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# Comparative Study of University - Industry Technology Transfer in EU, US, UK, India

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## ABSTRACT

*The aim of this paper is to critically analyse the comparison amongst different countries in terms of Industry-University Technology transfer. While doing so, the paper seeks to first unfold the mechanism of such collaboration. It will further discuss in detail the current scenario of a mechanism in the IPR sector and its relevancy.*

*The purpose of this research is to showcase in detail how such a concept of transfer of technology is being incorporated in different countries of India, EU, USA and UK. It will further have an empirical analysis of how different is its use and impact in one country from the other countries. With the progress of this paper it will delve into the background of technology transfer in these countries and how it was eventually adapted by IPR.*

*This paper also targets to discuss in a nutshell the types of technology transfer and the commercialisation aspect of it. For this the paper shall also showcase the some aspects of knowledge transfer and the impact of the collaboration on the global economy.*

*The current approach of the authors also aims to make a comparative analysis of the advantages and disadvantages that such technology transfer is leading to these countries and how such lacunas can be overcome by adapting innovation and implemented laws of the other countries.*


***Keywords:*** *Technology Transfer, Bay Dole Act 1980, Intellectual Property Rights, European Union, United States of America, United Kingdom, India.*

## I. INTRODUCTION

Technology transfer is the main focus of this paper, dealing with the laws that deals with the technology transfer in various nations and compiling it as a comparative study. So it is only logical to begin with how technology transfer plays a major role in development of a nations economy as well as work as an incentive for university students to give more effort into developing new innovations and discoveries.

Whereas the motive of technology transfer is overall the same throughout the world, where it

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differs is the legal aspect of it, as legislations to control technology transfer vary from country to country. To understand why there exists a variation of laws regarding a similar subject we need to understand what technology transfer is in short.

Technology transfer, with regards to research organizations, is the interaction by which new developments and different advancements made in those establishments' labs are transformed into products and commercialized. This is normally done by:

- authorizing protected licensed innovation to enterprises
- the formation of new businesses, which likewise frequently permit the IP made by the faculty.

So as most of these university research are funded by the government, certain laws are implemented to control various factors like the rate of transfer of technology to the private sector, avoiding monopoly of necessary inventions or innovations, restrict commercialization of any inventions or innovations made in certain fields like nuclear energy and etc. So in short the technology transfer laws controls the level of freedom in respect of ownership of intellectual property developed through university research.

So the difference in laws to regulate technology transfer comes from the economic condition of the countries and for which it is hard to adopt similar laws of one nation by another. But even then there are various pro's and con's of the laws adopted by various countries and in this paper we tried to compile the effects of such various laws in different nations through a comparative study.

## II. COMPARATIVE STUDY OF UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER IN EUROPEAN UNION

### (A) Scenario of University-Industry Collaboration in EU

With the evolving times, the mechanism for the protection of Intellectual Properties has also grown. Research and development have seen huge implementations and to achieve the best of results collaborative research and experiments have been taken into the picture. One glaring example of this in the current scenario is that of the COVID-19 vaccine developed by Oxford-AstraZeneca which has worked in collaboration to transfer the medicine developed for the entire economy.

University and Industry collaboration works the best in the best European competitiveness for coming up with best scientific achievements by a private and public organisation working together. Considering the status of European Union which is neither a state nor a federation,

the establishment of IPR laws in case of technology transfer holds a crucial deal. It involves certain national as well as institutional policies and strategies that help the two completely different worlds work in synchronization. The European Commission has a lot of involvement in such kind of formulations.[3]

The European Patent System which is managed by the European Patent Office despite not being part of the legal system is still a very successful system in itself. The idea behind compulsory licensing for free research or for the use of an innovation or technology for academic purpose is the sole driving force behind the concept of technology transfer.[4]

**(B) EU Approach towards the Technology Transfer through such Collaboration**

EU indulges in setting up of new technology associated companies under a university to enable their interaction for collaboration. Any researcher might leave the university and continue working in the associated company. It also provides the Central support in ways of exchanging ideas with other start-ups and in having access to printing or other electronic services.

The above-mentioned are only the first-hand or the primary approaches of EU towards technology transfer but the essence of it all lies the second generation ways to deal with the upgraded developments which is also known as the "second generation transfer"[5] . The primary one's definitely have their own merits but the Second generation caters to every kind of innovation which sometimes goes beyond the well-defined boundary of technology. Here comes into picture the role of inter-facial organisations. It works with the help of an individual researcher linking with extended institutional centres, technology transfer centres or patenting offices to work on a particular subject. One example of such a functioning is the Vienna University of Technology, The University Extension Centre.[6]

We are entering into a generation where such transfer is also catering to the needs of employment for many people. Dissemination of technology ensures the progress of national and international societies. EU under such dissemination has programmes like UK Teaching Company Scheme[7]. Such programmes not only help in getting financial aid but also give access to worldwide innovations and exposed collaboration options with different institutions and start-ups.

[3] www.core.ac.uk
[4] www.ec.europa.eu
[5] www.wipo.ent, Developing frameworks to facilitate University-Industry technology transfer
[6] https://uiin.org
[7] Peter Senker; Jaqueline Senker, SAGE Journals, Teaching Company Scheme: Transferring Technology and Expertise from Universities to Industry

Europe still relies for this on its Framework Programme[8]. The 4th Framework Program is in process which has for objects as to how the research and development can be a success with the help of university-industry collaborations. It improves the quality of innovation nd motivates the researches in terms of competitiveness.

EU has seen a significant shift in the governmental policies towards seeing the importance of industrial needs. Still a lot difference lies between the European countries and the region-wise implementation of such collaboration. The progress is gradual and is yet to enhance some radical schemes and programmes to escalate this procedure. Industrial orientation is the answer to pacing up the policies and strategies that are already in process. It is always a challenge at different levels as EU is a union of many divided regions but as a whole unit, EU is slowly but definitely achieving success at gaining the requisite result out of this mechanism.

**(C) Technology transfer impacting the global economy**

Technology transfer plays a vital role solidly influencing the economic growth. The accessibility of technology and its utilization in a nation's economics determines one's competition role in the global labour market to a large extent.

According to the prevalent foreign trade and capital flows theories are of the opinion that production factor like workforce, capital, and technology in a countries market landscape is a good starting point. Technology transition is a critical factor that influences economic development. Thus, we can agree that one's competitiveness position in the global labour market is dependent on the technological advancement available at our disposal and how it is utilized in respect to economic procedures. Because of the complexity of technology transfer, it is essential to develop a theoretical model.

Neotechnology theories such as product life cycle theory, technology gap theory, and production scale theory can be used to expand this. They argue that international trade is possible because of present supply gaps in production factors between countries Global trade is possible, according to the technology gap hypothesis, because of gaps in economic growth between countries. Meanwhile under production scale theory, gains and competitive shares are possible due to significantly higher specialization per output unit at minimal costs.

Technology transition dynamics are often influenced by a firm's innovation strategy. Some companies see technology licencing as the best and safest way to secure technology and extend the rent from exclusive ownership. Others see foreign direct investment as the best and safest

[8] www.ec.europe.eu; EU Science Hub on Technology Transfer

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way to expand.

The Central and Eastern European countries are lagging behind their neighbouring European Union counterparts in bridging the technological divide despite several developments. Eastern European countries, as well as the EU, are vital relevance to the success of integration process. R&D sector therefore needs to work closely with the industry to provide better outcome and for this purpose it requires having optimum funds to be beneficial.

**(D) Protection of IP Laws in EU**

The Treaty on the Functioning of the European Union empowers the European Parliament and Council to adopt legislation aimed at harmonising certain aspects of intellectual property rights and establishing a single European framework that protects intellectual property rights uniformly across all EU Member States. The EU has a number of unique legal tools in place to protect IPRs related to trademarks, designs, and geographical indications. The legal structure for trademarks and designs in the EU is currently being reviewed.

In order to effectively protect intellectual property (IP) rights in the EU, a number of general principles are needed. First and foremost, you must have a comprehensive plan in place to safeguard your intellectual property. Second, IP protection in the EU can vary from that in the United States. Third, under EU law, privileges must be registered and implemented in the EU.

According to international agreements, any copyrighted material produced in the United States would be provided protection across the European Union right after their production or release. Although it will be the laws laid down in respective EU member states that will determine the the extent of protection provided. Accordingly any unauthorized use shall be prevented as per each country's national laws.

**(E) Roles and Responsibilities**

To ensure that IPRs are adequately covered in the EU, the European Commission and other EU bodies collaborate with public authorities in Member States. The Commission is in charge of, among other things:

- developing legislative proposals to harmonise IPRs in the EU;
- verifying whether national authorities have implemented EU IPR legislation correctly;
- monitoring and preventing IPR infringements in the single market; and
- identifying failures in the EU regulatory framework so that they can be resolved.

The European Union deals with patents on a first-to-file basis. The first-to-file basis covers trademarks and design rights too. It should be kept in mind how to introduce your products or

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services to the EU market. Intellectual property rights are essentially private rights, thus making it difficult for US government to enforce it in behalf of private individuals in the European Union. Thus, the liability of defending the rights of the rights holder comes down to the right holders themselves through the means of counsel and attorneys they appointed themselves.

## III. TRANSFER OF TECHNOLOGY AND LICENSING IN UNITED STATES OF AMERICA

The United States Congress, in the later part of the 1970s, engaged with a progression of discussions on approaches to advance private sector development and improvement and usage of government funded innovative work. just 5% of government claimed licenses were at any point utilized in the private area preceding 1980[9]. For the most part the government held ownership of innovations, even if the R&D was done in government funded labs, in colleges, or by singular organizations. The rationale behind it being that since the government funded such research or innovation with taxpayer money, such innovation or invention should remain public in nature. For government patents to be utilized as Licenses they were haggled with firms either on a non-proprietary premise (which means extra organizations could utilize the innovation) or, all the more once in a while, on a proprietary premise by a single producer. Nonetheless, one argument was that without ownership of an innovation along with the security provided by it, an organization would not contribute the extra, and frequently generous time and cash important to popularize an item or interaction for the commercial center.

In 1980, the cost consumption of the government for research work added up to $55.5 billion[10]. The funding was mostly utilized to help innovative work for the necessary requirements of the administrative divisions (i.e. defence, pharmaceuticals, etc.) other than that for areas which required a distinguished requirement for R&D, basically resulting in no research work done for the private sector. Even though public authority's speculation prompted numerous new innovations that have significantly impacted our general public, many people within the government considered that more number of applications can be claimed by after by other sectors whenever given the legitimate incentives.

For such reasons a proposition for a new legislation were brought before the United States senate as an incentive to maximize university research and as well as other research facilities

[9] The Bayh-Dole Act: Selected Issues in Patent Policy and the Commercialization of Technology Wendy H. Schacht
Congressional Research Service, 2012

[10] National Science Board, Science and Engineering Indicators—2006, (Washington, National Science Foundation,
2006)

to facilitate increase in innovation and transfer of technology for the private sector to maintain their competitive edge within the global market as well as allowing the organizations to keep the ownership and title of any such inventions, which is supposed to work as an incentive to create new business, product and employment as well as help grow the economy. This was done through the introduction of two legislation in the 1980s which are

- The Bayh-Dole Act, 1980
- Stevenson-Wydler Technology Innovation Act, 1980

In an investigation it has been examined that the patent exchanges of the best 58 US universities from the year 2002 to 2010. it has been tracked down that of all the licenses allowed at the United States Patent and Trademark Office (USPTO), 37% have been associated with some type of monetization. Among them, 29.7% have been authorized out, 5.9% have been reassigned to different colleges and universities, National Laboratories, government offices or non-profit entities (NPEs), and 1.3% have been moved to organizations[11].

Firms and NPEs play a major role and are vital participants on the technology markets, and over the most recent couple of years, colleges have likewise started to consistently monetize their patented technologies. There has been an upsurge of university patenting since the execution of the Bayh-Dole Act in 1980, which worked with exchanging and permitting of IPRs coming about because of government subsidized research and exploration[12].

The Association of University Technology Managers (AUTM) revealed in the US Licensing Activity Survey (2016) that an aggregate of 16,487 new US patent applications were recorded in 2016, of which 7021 were allowed to the 195 colleges and research institutions that took part in the study[13]. Also, the report featured that the dramatic expansion in college licenses was joined by an equal expansion in licensing agreements.

*Table showing rough estimates of university patenting post introduction of the Boyh-Dole Act, 1980.*[14]

| **Before 1980** | **Financial Year 2005** |
|---|---|
| • Universities received 250 patents | • Universities received more than 3000 |

[11] The licensing and selling of inventions by US universities
Federico Caviggiolia , Antonio De Marcoa , Fabio Montobbiob , Elisa Ughettoa
[12] Mowery et al., 2001; Mowery and Ziedonis, 2002; Sampat, 2006; Thursby et al., 2009
[13] Technological Forecasting & Social Change, ELSEVIER, 159, 2020
[14] Marina Lamm, Office of External Affairs United States Patent and Trademark Office

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| | |
|---|---|
| (approx.) per annum | patents (approx.) |
| • Roughly 24 Universities engaged in technology transfer | • Roughly 200 Universities engaged in technology transfer |

The changes introduced to the patent laws through the sanctioning of Bayh-Dole Act had a target of facilitation of co-activity and collaborative endeavors between and among the scholarly world, industry, and government. During late 1980, Universities performed 14% of the R&D within USA[15](like today). This is refined as a part of the instruction cycle which therefore offered preparation to scientists, designers, and supervisors who were in this way later used by the private sector.

**(A) Post Implementation Results of Boyh-Dole Act, 1980**

The General Accountability Office, (GAO) in probably one of their earliest surveys of the enactment, discovered understanding among university administration and private company delegates that had a critical effect on their research and advancement efforts.[16] While evident it was hard to generalize and not right to make speculations regarding the scholarly community from the 25 colleges considered, GAO found that by 1987 all college directors addressed showed that the Bayh-Dole Act had been huge in invigorating business sponsorship of college research, which has grown 74% from FY1980 to FY1985.[17]

The National Science Foundation (NSF) in one of its investigation saw that industry support for scholastic exploration became quicker than some other subsidizing source until FY2002. Industry financing extended from 3.9% of college R&D in 1980 to 7.2% in 2000, in spite of the fact that by FY2009 industry support had dropped to 5.8% of scholarly R&D. In 1980, federal financing involved 67.5% of the absolute scholarly endeavor; by 2000 administrative help declined to 58.2% of college subsidizing, yet expanded to 59.3% in FY2009.[18] Although it ought to be noticed that the Government is as yet the significant source of funding or financing for a wide range of scholastic research works.

[15] National Science Board, Science and Engineering Indicators—2002 (Washington, National Science Foundation,
2002), A4-9.
[16] U.S. General Accounting Office, Patent Policy: Recent Changes in Federal Law Considered Beneficial, RCED-87-
44, April 1987, 3.
[17] The Bayh-Dole Act: Selected Issues in Patent Policy and the Commercialization of Technology Wendy H. Schacht
Congressional Research Service, 2012
[18] National Science Foundation, "Changes in Federal and Non-Federal Support for Academic R&D Over the Past Three Decades," InfoBrief, June 2002

the Association of University Technology Managers (AUTM), in their most recent overview (FY2011) found that universities distinguished a sum of 591 new commercial items that were promoted because of scholarly R&D. Likewise, the review demonstrated the formation of in excess of 671 new organizations to market university research with 6,051 new licenses/options conceded essentially to private ventures. Since 1980, in excess of 8,778 new firms have been set up to create and advertise academic R&D, with 3,927 new companies actually working as of the finish of FY2011.[19]

In short it provides a motivator to colleges to take the time and exertion to seek after a patent and to permit those licenses in its portfolio. This has prompted a critical expansion in scholarly protecting. In 1980, 390 licenses were granted to colleges, by 2009 the number expanded to 3,088.[20]

## IV. COMPARATIVE STUDY OF UNIVERSITY INDUSTRY TECHNOLOGY TRANSFER IN UK

### (A) History of Tech Transfer in Uk[21]

In 1997 the Labour Government came to power and introduced many changes it was as a result of the new Minister for Science, Lord David Sainsbury.

A number of schemes for innovative were made:

- 1998: University Challenge Seed Funds – under which the Government gave funds of 3to 4 million pounds for every 1 million pound that the university paid.
- 1999: Science Enterprise Centers – a competition was organized to develop management expertise in the range of £1m - £4m in size.
- 2000: Reach Out Funds (HEROBC) – a funding to new business up to 4 million
- In, 2002, 2004, and 2006: funds were steadily increasing.

These were the legislations that promoted tech transfer in the UK:

- In **The Export of Goods, Transfer of Technology and Provision of Technical Assistance (Control) (Overseas Territories) (Amendment) Order 2009** the citation provides a mention of technology transfer.

[19] Association of University Technology Managers, AUTM U.S. Licensing Activity Survey Highlights: FY2011
[20] National Science Board, Science and Engineering Indicators, 2012
[21]https://astp.fandom.com/wiki/Technology_Transfer_in_United_Kingdom#General_Principles_of_Technology_Transfer_at_UK_universities

- **In The Technology Strategy Board (Transfer of Property etc.) Order 2007** has a provision of knowledge transfer. Even in schedule ii part1 Schemes for the transfer of knowledge and expertise special schemes for knowledge transfer were organized.

**(B) University-Industry Technology Transfer in UK**

The University- Industry technology transfer has played a very important role in developing local industries specially Small and medium sized industries in UK. As of 2018 the total Research and Development spend in UK was £37.1 billion which is an increase of 94% from 1986 amount[22]. Out of this £37 billion, Public funding such as funding for research councils, university was £9.6 billion which is 26% of total R&D spending of the year. The UK is now a lead countries in international publication and citation with rank of 6 in Science Citation Index and Social Science Citation Index[23]. However before 1980s this huge spend in R&D did not resulted in commercialization of the output. This can be outcome of Charity law in UK.

Most public university in UK are governed by Charity law which means their basic objective is to contribute their resources for advancement of education and research which are deemed as public good. This law discouraged universities from commercialization of their technology before late 1980s. Although before 1980s there was many example of University-Industry technology transfer like Pencilin developed by Oxford, which has helped the Oxford University earn huge amount in royalty, but still University in UK used to publish their research on journal rather than go for commercialization. But there was a rapid development in commercialization of university research output after 1980s. This was partially inspired by introduction of Bayh-Dole's act in US which encouraged transfer of University technology by giving ownership of it to University. The UK government has promoted the transfer though various schemes. The commercialization of tech transfer has grown many folds during this time. This has resulted because the rapid adoption of technology transfers office by UK University. A survey done in 2002 has revealed that many universities have formed TTO in late 1980s and by the time of survey 80% of them have at least 1 dedicated staff for it[24]. The survey also revealed that the number is rising by 25% every year. This is mainly driven by increasing push by government by various public funding scheme like Higher Education Innovation Fund(HEIF), University Challenge Funds etc.

However even after all this the report released by Michael Porter has revealed that UK

[22]https://commonslibrary.parliament.uk/research-briefings/sn04223/#:~:text=In%20the%20UK%20in%202018,real%20terms%20increase%20of%2094%25.
[23] https://data.worldbank.org/indicator/IP.JRN.ARTC.SC?year_low_desc=true
[24] UK University Commercialization Survey, Financial Year 2002, UNICO, AURIL, NUBS, 2003

university were still relatively poor in commercialization of their technology and transfer it to local UK industries[25]. After global Financial crisis in 2008, public investment on university research dwindled. The balance sheet of many company became stressed. This has resulted in increasing attraction for University IPs by industry. Also universities were very interested in attraction Industry research money because public investment and donation on research was decreasing. The existing IP and the research capacity of the universities became carrot for industries to get attracted to University for research collaboration, licensing and development of existing technologies.

**(C) Knowledge Transfer Partnership**

In 2003 UK government has started Knowledge Transfer Partnership to promote efficient use of Knowledge, technology and skills that is stored in UK knowledge base[26]. The scheme enables the industry to bring in latest innovation, technology and skills to improve or deliver specific projects with partnership with academic partner. The academic partner here will develop the project and then help to implement it in business. The cost will be shared between Public grant and the business which is involved[27]. The Sainsbury Review of UK Government's science and innovation policy had said that the knowledge transfer is increasingly becoming important for growth and innovation of UK SMEs and business. The review also called for more government financial support for the technology transfer scheme like KTP[28]. The Knowledge Transfer Partnership can be said to be a partnership between The university, the Business, the Associate and the UK government. The partnership lasts for 12-36 months. The timeline mainly depends on the specifics of the projects and the type of business. During this time, the university appointed academic will support and supervise the project by bring specific knowledge and expertise to deliver the project. The KTP scheme resulted in many benefits for business in UK. While the primary aim of the scheme was for development and innovation of product or service, It also enhanced the professional ability, skills, strength of the business while at the same time developing organizational development of the business. Innovate UK the main organization responsible for KTP has said that the main focus of KTPs scheme has been SMEs and especially those business who are vulnerable to technology change and related problems. In a report release in 2015 revealed that from 2003 to now, the 45 KTPs initiated by University has resulted in gross value addition of £4.1 million[29]. After the completion of the

[25] UK Competitiveness: moving to the next stage, Michael Porter, 2003.
[26] DTI 2003
[27] https://www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply
[28] Department Of Innovation, University and Skills 2007, p.60
[29] Biggar Economics 2015

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scheme, the organization Innovate UK also provide grades range from A-E to projects. This is based on assessment of the project quality with A being Very good and E being satisfactory.

The continuous support to schemes that involves Technology transfer like KTPs are very crucial for development, innovation, future growth and sustenance of SMEs in UK. New age technology like Cyber security, Artificial intelligence, Nano Technology, 3d printing etc need to be encouraged more in KTPs by giving continued and extended support to business and knowledge bases. Confederation of British Industry in 2017 said that UK is a world leader in technology innovation. But after the innovation, commercialization aspects of it are not so good. The focus should also include increasing commercialization of technology to support future growth of local business so that efficient use the research resources and output can be done.

## V. INDIAN SITUATION IN REGARDS TO LICENSING AND TECHNOLOGY TRANSFER

"Colleges are information-based associations whose capacities are to a great extent bound to educating and research. They are intended to work - to find - and scatter information by having huge and important aptitude in all orders. India has a tremendous construction of schooling and its advanced education area is presently profoundly progressed, contrasted with its adjoining nations, (Report of Steering Committee on Science and Technology, Government Of India, 2006). The significance of innovation and science in this decade has been characterized unequivocally by Jospin, who has reasoned that New items and cycles will be needed to move the present businesses in the following century and to accomplish mechanical fitness and economical development."[30]

"In this period of the information economy, the drivers for financial development incorporate the solid base of revelation situated exploration in universities and institutions. There has been an extreme change in institutional need, towards examination and innovation improvement including IP creation, its commercialization, and the advancement of a subsidizing model that would deliver a maintainable, monetarily independent venture. Resulting to Mashelkar's council report acknowledgment, the Centers for very good quality exploration have advanced best practice tasks which incorporate IP Policy, Licensing methodology, and execution assessment. These organizations are making satisfactory skills in business, legitimate, and IP alongside the comprehension of University culture and administration direction. There is a dynamic commitment from the innovation ventures, production of Science and innovation

[30] Jospin. L.,Towards the factory of next century, In: Innovation and Technology Transfer. European Commission, Luxembourg, January 1998, pp. 16–21

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park, and business hatcheries at these establishments, who do have unsaid arrangement and arrangement receptive to beginning phase VCs and business heavenly messengers."[31]

"The improvement of science-based organizations (moreover named as "front line" adventures) has energized schools to have a more direct occupation in the progression cycle in the High Innovation Economy(HIE). School assessment and development move has been associated with the necessities of neighborhood industry for eg. Purdue University controlled the headway of the Locomotive Industry, the University of Oklahoma, for the improvement of the Petroleum Industry and the University of Akron added to the progression of the Polymer Industry."[32]

"The exchange of innovation from scholarly foundations is a significant piece of the college climate, addressing every organization's obligation to improving the public great by advancing the improvement of its protected innovation into usable items. The endeavors have the insurance advantage of advancing monetary development through the formation of organizations around scholastic advancements, work creation, and chaperon financial multipliers. The IP the board at the college advances out of an association of three interfaces, including innovation the executives rehearses, lawful viewpoints, and business issues. The innovation the board incorporates Research procedure, arranging, contract, creation exposure, patent data and search and innovation move measures. While, IP and legitimate perspectives incorporate IP Creation, data scattering, IP Guidelines, Patent application plan, IP Policy, lawful issue, Licensing and the executives of License."[33]

**(A) Types of Technology Transfers**

Technology transfer can be ordered into vertical and flat technology transfer

Vertical transfer alludes to the transfer of technology where transmission of new innovations is done from the age of new technology during the innovative work programs into the science and technology associations, for example, to the application identified with the modern and rural areas, or we can say that vertical transfer is the technology transfer starting from essential examination to applied exploration, from applied examination to development followed by development to creation.

While the horizontal technology transfer is the development of a notable technology starting with one prepared climate then onto the next (starting with one organization then onto the next)

[31] Albert N Link and John T Scott, US Science Parks: the diffusion of an innovation and its effect on the academic mission of Universities, International Journal of Industrial Organization, 21(2003), 1323-1356

[32] Rosenberg, N., Nelson, R., 1994. American universities and technical advance in industry. Res. Policy, 23, 323–348.

[33] Bayh Dole Act, (PL 96-517), Patent and Trademark amendment act of 1980, USA.

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or say alludes to the transfer and utilization of technology utilized in one spot or association to somewhere else or association.

**(B) Layout of Science Based Strategy in India: 1947-2016**

Indian policymakers had stepped up and start a few measures to make a development driven economy, which incorporates expanding logical establishments towards building scholarly capital and empowering commercialization of its logical exploration, any place conceivable to make durable customary qualities, for example, occupations and abundance and become an information center point. There have been a few approach intercessions by the Government of India to empower advancement, protection of IP, and motivation system in Indian scholastic foundations and furthermore to satisfy TRIPS prerequisite.

Remembering of the basic requirement for commercializing guarantee research, investment reserves were started from the mid 1980s and a particular intercession as Technology Development Board Act, 1995 was ordered. Since freedom, Indian Government has planned three science approaches: The Science Policy in 1958, The Technology Policy Statement in 1983 and the Science and Technology Policy in 2003 to reinforce the Science and Technology in the country.

In 2009, the Indian Government officially allowed research working in Indian public scholastic and examination organizations to hold value stakes inside projects, along these lines opening up technology brooding focuses as another method for Technology Transfers.

| **Name of the Policy** | **Year of Enactment** | **Major Provisions** |
|---|---|---|
| Industrial Policy Resolution | 1948 | Introducing the mixed economy model of development by categorising industries as private and public funded |
| Science Policy Resolution | 1958 | Developing personnel and infrastructure in science to solve developmental problems |
| Science and Technology Plan | 1974 | Foster indigenous technology, local research in compliance with import substitution |
| Establishment of National Science and Technology | 1982 | To foster entrepreneurship through innovation diffusion |

| | | |
|---|---|---|
| Entrepreneurship Development Board | | |
| Science and Technology Policy | 1983 | Understanding the limitations of indigenous methods, moving towards increasing diffusion of 12 technology through transfer |
| Technology Development Policy | 1983 | To develop technology to meet the social aspirations of people |
| New Industrial Policy | 1991 | Opening up private investment in technological fields |
| Technology Development Board Act | 1995 | Foundation of a legal body, to advance turn of events and commercialization of native innovation and transformation of imported innovation for more extensive application. |
| Science and Technology Policy | 2003 | "To establish an IPR regime to provide a strong, supportive and comprehensive policy environment for speedy and effective domestic commercialisation of technical innovations."[34][35] |
| Amendment to Science Policy | 2009 | "Researchers in universities can hold equity shares in spin offs."[36][37] |

From the audit of technology transfer in India, it arises that India has a solid logical yield and a frail development framework. In the mid-1950s, India started with a science strategy on making essential science yields that affected neighborhood development. The innovative dispersion at this stage was hampered by boundaries like import replacement and restricted nearby support. This likewise deterred nearby businesses from taking off. Following this stage, there was conscious strategy level mediation to encourage business ventures in established researchers during the 1980s. The opening of the Indian business sectors in 1991 incorporated the different constructions of technology development and commercialization. The various

[34]http://tdb.gov.in/about-tdb-2/#:~:text=The%20Government%20of%20India%20constituted,imported%20technology%20for%20wider%20application.
[35] https://www.indiamicrofinance.com
[36] https://www.allafrica.com
[37]*https://www.researchgate.net/publication/308031291_Exploring_University-Industry_Technology_Transfer_in_India_Two_Models)*

constructions of technology transfer including colleges, governments, and industry are working in a connected climate with the introduction of the information economy environment.

In India, side projects from scholarly organizations are as yet an incipient wonder. In the Indian development framework, the limit between the scholarly and the business circle isn't similarly penetrable because of two significant reasons. One is the institutional insufficiency in the IPR framework that interprets as the shortfall of the previous component of information transfer through TTOs and patent documenting. The second is the shortfall of an innovative framework that assists with seed capital, recognizing fittingness of examination for commercialization, and institutional guidelines to set up firms. Information transfer among college and industry is rather connected by the 'enterprising cycle'. This interaction can be of two sorts research plan drove (technology push) or business drove (business pull). The exploration plan drove model distinguishes the proper examination fields of coordinated effort and structures key organizations with accomplices for commercialization. The business model structures hatcheries that empower wandering and channelizing mechanical dispersion of different kinds through hatcheries and business cells. These models relate generally to the technology pull and business push of 'Roberts and Malone grouping. The way wherein the Indian innovative interaction goes amiss from the fundamental model is by obliging existing constructions of an association like laws, approaches, office, and faculty to perform new capacities or by starting proper courses of action between entertainers without structures. By steady formalization of guidelines in technology dissemination and business venture development, India is by all accounts pushing toward a more formal administrative system.

## VI. CONCLUSION

Organizations often become cautious due to the knowledge transfer. The main focus should be in capturing ideas from inside and outside and to apply that relevant knowledge into your organization for profits. This project focuses on the knowledge transfer process in European Union, in United States of America, in United Kingdom, and in India. We have discussed the various legislations, bills pending in parliaments and several government initiatives like donations for knowledge transfer improvements. It is very important to understand that creation of knowledge is important and more than that transfer of knowledge successfully is also important. This transfer must be unbiased though. We must also understand that it is very important to make a successful transfer of knowledge. Some companies make transfer just because of the retiring employees. We must keep in mind that to be up to date and to make a strong structure we must have a robust knowledge transfer strategy. This strategy will give

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your organization immense wealth of knowledge.

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