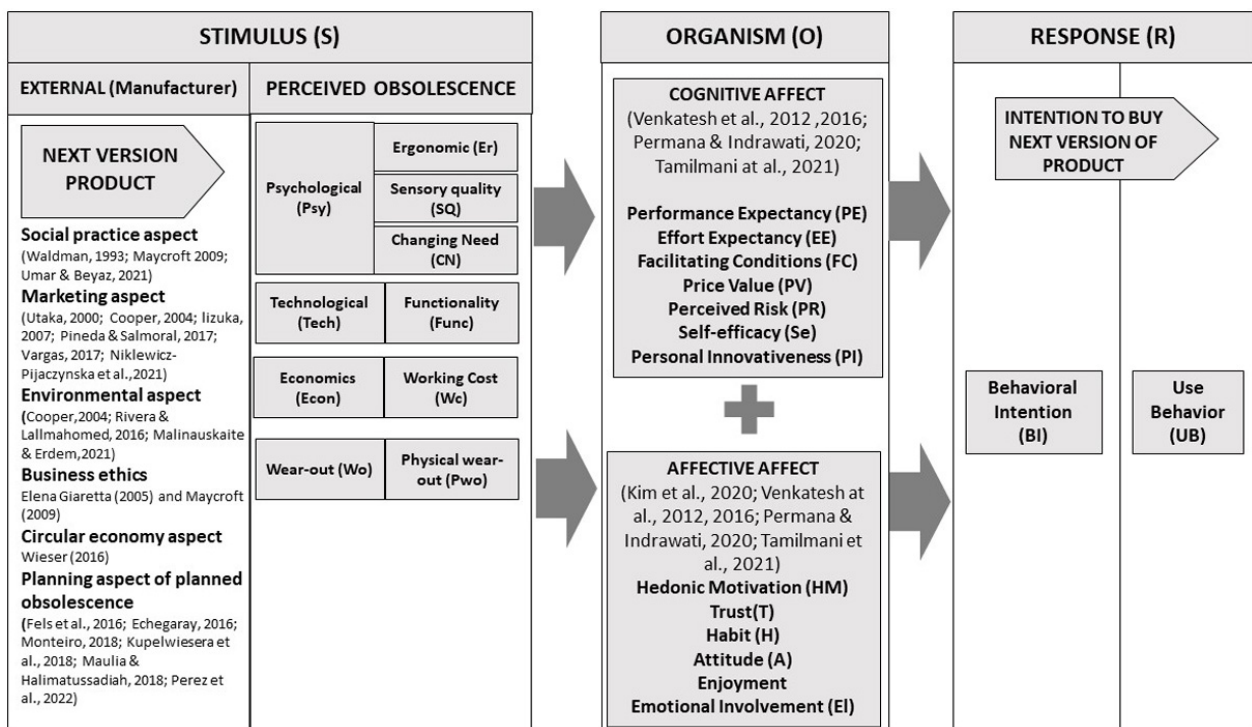


Fig. 4. Proposed conceptual model unifying planned obsolescence and innovation adoption toward consumer behavior

Conclusions

This study has proposed a unification of producer or manufacturer initiatives, usually in product life cycle planning, with consumer behavior. Both aspects are usually dealt with separately, as manufacturers are relatively in a better bargaining position due to the advantage of information asymmetry. This work intends to bridge those aspects that are theoretically discussed in parallel but are not much discussed in practice. The unification makes use of the stimulus-organization-response framework sufficiently to serve the purpose of unification

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