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**EMPOWERING THE SUSTAINABLE FASHION: WHERE
INNOVATION MEETS ICONIZATION THROUGH IP AND
TECHNOLOGY**

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Abstract

Fashion is the heart of creativity and glamour, but it is often scrutinized legally due to its complex nuances. At the soul of this legal scrutiny lies the intellectual property, which is similar to fashion in celebrating and recognising creations of the mind. IP laws are crucial in safeguarding the rights of fashion creators, especially in an industry where originality is both highly valued and frequently replicated². However, the rise of fast fashion has introduced serious environmental and societal concerns. These challenges are vital but are often ignored due to a lack of awareness. The growth of fast fashion definitely recognises the fruit of creative labour but also causes certain serious environmental and societal concerns, resulting in unsustainability for the future. These gaps can be filled by addressing them through the integration of innovative fashion technologies while protecting creators' IP rights. This may seem ambitious, but it can be achieved if technology and IP law are strategically executed³. This study has examined the intersection of sustainable fashion technologies and intellectual property by bringing attention to IP in encouraging innovation while protecting eco-friendly developments within the fashion sector. It has highlighted technological advancements⁴ such as biodegradable textiles, waterless dyeing methods, etc, which are gaining traction because of the industrial shift to sustainability. It showcases how Green technologies are protected through patents, trademarks, and design rights to ensure that inventors maintain control over

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²Wang, Mengyuan, *Bringing Sustainable Practices, Fashion Shows, and Sociological Insights Together to Reinvigorate Sustainable Fashion Education*, MDPI, (2025), <https://www.mdpi.com/2071-1050/17/2/631>

³ Ryding, Daniella, *Technology-Driven Sustainability: Innovation in the Fashion Supply Chain*, Academia, (2019), https://www.academia.edu/82195537/Technology_Driven_Sustainability_Innovation_in_the_Fashion_Supply_Chain

⁴*The Role of Technology in Fashion: Transforming Sustainability in the Industry*, Softline, <https://softlinebrandpartners.com>

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their creations while enhancing industrial work with technology. The blend of IP protection and sustainable fashion practice will enhance brand identity, market value, and ethically attract conscious consumers by securing lasting competitive advantages. This paper has analysed this synergy's broader economic and environmental implications and tried to represent it as a model for accountable entrepreneurship. It has demonstrated how fusion of sustainability and intellectual property is not only transforming business models but also repositioning the fashion industry as a crucial performer in the worldwide movement towards environmental responsibility and innovation-related growth

Keywords: *Design Rights, Eco-friendly innovation, fashion technology, Green Patents, IP in fashion, Sustainable fashion*

Introduction

Fashion is derived from a Latin word “facere⁵,” which means “to make.” It actually creates a powerful space representing creativity and culture together. It is something more than fabric and trends. It is a true reflection of art, culture and identity. From mesmerising rampwalks to bold designer statements, fashion and its controversies have always caught the limelight across the globe. However, behind this sparkly glamour lies a complex reality, especially concerning its environmental and legal intricacies. At the core of this⁶, Intellectual Property Rights play a crucial role in giving recognition to this art form. Similar to fashion, IP itself celebrated originality and creative expression. It protects the legal rights of those who bring an aesthetic and original vision to life and penalizes those who replicate them illicitly. Apart from unlawful duplication, the increased growth of fast fashion has created many other problems, which has contributed to significant environmental degradation, labour exploitation, and cultural dilution. These issues are often set aside⁷ but can pose serious long terms risk if left unaddressed. To tackle these challenges, we need more surface level solution. It can be achieved through technology transfer. It is a process of sharing technological knowledge, tools, or methods from one party to another, permitting innovative

⁵ IMPIGLIA, NENELLA, What is Fashion?, lost and found in fashionItaly,(2023),<https://www.lostandfoundinitaly.com/post/what-is-fashion>

⁶ Ghose, Adrija, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, NLUA Journal of Intellectual Property Rights, Volume 2, Issue 2, pg 107-109, (2022), <https://nluassam.ac.in/docs/Journals/IPR/vol2-issue-2>

⁷ Naveed, Ayman, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

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ideas to move beyond boardrooms and labs and into real-world applications. In the fashion sector⁸, this can mean sharing advancements like biodegradable materials, circular design techniques, or energy-efficient manufacturing systems. For such transfers to be successful, the innovator must be open to sharing, while the receiver must be equipped to absorb, adapt, and apply the innovation. When done right, technology transfer becomes the bridge that connects sustainable breakthroughs with industry-wide impact. It might sound surreal, but it can be easily achievable if we incorporate technology and IP laws strategically. Even in some parts of the world⁹, people are blending IP and sustainable technologies to achieve this new fashion era. Though fewer in number, patented waterless dyeing methods and proprietary recycling technologies to trademarked eco-conscious fashion labels, sustainable fashion technology with its protected rights is rising. IP safeguards creative and technological advancements. Without this protection, there remains a risk of ideas being copied or misused, discouraging innovators from investing in sustainable solutions. Strong IP protection not only rewards creators but also creates a safe space for collaboration and knowledge sharing. This study explores exactly the juncture where sustainable fashion technologies meet intellectual property law. It highlights how innovation and AI-driven advancements are repositioning the industry's response to sustainability. It emphasizes how these green technologies are protected through IP rights such as patents, trademarks, and design protections to ensure that creators retain control, recognition, and incentive to keep innovating.

Statement of Problem¹⁰

Despite increasing awareness and the pressing need for sustainable practices in the fashion sector, the incorporation of green technologies remains inconsistent and is frequently underutilized. Although certain progressions like biodegradable fabrics, circular production systems, and water-saving methods present encouraging solutions and their broad acceptance is hindered by insufficient legal protection and ineffective enforcement of Intellectual Property rights. Numerous eco-inventors cross paths with difficulties in obtaining IP

⁸ Chhabria, Hansika, *The critical role of technology in sustainable fashion*, The Times of India, (2023) <https://timesofindia.indiatimes.com/blogs/voices/the-critical-role-of-technology-in-sustainable-fashion>

⁹ Defranc, Nicole, *How Is Technology Changing the Sustainable Fashion Industry?*, Monterail, (2024), <https://www.monterail.com/blog/how-is-technology-changing-sustainable-fashion>

¹⁰ Hossain, Tanvir Md, *Techniques, applications, and challenges in textiles for a sustainable future*, Journal of Open Innovation: Technology, Market, and Complexity, Elsevier, Pg 6-9, (2024), <https://pdf.sciencedirectassets.com/782866/>

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protection. This makes their innovation susceptible¹¹ to replication and exploitation without appropriate acknowledgement or financial compensation. Additionally, this transfer of technology, i.e, responsible for spreading sustainable fashion, is often found ineffective due to low absorptive capacity among recipients and diffidence from innovators to share exclusive technologies lacking reliable legal guarantees. This gap between innovation and execution hampers¹² the fashion industry's transition towards environmental accountability. To tackle these problems, we need strong and efficient IP laws along with strategic transfer of technology, which can help in protecting, distributing, and commercialising sustainable fashion technologies. If these gaps are left unaddressed, the ability of this fashion industry to head worldwide sustainability initiatives may largely go unrealized, and the industry towards a more ethical, resilient, and financially beneficial future will be missed.

Research Questions

1. Whether intellectual property rights protect and promote sustainable innovations in the fashion industry?
2. What role is played by technology transfer in spreading eco-friendly fashion technologies, and how can it be enhanced?

Research Methodology

A research paper of high quality is produced when we are successful in identifying and incorporating authentic information that supports the research area. For this paper, the author has conducted research on the topic's statutory provision, laws, supporting research papers, and much more relevant information. She consulted many articles, blogs, and e-books, aligning the topic. The main objective of the topic is to study how intellectual property and technology transfer can support and reinforce sustainable innovation in the fashion biz. The paper has opted for doctrinal, critical, and analytical approaches and has relied on the information available on the internet. She has also referred to the bare acts of intellectual property rights, which have been carefully examined to ensure comprehensive coverage of the subject matter.

¹¹Dietterich, Amy, *Innovation meets Sustainable Fashion*, WIPO Green, (2022), https://www3.wipo.int/wipogreen/en/news/2022/news_0021.html

¹² Naveed, Ayman, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

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What is Sustainable Fashion Technology¹³?

Sustainable fashion technology is the amalgamation of inventive digital and scientific technologies with environmentally responsible fashion practices to transform how clothing is designed, produced, distributed, and consumed¹⁴. It aims at reducing the environmental footprint of the fashion industry, including waste, safeguarding natural resources, and upholding an ethical workforce and transparent supply chains. These include the use of bio-degradable textiles, recycled and upcycled materials, and those grown in laboratories, including mushroom leather or spider silk. Such technologies as 3D designing tools¹⁵ and digital prototyping help to minimize the production of physical samples, which limits waste in fabrics and the carbon footprint. Such smart manufacturing processes as automated cutting, on-demand production ensure that there is minimal overproduction and efficient resource utilization. AI predicts trends and batches, and blockchain technology offers traceability and ethical sourcing and optimizes inventory levels. Among the consumers, augmented reality (AR) and virtual dressing rooms enhance the shopping environment and reduce returns, whereas digital tags provide information relating to recyclability and sustainability. Ultimately, the sustainable fashion technology helps to transition fast fashion towards a slow one, a circular one that is not only new and trendy but incredibly dedicated to environmental and social health.

Importance of Technology in the Fashion Industry¹⁶

Once you pause and reflect on the world of fashion, it is rather impossible to wonder how technology has transformed literally every aspect including design, distribution, and daily ingredients to wear. An industry¹⁷ that once began as a hand sewn cloth and a small shop-to is being transformed by technology that is capable of increasing innovation and efficiency, its long-term sustainability and how brands can communicate with their customers. To begin with, design does not move at a slow pace. Computer-aided design (CAD) programs have

¹³ Isabel, Mary, *Sustainable AI-Driven Fashion Tech A New Era for Chile's Atacama Desert*, Revista, (2024), <https://revista.drclas.harvard.edu/>

¹⁴ *Future Technologies for Sustainable Fashion*, Fab Lab Barcelona, (2024), <https://fablabbcn.org/education/legacy-program/future-technologies-for-sustainable-fashion>

¹⁵ Christou, Luke, *7 sustainable fashion technologies for eco-friendly production*, 3D LOOK, (2024), <https://3dlook.ai/content-hub/7-sustainable-fashion-technologies>

¹⁶ Singha, Kunal, *IPR Policies in the Fashion Industry and Consumer Behavior during COVID-19*, NIFT, (2024), https://nift.ac.in/sites/default/files/2024-05/ejournal/volume-1/Article_3_KS.pdf

¹⁷ *Growing Importance of Intellectual Property in the Fashion Industry*, ABOU NAJA Intellectual Property, (2024), <https://abounaja.com/blog/intellectual-property-in-fashion-industry>

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basically eliminated the use of thick stacks of sketchbooks as it has allowed designers to experiment quickly and precisely in a pinpoint stage. As soon as the digitalized¹⁸ blueprints are in the stash, 3-dimensional modeling and virtual prototype come into play, using less physical samples of them and reducing waste and materials spending. Technology is also behind the movement towards a sustainability drive. The production of new textiles made with biotechnology, recycling and sustainable agricultural practices limits the environmental impact of the industry, whereas manufacturing processes operate more responsibly. Meanwhile, blockchain platforms¹⁹ provide more clarity across the supply chain, ensuring that workers, shoppers, and all other stakeholders are able to see the path of every garment. Technology has reversed the script on marketing and retail in the consumer-side. E-commerce websites can make product recommendations based on your history and preferences, and virtual reality (VR) and augmented reality (AR) can help you access the fit experience you get at the shop without leaving your dorm room. On the whole, technology has now become the hub of the fashion world, and dictates the entire transformation starting with ideation and stretching into delivery and in-store, that is, in-app, experience.

Technology Driven Sustainable Fashion²⁰

Here is the list of exciting sustainable fashion innovations transforming production and recyclability that will deepen your knowledge on how to create a greener fashion supply chain.

1. 3D Virtual Sampling: Historically, physical samples have formed a prerequisite in the design and buy sell process. There are samples for both designers and the retail buying teams to have an accurate look at the product but one style finished may require 20 or more samples landing into production. but in the coming years as 3D develops further, virtual sampling is already able to perform a digital full line review which will translate as being waste free in terms of design and product development²¹. The 3D virtual²², all design sketch to sampling

¹⁸ Naveed, Ayman, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

¹⁹ Wang, Mengyuan, *Bringing Sustainable Practices, Fashion Shows, and Sociological Insights Together to Reinvigorate Sustainable Fashion Education*, MDPI, (2025), <https://www.mdpi.com/2071-1050/17/2/631>

²⁰ Defranc, Nicole, *How Is Technology Changing the Sustainable Fashion Industry?*, Monterail, (2024), <https://www.monterail.com/blog/how-is-technology-changing-sustainable-fashion>

²¹ Fearnley, Libby, *3D Virtual Sampling Software: The Sustainable Future of Fashion*, Textura, (2022), <https://textura.ai/3d-virtual-sampling-software/>

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and showrooming will happen end-2021 for all Tommy Hilfiger processes. In theory, it's almost zero waste as it happens on the screen for 3D virtual sampling. Among the most significant benefits of this disruptive fashion sustainability technology is material & time cost reduction for physical samples manufacturing. It can also contribute to the virtual sampling of a consumer-led on-demand manufacturing process.

2. Alternative Textiles: Materials that are used in the textiles and fashion industry require many resources and ultimately also biodegrade quite slowly²³. It takes as much water to make one cotton shirt as a person drinks in 2.5 years. Nylon and polyester are good examples of synthetic materials that use very little in the manufacturing process, but they produce devastating greenhouse gas emissions. Nonetheless, the emergence of sustainable technologies in fashion and textiles that are biodegradable as well as recyclable, regenerative has provided another option. Other textile eco-solutions are reclaimed fibres and fibres coming from agricultural by-products like leaves or rinds²⁴. This means they result in less waste during production, more durable pieces, and new biodegradable textiles. Cotton is often replaced with natural fibers such as hemp, bamboo, and ramie. Cupro, made from the waste of a cotton plant that produces cotton lint, is extracted through a closed-loop technology and is chosen by brands like COS and H&M. Stella McCartney and others have long considered the cutting edge in bio-based materials and closed-loop business model, for instance, with her biohomme fur²⁵. This plant-based fabric made from 37% of plant: energy is up to 30% less energy-hungry and produces up to 63% less greenhouse gas when manufactured than conventional synthetics. Piñatex, i.e. the veg veg-tanned leather made from pineapple leaf fiber by Ananas Anam, and muskin, i.e. vegetable inked mushroom leather, have also been worth calling out in relevant portions.

3. Automation and Fashion on Demand²⁶: Fast fashion companies and mass production models is one of the reasons so much waste and returns. The marketers sold mass

²²Chhabria, Hansika, *The critical role of technology in sustainable fashion*, *The Times of India*, (2023) <https://timesofindia.indiatimes.com/blogs/voices/the-critical-role-of-technology-in-sustainable-fashion/>

²³*Future Technologies for Sustainable Fashion*, Fab Lab Barcelona, (2024), <https://fablabbcn.org/education/legacy-program/future-technologies-for-sustainable-fashion>

²⁴ Hossain, Tanvir Md, *Techniques, applications, and challenges in textiles for a sustainable future*, *Journal of Open Innovation: Technology, Market, and Complexity*, Elsevier, Pg 6-9, (2024), <https://pdf.sciencedirectassets.com/782866/>

²⁵ Gerson, Garrett, *Digital Transformation – The Solution To Sustainable Fashion*, (2023), <https://www.theinterline.com/2023/11/28/digital-transformation-the-solution-to-sustainable-fashion/>

²⁶ Guria, Anish, *Sustainable Fashion and Consumer Buying Behaviour*, *International Journal for Research and Analytical Review*, Volume 11, Issue 1, Pg 537-540, (2024), <https://www.ijrar.org/papers/IJRARTH00165.pdf>

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consumption to consumers and this mentality carried through this model for most of the 90s and 00s²⁷. However, as e-commerce and social commerce surged over the last decade to create a new business model entirely for the consumers are king and LOVE personalized experiences and the planet. Individual demand design and manufacturing is big in the future of fashion. Instead of creating the clothes and selling it, Customer orders Items then manufactured²⁸. Although it is much more expensive to make today single and small batch production, cheaper manufacturing and automation / reduced returns plus guaranteed sales will offset these costs with the money saved. Mobile Tailor is for the custom fashion businesses, use it so you can go 100% online and eliminate time and costs wasting on taking manual

4. Mobile Body Scanning²⁹: For designers who leverage very generic measurements (approximate), online shopping is associated with bad fit and high return rates. Consumers end up buying every size and returning the stuff that doesn't fit returns lost forever, making fashion one of the largest polluters on this planet. This might sound like the savior: Digital body scanning (such as 3DLOOK)³⁰ can provide longevity with true-to-fit data, making better garments which will have far fewer returns than average everything and boosting ecommerce conversion rates. It lifts the confidence of consumer fit and hence builds loyalty to the brand for a more trustworthy and eco-friendly fashion industry.

5. Virtual Dressing³¹:Try-On the Traditional Way Has Died Out Thanks to Virtual Try-On Thank goodness Traditional try-ons are dying out with virtual dressing Everything from returning to try-on-three-times sees the shopper see how items would look upon their own body shapes through mobile 3D body scanning overlaid on top of AR (I guess maybe even digitally at a retail location)³². Retailers such as Farfetch are providing virtual try-ons on

²⁷ Naveed, Ayman, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

²⁸ Kelkar, Kapil, *Technology Intervention to Develop Sustainable Fashion Products*, IJCRT, Volume 10, Issue 1, pg 720-721, (2022), <https://www.ijcrt.org/papers/IJCRT2201094.pdf>

²⁹ D'Itria, Erminia, *Shaping sustainable solutions in fashion through design-led strategies, approaches, and practices*, Springer Nature, Volume 5, Pg- 101-103, (2024), <https://link.springer.com/article/10.1007/s43621-024-00624-5>

³⁰ Chhabria, Hansika, *The critical role of technology in sustainable fashion*, The Times of India, (2023) <https://timesofindia.indiatimes.com/blogs/voices/the-critical-role-of-technology-in-sustainable-fashion/>

³¹ Singha, Kunal, *IPR Policies in the Fashion Industry and Consumer Behavior during COVID-19*, NIFT, (2024), https://nift.ac.in/sites/default/files/2024-05/ejournal/volume-1/Article_3_KS.pdf

³² Dias, Jessica et al, *Augmented Reality Based Virtual Dressing Room Using Unity3D*. Proceedings of the 7th International Conference on Innovations and Research in Technology and Engineering, (2022), <https://ssrn.com/abstract=4111818>

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platforms like Snapchat. The new-tech path customers travel leads to quicker fitting, fewer returns and gives sustainability a boost because there will be waste reduction and less shipping emissions by wearing as little apparel as possible. AR, VR and MR technologies aside—this is how we shop and interact digitally with fashion brands.

6. Closing the Loop on Fashion:³³In order to curtail the waste, many major brands including Burberry and H&M are supporting the Make Fashion Circular concept. It revolves around creating more durable clothes made from eco-friendly materials that can be re-used or recycled to maintain the lifespan in circulation and reducing waste.

7. Re-commerce³⁴: Doing the Re-commerce is booming with buying and selling used clothes. Re-commerce platforms like Poshmark or Thredup make sustainable shopping virtually effortless at a real discount. Shop in Trends? Yes!³⁵ Trends show that resale will overtake fast fashion by the next decade handed off to shoppers, and shoppers love sniffing out stylish pieces guilt-free. Another approach the industry is using to lessen waste and produce new goods is upcycling (using old fabrics and undone inventories to make new fashions).

How sustainable fashion tech can help to grow your sales³⁶

Fashion businesses ought be fervently seeking out eco-friendly innovations and swiftly implementing them reducing industry's environmental footprint drastically nowadays. Not just because it's morally upright but because it might prove crucial for business prosperity in surprisingly turbulent markets overseas suddenly³⁷. McKinsey reports over 60% of consumers factor in environmental impact when buying stuff while Nielsen says 66% will shell out extra cash for eco-friendly products³⁸. Online businesses face mounting pressure rather quietly to slash waste and curtail emissions amidst eye-watering return rates and hefty

³³ Christou, Luke, *7 sustainable fashion technologies for eco-friendly production*, 3D LOOK, (2024), <https://3dlook.ai/content-hub/7-sustainable-fashion-technologies/>

³⁴ Naveed, Ayman, *Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study*, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

³⁵ Rana, Preeti, *The Rise of Sustainable Fashion: How Technology is Transforming the Industry*, Medium, <https://medium.com/@preeti.rana.ai/the-rise-of-sustainable-fashion-how-technology-is-transforming-the-industry-d4bf7b37a639>

³⁶ Hossain, Tanvir Md, *Techniques, applications, and challenges in textiles for a sustainable future*, *Journal of Open Innovation: Technology, Market, and Complexity*, Elsevier, Pg 6-9, (2024), <https://pdf.sciencedirectassets.com/782866/>

³⁷ *World Intellectual Property Day 2020 – Innovation for a Green Future*, WIPO, (2020), <https://www.wipo.int/en/web/ipday/2020/greenfuture>

³⁸ Granskog, Anna, *Consumer sentiment on sustainability in fashion*, Medium, (2023), <https://medium.com/@preeti.rana.ai/the-rise-of-sustainable-fashion-how-technology-is-transforming-the-industry-d4bf7b3>

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environmental penalties. Embracing sustainable practices ranks high among ecommerce conversion hacks pretty much for folks keen on boosting online sales rapidly nowadays. Embracing digital transformation rather than persisting with antiquated methods is pretty crucial for curbing wasteful practices across fashion industry sectors nowadays. Major industry players are embracing sustainable fashion tech pretty quickly now as eco-aware consumers increasingly reject wasteful old practices³⁹. Harnessing novel 3D tech and leveraging digital upheaval⁴⁰ benefits everyone in supply chains and ultimately passes such perks downstream to buyers. Contact 3DLOOK today for insight into sustainability's quietly revolutionizing fashion industry norms very subtly for both retailers and consumers alike.

Protection of Green Fashion Technology with Special Emphasis on the Indian Intellectual Property Laws⁴¹

The purpose of the intellectual property law e.g. patents, trademarks, industrial designs, copyrights, trade secrecy protection and so on is to protect the outcome of human ingenuity and provide the creators of ideas, designs, brand design, etc, to enjoy the right of exclusive use of their work. The topic of IP does play an essential role in the fashion industry to preserve the identity and originality of a brand⁴². Examples include trade marks which protect brand names or logos, copyrights which protect original designs or prints to clothing, patents, which protect new inventions or process innovations in the production of garments. Usually positioned as a tool protecting a business, IP may also contribute to the trend of sustainability in fashion.

Patents⁴³

³⁹ *Growing Importance of Intellectual Property in the Fashion Industry*, ABOU NAJA Intellectual Property, (2024), <https://abounaja.com/blog/intellectual-property-in-fashion-industry>

⁴⁰ Ryding, Daniella, *Technology-Driven Sustainability: Innovation in the Fashion Supply Chain*, Academia, (2019), https://www.academia.edu/82195537/Technology_Driven_Sustainability_Innovation_in_the_Fashion_Supply_Chain

⁴¹ Rocket, Eleanor, Etal, *Fashion 4.0 and emerging designers: leveraging data and AI to drive creativity, innovation and compliance in global supply chain regulations*, *Journal of Intellectual Property Law & Practice*, Volume 20, Issue 2, pg 115-117, (2025), <https://academic.oup.com/jiplp/article/20/2/111/7932433>

⁴² Li Zen, etal, *Fashion innovation through an innovationecosystem – a research agenda*, *International Journal of Fashion Design, Technology and Education*, (2023), https://www.researchgate.net/publication/373258610_Fashion_innovation_through_an_innovation_ecosystem_-_a_research_agenda

⁴³ Kumari, Tanya, *The impact of intellectual Property Rights in the Fashion Industry*, *Indian Journal of Integrated Research in Law*, Volume 4, Issue 2, Pg 115-116, (2024), <https://ijirl.com/wp-content/uploads/2024/05/THE-IMPACT-OF-INTELLECTUAL-PROPERTY-RIGHTS-IN-THE-FASHION-INDUSTRY.pdf>

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Amongst the most important aspects where IP law can be used to make fashion sustainable is the patenting of eco-friendly innovative material. To develop new kinds of sustainable fabrics⁴⁴ like organic cotton (cotton that has been organically produced by non-genetically modified plants and with no usage of any artificial farm chemicals like fertilized and pesticides), recycled polyester (recycled polyester) and that which is biodegradable (which can easily be deteriorated by simple situations of nature), entails a lot of investment in terms of research and development. Innovators by patenting these materials can ensure that their investments are not lost giving them the comfort to continue inventing on sustainable textile materials. In addition to that, the patent protection can motivate the companies to invest in new material development with a reduced impact on the environment, thereby aiming at the industry sustainability. The fashion business is based on its originality and creativeness and often gaining a competitive edge will be based on how resourceful a brand can be in depicting its wares. Even though in most cases of artistic work there is protection by copyright law or certain design laws applied in fashion, where there is technology involved in making or creation of an artwork then that is when patent comes into play. The protection of patents in fashion is not provided on the visual design of any garment but on the underlying technology which enhances functionality, sustainability or efficiency as is the case with CROCS shoes, wrinkle-resistance in fabrics and water-proof materials. One would be the successful case of Novozymes⁴⁵, a Danish biotech company which patented a new enzymes-based technology applying cellulase to the washing process to obtain the stone-washed effect in denim without having to resort to harsh treatments. This innovation⁴⁶ was the property of denim manufacturers around the world and within three years, the manufacturers could license the move which revolutionized production and fabric finishing processes. Novozymes with over 4,200 active pending patent filings offers an experience on how patent laws are capable of protecting technological advancements in the field of fashion to ensure that the industry can experience sustainable and effective innovation.

Industrial Design

⁴⁴Cavagnero, Sara, *Governing the fashion industry (through) intellectual property assets: systematic assessment of individual trade marks embedding sustainable claims*, Journal of Intellectual Property Law & Practice, Volume 16, Issue 8, Pg 858–860, (2021)

⁴⁵Sharma, Vaidehi, *Patents in Fashion: Protecting Creativity and Innovation*, Global Patent filing, (2024), <https://www.globalpatentfiling.com/blog/Patents-in-Fashion-Protecting-Creativity-and-Innovation>

⁴⁶Copperpod, *Intellectual Property for Fashion Industry: Design Patents*, Copperpod Intellectual Property, (2024), <https://www.copperpodip.com/post/intellectual-property-for-fashion-industry-design-patents>

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An industrial design⁴⁷ (in some jurisdictions also called design patent) is the aesthetic shape and aspect of an object. It is associated with the protection of visual ideas of items, the distinctive looks of a product, not the material it is made of or its functionality (unlike patent). Therefore, industrial design (right) or design right secures the shape, feel, pattern, color or ornamentation of a product. The designs⁴⁸ may have application on different parts of fashion including clothing, footwear, accessories and textiles among others. To illustrate, the style of a dress, or a handbag pattern, the design of shoes could be industrial designs in case they provide clear, unique appearance and are used to enhance the appearance of the product in general. Using industrial design rights, the fashion sector can become more sustainable and environmentally friendly because it may motivate the designers to come up with their new innovative designs that will win in the market. The fact that a designer will only be able to explore and use sustainable materials and production saves the further incentive of designing since they are safe to design whatever they like with the exclusive rights to it.

Section 2 (d) of the Designs Act⁴⁹, 2000 defines a design as something that concerns only the features of shape, configuration, pattern ornamentation, or the disposition of lines or colors fastened to any article no matter whether the said piece is of two-dimensional, three-dimensional or a combination of the two, accomplished by any industry process, whether manual, mechanical, chemical, or otherwise, which without reference to the shape or the configuration or the pattern or the ornamentation or the disposition of the line or the color in the finished article judgment is made solely by sight. However⁵⁰ it contains no method or principle of construction or simply a mechanical gadget. Under the Act only the registered designs are actually afforded protection, so there is a superior right of the owner of a registered design to prevent reproductions or mimicry of their design, such as two two-dimensional design in the form of a textile design or three dimensional such as a handbag or an article of clothing. An industrial model can be a three-dimensional design and a printed design (on a fabric) is a form of protection available under industrial design. The design is

⁴⁷Kumari, Tanya, *The impact of intellectual Property Rights in the Fashion Industry*, Indian Journal of Integrated Research in Law, Volume 4, Issue 2, Pg 118-119,(2024), <https://ijirl.com/wp-content/uploads/2024/05/THE-IMPACT-OF-INTELLECTUAL-PROPERTY-RIGHTS-IN-THE-FASHION-INDUSTRY.pdf>

⁴⁸R, Kamali, Intellectual property in the fashion industry: Design protection and counterfeiting challenges, International Journal of novel research and development, Volume 9, Issue 11, (2024), <https://www.ijnrd.org/papers/IJNRD2411183.pdf>

⁴⁹ Section 2(d) in The Designs Act, 2000, Legal Service India, <https://indiankanoon.org/doc/618466/>

⁵⁰Chourasiya ,Rupesh,et al, Towards sustainable success: A framework for assessing performance of sustainable manufacturing adoption in Indian textile industry, ELSEVIER, Volume 7, (2024), <https://www.sciencedirect.com/science/article/pii/S2666188824000662>

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granted protection of 10 years after registration and this may be renewed by another 5 years. Where there is breach in design, the Act provides a fee that is payable to the extent of up to 25,000 Rupees to be paid as a kind of a contractual debt. It is really important to accept artistic creation does not appear in the definition of a design. *The Bombay High Court in PrandaJewelryPvt. Ltd. v. Aarya24K*⁵¹ took a different stance relating to artistic works by comparing them to industrial designs when it stated that with a painting on a canvas, merely reproducing each feature of the art piece is not the act of applying criteria such as shape or configuration, but in the repair to mixers or refrigerators, it would be considered that such features to be added to the items as attributes would mean that object to be considered as a design. Even illustrations, diagrams, plans with the merit of art could fall within the frame of designs when carried out to an item, the court ruled.

Trademark⁵²

Fashion brands find trademarks a very useful instrument in their efforts to build names and perception in the market. Trademarks can have positive benefits in the world of fashion when it comes to focusing on making sure that fashion is environmentally and ethically responsible by pointing to the ethical certification of the brand⁵³. Sustainable brands have an opportunity to use their trademarks to stand out against their rivals and draw consciousness buyers. Trademarks are one example, through which we can certify that a brand is applying a given standard on sustainability e.g. in fair trading, organic materials, carbon neutral production, etc. Such certifications would help them earn consumer trust and loyalty and thus more brands will come up to embrace the same consumer practices. Besides, trade marks will also address greenwashing- where companies pretend to be eco-friendly. Trademarks help create transparency and accountability in the industry since they safeguard authentic sustainable brands, which prevents the misinformed consumer due to misleading advertisement.

⁵¹Yolmo, Karma Thinlay, Role of copyright for the Fashion Industry in India, Legal Research & Analysis, Volume 1 and Issue 1, (2025), <https://legalresearchandanalysis.com/role-of-copyright-for-the-fashion-industry-in-india/>

⁵²van Santen, Sarah, Changing the Fast Fashion Paradigm: The Role of Intellectual Property and Sustainable Entrepreneurship, <https://ssrn.com/abstract=4589180>

⁵³Calboli, Irene, Upcycling, Sustainability, and IP: What It Means for the World of Fashion, WIPO Magazine, (2025), <https://www.wipo.int/web/wipo-magazine/articles/upcycling-sustainability-and-ip-what-it-means-for-the-world-of-fashion-56361>

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A trademark, as described under Section 2(zb) of the Trademark Act⁵⁴, 1999, refers to any mark that can be graphically depicted and utilized to differentiate one's goods or services from others. This encompasses names, logos, symbols, combinations of colors, shapes, and even packaging such as the "CD" logo or the "Christian Dior" trademark that distinguishes Dior products from other fashion labels. In the fashion sector, trademarks are vital because they safeguard a brand's identity and reputation, which is frequently the primary reason consumers select a product. Legal protection is granted only to registered trademarks. The Delhi High Court in *Micolube India Ltd. v. Rakesh Kumar*⁵⁵ Trading clarified that a design cannot be registered concurrently as both a design and a trademark; however, once a design is registered under trademark law, it may be freely utilized and safeguarded under the Trademarks Act, providing double safeguarding. Since obtaining design and patent protections is more challenging, most Indian designers opt for trademark protection. For instance, in *Christian Louboutin Sas v. Pawan Kumar and Ors*⁵⁶. The court affirmed that Louboutin's distinctive red soles were a well-known trademark and imposed a penalty of ₹10.7 lakhs on the defendants for marketing counterfeit versions. This case underscores the significance of trademark protection for designers and fashion brands in preserving their unique brand identity.

Copyright

Copyright law protects original works of authorship, including fashion designs, prints, and patterns. In the context of sustainable fashion, copyrights can play a crucial role in promoting sustainable fashion by protecting original designs, encouraging innovation, and supporting eco-friendly practices. Designers can use copyright to safeguard unique patterns, prints, and artistic elements, ensuring fair recognition and financial reward. This incentivizes designers to invest in sustainable solutions like upcycled or biodegradable materials, as they retain control over their creations. Furthermore, copyright can facilitate the sharing of sustainable design practices through licensing agreements, where designers allow others to use their copyrighted works in exchange for royalties or other forms of compensation. This can create

⁵⁴ Section 2(1)(zb) of the Trade Marks Act, 1999, <https://indiankanoon.org/doc/11717>

⁵⁵ Naveed, Ayman, Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study, Aequitas Victoria, (2024), <https://www.aequivic.in/post/application-of-ipr-to-the-indian-fashion-industry-and-its-flaws-a-legal-study>

⁵⁶ Ghose, Adrija, Application of IPR to the Indian Fashion Industry and Its Flaws: A Legal Study, NLUA Journal of Intellectual Property Rights, Volume 2, Issue 2, pg 107-109, (2022), <https://nluassam.ac.in/docs/Journals/IPR/vol2-issue-2>

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a more collaborative environment in the fashion industry, where sustainable practices are shared and adopted more widely.

In the fashion sector, copyright law is essential in safeguarding a designer's artistic creations and innovation. According to Section 2(c) of the Copyright Act, 1957⁵⁷, artistic works encompass paintings, sculptures, sketches, and other creative outputs, regardless of their visual appeal. Registration for copyright is not obligatory, and the protection extends for the creator's lifetime plus an additional 60 years following their death. For works that are anonymous or produced jointly, the protection lasts for 60 years from the point of publication. This is vital in the fashion realm, where a designer's ingenuity results in both recognition and profit. Nonetheless, copyright only shields artistic components such as textile patterns, surface designs, and sketches—not the actual cut, shape, or silhouette of clothing, as clarified in *Star Athletica v. Varsity Brands*⁵⁸. The Delhi High Court in *Rajesh Masrani v. Tahiliani Designs*⁵⁹ confirmed that embroidery and printed designs qualify as artistic works under copyright law. However, Section 15(2)⁶⁰ of the Act imposes a limitation on this protection: if an unregistered design is replicated on more than 50 items, copyright protection is forfeited. This loophole permitted BIBA in *Ritika Pvt. Ltd. v. Biba Apparels Pvt. Ltd*⁶¹. to evade liability after appropriating a boutique designer's creation and mass-producing it. Therefore, while copyright provides substantial protection for original artistic works in fashion, it also presents limitations that creators must navigate prudently.

Trade Secret

Trade secrets such as manufacturing processes, formulas, and supply chain strategies protect confidential business information that provides a competitive edge. In the context of sustainable fashion, trade secrets can be used to protect confidential innovative processes that reduce environmental impact. For example, a company that develops a new method for

⁵⁷ Section 2(c) of the Copyright Act, 1957, <https://indiankanoon.org/doc/121334999/>

⁵⁸ van Santen, Sarah, Changing the Fast Fashion Paradigm: The Role of Intellectual Property and Sustainable Entrepreneurship, <https://ssrn.com/abstract=4589180>

⁵⁹ Intellectual Property Rights in Fashion Industry in India, Lawbhoomi, (2022) <https://lawbhoomi.com/intellectual-property-rights-in-fashion-industry-in-india/>

⁶⁰ Copperpod, Intellectual Property for Fashion Industry: Design Patents, (2024), <https://www.copperpodip.com/post/intellectual-property-for-fashion-industry-design-patents>

⁶¹ Cavagnero, Sara, Governing the fashion industry (through) intellectual property assets: systematic assessment of individual trade marks embedding sustainable claims, (2024), <https://academic.oup.com/jiplp/article/16/8/850/6211406>

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dyeing fabrics using less water and energy can keep this process as a trade secret, giving them a competitive advantage while also contributing to sustainability.

Persistent Challenges to Sustainable Fashion through IP and Technology⁶²

While the integration of intellectual property (IP) and technology presents vast opportunities to transform sustainable fashion, numerous significant challenges obstruct this innovative pathway⁶³.

1. High Costs of IP Protection: Acquiring IP rights like patents, trademarks, and industrial designs is an expensive and intricate endeavor. For numerous sustainable fashion entrepreneurs and startups, constrained financial and legal resources pose an obstacle to safeguarding their innovations and iconic designs.

2. Limited Awareness of IP Mechanisms: Despite the increasing innovation in eco-friendly designs and materials, many creators remain uninformed about utilizing IP laws to protect and market their creations. This lack of understanding hinders sustainable innovation from receiving the recognition and safeguarding it merits.

3. Absence of Fashion-Specific Legal Framework: The existing IP framework fails to incorporate fashion-specific regulations that cater to the distinct requirements of sustainable fashion. This results in legal uncertainties, particularly regarding the safeguarding of traditional knowledge, cultural expressions, and upcycled creations.

4. Inadequate Enforcement of IP Rights: Even when rights are bestowed, feeble enforcement measures weaken their impact. Counterfeiting, unauthorized duplication, and digital infringement persistently diminish the worth of sustainable innovation.

5. Prevalence of Fast Fashion and Copy Culture: The prevalence of fast fashion, fueled by inexpensive mass production and swift trend cycles, frequently leads to the imitation of sustainable designs without proper acknowledgment or consent. This not only undermines original works but also deters investment in sustainable innovation.

⁶²AstariAsril, Fitri, Fashion's Sustainability Dilemma: When Upcycling Clashes with Intellectual Property Rights, ERIA, (2024), <https://www.eria.org/news-and-views/fashion-s-sustainability-dilemma--when-upcycling-clashes-with-intellectual-property-right>

⁶³ Elrod, Cassandra, The Domino Effect: How Inadequate Intellectual Property Rights in the Fashion Industry Affect Global Sustainability, Indiana Journal of Global Legal Studies, Jstor, Volume 24, No.2, pg 580-585, (2017), <https://www.jstor.org/stable/10.2979/indjglolegstu.24.2.0575>

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6. Complex and Opaque Supply Chains: Disjointed global supply chains complicate the assurance of transparency and the tracing of IP ownership, particularly when digital technologies are not utilized for traceability and responsibility.

7. Low Consumer Awareness and Engagement: The triumph of sustainable fashion is also reliant on informed consumer choices. Nevertheless, a lack of comprehension regarding the significance of IP, technology, and sustainability in fashion purchasing decisions continues to be a barrier to widespread acceptance.

Analysis

This paper investigates the relation between sustainable fashion technology and Intellectual property, examining how this amalgamation could manage environmental and economic challenges in the fashion sector. It focuses on Intellectual Property Rights, especially patents and trademarks, which protect green technologies. Apart from safeguarding, it encourages investment and promotes ongoing innovation. By syncing IP regulations with sustainability goals, fashion companies can achieve a competitive advantage, attract ethically educated consumers, and contribute to overall industry growth. This study also focuses on the function of technology transfer in distributing environment-friendly innovations throughout the fashion supply chain. Through this paper, the author has highlighted some key challenges, such as the struggle in the adoption of new technology and general hesitance to share exclusive methods, along with ways to tackle these. It suggests strong laws, improved infrastructure for implementing technology related to sustainable fashion. This combination of IP laws with sustainable innovation and promotion of tech transfer can improve the condition of sustainable fashion. This approach has helped in changing the dynamics of companies' operations and consumer behaviour towards eco friendly actions.

Conclusion & Suggestions⁶⁴

Intellectual property rights⁶⁵, when combined with sustainable fashion technologies, represent a significant prospective for managing environmental and economic challenges in the fashion

⁶⁴ Calboli, Irene, *Upcycling, Sustainability, and IP: What It Means for the World of Fashion*, WIPO Magazine, (2025), <https://www.wipo.int/web/wipo-magazine/articles/upcycling-sustainability-and-ip-what-it-means-for-the-world-of-fashion-56361>

⁶⁵ Dias, Jessica et al, *Augmented Reality Based Virtual Dressing Room Using Unity3D*. Proceedings of the 7th International Conference on Innovations and Research in Technology and Engineering, (2022), <https://ssrn.com/abstract=411181>

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industry. It is evident that IP is vital in promoting eco-friendly advancements like biodegradable materials and methods of waterless dyeing, and also encourages investment guaranteeing fashion brands stay competitive in an ethically aware marketplace. This industry of panache faces many big hindrances like the cost of protecting ideas, i.e, IP is too high, a lack of sharing new technologies, weak law enforcement, and a complex supply chain worldwide. Despite these Challenges, there are various ways to use IP and technology together to fasten and strengthen sustainable practices. If IP systems are successfully aligned with sustainability and shared knowledge effectively, the fashion world can spearhead global efforts towards sustainability. On its effective implementation, this can change business operations and consumer behaviour towards more eco-friendly choices and will lead to more sustainable future for this industry.

Here are some suggestions that might help in tackling the existing and future problems⁶⁶:

1. In order to ensure adequate protection in sustainable fashion innovations, the government should strengthen the current laws. It should make laws specific to fashion that would incorporate the various requirements of green technologies and sustainable practices. With this, provisions related to the protection of traditional knowledge, patents for sustainable materials, and a more transparent framework for combating counterfeiting in the realm of sustainable fashion could be embraced.
2. It is very crucial to handle the unwillingness to disclose proprietary technologies that would facilitate the worldwide implementation of green innovation. For effective implementation, there should be a collaboration between Fashion brands, technology creators, and policymakers in order to develop frameworks and stimulate technology transfer while protecting intellectual property. open-source platforms or innovation hubs are few examples of cooperative systems that could help in the distribution of eco-friendly technologies.
3. To address low capacity to implement new technologies, especially in developing markets, governments and industry stakeholders should invest in resources that would build infrastructure, supporting sustainable technologies. This facilitates financial backing, training, and technical assistance to minor entities within the supply chain.

⁶⁶ Singha, Kunal, IPR Policies in the Fashion Industry and Consumer Behavior during COVID-19, NIFT, (2024), https://nift.ac.in/sites/default/files/2024-05/ejournal/volume-1/Article_3_KS.pdf

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4. The success of sustainable fashion not only depends upon technology and strong legal frameworks but also on consumer interest. Public education campaigns are necessary to focus on the environmental consequences of this profligate fashion. The importance of validating sustainable brands and the role of IP in enhancing ethical business practices can be spread if proper awareness is raised.

5. Effective enforcement and strengthening of IP rights is vital for maintaining the identity of sustainable fashion brands. Strong IP helps in protecting the brand name and commercial value. Investment should be made by our government in more effective monitoring systems and accelerated legal processes to address infringing and unauthorized reproductions. This ensures IP protection is significant and impactful.



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