

Industry 4.0 Leading to Environment Sustainability: Consumer's Choice and Preference in Tech- Enabled Marketplace

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Abstract:

Technological advancements like artificial intelligence, machine learning, IoT, cloud computing, block chain, and sensing technology have revolutionized industries and enabled retailers to achieve sustainability objectives. These advancements have also been successful in achieving the Sustainable Development Goals (SDGs). Consumers today are increasingly conscious about the environment and its sustainability, leading to changes in their buying habits. They are increasingly accepting sustainable and eco-friendly products and services, and adhering to global quality standards. However, finding the optimal setting for businesses is challenging. Retailers face difficulties in predicting customer choices, as their psychographic attributes often influence their shopping decisions. Consumers today are tech-friendly and ecologically conscious, aiming to achieve shopping goals while protecting the environment. SDG awareness allows them to buy eco-friendly products and use technology to mitigate ecological consequences. This paper aims to uncover the changing beliefs of consumers towards using technology as a medium for attaining sustainability.

Keywords: Industry 4.0, SDGs, technology, sustainability, consumer psychographics and retailing.

1. Introduction

Sustainability is the use of scarce resources to meet the needs of present generations without compromising future generations. The Sustainable Development Goals (SDGs) are 17 schemes that support sustainability, and in retailing, technological intervention and innovation can help achieve these targets. Retailers must align their practices with these goals, communicate them to stakeholders, and balance sustainability with economic growth. Technology, such as AI-enabled forecasting, can help reduce waste and

returns, promoting sustainability. The technology eco-advantage allows retailers to use advanced technology to achieve sustainability goals without jeopardizing profitability. Consumers are increasingly choosing environmentally sustainable products and services, and retailers are using tech-based advantages to encourage sustainable purchases. The cutting-edge technologies of industry 4.0 have transformed consumer lifestyles, affecting their purchasing patterns. Technology-enabled retailing offers a dual advantage of fulfilling SDGs and satisfying consumer needs.

2. Objectives of the study:

- 2.1. To understand the role of technology in driving consumers towards environmental sustainability.
- 2.2. To synthesis SDG’s (9th and 12th) and environmental sustainability in retailing.
- 2.3. To study the impact of industry 4.0 technologies on environmental sustainability.
- 2.4. To propose a tech- enabled for achieving environmental sustainability in retail settings.

3. Literature Review

Industry revolution or industry 4.0 carries the potential of providing innovative solutions for combating global challenges. The cutting edge technologies associated with industry 4.0 when implemented for attaining sustainability drive optimal

results. Streamlining the technologies with green initiatives globally, SDGs can be implemented successfully (Berawi, 2019).

3.1. Sustainable Development Goals (SDG’s)

The United Nations Sustainable Development Goals (SDGs) aim to combat global environmental, social, and economic issues by 2030. These goals are closely related to the theme of achieving sustainability in retailing with technology. SDG 9 and 12 focus on building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation. SDG 9 focuses on building quality, reliable, and resilient infrastructure for economic development, ensuring human well-being, and providing equal access to resources and financial services.

Table 1: The Sustainable Development Goals

1.	End poverty in all its forms everywhere
2.	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3.	Ensure healthy lives and promote well-being for all at all ages
4.	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5.	Achieve gender equality and empower all women and girls
6.	Ensure availability and sustainable management of water and sanitation for all
7.	Ensure access to affordable, reliable, sustainable, and modern energy for all
8.	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
9.	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
10.	Reduce inequality within and among countries
11.	Make cities and human settlements inclusive, safe, resilient, and sustainable
12.	Ensure sustainable consumption and production patterns
13.	Take urgent action to combat climate change and its impacts
14.	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
15.	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and

	halt biodiversity loss
16.	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
17.	Strengthen the means of implementation and revitalize the global partnership for sustainable development

(Source: United Nations, 2015).

Strategies for achieving sustainable industrialization include promoting eco-friendly technology, increasing resource use efficiency, and providing financial services to those in need. Infrastructure development in developing countries is ensured through dedicated research and investment in the latest technological know-how.

SDG 12 focuses on responsible consumption and production, ensuring sustainable consumption and production patterns worldwide. It focuses on optimal resource utilization, reducing wastage during production activities, and sustainable supply chain management. Consumers are educated about sustainable consumption patterns, making environmentally conscious purchasing decisions through product certifications and eco-friendly packaging. SDG 12 also promotes a circular economy by product recycling and encouraging consumers to return or recycle products they no longer need. Digital technologies play a vital role in managing congestion, risks, and environmental impacts in cities and communities, contributing to sustainable cities and communities.

3.2. Industry 4.0:

Industry 4.0 focuses on environmentally friendly technologies and the integration of Sustainable Development Goals (SDGs) can lead to positive environmental outcomes and sustainability. The 9th SDG focuses on building resilient

infrastructure, promoting sustainable industrialization, and fostering innovation. The 3R's of sustainability are adopted, including reducing waste, reusing resources, and recycling products. The circular economy, which involves producing goods that can be remanufactured and reused multiple times before disposal, is another aspect of sustainability. Retailers, as bridges between producers and consumers, can adopt sustainable practices to benefit society.

Sustainability-focused choices are now a priority for both consumers and retailers. Consumers are becoming more concerned about environmental and social issues, leading to opportunities for retailers to yield profits while benefiting consumers without damaging the environment. Retail giants like IKEA, Walmart, and Patagonia have taken significant steps towards environmental sustainability, revamping supply chain operations and adopting eco-friendly approaches.

The COVID-19 pandemic has accelerated this transformation, with consumers becoming more concerned about health, economic, and social well-being issues. As a result, sustainability has become a key driver in consumer choice, leading to increased reliance on technology as a last resort. If embedded in a positive manner, technology can ensure environmental sustainability. Some in-store

retail technologies adopted by retailers in Industry 4.0 include:

3.2.1 Boots (A British health and beauty retailer) have adopted a practice of rewarding the consumers on returning the used product packaging. The consumer needs to register themselves to Scan2Recycle website and scan their used empty packages at the in-store collection point. As the total amount of empties reaches a total of 5, they are rewarded with loyalty points worth £2.50 for every five deposited items.

3.2.2 Morrisons and Co-op (UK based grocers) have also initiated the practice of recycling the second-hand electronic items like mobile phones, tablets, smart watches. The consumers need to register on Spring's website and add the items they need recycle and select a point to drop it. Every customer is given a unique QR code and on activating the payment is processed and deposited straight to the recipient's bank account.

3.2.3 Costa Coffee has launched a 6-month reusable coffee cup scheme called 'BURT', which entails borrow, use, reuse, take-back. Customers deposit £5 at the store, scan a QR code at the base, and the cup is linked to their personal account. Austella, a tech agency, tracks the cup's usage. When deposited back, the cup is automatically delinked, washed, and presented to the next customer.

The system of scan and re-cycle and scan and re-use connects customers with sustainability, involving them in the process and allowing them to contribute to a good cause, satisfying their need for participation in a good cause (Han, 2021).

3.3. Sustainability in Retailing

Sustainability in retail has been accelerated by technology-driven behavioral changes, particularly in the context of Industry 4.0. Consumers are increasingly aware of the use of technology and adopt environmentally-sound attitudes. Governments and retailers are working to influence their purchase preferences and environmental consciousness. This study focuses on the active participation of consumers and retailers in sustainable practices in retail. Technology can be used to fulfil these criterias, making consumers feel more empowered and influencing their environmental protection.

The paper aligns with SDG 9th and 12th, as technological innovation in the retail sector, particularly through the implementation of the circular economy, justifies these practices. Innovative practices in retailing provide more research opportunities for academics and researchers. The practical implications of these researches also have managerial implications. Innovation and sustainability cannot be limited to in-store technology but can be integrated throughout the retailer's supply chain. Retailers can drive positive consumer behavior by offering eco-friendly products. Technology related to Industry 4.0 is driving retail sustainability in the context of SDG 9th and 12th.

3.3.1 Supply Chain Optimization:

Data analytics is a powerful tool that helps retailers analyze large amounts of data to gain insights into consumer buying preferences and forecast future preferences (Hung et al., 2020). Accurate predictions based on consumer choices and related information enable precise demand forecasting, optimizing inventory

management and reducing waste (Kashyap et al., 2022). IoT (Internet of Things) solutions, equipped with sensors, enable real-time tracking of products within the supply chain, ensuring transparency and visibility. They also monitor stock levels in real-time, preventing overstocking or understocking and minimizing wastage. IoT sensors also track expiry dates and conditions of perishable goods, ensuring their availability within specified timeframes, contributing to responsible consumption. Investment in IoT-led technology ensures better resource allocation, reduces inefficiencies, and promotes sustainable practices. Overall, data analytics and IoT-based solutions are essential for retailers to stay competitive and meet the needs of their customers.

3.3.2 Enhancing Customer Experiences:

AI-powered personalization systems analyze large amounts of consumer data to provide personalized offers (Kumar et al., 2019), fostering innovation in retail practices and promoting environmentally friendly products. These systems use chatbots and recommendation systems to curate information and make it easily accessible to consumers. AI-driven consumer insights also enable retailers to produce and offer environmentally friendly products, educating consumers towards sustainable choices and ensuring responsible consumption decisions. Accurate personalized offerings makes product's utilization effective, improving its life span (Bjørlo et al., 2021).

IoT-enabled devices like smart shelves and sensing technology like beacons enable personalized in-store experiences and promotions, making it easier for consumers to find sustainable yet suitable products(Tan

& Sidhu, 2022). Predictive capabilities analyze consumer choices, reducing downtime and resource waste. This unique shopping experience enhances sustainability and provides real-time information on environmental impact, promoting responsible consumption choices(Srivastava & Bag, 2023). It provides an indulging shopping experience to the consumers which unique and enhances sustainability equally. All the required detail concerning its impact on the environment it available in real- time which promotes responsible consumption choices (Sabu & Sreekumar, 2023) (SDG 12). Retailers can also gather valuable data on foot traffic and customer preferences, enhancing the shopping experience. IoT sensors can track product performance and usage patterns, enabling businesses to design more sustainable products. Overall, AI-powered personalization and IoT-enabled devices are crucial for enhancing customer engagement and promoting sustainable practices in the retail industry.

5. Conclusion and managerial implication

Sustainability in retail has been accelerated by technology, particularly in the context of Industry 4.0, which has driven digitalization and increased consumer dependence on technology. Technology is present in every aspect of life, including shopping, and when incorporated with sustainability assumptions, it can lead to positive results. Consumers are becoming more aware of the environment and are more committed to acting responsibly towards it. This research focuses on the involvement of consumers in ensuring sustainability in retailing through technology medium, which can significantly affect their shopping choices and

preferences. Likewise, it is expected to have a transformational influence on the manner in which a consumer protects the environment through sustainability (Berawi, 2019).

The paper focuses on the 9th and 12th Sustainable Development Goals (SDGs) related to infrastructure, sustainable industrialization, innovation, and sustainable production and consumption patterns. Technology-based innovation in retailing, particularly the implementation of the circular economy, justifies these practices. Innovative practices in retailing provide more research opportunities for academicians and researchers (Grewal, Gauri, Roggeveen, & Sethuraman, 2021).

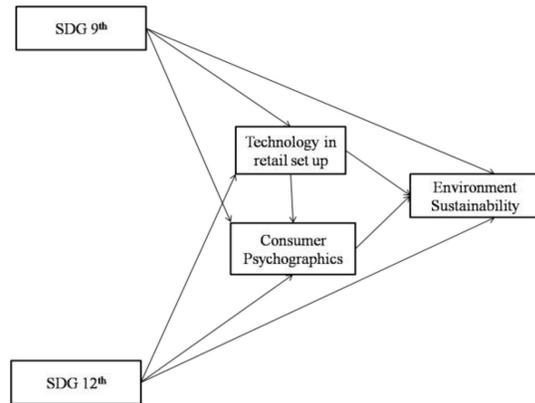
Retail practitioners can apply the results of this research in real-world settings to help market players act environmentally sensitive and ensure sustainability. Innovation and sustainability cannot be limited to in-store technology but can be built within the entire supply chain of the retailer. Retailers can drive positive responses from consumers by providing opportunities to ensure sustainability and developing a sense of empowerment within them. This fosters a sense of belongingness and loyalty towards the retailer.

6. Conceptual model:

For researcher and practitioners, a conceptual model is prepared linking 9th and 12th SDG, Retail technology and Consumer's Psychographics and environment sustainability in retail setting.

This study has majorly highlighted the impact of technology on consumer's choice and a collective impact in achieving environment sustainability.

Fig1. Environment Sustainability in Retail Settings



Industry 4.0 is making world digital, consumer's purchase preference is strongly influenced by existing technologies. Sustainable Development Goals (SDGs) showcase a path to attain environmental sustainability. Both retailers and consumers can utilize industry 4.0's technological disruption for achieving sustainability. SDG 9th and SDG 12th were found to be best suited in retail settings. Keeping sustainability as a prime concern, retail infrastructure can be equipped with latest technological breakthroughs to achieve innovation along with reaping profit and competitive advantage. SDG's and technology (utilized for achieving sustainability) collectively forms consumer's psychographics in retail set up that helps in attaining environmental sustainability. All the elements carry a profound impact on the psychology of consumers making them environmentally conscious. They ultimately affect consumer's shopping preferences and are motivated towards making sustainable choices. The model is conceptual in nature. A relationship between the different elements of the study is being established which can be further investigated in future studies.

References:

- Antonopoulos, I. S., Zouboulis, A., Samaras, P., & Karagiannidis, A. (2013). Indicators and options towards sustainability in industrial areas. *International Journal of Innovation and Sustainable Development*, 7(3), 215. <https://doi.org/10.1504/ijisd.2013.056941>
- Arcuri, A., & Partiti, E. (2021). *TILEC Discussion Paper SDG 12: Ensure Sustainable Consumption and Production Patterns SDG 12: ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS*. <https://ssrn.com/abstract=3814765> Electronic copy available at: <https://ssrn.com/abstract=3814765>
- Bjørlo, L., Moen, Ø., & Pasquine, M. (2021). The Role of Consumer Autonomy in Developing Sustainable AI: A Conceptual Framework. In *Sustainability* (Vol. 13, Issue 4). <https://doi.org/10.3390/su13042332>
- Chen, S. C., & Shang, S. S. C. (2021). Sustaining user experience in a smart system in the retail industry. *Sustainability (Switzerland)*, 13(9). <https://doi.org/10.3390/su13095090>
- Djekic, I., Batlle-Bayer, L., Bala, A., Fullana-I-palmer, P., & Jambrak, A. R. (2021). Role of the food supply chain stakeholders in achieving un sdgs. *Sustainability (Switzerland)*, 13(16), 1–16. <https://doi.org/10.3390/su13169095>
- Frank, B. (2021). Artificial intelligence-enabled environmental sustainability of products: Marketing benefits and their variation by consumer, location, and product types. *Journal of Cleaner Production*, 285, 125242. <https://doi.org/https://doi.org/10.1016/j.jclepro.2020.125242>
- Fukuda, S. (2020). *From Working for Others to Working for Yourself BT - Advances in Manufacturing, Production Management and Process Control* (B. Mrugalska, S. Trzcielinski, W. Karwowski, M. Di Nicolantonio, & E. Rossi (eds.); pp. 157–162). Springer International Publishing.
- Graciola, A. P., Rizzon, F., Milan, G. S., De Toni, D., Da Rocha, J. M., & Olea, P. M. (2018). Sustainability, Retail and Supply Chains: Twenty Years of Research. *Revista de Negócios*, 23(2), 7. <https://doi.org/10.7867/1980-4431.2018v23n2p7-23>
- Hollebeck, L. D., & Belk, R. (2021). Consumers’ technology-facilitated brand engagement and wellbeing: Positivist TAM/PERMA- vs. Consumer Culture Theory perspectives. *International Journal of Research in Marketing*, 38(2), 387–401. <https://doi.org/https://doi.org/10.1016/j.ijresmar.2021.03.001>
- Hung, J.-L., He, W., & Shen, J. (2020). Big data analytics for supply chain relationship in banking. *Industrial Marketing Management*, 86, 144–153. <https://doi.org/10.1016/j.indmarman.2019.11.001>
- Jones, P., & Comfort, D. (2019). “Better Retail, Better World”: A commentary on British retailers and the sustainable development goals. *Journal of Public Affairs*, 19(2), 1–6. <https://doi.org/10.1002/pa.1910>
- Kashyap, A. K., Sahu, I., & Kumar, A. (2022). Artificial Intelligence and Its Applications in E-Commerce – a Review Analysis and Research Agenda. *Journal of Theoretical and Applied Information Technology*, 100(24), 7347–7365.
- Kumar, V., Rajan, B., Venkatesan, R., & Lecinski, J. (2019). Understanding the role of artificial intelligence in personalized engagement marketing. *California Management Review*, 61(4), 135–155. <https://doi.org/10.1177/0008125619859317>
- Kynčlová, P., Upadhyaya, S., & Nice, T. (2020). Composite index as a measure on achieving Sustainable Development Goal 9

- (SDG-9) industry-related targets: The SDG-9 index. *Applied Energy*, 265(September,2019).
<https://doi.org/10.1016/j.apenergy.2020.114755>
- Li, Q., & Liu, A. (2019). Big data driven supply chain management. *Procedia CIRP*, 81, 1089–1094.
<https://doi.org/10.1016/j.procir.2019.03.258>
 - Oláh, J., Aburumman, N., Popp, J., Khan, M. A., Haddad, H., & Kitukutha, N. (2020). Impact of industry 4.0 on environmental sustainability. *Sustainability (Switzerland)*, 12(11), 1–21.
<https://doi.org/10.3390/su12114674>
 - Rangaswamy, E., Nawaz, N., & Changzhuang, Z. (2022). The impact of digital technology on changing consumer behaviours with special reference to the home furnishing sector in Singapore. *Humanities and Social Sciences Communications*, 9(1).
<https://doi.org/10.1057/s41599-022-01102-x>
 - Sabu, A. M., & Sreekumar, S. (2023). *Greening the Market: Strategies for Combating Climate Change with Sustainable Products and Marketing*.
 - Source: United Nations. (2015). *Sustainable Development Goals*.
 - Srivastava, S. K., & Bag, S. (2023). Recent Developments on Flexible Manufacturing in the Digital Era: A Review and Future Research Directions. *Global Journal of Flexible Systems Management*.
<https://doi.org/10.1007/s40171-023-00351-2>
 - Tan, W. C., & Sidhu, M. S. (2022). Review of RFID and IoT integration in supply chain management. *Operations Research Perspectives*, 9, 100229.
 - United Nations. (2023). *Dead for action*. 2023.
 - Velazquez, L. (2021). The Fundamental Concepts of SDG9. In *SDG9 – Industry, Innovation and Infrastructure* (pp. 5–37). Emerald Publishing Limited.
<https://doi.org/10.1108/978-1-80117-131-120211002>
 - Visvizi, A., & del Hoyo, R. P. (2021). *Chapter 1 - Sustainable development goals (SDGs) in the smart city: A tool or an approach? (An introduction)* (A. Visvizi & R. B. T.-S. C. and the un Sdg. Pérez del Hoyo (eds.); pp. 1–11). Elsevier.
<https://doi.org/https://doi.org/10.1016/B978-0-323-85151-0.00001-4>.
