**THE CONVERGENCE OF BIOTECHNOLOGY, NANOTECHNOLOGY, INFORMATION TECHNOLOGY**

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**Abstract**

The convergence of Technology leads to miracles. Miracles, the humankind has never imagined and it is only a start-up element for the infinite development that is to be achieved. We would like to consider the view of our Hon’ble 14th Prime Minister of India, Shri Narendra Modi, who has said that “Convergence of Technology is important. One people, one mission and one nation.”

With a broader view of the capability of technology, it is also something that the Former President of India, Dr. A.P.J. Abdul Kalam has considered and stated wherein he said that “I saw how two different sciences are shaping each other without any iron curtain between the technologists. This reciprocating contribution of sciences to one another is going to shape our future and industry needs to be ready for it.”

Definitely, this is something that the industry and the future of mankind need to be ready for, but the vital essence of our paper today deals with the aspect of the Legal Environment which has been provided for the convergence of technology, especially biotechnology, nanotechnology and information technology. The aim of this paper is to understand the essence of services that these technologies do provide, wherein it is necessary to remind ourselves, that at the end of the evening, technology is for ease of living for humans.

This paper also concentrates on the aspects of various provisions and enactments which are existing in India and the interpretation of various Courts on Landmark Case Laws in India which provides us with a wholesome view of the extent of such facts which determine whether the laws in India are friendly or open towards this convergence of Biotechnology, Nano-technology and Information technology.

To rule this out in further contexts of this paper, we will try to establish the convergence of technologies.

**INTRODUCTION**

Today, we would like to research various aspects of the convergence of Biotechnology, Nanotechnology and Information Technology wherein we will be discussing aspects like the basics of these technologies. Many Great Scientists such as Dr. Abdul Kalam have discussed outcomes like the convergence of the three core technologies which are bio, nano and information technology.

He has stated “I saw how two different sciences are shaping each other without any iron curtain between the technologists. This reciprocating contribution of sciences to one another is going to shape our future and industry needs to be ready for it.”[[1]](#footnote-1) Dr. Kalam has perceived the convergence of multiple technologies in the year 2012 itself. Technology is rapid as thin air which develops constantly with the advancement of mixed economies and technological markets like India.

Never have we imagined, that we would live in a virtual society where people meet through technology, and communicate through technology which has led to an ameliorated amount of development wherein every day is like an open window of development for the technology of any kind from an app to the major user interface wherein it is the direct product of the imagination that our mind enlightens or possibly hits on us.

For the Gen Z, it is impossible for them to use the computer with older software, owing to the reason of its pure interface. Never have we imagined that we would be able to identify a plant's feelings such as its necessity for water, sunlight to initiate photosynthesis is imminent.[[2]](#footnote-2) Maybe it is more of a “Necessity” than the feelings of the plant and maybe we can progress tomorrow is such a manner where we can really be able to understand its feelings through Neural Machine Learning.

Real deal and according to us, the magic figure would still then be the point of convergence. For example, is Google Tulip a scientific product of Nanotechnology? Certainly we can determine that it is information technology or there exists a minor element of information technology because it outsources data through the existing technology to an external product from the tulip or any other flower to which it is compatible to.

At this juncture of thought, one might add that user data is the new element with those features of a chameleon in the oceanic concept of information technology. As Ed Snowden has time and again stated about the importance of data privacy, it comes to our knowledge that data is another element of information technology and therefore, we can scientifically, till this chain of thought, say that google tulip is a converged product of biotechnology and information technology.

**CONVERGENCE OF CORE TECHNOLOGIES: BROADER VIEWS**

The curious case of Nanotechnology is that it is microscopic wherein when we try to see the convergence as a whole in the product, we could see it, for example, biotechnology is transfused into data generated to the google product, thereby introducing information technology, but could you consider the molecular activity under the roots of the tulip plant as nanotechnology?

Wherein it is an axiom that technology by and large in itself is artificial (man-made) whereas what happens at the roots of a tulip plant is something that has to do with the natural process in a living being such as a plant. So, we would like to introduce briefly what biotechnology and nanotechnology are in order to make the point of convergence easier to understand. Biotechnology is something which grows as an evolutionary technology with the help of biology.

Nanotechnology is such a scenario wherein the molecular activity of atoms and microscopic particles creates a whole new level segment of a technology. So, we would like to throw in another factor of neurosciences or neuro-technology in relation to the convergence of the three core technologies. Firstly, to understand biotechnology, this is a flexible concept which has the dynamics to evolve into almost all the industries.

Biotechnology can merge with Information Technology via the technological concept of Neural Machine Translation as we have observed before in the product of Google Tulip.[[3]](#footnote-3) Biotechnology can also been seen individually in various food productions, Therapeutic processes such as DNA Fingerprinting, and its elements can be observed in various medicines and pharmaceutical products.[[4]](#footnote-4)

In other words or interpretation, we can also analyse that Biotechnology is a combination of application of various microscopic organisms, cells and their molecular activity and some engineering sciences to give a final output in terms of a product or a service.[[5]](#footnote-5) The father of Biotechnology, Karl Ereky, a Hungarian Agricultural Engineer has coined the term “Biotechnology” and he has envisaged a vast exposure of utility with this concept of biotechnology.[[6]](#footnote-6)

This has led to a greater expansion in the field of biology due to his exemplary vision with regards to the convergence of technology and biology. A lot of development also took place in the concept of genetic engineering in the late 1970s owing to the invention of this magnificent concept which has brought a vast development in the health sector.[[7]](#footnote-7) Therefore, we would be coming to the discussion in answer to the above questions such as, on a broader note, did the convergence already happen?

To which, we can observe that the products such as Google Tulip may definitely come under the ambit of a converged concept, though legally, the identity of the product is yet to be understood under the IP (Intellectual Property) Laws and legal framework of India. But, on the technology note, we could actually bring it up under the aspect of convergence wherein with a general knowledge, we could clearly understand the fact that Neural Machine Translation requires some Nano technology parts such as sensors to be placed at some vital parts of the Tulip plant in order to ascertain the flow of information.

These vital parts of the plant are in such a method wherein information can be clearly converted into a more comprehendible manner or form, such as an external computer or tablets where a human could understand in this case. The application of a the cell or the molecular activity in the plant at this given stage and can be observed in the transfusion of data via these sensors to the software which can apply Neural Machine Translation which gives the output in the form of a natural language such as “I need more sunlight” etc.[[8]](#footnote-8)

Therefore, it has been adequately established that the product of Google Tulip is a nascent product wherein convergence can be observed as a prototype. Perhaps, it would be wiser to also observe the newest technology to actually determine if there is even an ounce of convergence in it or not. The greater examples can be Neuralink, which has been developed by Neuralink Corporation, a neuro-technology company.

To be precise, this company actually develops new implantable brain-machine interfaces which can be, theoretically, implanted in a human’s mind to actually let him/her browse through instantly with the associated thoughts in their mind.[[9]](#footnote-9) The implant wire itself would be tiny in size, precisely in the size of a strand of hair, which can enable itself to transmit data from a human mind to any connected computer or smart device.[[10]](#footnote-10)

At this juncture of context, we would further add that this project as a prototype has succeeded in the year of 2006 wherein a person who has been implanted with a BMI (Brain-Machine Interface) has played Pong on his phone just through his thoughts, although it took him nearly 4 days to practice the basic moves in that game.[[11]](#footnote-11)Something that can be learnt from the above examples would be that convergence of the three technologies, fundamentally, is possible, with some additional sub-variants of technologies such as neuro-technology or neurosciences.

However, before we move to the legal framework of Intellectual Property which brings these innovative technologies in their ambit, it is essential for us to understand that there are several improvements too which should be considered for many of the converged products wherein, for example, if we take Google Tulip, it has become difficult for google to establish the essential bandwidth to actually obtain data which has been given by a group of plants combined together.[[12]](#footnote-12)

Maybe the patent can be granted for an individual plant but we really don’t think the objective has been achieved from the viewpoint of Google in this scenario. When we consider, Neuralink, we opine that it is the best product to achieve convergence. Having said that, there are many social, ethical and legal ramifications to be considered when the Company is going towards this approach of creating a product.[[13]](#footnote-13)

By these very solid real time products we are directed to understand that convergence between the three core technologies is truly possible and the idea of convergence does have an optimistic impact on the society. But as stated above, are the products able to meet the current social and ethical standards of the market demands? To which we would be further substantiating this angle of the paper in the further contexts.

**DISCRETE DISADVANTAGES OF THE OUTCOMES OF CONVERGED PRODUCTS FROM THE CORE TECHNOLOGIES**

We would like to state a few disadvantages of the current converged products from the three core technologies having established that convergence is possible. We would also like to explain the Legal hurdles which are faced by the products for Intellectual Property Rights under independent technologies such as information technology, biotechnology and nanotechnology to understand the larger issue in a later context.

At the forefront, it actually appeared as an optimistic approach that convergence is possible. Indeed, convergence is, but the legal framework is something that this paper aspires to work upon and also till now we have discussed the products to be rolled out in the market to assess the level of a legal framework to be developed or executed in India specifically. The core disadvantages of neuralink can be observed in the nature of its vulnerability.[[14]](#footnote-14)

Critically speaking, the issue is not with the analysis of the brain data compiled together through a chip installed for the integration of the brain as such, but the actually writing of the algorithm or the computer program in our brain for the adequate functioning through the given data which is impossible owing to the fact the Brain is an organic thing unlike a computer hard drive in which the code to execute can be written for the proper functioning of a computer.[[15]](#footnote-15)

Also, to understand another fundamental problem behind such type of products such as writing information into the brain, Deep Brain stimulation technology has been experimented for quite a long time over the treatment of various diseases, such as, Parkinson’s disease, however, we are still unable to realise the actual mechanism behind the deep brain stimulation which leads us to come to an approach that Neuralink may not be an actual successful product.[[16]](#footnote-16)

Another factor to take into consideration is that there are no definitive solutions for the existence of certain feelings of human beings such as depression or anxiety which is unique for every individual and might not be under a generalised mechanism which can be adequately covered by the Neuralink.[[17]](#footnote-17) Therefore, in the further contexts of this paper, we would like to move on to the Legal Hurdles of the products which are independently invented under these core technologies and then we would briefly relate them to convergence if there is minimal scope of the legal framework for converged products of information technology, biotechnology and nanotechnology.

**LEGAL FRAMEWORK FOR THE COMBINATION OF NANOTECHNOLOGY AND BIOTECHNOLOGY IN INDIA**

Primarily, it is important for us to understand the existing legal framework in the country for dual-combined technologies such as nano-biotechnology in order to ascertain the legal framework to be established or executed and interpreted for a converged product with core technologies. Nano-biotechnology is a combination of biotechnology and nanotechnology which has been a technology of rapid growth currently and it also has the ability to acquire the larger shares of the agricultural market in the future.

Correspondingly, for every new nano-biotechnology invention, there comes a need for protection of the invention through the instruments of IPR such as Patents. There are many challenges highlighted in this paper regarding the grants of patents for the newer and emerging products of nano-biotechnology. One of the major problems that we can face once after granting a patent to a nano-biotechnological product is that it poses various problems with its inherent multi-disciplinary character as we have observed in Google Tulips, Broader Claims regarding the product.[[18]](#footnote-18)

Another problem which we were able to observe was that the products which were created through nano-biotechnology were unable to fulfil the patentability criteria for novelty, non-obviousness and also industrial application.[[19]](#footnote-19) Also, there is no standardized terminology even in the science community for the products invented through nano-biotechnology which makes it even more difficult for patenting a product and identifying nano-bio patents.[[20]](#footnote-20)

However, coming to the aspect of novelty in the case of nano-biotechnology, it can be substantially observed in the reduction of the size of a nano particle. The word “Nano” encompasses the inventions of 100nm in size or smaller than that. Major beneficiaries of these types of technologies are pharmaceutical industry wherein this technology is used in the industry for research based on drug targeting.[[21]](#footnote-21)

Furthermore, brighter examples of the application of nano-biotechnology can be observed in nano syringes which are specifically used for the drug release and injection of the substance in the cell and nano-engineered prosthetics enhance the biocompatibility of artificial bones.[[22]](#footnote-22) Nanocrystals can be tagged to DNA (Deoxyribonucleic Acid) which might also be useful for identification of a specific DNA of an individual.[[23]](#footnote-23)

Now, we can also use these kinds of procedure for the advancement of the concept of DNA Profiling which is still possible. There are many Landmark Case Laws if we can actually observe by analysis the amount of utility we can get from the products of nano-biotechnology. When we see the Landmark Case of ***Inspector of Police v. John David*** before the Hon’ble Madras High Court, the facts of the case were such that a murder has taken place and the corpse of the victim has been dissected into several parts wherein the accused has hidden each parts separately.[[24]](#footnote-24)

The police were able to find all the parts of the victim accurately by purely depending on the DNA test via the procedure of DNA Profiling without which it would have probably been an insolvable case.[[25]](#footnote-25) Another such Landmark Case Law which has been before the Hon’ble Madras High Court was ***Sushil Mandal v. The State*** wherein the Hon’ble Madras High Court has taken a judicial notice of a test of DNA Profiling and has established in Para 17 of its judgment stating thus:-

“We take judicial notice of the fact that DNA profiling begets 99.99% accurate results which has prompted the Supreme Court also to say that it will even dislodge the presumption under ***Section 112 of the Evidence Act***.”[[26]](#footnote-26)

Stating the above-mentioned, the Hon’ble Madras High Court has also referred to the Supreme Court Judgement in the Landmark Case Law “***Nandlal Wasudeo Badwaik v. Lata Nandlal Badwaik & Anr***” wherein this concept of DNA Profiling and the accuracy of the test has been explained in detail. What we wanted to convey through various above-mentioned Landmark Case Laws like this is that we need to essentially get 100% results, not only in the area of forensic sciences but in every scope of subject that this type of nano-biotechnology touches and Nanocrystals might still play a greater role in it.

Coming to the Legal Framework of such rapidly improving nano-biotechnology, we can analyse the World Trade Organization’s Trade-Related Intellectual Property Rights Agreement, shortly known and referred to as the TRIPS Agreement being a global regulatory device for nano-biotechnology. We shall be examining its role in the contexts of this paper by questioning the applicability of the Agreement with regards to the current and future nano-biotechnology applications.[[27]](#footnote-27)

**ROLE OF TRIPS ON NANOBIOTECHNOLOGY**

The role of Intellectual Property Rights across the globe had increased exponentially owing to the primary factors of the rules which were prescribed by the WTO’s TRIPS and by the bilateral/regional trade agreements in almost every area of science and technology wherein it is very much useful to understand the fact that the TRIPS agreement obligates all the WTO Member Countries to adopt minimum standards of intellectual property.[[28]](#footnote-28)

Now, that is useful in a scenario of war to which we could determine that the objective of TRIPS certainly has a vision for the development of IP Regime. Even if not a war, it can be simple chaos between two nations, particularly if we see the current scenario of economic tensions between the NATO and Russia, it is very essential to observe that the Russian President Vladimir Putin has sanctioned a decree legalizing the piracy of Intellectual Property of any Unfriendly Nations towards Russia.[[29]](#footnote-29)

TRIPS can be an example of an optimistic growth of IPR considering unfortunate incidents such as the present economic tensions and belligerent situation between Russia and Ukraine. Furthermore, another requirement of the TRIPS Agreement is that the member countries should make patents available for inventions, whether products or processes, in all fields of technology without discrimination, subject to the standard patent criteria (novelty, inventiveness, and industrial application).[[30]](#footnote-30)

During the negotiations on the TRIPS Agreement, consensus was not reached on the aspect of biotechnological inventions between the Developed Countries and many other developing countries wherein developed countries such as the United States pushed for no exclusions to patentability, while the latter preferred to exclude all biological diversity-related inventions from IP Laws.[[31]](#footnote-31)

It is rather a bigger controversy and debate around the topic of biological inventions as such, because for the developing countries, it is more than the monopoly and most about the protection of such inventions which might originate from traditional knowledge. Despite the debate, all the WTO Members shall offer protection for plant varieties either by patents or by an effective sui generis.[[32]](#footnote-32)

The best example to show that effective sui generis has been provided in India can be showcased by its enactment of ***Protection of Plant Varieties and Farmers Rights Act, 2001*** wherein the Unique plant varieties have been protected ever since the enactment. Additionally, the first Landmark Case Law in the history of the country can be observed before the Hon’ble Protection of Plant Varieties and Farmers Rights Authority in ***Kavitha Kuruganti v. Pepsico India Holdings Pvt. Ltd***.[[33]](#footnote-33)

The brief facts of the case were such that the some farmers based in Gujarat have been planting the seeds of potato and cultivating them after the purchase of seeds from licensed farmers based in Punjab. Having been aggrieved, Pepsico India had approached the Gujarat High Court which turned out to be a ***David v. Goliath*** fight ever since the year of 2019 owing to the reason of IP Infringement of these plant varieties.[[34]](#footnote-34)

Initially, since the year of 2009, around 12,000 farmers were in a contract with Pepsico India Holdings for cultivating these types of potatoes and creating agricultural produce for the Company.[[35]](#footnote-35) However, the company has alleged that the farmers in Gujarat are not a part of this cultivation programme and has initiated nine intellectual property infringement cases against them for compensatory damages totalling to an amount of Rs. 4.2 Crores.[[36]](#footnote-36)

It is ideal to understand at this point of time that the *Protection of Plant Variety and Farmers Rights Authority* (herein after PPVFRA) has highlighted in a few instances in its judgment that:

“A person who was ineligible to make an application for registration of the plant variety at the time of making application cannot be shown to have become eligible after registration of the variety. An applicant has to be a breeder or an assignee of the breeder or plant variety right holder at the time of making of the application and not subsequently. A condition precedent for registration cannot be complied after registration.”[[37]](#footnote-37)

Further the PPVFRA also made significant remarks on the Registrar regarding the proper procedure in granting protection to the Plant Varieties by stating thus:-

“The Registry and the Authority have many lessons to take from this matter as it has unfolded above, so that neither the plant breeders who legitimately deserve to have their rights to be exercised on the varieties bred by them by registering those by the Authority nor the user-farmers who in turn, equally deserve to get their due farmers’ rights protected so that their livelihoods are not put to jeopardy needlessly, are denied of what is due to them on registered plant varieties. The plant breeders’ rights and farmers rights together serve the large interest of keeping the two wheels of agriculture moving forward providing more and more better performing varieties available for enhancing agricultural productivity of the country”[[38]](#footnote-38)

Furthermore, we were also able to find out an exact scientific case of Google Tulips in another Landmark Case Law before the Hon’ble Delhi High Court, namely, ***Nuziveedu Seeds Ltd. and Ors. v. Mosanto Technology LLC and Ors.***, wherein, it should be observed that Mosanto Technology sold fifty seeds of Bt. Cotton Transgenic Variety (Donor Seeds) for 50 lakhs to Nuziveedu and its subsidiaries under licensing agreements in the year of 2004.[[39]](#footnote-39)

These agreements have been renewed in the year of 2015. Meanwhile, Nuziveedu Seeds and its subsidiaries have used those Donor Seeds for their breeding program for the development of the Bt. Cotton Trait, although with different characteristics from the original Donor Seeds which has been provided by Mosanto and also applied for Plant Variety Protection under the ***PPVFR Act, 2001***.[[40]](#footnote-40)

It is essential to take a note that Nuziveedu Seeds Ltd. had contended before the Hon’ble Delhi High Court that “Plants” are excluded from ***Article 27(3)(b) of the TRIPS Agreement*** from patentability which is the same reason for the advent of ***PPVFR Act, 2001*** wherein plant varieties and Farmers Rights are specifically protected.[[41]](#footnote-41) It is also an issue of importance here that the Donor Seeds have also been additionally recognised by the Central Government and have been listed under the ***Essential Commodities Act, 1955.[[42]](#footnote-42)***

The Hon’ble Delhi High Court has also stated that the seeds sold by Mosanto Technology cannot be patentable and it attracts the provision of ***Section 3(J) of the Indian Patents Act, 1970*** thereby excluding the seeds from the patents wherein the Hon’ble Delhi High Court has also considered the ***Essential Commodities Act, 1955*** thereby providing another opportunity for Mosanto Technology for applying for a Plant Variety protection within three months from the date of judgement.[[43]](#footnote-43)

Therefore, what we are determining from the above judgements is that India has been able to provide adequate sui generis under the ambit of ***Protection of Plant Varieties and Farmer Rights Act, 2001*** (PPVFRA) and has not provided a separate patent for new plant inventions thereby making it a serious question of ambiguity regarding the IP provision of law concerned for a converged product such as Google Tulips.

We should also observe ***Section 3(J) of the Indian Patents Act, 1970*** wherein the subject “plants” have been excluded in accordance with ***Article 27(3)(b)*** thereby making it difficult for certain products of nano-biotechnology.[[44]](#footnote-44) On the whole, we were able to come to conclusion that the legal framework has been adequately safeguarded in terms of individual inventions such as pure biotechnological inventions or pure Nano technological inventions.

Furthermore, the role of TRIPS in nano-biotechnology has clearly not been envisaged for converged multi-technological inventions, though it might really be inclined towards. In the further contexts of this paper, now, that we are clear with a side of the project, it is better to understand the legal framework of biotechnology with a combination of information technology in the present context to assess the convergence in the later stage.

**LEGAL FRAMEWORK FOR A COMBINATION OF INFORMATION TECHNOLOGY AND BIOTECHNOLOGY IN INDIA**

Certainly, at this stage of a research paper, we are clear that Google Tulips is a near to reach converged product with bio, nano and information technology. Unfortunately, the patent for this Google Tulip has a better chance of failing specifically in India owing to the reason of certain provisions such as ***Section 3(k) of the Indian Patents Act, 1970*** which states that any product which has come into existence with an element of a mathematical formula, business method or algorithm shall not be granted Patents for the same thereby making the Neural Machine Translation in a Google Tulip, an exception owing to the fact that there is a basic algorithm behind the concept.[[45]](#footnote-45)

However, a beautiful exception to this provision has been elaborated by the Hon’ble Delhi High Court in the Landmark Case Law ***Ferid Allani v. Union of India*** wherein the interpretation has been made keeping in mind the rapid development of technology concerned. The Hon’ble High Court has viewed S. 3(k) of the Patents Act as a hindrance to the grant of certain technological inventions.[[46]](#footnote-46)

**CONCLUSION**

After the observation from various viewpoints regarding the convergence and the legal framework around the converged products in India and a broader expedition of research, we were able to conclude that we have proved the convergence of the three core technologies with many challenges such as technological challenges, Public Interests and Legal challenges and we believe that a 100% of convergence has not been achieved yet.

However, we are optimistic with the higher enlightenment of Dr. Abdul Kalam that convergence within core technologies is possible and we also believe that a legal framework would be an added bonus to India.

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