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Protection of Patent Rights in the Age of 3D Printing

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3D Printing is a disruptive technology that has come to alter traditional supply chains by changing the process flow for the making of tangible goods. 3D printing has bridged both the gap between the tangible and the intangible and that between the producer and consumer, creating a new class of 'consumers'. With 3D printing has come great ease in infringing patent rights. It has also led to a change in manufacturing and supply chains and therefore disrupted the rules governing placement of liability. This work attempts to identify the specific effects of 3D printing on supply chains and ease of infringement, with a view to proffering ways in which the interests of innovators and consumers can be protected. It finds that since 3D printing has eroded the line between the tangible and the intangible, it is necessary to depart from the old legal tradition of hinging patent infringement liability on tangibility. There should at least be infringement liability for certain acts such as selling and offering to sell, done in relation to CAD files from which patented products are printed.

Keywords: 3D Printing, Supply Chain, Infringement, Patent Rights, Legal Protection, CAD, Active Inducement, Contributory Infringement, Digital Patent Infringement

Digital content invokes the idea of intellectual property like no other class of product. As a result of its nature and mode of transmission, the trade in digital content is more likely to involve infringement of intellectual property. This calls to mind the obligation placed on sellers not to sell goods encumbered by third-party rights. Such third-party rights include intellectual property rights. Owing to the fact that the practice of 3D printing necessarily requires digital files, a market has developed for the sale of such files. Some of these files infringe on existing patents. There is therefore a need to protect buyers of such files from law suits and liability, and also the interests of patentees. The choice to focus specifically on 3D printing here is justified by the fact that it is a highly novel and radical technology that alters existing paradigms in manufacturing, supply chains, and patterns of intellectual property rights infringement.

At the core of intellectual property law is the notion that creators need to be adequately compensated for their labours. The need for compensation is justified by both person-centred and broad societal interests. At the personal level, it is only just that individuals receive the due reward from their creative efforts. And at the societal level, it has been observed that in order for progress to be stimulated and sustained individuals who participate in progressive ventures must be incentivized. As regards scientific and technical inventions, patent rights were developed to reward inventors. For these inventors to enjoy the protection of patent rights, their work must be shown to be novel, inventive, and capable of industrial application.[1] Patent rights are usually granted for twenty years in Nigeria.[2] But in return for protection, grantees must make a disclosure of their invention in the register of patents to such an extent that would enable other skilled individuals replicate and improve on the patented invention when the patent expires. Anyone that manufactures, aids, or procures the manufacturing of a patented invention commits a crime. Illegal importation, offering for sale and sale of patented inventions is also prohibited.[3]

Usually, it is easy to trace the source of infringing goods by following the supply chain. For example, if a retailer sells in Lagos, goods that infringe upon the patent rights of a manufacturer in Nigeria, all that the relevant authorities would need to do is to backtrack on the supply chain to identify all actors, who would bear varying degrees of guilt depending on the point in the chain in which they participate in the infringement. However, with the emergence of 3D printing, traditional supply chains are disrupted in a way that produces a variety of scenarios. So, what is 3D printing? To offer a very basic explanation, 3D

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printing is the making of three-dimensional objects by means of a 3D printer in a manner which is to a certain general extent similar to the printing of documents. It is a process of making three dimensional solid objects from a digital file. The creation of a 3D printed object is achieved using additive processes where successive layers of material are laid down until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.[4] This process usually requires a computer-aided design (CAD) file, the material to be used for printing the object, and the printer itself. These printers could be of industrial size or those suitable for home use. The relationships involved in the whole process also vary. Thus, both the design and printing may emanate from the same source, or there may be a commercial printer offering printing services for a profit. Consumers may also do the actual printing by themselves. In a nutshell, there are different permutations that may play out as regards the chain of relationships.

The paper seeks to confront the difficulties raised by the disruptive effects of 3D printing on market chains. It attempts to determine the transactional relationships that emerge as a result of 3D printing. It also goes ahead to consider the choices available with regard to what activities should now be regarded as infringing a patent and what particular actors should be held responsible for those infringing activities. These considerations are influenced not only by the traditional legality or otherwise of actions but also by the possibility of enforcing prohibitions. The discourse is guided by questions like, what are the changes in supply chains resulting from 3D printing; in what manner have these changes given rise to new ways of infringing patents; and what are the reforms that must be made in patent law to bring it in tune with the imperatives of 3D printing?

Comparative Evaluation of Traditional Supply Chains and 3D Printing Supply Models

Supply chains built around conventional methods of manufacturing usually include a standard set of nodes whether the products involved are tangible or digital. While the form of products and mode of transfer might differ in the case of digital products, the chain of actors is not much different than with tangible goods. Thus, supply chains usually involved the manufacturer as the source, wholesalers, retailers, and end users. Connecting these actors are logistic operations that ensure movement of product from one stage in the distribution chain to another. The above is true even though a supply chain might miss one or two traditional links depending on the kind of business involved. Also, instead of physical transportation, there is digital transmission in the case of digital content. It is with regard to digital content not captured in any physical carrier medium that there is considerable departure from the traditional supply chain, as there may in this case be direct delivery to end users.[5] This distinction is seen in the two definitions of digital supply chain. The first definition describes digital supply chain as the digital aspect of a traditional supply chain. This definition is usually used when discussing how the development and implementation of advanced digital technologies can drive improvements to traditional supply chains.[6] The second definition of digital supply chain says that a digital supply chain is the chain of technology companies involved in the delivery of digital products.[6] 3D printing while embodying digital supply chain processes, especially those concerned with the second definition, goes further to bridge the gap between the tangible and digital not just in terms of the delivery process but the product itself.

With 3D printing, a whole different and diverse set of scenarios are introduced. It has been observed that 3D printing has many implications for supply chains such as regarding supply chain sustainability, production flexibility, transportation costs, lead times, inventory, product quality and reliability, productivity and economies of scale, new business models, opportunities for new suppliers, customer engagement, distribution of manufacturing, and type of manufacturing operations.[7] Michael Ryan *et al* focus on the three areas of customer engagement, manufacturing distribution, and type of operation. They identify 3D printing scenarios mentioned in the literature and use the scenario planning approach to identify 'white spaces' where new scenarios could be built. As regards customer engagement, the authors make use of order penetration point (OPP) to classify different stages of customer involvement. OPP refers to the point at which the features of a product become defined. From a customer engagement perspective this represents the point at which the manufacturer-customer interaction crystallizes into an agreed product configuration.[7] The authors identify six OPP's: engineer-to-order,[8] buy-to-order,[9] make-to-order,[10] assemble-to-order,[11] make-to-stock,[12] and ship-to-stock.[13] Scenarios not falling within these OPP's are regarded as unknown and novel. As 3D

printing enables greater customization and flexibility, there is a preponderance of 3D printing scenarios that fall under engineer-to-order, buy-to-order, and make-to-order.

Concerning distribution of manufacturing, five thresholds are identified: personal, local, regional, national, and mobile. These thresholds have to do with the closeness of manufacturing to the end user. In the 3D printing context where even individuals may own 3D printers, personal and local manufacturing become commonplace and rampant. Depending on the type of operations, 3D printing may also be employed in regional and national operations. But a very unique possibility brought about by 3D printing is mobile manufacturing. This area is identified as a white space where further research is required.[14]

Finally, concerning the type of operation, three modes are identified: craft, job shop, and factory. Craft manufacturing is done at an artisanal scale with the equipment usually operated by the end user. Similar to craft-level manufacturing, job shops involve low-volume manufacturing, but in this case, production is higher and caters to customers. Higher quality equipment, expertise, and a higher number of machines, are a feature of job shops, which bring together a number of skills. Lastly, factory manufacturing is industrial in scale and involves specialised equipment. It requires less expertise since the process is usually standardized resulting in a routine.[15]

Viewed from the angle of patent rights, the combination of higher-level OPP such as engineer-to-order, and personal, artisanal production made possible by 3D printing, increases the ease and likelihood of patent infringement. And in addition to ease of infringement, the dynamics of infringement are also changed. Different from conventional infringement where the manufacturer of infringing goods bears primary responsibility and such responsibility trickles down the distribution chain, in a 3D printing scenario, there are very many probable relationship chains which call for a careful consideration of how liability rules should look like. For example, should the maker of the design, or end user/producer of an infringing item, the producer of the 3D printer, or the maker of the CAD file be liable? Further yet, should liability extend to print shops in cases where their services are hired? What if designs are shared freely on a peer-to-peer site? Added to all these is the possibility that the origin of designs might be unknown. Assuming that the personal locus of alleged infringement has been determined, what should be the criteria for determining whether the activity involved is actionable? These questions should be answered bearing in mind that apart from 3D printers, there are 3D scanners that have the capability to scan patented objects into design files for subsequent printing. Therefore, the question of enforceability should also play a key role in fixing the boundaries of liability with regard to a technology that promises to trigger intense proliferation of personal and small-scale manufacturing.

Patent Infringement in the Context of 3D Printing

Similar to the manner in which the digital revolution threatened and continues to challenge the copyright system, digital manufacturing technology (DMT), which encompasses both 3D printing as already defined in this work and biochemical molecular manufacturing, has come to question the suitability of current patent regimes. As with other disruptive technologies, there are two main options in the legal regulation of 3D printing as it relates to patents: to apply existing laws by purposive interpretation, accompanied by statutory amendments where necessary, or to make radical reforms to the existing law, often with the enactment of new statutes.

Under existing patent laws, a patent may be infringed either directly or indirectly. Of course, a direct infringer would include someone who makes a patented item or applies a patented process. Infringement may also occur where there is selling, offering to sell, or importation of a patented product. There are two types of indirect infringement under United States law; induced and contributory infringement.[16] The Patents and Designs Act applicable in Nigeria does not expressly make a distinction between direct and indirect infringement but merely states what would amount to infringement. Section 6(1) provides that making, importation, sale, use or stocking for sale or use constitute infringement. As regards process patents, making use of the process or making, importation, sale, use or stocking for sale or use, of a product resulting from the protected process, would amount to infringement. It is submitted however that the above criteria cover both cases of direct and indirect infringement. In trying to apply the existing patent regime to 3D printing, the choice is between relying on direct infringement or indirect infringement.

Infringement through Actual Printing of Patented Products

Direct Infringement

Provision for liability by direct infringement is made in Section 271(a) of the Patents Act of 1952 applicable in the United States. This includes unauthorized making, importing, selling, and offering for sale of a patented invention. The determination of direct liability for infringement of patents in the context of 3D printing is less problematic where the contention is centred on the actual activity of printing a protected product with a 3D printer. This is the natural course that comes to mind when direct liability is discussed because patent law does not contemplate infringement except in relation to a tangible representation of a patent. Hinging a claim on the physical printed product would usually result in towing the direct infringement path, since the act of printing can only be regarded as direct infringement. However, there are reasons why right owners may choose not to act against direct infringers. First of all, there is the diffuse nature of patent infringement owing to the ease in transferring CAD files and the highly decentralised nature of printing activity, even extending to personal manufacturing. Secondly, since 3D printing enables personal manufacturing by end users, right owners may be dealing with persons, who apart from the possibility of printing the product, are conventional purchasers. Because such persons may still purchase the product in question from the normal source, right owners might be wary of offending them. Right owners experienced such internal inhibition with regard to downloaders of music files. Eventually, however, some actions were brought against downloaders.[17]

As has already been mentioned, patent law does not contemplate infringement except through a tangible violating item. This means that even indirect liability has to be connected to the physical incarnation of the protected item. Thus, both indirect infringement through active inducement and contributory infringement, provided for in Sections 271(b) and 271(c) respectively, necessarily have to be linked to some physical item.

Active Inducement

There are three ingredients to active inducement: (i) there must have been direct infringement (ii) there must have been specific intent to induce a third party to infringe the patent in question, and (iii) an affirmative act by the inducer. There are again difficulties associated with these preconditions. The direct infringement requirement means that claimants would have to meticulously trace incidences of CAD file download. In addition, they would have to prove that these files were, as a matter of fact, printed. This would occasion much difficulty and cost. Secondly, the specific intent requirement implies that the defendant must have actual knowledge of the patent in question or must have demonstrated wilful blindness to its existence.[18] Apart from generally imposing a stringent standard, this requirement is especially problematic considering the fact that 3D printing enables the involvement of laymen, who are most likely to be ignorant of patent law, in manufacturing. Most times, these laymen would not be aware of the existence of patents themselves, nor seek legal counsel in that regard. They would therefore have a defence against a claim of active inducement of patent infringement. The law is such that even if a product is marked with a patent number, the defendant would not be liable if they did not take note of the patent number.[19] Where the defendant has actual notice of the patent, they may still escape liability if they acted on a good faith belief that the patent is invalid or that their product does not infringe the existing patent.[19] Legal counsel to the effect that a product does not infringe an existing patent would definitely meet the good faith standard. But the question that remains is what would constitute good faith in the absence of legal counsel; is the test objective or subjective? The answer to this question is not generally clear, except in the case of wilful blindness where the test is subjective, requiring that the alleged infringer first have a subjective belief that there is a high probability of infringement.[20] However, with regard to the cognate area of wilful infringement, the United States Supreme Court has stated that a defendant's subjective view would not negate intent.[21] To prove wilful infringement, a claimant must show that the defendant acted despite an objectively high likelihood that their action would amount to infringement, and that such objectively defined likelihood, usually determined from the record developed in the proceedings, was known or should have been known, to the defendant. For the good faith belief exception to apply here, it must be based on legal counsel, hence an element of objectivity. If this approach is adopted with regard to active inducement in general, then the test of intent would have incorporated some measure of objectivity.[22]

Concerning the condition that alleged infringers must have taken affirmative steps to induce infringement, what 'affirmative step' means is not yet

clear. Would it suffice that a defendant transferred CAD files, or must they have done some additional act?[23] It is submitted here that transfer of CAD files or any other act done to facilitate transfer of files should suffice.

Contributory Infringement

Under the principle of contributory infringement, a patent is breached when there is sale, an offer to sell, or importation of a component of a patented invention.[24] The question is whether a CAD file can be considered a component of a patented product. The answer would seem to be a no under prevailing jurisprudence. Another challenge to the application of contributory infringement is the fact that CAD files might not actually be offered for sale or actually sold but distributed free, meaning that the defendant could escape liability for having not engaged in commercial distribution.

As a result of the evidential burdens and other shortcomings associated with relying on active inducement and contributory infringement, it has been suggested that an exception be made in the case of 3D printing and infringement liability be allowed based on the CAD files from which 3D printers may manufacture patented products.[25]

Infringement through CAD Files (Digital Patent Infringement)

Considering infringement from the perspective of CAD files, a pertinent question to ask is under what category of infringement can a patent owner make a claim; direct or indirect? Patent law is different from copyright law which regards copies of copyrighted works stored in a soft form as essentially the same as the hard copy.[26] More fundamentally, copyright prohibits the act of unauthorized copying itself as opposed to patent which only prohibits unauthorized making, selling, offering to sell, and importation. Patent law does not contemplate tangible objects having soft counterparts. Even process patents are breached not by the conception of an identical process but by its application in a tangible context. Thus, since CAD files are not tangible, their mere existence cannot ground a claim for direct infringement in patent law, an aspect of the law which is founded on matter. However, because of how 3D printing technology has eroded the line between the tangible and intangible, as a physical product is only one push of a button away from the digital file, it has been suggested that it should be possible to ground a claim of direct infringement on the creation of CAD files alone. This would be equivalent to making a patented invention. Nevertheless, because of the effects that a policy of grounding direct infringement on CAD files might occasion, it has been counselled that careful consideration of its possible corollaries be made. Specifically, it has been observed that such a policy may lead to an unprecedented level of liability among lay people and also inhibit follow-on innovation. Consequently, a more practicable option might be to base digital infringement through CAD files on the acts of importing, selling and offering to sell a patented invention.[27]

The Case for Digital Patent Infringement

As a result of the limitations associated with founding infringement on tangibility, it has been suggested that the scope of infringement be extended to include the making, offering to sell, sale, and importation of CAD files.[25] As has been mentioned earlier, patent infringement liability is largely hinged on tangibility. This is certainly true for tangible products, even though the tangibility requirement no longer applies to some cases such as in process patents under abbreviated new drug application (ANDA) litigation in the United States. However, it has been contended that unauthorized creation or transfer of digital copies should be able to ground a claim for infringement even as regards tangible items. This is because with the combination of digital files and 3D printers, the line between the intangible and tangible has been largely eroded. It has been explained that patent infringement liability for tangible items could be imputed based on two justifications; unauthorized production of the tangible replica and unauthorized appropriation of the economic value. Flowing from this it has been argued, the infringing actions of making, using, selling, offering to sell, and importing could be divided into those that infringe the physical item and those that unduly appropriate the associated economic value. While making, using and importation amount to physical appropriation of the patent, selling and offering to sell amount to appropriation of the associated economic value.[28] This line of thinking was applied in *Transocean Offshore Deepwater Drilling Inc*. v *Maersk Contractors USA Inc*.[29] In that case Maersk put forward an offer to sell an oil rig, which was accepted. Even though the oil rig actually supplied under the contract did not infringe the patent

subject of this case, it was held that the diagrams that had been presented by Maersk infringed the patent. The court reasoned that the:[30]

…underlying purpose of holding someone who offers to sell liable for infringement is to prevent 'generating interest in a potential infringing product to the commercial detriment of the rightful patentee'.[31]

The arguments of the defendants in *Transocean*, that 'the entire apparatus must have been constructed and ready for use in order to have been sold', was rejected by the court.[32] The fact that commercial exploitation of a patent can be distinguished from its physical appropriation has been demonstrated by the United States Supreme Court in relation to the on-sale bar contained in the Patent Act of 1952. Under the on-sale bar provisions of the 1952 Patent Act, a patent applicant is barred from obtaining a patent if they offered to sell the invention more than one year prior to filing the application.[33] Flowing from this, the United States Supreme Court was of the opinion that to be on-sale, the invention need not be physically built, but that diagrams and other descriptions that would enable a person of ordinary skill in the relevant field to build the device are sufficient.[34] Therefore, the selling and offering for sale of CAD files should constitute direct digital infringement under this line of reasoning. However, because offering for sale and sale does not cover cases of free sharing of CAD files, the protection that would result would remain limited.

Apart from selling and offering for sale, it has been opined that as a result of the erosion of the divide between the tangible and intangible by 3D printing technology, infringement by making which would ordinarily require a physical version of the patented invention like any other infringement claim, should now extend to cases of creation of CAD files. This is because of the fact, among others, that liability grounded on offering to sell or sale would not cover cases of free sharing. Free sharing however poses a greater threat to patents than both commercial sale of CAD files and physical manufacturing of patented items.[35] Whether or not making of CAD files should amount to making a patented invention has been subjected to an analogy involving CAD files and the traditional process of manufacturing tangible projects. Under the analogy, it is explained that traditional manufacturing involved a spectrum of activities that ranged from blueprints through moulds and unassembled parts, to the finished product. Comparisons are then made between blueprints, moulds and unassembled parts on the one hand, and CAD files on the other hand. Questions are asked whether CAD files are analogous to blueprints, moulds and unassembled parts and whether these are regarded as being equivalent to the finished product under traditional manufacturing practice in relation to patent law. It is agreed that blueprints have never been regarded as being the same as the patented invention. Also, while moulds move closer to the finished product, especially where the product is one that may be completely manufactured by a moulding process, because of the high financial and scientific cost of production, as well as the fact that very few products can be manufactured entirely by moulds, it is opined that moulds also do not amount to making of an invention. Concerning unassembled parts of an invention, there could be a situation where all parts required to assemble an invention have been made but not yet put together although this is not always the case. The question is whether a complete set of unassembled parts is equivalent to the completed product. In *Paper Converting Machine Co*. v *Magna-Graphics Corp*[36] the defendant who had the unassembled parts of an invention assembled them after the expiration of the patent. Prior to assembling the parts, the defendant had tested the different parts in isolation. The actual assembling was done two days after the expiration of the patent. The Court decided that there was infringement. Even though this decision has since been marginalized, it demonstrates that the making of a complete set of unassembled parts of a patented invention does constitute infringement in the eyes of some. Nevertheless, while unassembled parts are tangible CAD files are intangible. However, because of the faded line between both classes, it has been contended that it might be best to regard CAD files as equivalent to their physical counterparts.[37]

Another justification has been provided for extending direct infringement liability to cover CAD files. This is the doctrine of equivalence. By this doctrine, the 'scope of a patent is not limited to its literal terms but instead embraces all equivalents to the claims described'.[38] This doctrine helps to protect patented inventions against subsequent developments that are nevertheless substantially the same as the patented one. The application of the doctrine is a question of fact and there is no generic formula for implementing the doctrine. There are however some

key tests usually applied by the courts in the United States. One of such is the insubstantial difference test. Under this test, the court inquires whether there is a substantial difference between a patent and a new development. Another test often applied is the triple identity test under which the court will ask whether the new invention performs substantially the same function in substantially the same way to achieve substantially the same result. In addition to these two tests, courts also consider the interchangeability of the limitation mentioned in the patent and the subsequent development. As regards CAD files, it has been observed that courts could apply the doctrine of equivalence by comparing the limitations in patent claims to elements of the physical items that would result from CAD files.[39]

Generally, one has to consider the effect of the decision whether or not to expand the scope of infringement liability to include CAD files. For instance, the major reason for patent protection is to incentivize innovation, and as such it may be argued that leaving innovators without protection from imitation through creation and distribution of CAD files may dampen their motivation. On the other hand, 3D printing promises to reduce production and transportation costs. This means that the incentive for patents might be greatly eroded and rather than increasing the extent of patent protection, there might actually be a need to narrow the level of protection. Either way, there is a need to re-evaluate patent systems in the light of 3D printing. This re-evaluation would need to be done selectively, making specific adjustments for impacted industries as 3D printing would likely have disparate impact on different industries.[40]

Another possible effect of extending patent infringement liability to include the creation, use and transfer of CAD files is increased liability of individuals. Where individuals are increasingly held liable for infringement, there may be a backlash against the patent system which may result in massive defiant infringement and the widespread use of avoidance technologies. This concern is given more credence when one considers the fact that patents are usually written in technical language that is not clear to the ordinary individual. A possible solution would be to exempt individuals from liability for patent infringement through CAD files. This would however protect intentional offenders as well. A better option therefore would seem to be an arrangement where liability is limited to commercial appropriation with culpability as opposed to a strict liability regime that extends to all individuals. However, in deciding the standard for measuring culpability, care should be taken not to place too much evidential burden on either the patent holders or defendants. An alternative to exempting individuals from liability altogether, or holding only commercial infringers with culpability liable, is to consider mitigating factors in the award of remedies while still retaining a general coverage in terms of liability.[41]

Digital patent infringement liability also promises to increase the instances where intermediaries like websites that host CAD files are held liable. In order to avoid multiple liabilities with attendant costs in damages, such intermediaries might be forced to shut down. In order to prevent this, it has been suggested that a notice-and-take-down mechanism be applied, even though this is likely to either result in additional cost of evaluating infringement notices or a situation where intermediaries seeking to avoid the cost of such evaluation take down CAD files subject of any infringement claim, thereby hindering the free sharing of legitimate CAD files.[42]

There are also concerns with extending patent infringement liability to CAD files in relation to the need to sustain follow-on innovation. By design, patents are meant not only to ensure exclusive exploitation by the innovator, but also to guarantee further innovation by requiring that inventors make such disclosure of their invention that would enable others to make improvements to them. Research geared at improving on existing patents usually involves the process of computer modelling, since the physical replication of patents would amount to infringement. However, regarding the creation of CAD files as amounting to infringement would limit the ability of researchers to improve on patents through computer modelling. It is therefore preferable to either exclude the creation of CAD files for research purposes from the ambit of liability arising from creation of CAD files, or not regard the creation of CAD files as an infringing activity.[43] It is submitted here that the former seems to be the better option.

Concerning copyright protection for CAD files, it has been suggested that while CAD files may be eligible for protection, the extent of protection would in practical terms be limited to cases where those files represent a creative expression of an idea. This is because copyright does not protect ideas *perse* but

creative expression of ideas. Thus, where a CAD file merely denotes an already known invention in the form of computer code, protection will likely not be available. This is exactly the case with copyright protection for computer software. In addition, or alternatively, CAD files may be protected as pictorial, graphic, or sculptural works. However, the fact that a CAD file is copyright-protected would not prevent others from creating a CAD file of the same kind of item. This is because any copyright would be limited to the file and not the related class of physical item.[44]

Conclusion

To the extent that this research is concerned with creating a legal regime for regulating trade in digital content and implicates the terms implied in a sale, the discourse on 3D printing is relevant in that CAD files may be infringing on other CAD files or on existing patents if they are used to make physical products. Even where CAD files are acquired from a person who habitually deals in such files, they may still result in infringing products when printed. For this reason, it is counselled that a requirement similar to the one in sale of goods, that goods be free from third-party encumbrances, be made applicable to digital content in the context of 3D printing and CAD files. This is necessary in order to protect the interests of innovators and the viability of the economy. It would also protect buyers from unwanted law suits.

It has been seen that the distinctions contained in the Patent Act, 1952 applicable in the United States concerning infringement have not been made in the PDA applicable in Nigeria. This has deprived our jurisprudence the benefit of the analyses that flow therefrom, such as the elaborate discussions that have been made in the United States concerning the effect of 3D printing on patent infringement liability and enforcement. As a matter of fact, the topic of 3D printing and its possible effect on patent law has not been giving proper attention in Nigeria. This ought not to be so, and it is counselled here that a comprehensive re-evaluation of the patent system be done and necessary reforms made. These reforms should cut across all implicated frameworks and institutions.

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9 This is usually used when there is no desire to keep inventory and might embody make-to-order where it involves customization.

10 Make to order (MTO), or made to order, is a business production strategy that typically allows consumers to purchase products that are customized to their specifications. It is a manufacturing process in which the production of an item begins only after a confirmed customer order is received. It is also known asmass customization. Hayes A, Make to Order (MTO), *Investopedia* https://www.investopedia.com/ terms/m/make-to-order.asp (accessed on 13 November 2019).

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