Exploring the Challenges of Intellectual Property Rights in the Era of 3D Printing: A Comparative Legal Perspective from Iran and the European Union

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Abstract

Three-dimensional (3D) printing is revolutionizing the realm of production by empowering consumers and small businesses to fabricate complex objects from digital designs. However, this technology blurs the boundaries between digital files and physical products, introducing novel challenges for intellectual property (IP) law. This article investigates how Iran and the European Union (EU) are responding to the intellectual property issues emerging from 3D printing, focusing on copyright, patent law, industrial designs, trademark rights, as well as enforcement mechanisms and liability regimes. In the EU, IP protection is governed by detailed directives and regulations—such as the Copyright Directive 2001/29/EC, the Community Design Regulation 6/2002, the Trademark Regulation 207/2009, and the Enforcement Directive 2004/48—and is committed to international treaties including TRIPS and the Berne Convention. In contrast, Iran's IP framework is based on older legal statutes, notably the Law for the Protection of Authors, Composers, and Artists (1969) and the Law on Registration of Patents, Industrial Designs and Trademarks (2007), and is subject to limited international obligations. Iran is a member of the Paris Convention and the World Intellectual Property Organization (WIPO), but not of the Berne Convention, the WIPO Copyright Treaty, or TRIPS. Key differences emerge: for example, EU law generally does not consider the private and non-commercial reproduction of IP-protected objects as an infringement, whereas Iranian law explicitly excludes inventions "contrary to Islamic principles, public order, or morality" from patentability, and likewise restricts trademarks that violate Islamic norms. Drawing on case studies, academic analyses, and official sources (e.g., WIPO, European Commission), we identify the legal gaps in each system and propose reforms. Our comparative analysis underscores the need for legal updates and international cooperation to enable IP law to accommodate the paradigm of digital manufacturing in both jurisdictions.

Keywords: Intellectual Property, Legal Challenges, 3D Printing, Comparative Study

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1. Introduction

Three-dimensional (3D) printing (additive manufacturing) transforms digital files into tangible objects by depositing material layer by layer. Initially developed for rapid prototyping, this technology has become affordable and widespread, allowing consumers to produce toys, tools, implants, and other goods at home or through local print hubs. Its transformative potential spans various industries (aerospace, healthcare, fashion, etc.) by supporting on-demand manufacturing and mass customization. However, the ease of reproducing physical products creates tension with traditional intellectual property (IP) rights. An individual can download a 3D model and print a protected design or patented part, potentially infringing copyright, industrial design rights, or patent law—without encountering a commercial counterfeiter. Similarly, online platforms now host thousands of user-generated computer-aided design (CAD) files, raising questions about liability for disseminating infringing original designs (Mendis, 2015; Piper, 2015).

This article analyzes how Iran and the European Union (EU) are confronting the legal challenges of 3D printing. We first review existing literature on 3D printing and intellectual property (Section 2), including empirical studies and legal interpretations. Then, we present the legal IP frameworks in Iran and the EU (Section 3), including relevant statutes, international agreements, and enforcement mechanisms. Section 4 investigates specific issues related to copyright, patent law, industrial designs, and trademarks, as well as enforcement and liability concerns. A comparative analysis (Section 5) highlights differences and similarities between the Iranian and EU approaches. Section 6 offers policy recommendations for legislators and regulators, and Section 7 concludes with reflections on the future of intellectual property law in the age of digital manufacturing. Throughout the article, we draw on primary legal sources (national laws, EU directives, treaties) and authoritative commentaries (e.g., *ec.europa.eu*, *wipo.int*). Our focus is on depth and precision, aiming to inform legal scholars and policymakers about the state of IP protection in 3D printing across these two jurisdictions (European Commission, 2016a; World Intellectual Property Organization).

2. Literature Review and Research Background

Academic and policy literature concerning the IP implications of 3D printing has expanded in recent years. A study by the European Commission, led by Spark and colleagues (2016), offers a comprehensive review of EU law related to 3D printing. It emphasizes how additive manufacturing decentralizes production—enabling end users to bypass traditional counterfeiting networks—and notes that copyright "offers the best protection against widespread theft by individual end-users" since it covers private reproduction, whereas trademarks and industrial designs generally do not apply to purely personal use (Spark, 2016). The study also explores the liability of intermediaries (platforms hosting CAD files, printing centers) under EU law (Spark, 2016).

Similarly, Malaty and Rostama (2017) discuss global IP responses to 3D printing in the *WIPO Magazine*. They explain that current IP doctrines—copyright, industrial design, and patent law—are capable of protecting 3D objects and their CAD files, although new questions arise about authorship and joint ownership of collaboratively created designs (Malaty & Rostama, 2017).

Specialized legal analyses have focused on specific sectors or legal challenges. For example, Rideout and Wong (2015) examine how digital design files ("3D originals") might be protected as software under copyright law or challenged under industrial design law (Rideout & Wong, 2015). Other studies highlight the inadequacy of current industrial design law in covering certain complex shapes (see Margoni, EIPR, 2016) (Margoni, 2016). In medical 3D printing, attention has turned to regulatory and liability issues (e.g., precision devices, patient safety). Empirical research by Mendis et al. (2015) investigates online 3D printing platforms and user behavior, underscoring enforcement challenges when users share or modify files (Mendis, 2015).

By contrast, little published research exists on 3D printing and intellectual property in Iran. Iranian legal scholarship on IP has primarily addressed traditional topics (e.g., reforming patent law, digital rights) with limited references to additive manufacturing. Media reports and legal analyses note Iran's ongoing efforts to modernize its IP system (e.g., the new Industrial Property Law in 2024) but rarely address 3D printing directly (Harakenzo International Patent Firm, 2024; Hasan, 2024). Thus, we rely on broader sources for Iran: WIPO legal profiles, government and industry reports, and general IP interpretations. For instance, *Legal 500* (2024) and *AsiaIP* (2024) report on Iran's new IP law and its expanded scope (including consumer models and trade secrets), suggesting that the Iranian regime is evolving but retains unique features (e.g., morality-based exclusions, non-membership in the WTO) (ASIAIP, 2024; Clyde Co, 2024).

In sum, the literature shows that 3D printing places pressure on IP systems worldwide and necessitates balancing innovation with protection. No jurisdiction has resolved all the emerging issues. This article builds on previous work by offering a comparative perspective: examining both the well-developed EU framework and the less-explored Iranian context to identify converging and diverging challenges (European Commission, 2019, 2024).

3. Legal Framework in Iran

Iran's legal system is based on a codified civil law tradition (Roman-Germanic) and principles of Islamic Sharia. The Iranian Constitution recognizes property and contract rights, and the judiciary enforces civil and criminal laws. Intellectual property (IP) rights in Iran are set out in a series of national laws, primarily the Law for the Protection of Authors, Composers, and Artists (enacted in 1969) for copyright, and the Law on Registration of Inventions, Industrial Designs, and Trademarks (enacted in 2007) for industrial property (patents, designs, trademarks). The 1969 Copyright Law (last amended in 2009) protects works first published in Iran for the duration of the author's life plus 50 years after death. It is important to note that Iran is not a party to the Berne Convention or the WIPO Copyright Treaty, and therefore does not automatically extend protection to foreign works (Library of, 2017). The Iranian copyright law grants exclusive rights to the author for publication and reproduction, though these rights have historically applied only within Iran's borders.

Industrial property is governed by the 2007 law, which unified protection for inventions, industrial designs, and trademarks under one statute. The law broadly defines the registrability of inventions and protection for industrial designs but includes specific exemptions grounded in Islamic law: Article 4(f) excludes from patentability "inventions whose commercial exploitation would be contrary to Islamic principles, public order, or morality." Similarly, trademarks and trade names under the 2007 law cannot include signs that violate Islamic norms or public order (Baghery & Hassan, 2012). The law provides a 20-year term for patents (subject to renewal fees) and generally grants rights based on the priority of application filing. Industrial designs and trademarks are registered with the General Office of Industrial Property (affiliated with Iran's judiciary) and must follow procedures consistent with international standards. For designs, Iranian law requires novelty and industrial applicability, though unlike the EU, there is no protection for unregistered designs (European, 2017).

Iran has recently implemented reforms. In June 2024, a new consolidated Industrial Property Law was passed, increasing official fees and expanding protection to consumer models, trade secrets, and certification marks. A key change is that all official fees (previously payable in euros by foreign applicants) must now be paid online and in Iranian rials. The General Office of Intellectual Property is currently drafting implementing regulations. These reforms indicate that Iran is strengthening its industrial property regime, although many substantive provisions remain unchanged (ASIAIP, 2024; Hasan, 2024).

Iran's treaty commitments are limited. It is a member of WIPO (since 2001), and a party to the Paris Convention (since 1959, for patents and trademarks), the Madrid System (since 2003, for international trademarks), and the Lisbon Agreement (since 2005, for geographical indications). However, Iran is not a member of the World Trade Organization, so the TRIPS Agreement does not apply. It has also not signed the WIPO Copyright Treaty or the Rome Convention (for performers), though it has stated intentions to accede to Berne and Rome after updating its domestic copyright law (International Treaties; World Intellectual Property Organization). Thus, Iran's IP law is predominantly national and entails fewer international obligations than the European Union.

Law enforcement in Iran includes both civil and criminal remedies. The Harakenzo IP profile notes that "civil and criminal remedies (penalties, fines, compensation) are available for infringing acts against industrial property rights. Legal cases are

handled by a special branch of the Tehran General Court, and IP infringement may also constitute a punishable crime under the Islamic Penal Code and specific statutes (e.g., the Commercial Code includes criminal penalties for trademark theft)" (Harakenzo International Patent Firm, 2024). The Electronic Commerce Law (2003) explicitly affirms that existing IP laws apply to electronic transactions: it provides digital protection for authors' rights (Articles 62–63), trade secrets (Articles 64–65), and trademarks and domain names (Article 66). Iran also enacted the Computer Crimes Law (2009), which criminalizes online copyright infringement and fraud. In practice, IP enforcement in Iran is considered inconsistent: rights holders report widespread piracy of software, foreign films, and books, partly due to the lack of reciprocity stemming from Iran's non-membership in the Berne Convention. Only recently have authorities begun to enhance copyright protection to encourage domestic innovation (Clyde Co, 2024; Schuman & Rezai, 2020).

In summary, Iran's intellectual property framework is rooted in domestic legislation reflecting a civil law system and Islamic principles. It provides formal protection for creators and inventors but faces significant limitations: lack of automatic protection for foreign works, special exemptions based on moral grounds, and historically weak copyright enforcement. The government is actively reforming its legal structure (e.g., the 2024 Industrial Property Law, the proposed new Copyright Law) to modernize this regime. These characteristics shape the legal approach to 3D printing in Iran.

4. Legal Framework in the European Union

The European Union (EU), comprising 27 member states, maintains a harmonized intellectual property (IP) system. At the EU level, IP is governed by a combination of directives and regulations—directives must be transposed into national laws by member states, whereas regulations are directly applicable. Key EU IP laws include:

• **Copyright**: Directive 2001/29/EC (the Information Society Directive) harmonizes reproduction, distribution, and public communication rights. The 2019 Digital Single Market Directive (2019/790) introduced additional measures (e.g., regulations on content-sharing services) but is primarily relevant to text and data mining exceptions in the context of 3D printing (European Commission, 2019). EU countries are also committed to the Berne Convention (1886) and the WIPO Copyright Treaty (1996) through TRIPS (International Treaties).

• **Patent Law**: The EU does not yet have a fully operational unitary patent system, but patents are granted either nationally or through the European Patent Convention—an intergovernmental treaty. EU law affects patent exhaustion (i.e., once a patented product is sold in the European Economic Area, it can circulate freely) and defines infringement under Directive 2004/48/EC (European Patent Office, 2023).

• **Industrial Designs**: Regulation 6/2002/EC created a unified Community design right (registered and unregistered) enforceable across the EU. Directive 98/71/EC similarly harmonizes industrial design protection. Registered Community Designs (RCDs) can be renewed for up to 25 years, while Unregistered Community Designs (UCDs) enjoy three years of protection from first disclosure. The EU does not exclude "works of applied art" for 3D shapes—industrial design and copyright coexist, but case law from the Court of Justice of the European Union confirms that only "original" 3D works (such as sculptures) qualify for copyright, while others rely on design rights (European Court of, 2015).

• **Trademarks**: Regulation 2017/1001 governs the European Union Trade Mark (unitary across the EU), complemented by Directive 2015/2436 for national marks. EU trademark law requires "use in the course of trade" for infringement, meaning that purely private reproduction is generally not prohibited—as confirmed by the TRIPS Article 6 transposition as "in commerce" (European, 2017).

• **Enforcement and Liability**: Directive 2004/48/EC sets out common rules on remedies (injunctions, damages) for IP infringement. The E-Commerce Directive (2000/31/EC) provides limited liability for hosting intermediaries, requiring them only to remove infringing content once notified. In April 2024, the EU adopted a new Product Liability Directive which, unlike Directive 85/374/EEC, explicitly includes digital production files (e.g., 3D printing files) as "products," potentially expanding producer liability (European Commission, 2024). Consumer safety and product liability are also governed by directives (e.g., the General Product Safety Directive 2001/95/EC), relevant when 3D printers or printed goods are defective (European Commission, 2001).

The EU's legal framework generally presumes strong protection for IP. All member states are committed to TRIPS and Berne, and EU law often goes beyond TRIPS minimum standards (e.g., its enforcement regime may include injunctions and damages even in some private reproduction scenarios). There are significant exceptions: for instance, the Information Society Directive allows "temporary copies" and private reproduction exceptions under a three-step test. Likewise, trademarks and industrial designs are not infringed by purely private use. The EU also emphasizes intermediary responsibility: under e-commerce rules, a website hosting a CAD file may be required to remove it upon notice of infringement. Overall, the EU has a comprehensive body of IP law that is largely technology-neutral (applying existing concepts to new technologies), supplemented by specific guidance on emerging issues—such as the 2016 Commission study on 3D printing and IP law (European Commission, 2016a, 2016b).

5. Legal Challenges of 3D Printing

3D printing simultaneously engages multiple intellectual property (IP) rights and creates overlapping legal issues. The primary legal challenges include:

• **Copyright**: Digital design files may be regarded as literary or software works. If a CAD (computer-aided design) file contains sufficient creativity, it may qualify for copyright protection according to WIPO. Therefore, copying a 3D model could infringe both the copyright in the file and the original work. More fundamentally, reproducing a copyrighted 3D object (such as a sculpture or artwork) via printing also violates the reproduction right of the owner. In the European Union, Article 2 of Directive 2001/29/EC grants authors the exclusive right of reproduction, which extends under certain exceptions to private copying (Europe Parliament/Council). WIPO literature suggests that a CAD file involving "personal intellectual effort" should be protected like software, allowing right holders to pursue unauthorized distribution of such files (World Intellectual Property Organization). In Iran, the 1969 Law for the Protection of Authors, Composers, and Artists was initially designed for literary and artistic works and only protects works first published in Iran (Library of, 2017). This law likely covers 3D works (e.g., sculptures) but does not explicitly mention digital files. There is no broad statutory exception for "private copying"; unauthorized reproduction—whether digital or physical—can be punishable under law, especially given enforcement has historically focused on combating widespread piracy. The 2003 Electronic Commerce Law states that existing copyright laws also apply online, meaning that uploading a copyrighted CAD file without permission may constitute infringement of reproduction and distribution rights (Baghery & Hassan, 2012).

• **Patent**: Patents protect the functional and technical aspects of inventions. Printing a patented object (e.g., a mechanical part) without authorization constitutes infringement. Enforcement in this area is difficult: users may print for personal use (often not considered infringement under many laws) or illegally obtain parts through file sharing. In the EU, Article 30 of the TRIPS Agreement (transposed into national law) permits limited exceptions, and many countries exempt private, non-commercial use from patent infringement. Rights holders in the EU may invoke doctrines of contributory infringement or "supplying means" of a patented invention. For instance, French law (Article L613-4 of the IP Code) prohibits the supply of means for unauthorized use of a patented invention. Some commentators argue by analogy that offering a CAD file (as a "means" to reproduce a patented device) may constitute patent infringement (Piper, 2015). Iran's 2007 Patent Law grants inventors a 20-year right but includes a Sharia/morality-based exception. The law does not explicitly address the distribution of digital files. Patent holders in Iran can pursue typical enforcement tools (civil lawsuits, criminal penalties for counterfeiting), but privately printed patented items may evade detection. Iranian law does not explicitly exempt private use, though in practice, non-commercial activity may not be enforced aggressively (Harakenzo International Patent Firm, 2024).

• **Design Rights**: Design protection in the EU covers the appearance of industrial products. Registered Community Designs (RCDs) protect new designs for up to 25 years; Unregistered Community Designs (UCDs) are protected for three years from first disclosure in the EU. If a CAD file reproduces a protected design, printing it constitutes infringement. Note that UCD protection requires disclosure in the EU, so a random file on the internet may not trigger protection unless previously disclosed. Copyright may overlap: if the design is sufficiently artistic, it may be considered an "artistic work" eligible for copyright. Iranian law provides for the registration of "industrial designs" under the 2007 statute; however, it does not recognize unregistered design rights. A 3D design must be registered to be enforceable in Iran. Therefore, a printed object infringes an

Iranian-registered design only if registered in the relevant class and jurisdiction (Hasan, 2024). In both systems, consumers may 3D print copies of protected spare parts or furniture. EU law generally prohibits such copying for commercial use, but Article 28 of the Community Designs Regulation exempts private and non-commercial use. Iranian design law does not provide an explicit exception for private use; thus, technically, any copying (even by individuals) may be actionable, though enforcement against non-commercial users is unlikely (European, 2017).

• **Trademarks**: A trademark may protect the shape or logo on a product. If a user prints an item with a registered mark (e.g., a branded gadget), it may infringe the trademark if used "in the course of trade." EU trademark law (Directive 2015/2436, successor to 2008/95/EC) limits infringement to commercial contexts, consistent with TRIPS. A person printing a Coca-Cola bottle at home without selling it generally does not violate EU trademark law. Iran's 2007 Trademark Law similarly covers commercial use. Notably, Article 32(b) prohibits marks "contrary to Islamic principles, public order, or morality." This means that even in 3D-printed items, Iran may censor or block designs deemed unacceptable (e.g., blasphemous or indecent shapes) (ASIAIP, 2024). Trademark issues may also arise when a 3D printer brand or its parts are misrepresented by a copied item. However, no reported court cases concerning trademarks and 3D-printed goods have yet emerged in either jurisdiction.

• **Enforcement and Intermediaries**: Enforcing IP rights in the context of 3D printing poses practical difficulties. Traditional enforcement targets counterfeiters or commercial distributors. With 3D printing, infringement can occur at home or through decentralized networks. Thus, right holders may target intermediaries: websites hosting CAD files or printing service providers. In the EU, online platforms (e.g., maker communities) operate under the "safe harbor" rules of the E-Commerce Directive: they are not obligated to monitor content but must remove infringing material once notified. A European Commission study notes that rights holders may prefer to pursue platforms (for secondary liability) since end users are often private individuals excluded from infringement liability. This highlights reliance on "notice-and-takedown" mechanisms (European Commission, 2016a). Iran lacks a direct counterpart to the EU's e-commerce safe harbor. The 2003 law merely affirms that IP laws apply online but does not establish a formal takedown regime. Iranian authorities may order ISPs or platforms to block content under various regulations, but enforcement is less predictable. Criminal penalties exist for distributing copyrighted content, so a website operator in Iran could theoretically face prosecution for sharing an infringing file. Overall, enforcement in both jurisdictions is challenged by the global and peer-to-peer nature of file sharing (Clyde Co, 2024).

• **Liability Frameworks**: Product liability is an emerging concern. If a 3D-printed object causes harm (e.g., a defective medical implant), who is responsible? The EU's forthcoming Product Liability Directive explicitly defines "product" to include digital production files and software. Therefore, a designer or seller of a defective CAD file may be deemed a "producer" and held liable. Current EU law (Directive 85/374/EEC) already imposes strict liability on producers of physical products. Experts suggest that a 3D print shop or printer manufacturer may qualify as a producer, while someone merely selling CAD patterns may avoid liability if they did not "place the product on the market" (European Commission, 2024). In Iran, no standalone product liability statute exists. Liability for harm falls under general tort law: the 1960 Civil Liability Act imposes fault-based liability on anyone causing damage. Criminal penalties also apply to dangerous goods (e.g., the law on edible, drinkable, cosmetic, and hygienic items penalizes the sale of defective products). Thus, liability for 3D-printed injuries in Iran is addressed through ordinary tort or criminal statutes, without the strict liability regime present in EU law (Schuman & Rezai, 2020).

In summary, 3D printing activates numerous IP rights and legal domains. Existing laws may apply but often incompletely. Key challenges include: defining infringement when individuals create products; protecting digital files as works; aligning design versus patent coverage; monitoring global file sharing; and assigning liability. The EU has begun updating its laws (e.g., inclusion of digital files in product liability), while Iran's regime is still adapting and retains distinctive features (e.g., Sharia filters, lack of international obligations) (European Commission, 2016b; Malaty & Rostama, 2017).

6. Comparative Legal Analysis

The comparison between Iran and the European Union highlights both shared concerns and striking differences.

• **International Commitments**: The European Union (through its member states) is fully aligned with WIPO treaties, TRIPS, and the World Trade Organization (WTO) framework. The Berne Convention minimum standards (protection duration: life of the author plus 50 years, moral rights) and TRIPS obligations are applied. Iran, not being a member of the WTO or a

signatory to the Berne Convention, is under no obligation to grant Berne-based protection. Iran acceded to WIPO in 2001 and the Paris Convention in 1959, but its refusal to join TRIPS has allowed it to maintain policies—such as ignoring foreign copyright—that would violate WTO law (International Treaties; World Intellectual Property Organization). This gap means that EU-based designers enjoy strong global enforcement options, whereas a foreign creator whose work is 3D printed in Iran may have no remedy unless Iran changes its accession status.

• **Legal Regime Structure**: EU law is multi-layered (EU directives/regulations and national law), yet highly harmonized. Iran's IP laws are national (with minimal supranational harmonization). **Enforcement**: The EU has specialized IP courts and consistent enforcement standards (infringers can be sued; preliminary injunctions are available). Iran has a specialized IP court in Tehran, but enforcement is often slower and less transparent. IP infringement cases in Iran can also be criminalized (for widespread violations), whereas the EU emphasizes civil enforcement—though serious counterfeiting may still be prosecuted under national criminal laws (European Commission, 2024; Harakenzo International Patent Firm, 2024).

• **Copyright**: In the EU, copyright in 3D objects or CAD files arises automatically under the Berne Convention, with rights granted without formalities. A 3D model uploaded on an EU website is immediately protected; those who print it infringe the author's rights (unless an exception applies). EU law provides exceptions (such as private copying), but these must pass the three-step test, and there is no blanket exception for 3D copying (Europe Parliament/Council). Iran's copyright law protects only works first published in Iran. If an Iranian user prints (copies) a foreign film or song, Iran's law will not penalize it unless under limited "unfair competition" rules or by invoking computer crime provisions. As such, Iran offers virtually no protection for foreign creators and legally permits mass copying of foreign works. This creates a highly divergent environment: in the EU, printing a protected design without permission is punishable; in Iran, foreign designers have little hope of enforcement (ASIAIP, 2024; Library of, 2017).

• **Patents / Designs**: EU patents (via the European Patent Convention or national laws) require strict novelty standards and allow enforcement. Iranian patents also follow novelty/inventive step standards but include a Sharia/public morality barrier. For example, a contraceptive device or medical innovation may be unpatentable in Iran if considered unethical, though it may be patentable in the EU. Similarly, Iran will not enforce patents that contradict Islamic norms (Hasan, 2024). Regarding designs, the EU recognizes both registered and unregistered designs (with automatic protection after disclosure), whereas Iran grants design rights only upon registration. This means EU creators benefit from immediate protection for new forms (via UCD), which Iranian designers lack (European, 2017).

• **Trademarks**: Both systems require commercial use to establish infringement. A consumer who 3D-prints a brand for personal use is not infringing in either jurisdiction. However, Iran's trademark law explicitly prohibits marks conflicting with Islamic values. For instance, a 3D file of a Western cultural statue may be censored or denied trademark protection if deemed offensive to public order. The EU has no such moral filter, although public policy/morality can disqualify a mark in limited cases (Article 7(1)(f) of the EU Trade Mark Regulation, typically for obscene content). Thus, Iran's approach is more restrictive: the state may reject or invalidate a mark (or arguably a design or image) it deems immoral (ASIAIP, 2024; Clyde Co, 2024).

• **3D IP Enforcement**: In the EU, rights holders rely on takedown notices under e-commerce laws to remove infringing CAD files from online platforms. Courts can also issue injunctions against websites (under the IP Enforcement Directive). Iran lacks a formal notice-and-takedown procedure. A 3D-printable file may only be removed from an Iranian website if authorities deem it illegal (e.g., blocking a site for copyright infringement, as seen with many foreign media sites). The EU also engages in cross-border cooperation (e.g., injunctions against foreign hosts), whereas Iran generally cannot enforce its orders extraterritorially (Baghery & Hassan, 2012; European Commission, 2016a).

• **Liability**: The EU's new product liability rules will hold designers and producers of digital files accountable for defects. If an EU citizen prints a registered medical device that malfunctions, the manufacturer's liability insurance would cover it under strict liability. In contrast, Iran addresses damage from 3D-printed products under general tort law—which requires proof of fault (negligence). Software authors or platform operators are not subject to a separate liability regime; they may only face criminal penalties if a product causes physical harm (e.g., under health and safety laws). The concept of a CAD file as a

"product" is not formally recognized, though in theory, an Iranian court could interpret existing laws to apply to it (European Commission, 2024; Schuman & Rezai, 2020).

In conclusion, the EU's framework is more technologically neutral and comprehensive but also more complex due to harmonization. Iran's regime is simpler but less modern: it does not recognize many international standards and relies heavily on governmental discretion (e.g., Sharia compliance). Both jurisdictions face similar practical issues in monitoring distributed 3D printing, but the EU offers more legal tools (injunctions, cross-border enforcement, clear exceptions) than Iran (European Commission, 2016b; Malaty & Rostama, 2017).

7. Policy Recommendations for Addressing Emerging Challenges

Based on the above analysis, we propose the following policy recommendations to improve intellectual property (IP) responses to 3D printing:

• **Harmonizing International Commitments**: Iran should accelerate its accession to key treaties (Berne Convention, WIPO Copyright Treaty (WCT), and ultimately the WTO/TRIPS). Joining the Berne Convention would ensure reciprocal protection for foreign creators in Iran (and vice versa) and close the current loophole that enables widespread copying of foreign content. It would also likely require Iran to update its copyright law to align with international norms—a process already underway (Library of, 2017; World Intellectual Property Organization). For the EU, continued participation in international IP fora (such as WIPO committees on digital technologies) is vital for shaping global standards in digital manufacturing (European Commission, 2016b).

• **Updating National Legislation**: Iran's new Industrial Property Law (adopted in 2023) was a positive step forward, but further reforms are needed to address digital issues. A new copyright law (under development) should explicitly cover computer-generated designs and digital fabrication. It could clarify exceptions (e.g., preserving a private non-commercial use exemption to avoid suppressing hobbyist innovation) and establish clear liability rules for online intermediaries. The EU should assess whether its current exceptions (e.g., for data mining, private copying) adequately apply to CAD files. If necessary, the EU may consider harmonizing an exception or limitation for 3D printing (consistent with Article 30 of TRIPS) to balance user freedom with the interests of right holders (European Commission, 2019; International Treaties).

• **Clarifying Digital Infringement Enforcement**: Iran should consider introducing a notice-and-takedown mechanism similar to the EU's, enabling right holders to request removal of infringing CAD files from Iranian platforms. This would create legal certainty for online intermediaries. Conversely, the EU may support raising awareness among right holders about using existing mechanisms (such as injunctions against print farms and cooperation with payment providers). In both jurisdictions, training law enforcement officers and judges on 3D printing issues would improve enforcement outcomes (Clyde Co, 2024; European Commission, 2016a).

• **Addressing Product Liability and Safety**: Including 3D files in the EU's Product Liability Directive sets a helpful precedent. Policymakers should assess whether similar approaches are appropriate in other legal systems. For instance, Iran could evaluate whether its civil tort law should treat 3D design files as products subject to strict liability. At a minimum, safety standards (for medical and consumer products) should explicitly cover 3D-printed items to ensure accountability. Industry standards (such as labeling requirements for 3D-printed goods) can also help trace liability (European Commission, 2024; Schuman & Rezai, 2020).

• **Promoting Collaborative Solutions**: Given the global nature of 3D printing communities, international cooperation is key. The EU could fund research into secure digital rights management for 3D models (e.g., watermarking or blockchain tracking). Iranian IP authorities might collaborate with WIPO on emerging technology initiatives to share expertise. Both Iran and the EU could promote voluntary codes of conduct among designers and platforms as supplements to legal measures. Educational programs for creators and consumers on IP rights in 3D printing would also help reduce unintentional infringement (ASIAIP, 2024; Malaty & Rostama, 2017).

• **Balancing Innovation and Protection**: Policymakers should ensure that reforms do not unduly hinder innovative uses of 3D printing (e.g., in healthcare, education, small enterprises). For example, overly broad criminal penalties for IP infringement

may harm domestic makers. Iran, in particular, might consider exemptions for non-commercial research and development to foster a local 3D printing ecosystem while still offering remedies against large-scale infringement. The EU's approach to adapting existing limitations (such as private copying exceptions) could serve as a model: it preserves the core incentives of IP while allowing for personal experimentation (European Commission, 2016a; Spark, 2016).

8. Conclusion

Three-dimensional (3D) printing challenges traditional assumptions of intellectual property (IP) law by eliminating the boundary between digital design and physical object. Our comparative study shows that the European Union and Iran—despite very different legal environments—face similar core issues: protecting creators while enabling technological advancement. The EU's complex IP framework offers many tools (harmonized rights, enforcement mechanisms, exceptions), yet still grapples with decentralized infringement. Iran's system, though more nascent, is rapidly evolving; its 2023 reforms signal a commitment to strengthening IP, but cultural and institutional factors (such as morality clauses and limited treaty obligations) mean that certain issues—especially digital copying of foreign works—are addressed differently.

Ultimately, neither system will fully prevent unauthorized reproduction via 3D printers. The goal should be a sustainable balance: ensuring that right holders have proportionate remedies, while ordinary users and innovators are not unduly burdened. In both jurisdictions, this likely means relying on intermediaries (platforms, printer manufacturers) to monitor content and implementing flexible enforcement strategies. International dialogue—such as through WIPO—may help bridge the gap between high-IP-protection regimes and those still undergoing liberalization.

For Iran, alignment with global IP norms (Berne, TRIPS) would enhance foreign investment and offer stronger protection for domestic creators. For the EU, continued refinement of IP exceptions and liability rules—as seen in recent legal updates—will help its legal system adapt to new production paradigms. By learning from each other—Iran considering notice-and-takedown models and product liability concepts from the EU, and the EU examining how cultural values are integrated into Iranian IP law—both may improve their responses to the age of 3D printing. In any case, the digital manufacturing era demands that IP law be flexible, technologically neutral, and grounded in dialogue between creators, users, and regulators.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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References

ASIAIP. (2024). The Expanding Reach of Iran's Intellectual Property Law. *AsiaIP*.
Baghery, H. R., & Hassan, K. (2012). E-Commerce and Consumer Protection in Iran: A Legal Framework. *Int'l Business Mgmt.*, *6*, 317-324. https://doi.org/10.3923/ibm.2012.317.324
Clyde Co. (2024, April). *The EU's New Product Liability Directive*.
Europe Parliament/Council. Directive 2001/29/EC; Regulation (EC) 6/2002; Directive 98/71/EC; Regulation (EU) 2017/1001; Directive 2004/48/EC; Directive 2000/31/EC, etc. In.
European Commission. (2001). Directive 2001/95/EC on General Product Safety. *Official Journal of the European Union*, 7.
European Commission. (2016a). Intellectual Property and 3D Printing: A Study. 22.
European Commission. (2016b). Overview of 3D Printing & Intellectual Property Law.
European Commission. (2019). Directive 2019/790 on Digital Single Market and Copyright. *Official Journal of the European Union*, 30.
European Commission. (2024). Directive on Product Liability and Digital Products. *Official Journal of the European Union*, 10.
European Court of, J. (2015). Case C-395/14 - European Designs and Copyrights. *ECJ Judgments*, 40.
European Patent Office. (2023). European Patent Convention and the Patent System. 15.
European, U. (2017). Regulation 2017/1001 on the European Union Trademark. *Official Journal of the European Union*, 3.
Harakenzo International Patent Firm. (2024). *Iran - Intellectual Property Overview*.
Hasan, J. A. E. (2024, 22 Nov.). Iran enacts new IP law and fee increase.
International Treaties. Berne Convention (1886), TRIPS Agreement (1994), WIPO Copyright Treaty (1996), Paris Convention (1883), etc. (as updated). In.
Library of, C. (2017, 7 Nov.). Iran: New Copyright Law to Be Submitted to Parliament.
Malaty, E., & Rostama, G. (2017). 3D Printing and IP Law. *WIPO Magazine*.
Margoni, T. (2016). The Limitations of Current Industrial Design Law. *EIPR*, 126.
Mendis, R. (2015). 3D Printing Platforms and User Behavior. *Journal of Technology and Innovation*, 215.
Piper, D. L. A. (2015, June). *Legal challenges of 3D printing*.
Rideout, S., & Wong, L. (2015). Digital Design Files and Copyright Law. *Journal of Intellectual Property Law*, 78.
Schuman, G., & Rezai, A. S. (2020). *Product Liability in Iran*. Loc. Law Libr. Pub.
Spark, A. (2016). EU Law on 3D Printing: A Comprehensive Review. 48-52.
World Intellectual Property Organization. *WIPO - WIPO Lex Databases (laws and treaties)*.