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Critical Analysis of Implications of 3D Printing on Intellectual Property Laws in India

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Introduction

Technological advancement throughout the country have been evident since ages from the development of various techniques over time for making or doing things. Research and development throughout the centuries demonstrate our tendency to make things even faster. In the quest of making our lives easier, one such technology named 3D printing was developed. Some people have indicated 3D printers as disruptive technology, while others say it as a harbinger of new industrial revolution. This new technology has made the way of creating of new objects easy. 3D printing allows corporations to cut costs by decentralising manufacturing, even consumers having access to this technology would be able to print products from their own residence. But despite of this, 3D printer's use makes it technically possible to copy any object with or without the authorisation of the people holding intellectual property rights of that object which has posed serious challenges towards various manufacturing industries as well as it has become a threat to the intellectual property rights of products, innovations, manufactured or invented by various entities or individuals. This is the main issue which is further addressed throughout this research paper.

Aim of Study

The aim of this research paper is to understand the concept of 3D printing. This study sets out to analyse that how 3D printing poses threat to various IPR of objects invented or manufactured. Also impact of 3D printing on patent regime. To ascertain that whether the current IP laws are efficient in handling 3D printing related issues. What measures could be taken to curb the use of 3D printing to avoid infringement or unauthorised use of IP protected objects. To analyse that how 3D printers pose challenges to the privacy of individuals. All these we will understand by looking into the real-world examples demonstrating the implications of 3D printers.

Literature Review

To explore the implications of 3D printing on various industries and IP rights holders, we would first review certain literatures.

3D printing's application on various Industries[1]

The current literature review states that relationship between the 3D printing and intellectual property and its impact on global economy and society. 3D printing makes it possible to produce complex designs which could otherwise have not been manufactured[2]. Also, products created by this are lighter in comparison to those using traditional manufacturing methods[3]. All this is possible at no extra cost leading to increased volume of

[1] Dr Thomas Birtchnell (2018) "3D printing and Intellectual property futures", *The Intellectual Property Office* (August)
[2] Mellor et al 2014

[3] Petrovic et al 2011

production if needed[4]. are also various challenges like high capital investment, poor range of materials, low printing speed[5].

3D printing has been introduced in many industries such as aerospace, automative, medical, construction and jewellery. Like in construction industry, cost of houses could be reduced but there are several limitations as well like quality of materials need to be improved as well as printing accuracy[6]. Application of 3D printing in Dentistry industry was studied wherein it was found that though 3D printing could aid to improve some of the process but yet various challenges exist[7].

3D Printing and IP

In relation to 3D printing, commercial spaces are comparatively regulated and less risky for the IP violations than the household arena wherein there is high risk for IP enforcement. Yet, a significant factor pertaining to intellectual property is the significance of patent expiration in the 3D printing industry which results from business interest in utilising open designs[8].

3D printing significance in the field of medicine[9]

This literature examines the role played by the 3D printers in the medical field in India. 3D printer's impact on the medical field is immensely significant as it helps in creating customised medical products. 3D printers

[4] Berman 2012; Weller et al 2015

[5] Mellor et al 2014; Rylandset al 2016; Arcos-Novillo and Guemes-Castorena 2017

[6] Kothman and Faber 2016

[7] Deradjat and Minshall 2017

[8] Gao etal 2015

[9] Shardha Rajam & Adhya Jha (2018) "3D printing-an analysis of liabilities and potential benefits within the Indian legal framework", 11 NUJS law review 361 (July-September)

have been of great help in the outer countries to overcome the non-availability of organs. In India, also first artificial liver tissue was created using 3D print technology[10].

3D printing and product liability concerns

In this literature, 3D printing and product liability concerns have been explained. Like it states that 3D printers make it easier to collect evidences to prove that negligence claims in product liability. If any injury is caused through 3D printed product whose strict liability would come- 3D printer or individual who created and sold the product[11]?

3D printing and Patent concerns

This literature presented that using 3D printers to replicate patented products could cause infringement under the act of 1970[12]. Also, that not all 3D printed goods are patented. As for being patented the product need to fulfil the criteria i.e. it must be novel, must have an inventive step and capable of industrial application. Like bio printed organs could not be patented. That to 3D printed organ of animal could not be patented as sec. 3(j)[13], prohibits patent in plants or animals or any part thereof. And to create 3D printed organ of an animal, bio material of animal would be definitely needed which comes under the purview of "thereof".

[10] Himanshu Goenka, *Indian Biotech Startup, Pandorum Technologies, Develops 3D-Printed Liver Tissue,* December 24, 2015

[11] Kennedys,3-D Printed Products, Product Liability and Insurance Implications, June 2, 2014

[12] The Patents Act,1970

[13] The Patents Act,1970

Research Objectives

Through this research paper, the objective is to:

- Evaluate in what ways 3D printing challenges the effectiveness of various IP laws
- Assess that whether the existing IP laws provide adequate protection to those involved in 3D printing process and for the products made by them
- Examine various liabilities and benefits arising Out of 3D printed products within the Indian legal framework
- Evaluate the IP related tensions arising between the consumer and right holders in relation to 3D printing

Research Questions

- What impact does 3D printers had upon various industries?
- What are the major concerns of intellectual property right holders regarding the impact of 3D printing on their rights or what challenges are faced by holders in enforcing their rights in the context of 3D printing?
- How do users perceive the ethical consideration of reproducing patented or copyrighted objects using 3D printing technologies?
- What regulatory frameworks or policy interventions are being proposed or implemented to balance innovation with the protection of intellectual property rights in the context of 3D printing?
- To what extent Indian IP framework regulate CAD files and 3D printed objects?

Research Methodology

This research paper includes various research methodologies that are commonly used by the researchers. By conducting Qualitative research and Quantitative research, this research paper aims to provide the clear and concise information and data regarding the intersection of Intellectual property laws with the 3D printing technology. In order to conduct evaluation, it was necessary to collect data on patent fillings, lawsuits regarding infringement of IP rights, market trends regarding 3D printing technologies, thus database likes LexisNexis, google scholar, ResearchGate, academic articles like JSTOR for legal cases and articles were used.

Statistical methods were used to analyse numerical data, gathered data by searching for articles in legal, technological journals even by conducting surveys. Even looked for real life projects of 3D printers in India.

This research study was important to conduct as it pertains to the field of intellectual property which is a growing industry in today's era but is exposed to certain risks of IP infringement due to 3D printing technology thus, to review current IPR laws in relation to the 3D printing and identify the gaps where these laws are I insufficient to prevent unauthorised copy of physical products of various industries and to suggest legal reforms to address the gaps in the legal framework.

Understanding the Concepts

What is 3D Printing Technology?

Despite the fact that 3D printer technology has been invented in the year 1981 by Dr. Kodama working in Industrial Research Institute in Japan, yet there are many people for whom this technology is as new as a penny thus before going into detail, this section would provide a brief introduction about this technology.

3DP stands for three-dimensional printer, a.k.a. additive manufacturing. It is essentially about producing physical objects. Additive manufacturing is a process which involves adding material to create object. It is different from subtracting manufacturing process which involves removing material to create objects. Thus, Additive manufacturing is a digital process which uses a 3D model to create a physical object by bonding thin layers of materials together. It builds parts by adding material layer by layer. Bricklaying is a conventional example of the AM, 3D printing is also included in this broad category. In this way, the concept of printing an object layer by layer with the aid of computer software is the base of the 3D printing. 3D printers are used to construct the 3-dimensional object from a CAD model.

What is a CAD File?

A CAD file or a.k.a. Computer aided design file, is a digital file that contains 2D or 3D models of physical objects. CAD files contain information like material properties, manufacturing data, geometric data and other data related to the product. These CAD files provide instructions to 3D printers to build a product or prototype. In this way, CAD is the representation of 3D printed objects via the file format stereolithography. CAD file is the “vessel” which carries the 3D model i.e. the blueprint of the physical model. 3D printer is not able to print anything without the CAD file, just as 2D printer requires word file or PowerPoint file to produce a printout.

What is STL File Format?

Stereolithography is file format which is commonly used by 3D printing and CAD. A set of connected triangles that represents the surface geometry of the 3D object makes up the STL files. Depending upon the complexity of the design, more triangles and higher the resolution is used. From this we understood that STL files does not contain colour or information rather they focus only on geometry.

Rapid Prototyping?

3D a.k.a. Rapid prototyping which is a technique which uses digital technology to create physical sample models or prototypes and functional parts from digital designs. It also uses CAD data to build a model layer by layer.

How does a 3D Printer work?

Till now we understood that 3D printers use digital files to create solid or physical objects by placing materials layer by layer or "sequential material layers". Let's look at the quick recap of how Physical object is created by 3D printer.

Firstly, Digital file i.e. CAD file which is 3D electronic blueprint which contains the schematics of the object to be printed is created manually using software or using a 3D scanning device. Secondly, the file is sent to the 3D printer using a specialised software, which builds up layers upon layers of molten material to create the final thing i.e. layers of material are deposited in the printer which slowly builds the structure until the final product emerges. This is how digital model is converted into a physical object[14].

[14] By Elsa Malaty, "*3D printing and IP law",* WIPO magazine, February, 2017

Advantages of 3D Printers in today's World

The introduction of 3D printers has been advantageous in someways to various industries. Let's look deeper to those instances:

1) Manufacturing industry – Prototyping can be accelerated by using 3D printing to quickly make parts. It can be used to print on demand which can save cost by reducing the need to keep inventories. 3D printing can be more versatile, enabling the creation of intricate patterns. 3D printing can be more versatile enabling the creation of intricate patterns.
2) Customisation – Highly customised and personalised products could be created by 3D printing without the need for tooling or moulds which could reduce costs.
3) Maintains Sustainability – As in 3D printing exact amount of material is utilised thus it helps in reducing waste and pollution and becomes environment friendly.
4) Design Flexibility – Complex shapes that might not be possible to create by other methods can be created by 3D printers.
5) Cost reduction – Since 3D printers are fully automated thus it helps in reducing costs by reducing staff costs.
6) Fuel efficiency – Plastics are advantageous in terns of weight as they are lighter than their metal counterparts. And the main material used in the 3D printers is plastic. Thus, this feature is important in automative and aerospace industries wherein light weighting is an issue and this light weight of plastic can deliver greater fuel efficiency as plastics make vehicles lighter and lighter vehicles require less energy to accelerate and maintain speed.

7) Ease of Access – With more local service providers offering outsourcing services for manufacturing operations, 3D printers are becoming more and more accessible. Compared to traditional manufacturing procedures, this saves time and does not require expensive transit costs.

Due to these various benefits, Industries would be able to focus on innovation and development of products rather than paying attention minimising the cost of production and distribution.

Application and Adoption rate of 3D Printing in various Industries

3D printing has huge impact on all sectors which involves manufacturing and thus, it is becoming a viable manufacturing technology across various industries

1. Pharmaceutical Industry - Indian pharmaceutical industry has been benefited from 3D printers has it has helped to develop medical devices like implants, prosthetics, dental devices like dental aligners, dental models and restorations. Also, 3D bioprinting uses 3D printers to create living tissue models by layering biomaterials and cells. 3D printing drugs can also resolve supply chain efficiencies, permit healthcare practitioners to customise drugs according to their patients need. This could help in reducing bio waste by allowing pharmaceutical companies to perform on demand production.
2. Aerospace Industry – Aerospace industry was one of the 1st industries to adopt 3D printing technology. 3D printing in aerospace industry was used to develop combustion chambers, rocket engine parts, surveillance drones, air ducts. Aerospace industry companies like Boeing, Airbus, GE Aerospace are the major players to use 3D printing technology. Since 3D printers helps in making fuel efficiency objects, complex geometries parts without expending in tools and in less time, 3D printers have proved to be beneficial.

3. Défense Industry – Various countries in the world have started to deploy 3D technology in Défense industry. Like USA has used 3D printers to print spare parts for nuclear submarines[15]. Also in India, Hindustan Aeronautics Limited, an Indian state-owned aeronautics and defense company is using 3D printing technology to print components for Hindustan Turbofan engine-25. Defense Industries are moving towards 3D printers as they aid in cutting down the maintenance costs of weapons systems, provides high level of customisation, can bring efficiencies with less risk of abuse until the CAD files are secured. SAFRAN is an aerospace and defense industry using 3D printers' technology.
4. Food Industry – Printing food is one of the most exciting developments that occurred till date. As we have seen in sci-fiction novels, machine made food as a prop, no longer remains a prop. Like "FOODINI" is a food printer kitchen appliance. However, it does not cook food as the result need to be baked or fried. FSSAI[16] ensures availability of healthy and safe food for human consumption, has sought to examine the challenges exposed to 3D printed food like food safety, long term effect on human body. Also, "printed food" is capable of falling within the purview of food definition under the FSSA act, 2006[17]. Since 3D printed food is innovative and until it is not unsafe food it is also considered to be "novel food". This technology helps to reduce wastage of food by proving on demand food supply.

[15] '3D Opportunity in the Department of Défense: Additive Manufacturing Fires Up

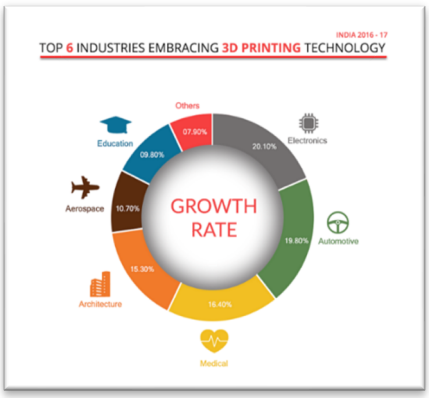
[16] Food safety and standards authority of India is established under the act FSSA: Food safety and standards Act,2006.

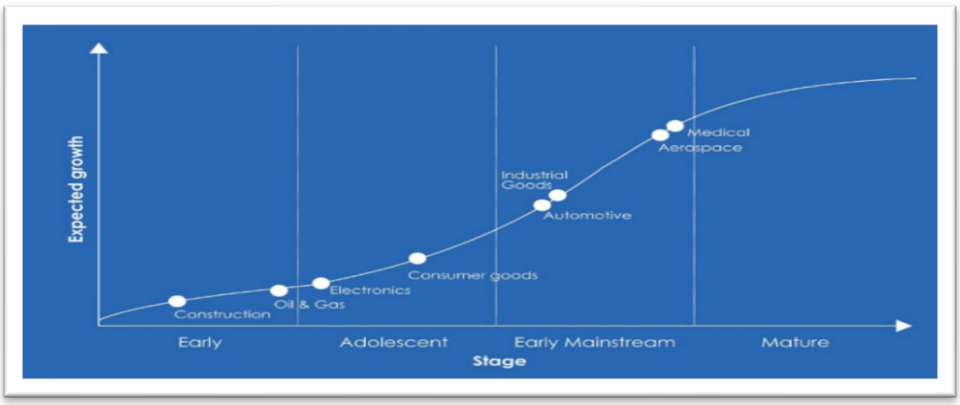
[17] Section 2(j) of the Food Safety and Standards Act, 2006.

5. Automative Industry – This industry is growing user of 3D printers. Companies like Porsche, BMW, Ford have started using this technology to 3D-printed body foam full-bucket seats, tooling equipment such as spare and replacement parts. This technology helps in faster product development, design flexibility and mass customisation. The automative 3D printers have been forecasted to grow by billions till 2025.
6. Industrial goods Industry – 3D printers technology aids in creating parts in short time period, with new design opportunities and provides on demand production. It can be used to create jigs and fixtures, spare parts, tooling etc.
7. Consumer goods – Consumer goods like footwear, eyewear, jewellery, midsoles, protypes are created by using 3D printers. It also helps in faster product development, variety of designs, mass customisation. Brands like Adidas, Nike, Reebok uses this technology.

In this way, 3D printers have capability to revolutionise various industries. And its adoption shows the watershed moment in the evolution of new age manufacturing and design.

Adoption Rate Statistics





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3D Printing and Intellectual Property Laws

To what extent does IP laws provide protection to the original work contained in CAD files against the infringement or unauthorised use by 3D printers?

Proper protection must be rendered to the Intellectual property right holders for their original work, i.e. in relation to 3D printing industry, proper protection rights must be given to the author of the original work to protect his original work in CAD files from being abused unauthorisedly by 3D printer user. Otherwise, the rights of the IP holders could be hampered. Let's look in detail how each IP would regulate CAD files.

a) **Copyright**

A copyright grants an exclusive right to the copyright holder to reproduce the work in any material form including storing it in the electronic medium[18].

As per the Copyright Act 1957, original literary, dramatic, artistic, cinematography, films, sound recordings are protected by copyright. But with the advent of 3D printing technology, anyone with access of 3D printer can scan a work that is protected by copyright and reproduce it without the original owner's consent which may lead to copyright violation. As above mentioned, copyright holder can reproduce the work in any material form be it storing in electronic medium. Thus, it means original work stored in CAD file is also protected as original literary or artistic work and copyright holder gets the right to protect digital copies of such work.

Thus, the major challenge that arises before the copyright holder is to regulate the unauthorised transfer of CAD files online.

[18] Section 14(c)(1) of the Copyright Act, 1957

To avoid unauthorised use by 3D printers, one way is to provide them with the license in respect of the CAD files along with restrictions imposed upon its use. This confers the exclusive right upon the copyright holders to provide license.

As a result, current Copyright Act is sufficient to protect the right of the copyright holder against unauthorised transmission of CAD files containing their artistic works.

Copyright even protects original works of authorship, including 3D printed objects designed using CAD software.

b) **Patent**

A patent confers the exclusive right to the patent holder to prevent third parties from carrying on the following acts in respect of the patented invention, over which the patent holder has exclusive rights: making, using, offering for sale, selling or importing[19].

Patent infringement is quite easier by 3D printers, as CAD files which contain information about Patented invention can be easily distributed over the internet and can be printed without the permission of the patent holder at many locations.

To avoid infringement, patent holders could either target those people who are aiding in transferring the CAD files over the internet or those websites which sell or share the CAD files.

As a result, Indian Patent Act is not so sufficient to protect the right of the patent holder against unauthorised transmission of CAD files containing their patented invention.

[19] Section 48 of the Patents Act, 1970

A patent may even protect an improvement in its 3D printing process. That is 3D printing technique is itself not patentable rather innovation if created using technique can be patented if it fulfils the criteria.

c) **Trademark**

Trademark registration confers the exclusive right to the registered proprietor to use the trademark in relation to goods or services in respect of which the trade mark is registered and to obtain relief in respect of infringement of the trade mark in the manner provided by this Act[20].

The function of the trademark is to an indication to the potential purchasers as to the manufacturer or the quality of goods or services[21]. CAD files may contain the digital version of holder's trademark and its unauthorised use can lead to either infringement or passing off of trademark.

For example, CAD file may contain sample of a famous NIKE shoe with its trademark Nike Swoosh. Now anyone with the access of this CAD file and 3D printer can easily print out the article having that trademark engraved on it thus, registered proprietor of that Trademark losing the reputation or goodwill associated with it. Even the secondary infringement under the trademarks act would be imposed upon the one who created the CAD file. Even 3D replica of trademark constitutes infringement as 3D shapes also comes within the purview of definition.

As a result, we need more stringent law with respect to protection of CAD files contains trademarks.

[20] Section 28 of the Trademarks Act, 1999

[21] Godfrey Phillips India Ltd. vs Girnar Food & Beverages Pvt. Ltd 1997 (2) Arb LR 559

What concerns does Intellectual property right holders have regarding the impact of 3D printing technology on their original works

a) **Infringement and piracy:** 3D printers make it easier to make duplicate protected designs and distribute them without authorisation. Online sharing of CAD files over the internet leads to without permission reproduction of IP protected items.

b) **Challenge in enforcement:** Since 3D printing can be done privately, even from a residence on a small scale, at multiple locations, thus tracking down infringement cases become difficult task. The worldwide reach of the internet and the ease with which the digital files can be exchanged across national boundaries also makes it a challenging task to enforce IP rights.

c) **Loss of reputation:** 3D printer users could easily modify the digital files and the end product could compromise in the quality which may not meet the quality standards of the original work; thus, this may harm the reputation of the original author.

d) **Economic loss:** Unauthorised 3D printing can lead to loss of sales and revenues. And intellectually skilled authors would need to face cheap and unfair competition from those who created counterfeit goods using 3D printing.

e) **Depletion of Brand's value:** Duplicate copies made by 3D printers could create confusion regarding the content and quality thus loss in brands value could take place.

Thus, there is a need for more stringent laws regarding the protection of IPs from 3D Printers to foster more innovations which would also encourage the authors to create more original work of their skills. Despite of these concerns, Intellectual property owners would have difficulty in targeting the manufacturers of 3D

printers as Supreme Court in one case gave decision[22] which exempted manufacturers of recording devices which devices had a legitimate purpose from copyright infringement.

User's perception about the ethical consideration of reproducing patented or copyrighted objects using 3D printing technologies

User's perception about the ethical consideration of reproducing patented or copyrighted objects using 3D printing technologies widely vary depending upon various factors:

1. Informed Users – Some users of 3DP are well aware about the IP laws in India and know the importance of protecting the IPs of others. Thus, they perceive the duplication or reproduction of the patented or copyrighted materials as unethical which may prejudice the efforts, skills and reputation of the authors.
2. Ignorant Users – Apart from abovementioned, there are certain users who does not have knowledge about IP laws or despite of having knowledge claims to be ignorant in respect of protecting the original work. And these people do not find it unethical to make duplication of original work.
3. On the basis of reproduction of IP protected work, certain mentality of people justifies the 3D printing by saying that if the 3D printed work is being used only for personal use it would amount to minimal range of infringement which is negligent ethical breach. While others thinks that whether it is minimal or maximal, exact reproduction of original work demoralises the authors to earn profit or goodwill from their own efforts.

[22] Sony Corp. of America v. Universal City Studios, Inc. (1984).

4. On the basis of innovation, certain people are of perception that 3D printing aids in altering or modifying the primary object thus, they might take IP laws as restrictive. But certain people believe that disrespecting the IP rights of authors undermines their hard work, incentives.

In this way, 3D printing technology had negative impact on innovation and creativity in product development and design.

What regulatory frameworks or policy interventions could be proposed to balance innovation with the protection of intellectual property rights in the context of 3D printing

After studying the application of 3D printing in various industries, infringement of IP rights due to 3D printers, there are certain proposals which could be looked upon in order to balance innovation with the protection of IPRs in the world of 3D printers:

1. Stricter enforcement is needed of existing patent, copyright, trademark and other IP laws in respect of the 3D printed products in order to ensure adequate protection to the IP protected objects.
2. Updating the provisions in the IP Acts which provides for the infringement. As with the advent of new technologies like 3D printers, stronger shield is required to protect the IPs from infringement.
3. Also, in order to protect certain 3D printed objects new categories or subcategories need to be added in the patent law.
4. Implementing digital rights management technologies for digital files used in 3D printing to prevent unauthorized copying and distribution.
5. Extending copyright protections to cover digital designs used in 3D printing, similar to those for music, films, and software.

6. Developing technologies for watermarking and tracking 3D printed objects to ensure authenticity and traceability.
7. Using blockchain technology to create records of design, ownership and transfer, providing a clear chain of custody for IP rights.
8. Promoting awareness and education regarding IP rights and responsibilities among creators, manufacturers, end users in 3D printing ecosystem.
9. Including and discussing specific provisions for 3D printing and IP in International trade agreements.
10. Developing industry standards and best practices for the use and distribution of 3D printing designs, including respecting IP rights.
11. Adopting Creative Commons licenses for 3D printing designs to specify the terms under which designs can be used, shared, and modified.
12. Encouraging open-source licenses for 3D printing designs, which can foster innovation while still providing creators with some level of control over their work.

Real life Projects of 3D printing technology[23]

1) In the year 2020, diamond ring made by the Imaginarium, a 3D printing service based in India. It created a ring with the most diamonds in it. The ring was moulded using CAD and its Mold was 3D printed. This was even recorded in Guinness world record. A Rapid Shape resin machine was used to

[23] https://www.3dnatives.com/en/what-is-the-state-of-3d-printing-in-india-020420245/#!

3D print the model of the ring. This shows that in jewellery sector, manufacturers are starting using 3D printing to create more complex and custom models[24].

2) In the year 2021, India's First 3D printed house was built at IIT Madras by Tavasta construction. The entire house was designed using software and was printed using 3D printing technology.
3) In the year 2022, In Ahmedabad, first 3D printed House for Indian Soldiers was constructed by Military Engineering Services (MES) by incorporating the latest 3D rapid construction technology. It is a disaster resilient structure complies with green building norms.
4) In the year 2023, it was reported that In Bengaluru, Larsen and Toubro (L&T) construction company is making World's First 3D printed post office. *"L&T Construction's primary focus for 3D printing technology includes affordable housing up to G+3 floors, villas, military barracks, and single-floor schools, post offices, and factories. We are actively seeking to expand our portfolio of 3D printed*

[24] The different sections of the ring in castable resin (Photo Credits: Imaginarium and Guinness World Records

structures in various sectors and are positioned well to capitalize on the benefits of this innovative technology." Said by M.V. Satish, the whole-time director and senior executive vice president of L&T.

5) In 2024, Nanavati Max Super Speciality hospital in Mumbai, opened a medical 3D printing laboratory, with which they aim to provide high precision surgeries. This 3D printing laboratory is equipped with printers which aids in creation of bone models which further improves the study of anatomy and complex pathologies.
6) Also, Researchers from IIT Madars in partnership with the ZorioX innovation labs, which is startup founded by dental surgeons in Chennai create 3D printed, metal face implants for patients suffering from black fungus disease in India.

Conclusion

As a result, we could say that 3D printing has both negative as well as positive impact upon the development & innovation in India. But yet due to certain amount of risk which is exposed to the IP protected objects, it becomes necessary to introduce significant amendments in the legal framework pertaining to IP rights. Thus, if we proactively deal with the growing technology of 3D printers in India then this could enable us to harness full potential of the 3D printers as well as safeguard the rights of the creators and inventors, which may further enable to us foster innovations along with taking benefit of new technologies like 3D printers.