D J Med Sci 2025;11(1):i-xv
doi: 10.5606/fng.btd.2025.964

Review

An evaluation of intellectual property rights and commercialization potential of academic inventions: A case study of the university of health sciences technology transfer office

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ABSTRACT

This study examines the role and achievements of the University of Health Sciences (UHS) Technology Transfer Office (TTO) in the commercialization of patents. By emphasizing the significance and position of patents in intellectual property rights, the strategies implemented by the UHS TTO in this field and the outcomes achieved are detailed. The stages from invention disclosure to patent applications, registration, and commercialization are addressed in the study, and the mechanisms supporting university-industry collaboration are explained. Additionally, how patent portfolio management, training activities, awareness campaigns, and revenue-sharing models contribute to the development of innovative solutions and economic benefits are discussed. In conclusion, the importance of strengthening international collaborations, increasing research and development investments, and promoting an innovation culture to support the leadership goals of the UHS in the fields of health and biotechnology through the UHS TTO has been emphasized.

Keywords: Intellectual and industrial property rights, patent portfolio management, technology transfer office, university-industry collaboration.

INTELLECTUAL AND INDUSTRIAL PROPERTY RIGHTS

Intellectual Property Rights (Rights Over a Work)

Author's rights

The rights of the author of a work, encompassing both moral and economic rights, are collectively referred to as copyright.[1] contend that copyright law acts as a catalyst for creative endeavors, contributing significantly to cultural and economic development. Moral rights, which are inherent to copyright, safeguard the author's personal connection to their work, preserving their reputation and integrity. For instance, altering the title of a work or failing to attribute the work to its author constitutes a violation of moral rights. On the other hand, economic rights grant the author the right to exploit their work commercially and to derive income from it. For example, the publication of a book or the digital distribution of a musical composition are examples of economic rights. These rights empower the author to prevent the unauthorized use, reproduction, or modification of their work.

Ginsburgemphasizes that copyright is crucial for ensuring the economic sustainability of creative industries.[2]

Neighboring rights (Related rights)

Neighboring rights refer to the rights granted to individuals other than the author of a work who contribute to the dissemination of that work.argue that neighboring rights are crucial for ensuring the economic sustainability of creative industries. These rights are typically held by performers, producers, and broadcasters. Performers' rights, for example, protect against the unauthorized

Received: January 20, 2025
Accepted: February 13, 2025
Published online: March 20, 2025

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Cite this article as:
Çömlek O. An evaluation of intellectual property rights and commercialization potential of academic inventions: A case study of the university of health sciences technology transfer office. D J Med Sci 2025;11(1):i-xv. doi: 10.5606/fng.btd.2025.964.

recording or use of their performances.[3] The rights of producers of sound recordings and audiovisual works include the right to control the reproduction and distribution of those recordings. Publishers' rights confer upon publishers the right to control the unauthorized commercial exploitation of the works they publish. Ginsburg contends that neighboring rights foster cultural development by facilitating the wider dissemination of Works.[2]

Industrial property rights

Trademark

A trademark is a sign that identifies the source of a product or service, distinguishing it from others. Aaker argues that trademarks enhance a company's competitive advantage by building consumer trust and loyalty.[4] Brands encompass various elements of corporate identity such as names, logos, symbols, or color combinations. Trademarks enhance a company's competitive advantage by building consumer trust and loyalty. Additionally, trademark influence consumer purchasing decisions by guaranteeing the quality of a product or service. Cornish and Llewelyn argue that trademarks play a critical role in protecting commercial identities and a company's marketing strategies.[3]

Patents and utility models

A patent is an intellectual property right that protects technical innovations. A utility model is a form of protection for smaller innovations. Teece and Pisano argue that patents play a critical role in commercializing technological innovations and gaining a competitive advantage.[5] Patents are granted to inventions that meet the criteria of novelty, inventive step, and industrial applicability. Utility models, on the other hand, provide faster and more cost-effective protection. These rights grant the inventor the exclusive right to make, use, and sell the invention for a specified period. Helfat and Raubitschek argue that patents significantly influence innovation strategies and accelerate technological change.[6] This paper will further examine the topic of patents.

Design

Design is an intellectual property right that protects the aesthetic or visual features of a product. Heskett, argues that designs enhance a company's competitive advantage by boosting a product's market performance.[7] These rights cover elements such as the shape, pattern, or ornamentation of a product. Designs enhance a product's market performance, thereby strengthening a company's competitive advantage. Additionally, designs are a significant factor influencing consumer preferences. Cornish and Llewelyn assert that designs are a key factor in shaping consumer preferences.[3]

Geographical indications

Geographical indications are signs used on products that indicate that the product originates in a specific geographical location and possesses qualities or a reputation linked to that origin. Rangnekar argues that geographical indications provide economic benefits to local producers and contribute to the preservation of cultural heritage.[8] These rights typically cover products such as agricultural products, food, wines, and handicrafts. Geographical indications provide economic benefits to local producers and contribute to the preservation of cultural heritage. Ginsburg states that geographical indications increase consumer confidence and enhance the value of products in the market.[2]

Other rights

Trade names

Trade names are the names that define a business's commercial identity. Cornish and Llewelyn argue that trade names are essential for businesses to protect their commercial identity and gain a competitive advantage.[3] These rights protect a business's reputation and secure its commercial activities. Trade names enhance a business's market recognition and provide a competitive advantage. Ginsburg states that trade names play a critical role in enhancing a business's brand value.[2]

Unregistered rights

Unregistered rights refer to the protection of intellectual property rights (IPRs) without formal registration. Ghidini argues that unregistered rights encourage innovation, particularly in fast-paced sectors.[9] These rights typically cover elements such as trade secrets and unregistered

designs. Unregistered rights encourage innovation, particularly in fast-paced sectors. Cornish and Llewelyn contend that unregistered rights increase the flexibility of the intellectual property system.[3]

Traditional product names

Traditional product names protect the names of products specific to a particular culture or community. Kurin argues that traditional product names play a significant role in preserving cultural heritage and supporting local economies.[10] These rights provide economic benefits to local producers while contributing to the preservation of cultural heritage. Rangnekar also states that traditional product names provide economic benefits to local producers.[8]

Integrated circuit topographies

Integrated circuit topographies protect the three-dimensional structure and layer arrangement of an integrated circuit. Cornish and Llewelyn, argue that integrated circuit topographies stimulate innovation in the semiconductor industry.[3] These rights protect the innovative arrangements used in the design of integrated circuits and their commercial exploitation. The protection of integrated circuit topographies safeguards the investments of designers and manufacturers, supporting competition and technological advancement in the industry. Ginsburg states that these rights play a critical role in protecting and commercializing technological innovations.[2]

Plant breeder's rights

Plant breeders' rights protect the development and protection of new plant varieties. Janis and Kesan argue that plant breeders' rights stimulate agricultural innovation and contribute to food security.[11] These rights encourage agricultural innovation and contribute to food security. Cornish and Llewelyn state that these rights are of critical importance for biotechnological research.[3]

Undisclosed information
(Confidential information and trade secrets)

Confidential information and trade secrets are industrial property rights that protect the confidential information that gives a business a competitive advantage. Friedman, Landes, and Posner, stated that trade secrets enable companies to maintain a competitive advantage and develop innovative business models.[12] This information typically includes commercial information such as production methods, customer lists, or marketing strategies. Cornish and Llewelyn stated that the protection of trade secrets plays a critical role in helping businesses achieve their long-term strategic goals.[3]

PATENT

Information is one of the most important elements of our time. Measures taken to protect information are guaranteed by intellectual property laws. The concept of intellectual and industrial property rights has a broad scope, encompassing patents, utility models, industrial designs, trademarks, geographical indications, literary and artistic works, company names, trade names, and even confidential information.[13] In this context, a patent is a way of protecting inventions, which are derived from human ideas that can be expressed concretely through technical terms and creative thinking. In other words, a patent is a legal document that indicates who has the right to use an invention in scientific, technical, and application fields. According to the World Intellectual Property Organization (WIPO), a patent is defined as "a document issued by a government authority or regional office acting on behalf of several countries to which an application has been made, describing an invention and creating a legal situation by which the patented invention can be exploited only with the authorization of the patent owner".[14]

However, since not all information and inventions are valuable, certain criteria have been established to determine which information and which inventions are worthy of patent protection. According to the Turkish Patent and Trademark Office, these criteria can be listed as follows:

Novelty: The invention must not exist anywhere else in the world.

Inventive step: The requirement that the invention must be understandable to experts in the relevant field of technology.

Industrial applicability: The invention must be capable of being manufactured, used, or implemented on a commercial basis.[15]

Evaluation of inventions according to the criteria of the Turkish Patent and Trademark Office: Novelty, inventive step, and industrial applicability

The Turkish Patent and Trademark Office evaluates patent applications according to specific criteria. These criteria include the fundamental elements of patents such as novelty, inventive step, and industrial applicability. In this section, the definitions of each criterion will be provided, along with references to international academic studies on these criteria.

Novelty

Novelty is one of the most critical criteria for an invention to be patentable. An invention must be new and not have been previously disclosed or published. In other words, for an invention to be considered novel, it must not have been described in a prior patent application or a published scientific article.

Academic studies on the evaluation of the novelty criterion in the patent application process particularly emphasize its impact on technology transfer and competition. Novelty implies that an invention must make a new contribution to technological advancement.

Teece and Pisano argue that innovation plays a critical role in gaining competitive advantage and commercializing technological innovations.[5] Innovation is an especially important concept for innovation strategies and discusses how technological advances can be used to gain competitive advantage.

Inventive step

The inventive step signifies not only that an invention is novel in relation to the prior art but also that it possesses a characteristic that cannot be easily derived by a person skilled in the art. In other words, the invention should not be obvious to a person of ordinary skill. Unlike novelty, the inventive step emphasizes the unpredictability of an invention. Specifically, the inventive step criterion ensures that patent applications provide innovative solutions that require in-depth technical knowledge and experience.

Helfat and Raubitschek have argued that the inventive step plays a crucial role in innovation strategies, particularly in the context of accelerating technological change.[6] This criterion can pose a significant barrier to the commercialization of new technologies.

Industrial applicability

Industrial applicability means that an invention can be used in industrial applications. This implies that the invention cannot be a mere theoretical discovery but must have real-world applications in a practical sector or industry.

Industrial applicability is crucial for the commercialization of inventions and their implementation in industrial production. This criterion mandates that inventions have the capacity to enhance efficiency and reduce costs within industrial production processes.

Lanjouw and Schankerman have argued that industrial applicability is a powerful tool for enhancing the commercial potential and economic value of an invention.[16] Moreover, they highlight the role of this criterion in aligning inventions with market demands.

The criteria employed by the Turkish Patent and Trademark Office, such as novelty, inventive step, and industrial applicability, play a decisive role in determining the technological contribution and commercial value of patent applications. These criteria highlight the significance of an invention's novelty and competitive advantage.[5] A literature review underscores the importance of these criteria in driving technological advancement, competitive advantage, and industrial contribution.[5] The evaluation of patent applications based on these criteria enables strategic decision-making at both academic and industrial levels.[16]

This article elucidates the fundamental criteria, such as novelty, inventive step, and industrial applicability, considered in the evaluation of patent applications and explains how these elements influence the commercial potential of patents.

The first study on industrial and intellectual property issues in the period following the proclamation of the Republic was the Paris Convention for the Protection of Industrial Property, enacted in 1925, which aimed to establish an international union for the protection of industrial property. The Trademark Law of

1965 and the accession to the 1967 Convention Establishing the WIPO played significant roles in the developmental stages following the establishment of the Republic. On June 24, 1994, the Turkish Patent Institute (TPI) marked a turning point for Türkiye. In 2003, the "Law No. 5000 on the Establishment and Functions of the Turkish Patent Institute," which adapted this administratively and financially autonomous institution to contemporary realities, came into effect. In 2016, the TPI took its current form with the Industrial Property Law No. 6769, and its name was changed to the Turkish Patent and Trademark Office.[15]

The primary purpose of granting patents to protect inventions is to stimulate inventive activities, facilitate the transfer of technical solutions derived from inventions to industry, promote their implementation, and encourage others to learn from these inventions and develop them further.[17]

Patent applications can be filed in three distinct ways: regional, national, and international. Firstly, a national application can be filed for a national patent, providing protection for the invention solely within that specific country. Secondly, an international application can be filed under the Patent Cooperation Treaty, resulting in a national or regional patent that protects the invention in designated Contracting States. Thirdly, an applicant can request a European patent, which will be valid in the designated States specified in the application.[18]

The importance of patents for individuals, companies and society

By protecting innovations, patents have a multifaceted impact on individuals, corporations, and society as a whole. This impact manifests in various areas, including technological advancement, economic growth, and competitive advantage.

Importance for individuals

By protecting the inventions of individual innovators, patents prevent the unauthorized use of their ideas. This protection provides incentives for inventors to engage in research and development (R&D) activities.[19] Furthermore, patents enable individuals to commercialize their innovations and support entrepreneurial endeavors.[20] This process not only enhances the economic returns for individuals but also fosters the creation of new business opportunities.

Importance for companies

Patents serve as a strategic tool for companies to gain a competitive advantage. By safeguarding their innovations, patents enable companies to differentiate themselves in the market and deter imitation by competitors.[21] Moreover, patent portfolios enhance a company's ability to attract investors and foster strategic partnerships. Patent protection maximizes the returns on a company's R&D investments and contributes to long-term strategic planning.[22]

Moreover, patents serve as a source of assurance for investors and financiers. Gans and Stern argue that patents enable investors to mitigate technological risks and invest in new projects.[23] The economic value of patents allows companies to secure financing and achieve their long-term strategic objectives.

Importance for society

The societal significance of patents lies in the dissemination of technology and knowledge. By mandating the disclosure of inventions, the patent system accelerates scientific and technological progress.[24] Moreover, patents incentivize the development of solutions to improve overall societal welfare. For instance, in the healthcare sector, patents facilitate the development of new drugs and treatment methods.[19]

Furthermore, patents have become an essential element of international trade.[25] Has investigated the impact of patents on the growth of global trade and has shown that patents facilitate the trade of patented products worldwide. This situation supports the growth of national economies and can create opportunities, particularly for developing countries.

Under which circumstances is it possible to apply for which type of patent?

When applying for a type of patent, the nature and field of application of the invention should be considered. For example:

- A product patent for a new device or machine,

- A process patent for a method that improves a production process,
- A utility model patent for minor technical improvements.

However, since patent legislations vary between countries, national and international regulations should be carefully reviewed before applying.[21]

The role of technology transfer offices in patent processes

Technology transfer offices (TTOs) play a crucial role in commercializing inventions at universities, research institutes, and similar organizations. Particularly in the context of patent processes, TTOs are involved in key stages such as protecting inventions, assessing their commercial potential, and transferring them to industry. These processes encompass a broad spectrum, from patenting academic inventions to negotiating licensing agreements. The role of TTOs in patent processes and the various aspects of this role are explained below.

Patent application and invention evaluation

Technology transfer offices take the first step in evaluating the patentability of inventions by researchers and academics. Etzkowitz and Leydesdorff emphasize that TTOs are critical building blocks that support university-industry collaboration (UIC) and the commercialization of scientific discoveries.[26] Before filing a patent application, an invention must be evaluated in terms of fundamental patent criteria such as novelty, originality, and industrial applicability. In this process, TTOs collaborate with patent attorneys and experts to determine the patentability of inventions.

Technology transfer offices provide accurate guidance to researchers and inventors regarding the feasibility of filing a patent application. Mowery and Ziedonis assert that TTOs are among the most critical actors in the commercialization of academic inventions and provide guidance on how to strategically direct patent applications.[27]

Patent protection

Throughout the patent application process, TTOs provide the necessary legal and technical support to protect inventions. The patenting process involves preparing application documents, filing applications with patent offices, and, if necessary, defending against oppositions. Technology transfer offices offer comprehensive guidance to inventors on the requirements, deadlines, and legal procedures of the patent application process. Siegel and Wright highlight the crucial role of TTOs in protecting inventions at universities and emphasize that these processes are critical for the commercial success of inventions.[28]

Management of licensing and commercialization processes

Once patent protection is secured, TTOs play an active role in licensing these patents and assessing their commercial potential. Di Gregorio and Shane highlight the significant role of TTOs in evaluating the commercial value of university patents.[29] Technology transfer offices connect these patents with industry, manage licensing processes, and serve as a bridge between universities and industry.

Additionally, TTOs are responsible for drafting licensing agreements, protecting IPRs, and optimizing commercialization processes. To protect the interests of both the university and the inventors, TTOs act as intermediaries in negotiations, facilitating the conclusion of commercial agreements in the most favorable manner.

Patent strategies and global protection

Often, it becomes necessary to protect a patent not only locally but also globally. Technology transfer offices develop strategies for such global patent applications and take the necessary steps to register the patent in different countries. Jensen and Thursby argue that universities' international patent strategies are essential for competing in the global market and that TTOs play a significant role in developing these strategies.[30]

Education and awareness raising

Technology transfer offices provide training on patents and technology transfer for researchers and academics. These trainings enable academic staff to gain a better understanding of patent applications, IPRs, and commercial opportunities. Rothaermel and Thursby note that TTOs not only educate university personnel on patenting and commercialization but also provide guidance on managing these processes.[31]

Supporting the innovation ecosystem

Technology transfer offices do not limit the commercialization of academic inventions to patenting; they also contribute to the development of innovative ecosystems. O'Shea et al.[32] argue that by supporting the research culture at universities, TTOs facilitate the development of innovative projects and enable these projects to be transformed into potential drivers of economic growth.

The role of TTOs in the patent process extends beyond patent application and protection. Technology transfer offices play a critical role in commercializing inventions, licensing, developing global patent strategies, and providing training to researchers. These processes enable academic discoveries to be transformed into industrial innovations and contribute to the economy.

PATENT PORTFOLIO MANAGEMENT

Patent portfolio management is a critical process that enables companies to effectively manage their patents in alignment with their innovation strategies. This process extends beyond mere patent protection; it involves maximizing the commercial potential of these patents, strengthening the company's competitive advantage, and strategically utilizing legal rights. Patents are valuable assets that reinforce a company's technological leadership and increase market share. In this context, patent portfolio management is directly linked to a company's business model and strategic objectives.

A study by Teece and Pisano highlighted the role of patent portfolios in creating dynamic capabilities and competitive advantage.[5] In this context, it is argued that patents are not merely tools for technological protection but also serve a strategic function and enhance long-term value for companies.

Key components of patent portfolio management

Patent portfolio management requires strategic planning. Companies not only protect their patents but also utilize them to create commercial opportunities. Below, the fundamental components of patent portfolio management will be discussed.

Developing a patent strategy

The patent strategy supports a company's innovation and competitive strategies. Companies can use their patents as part of a defensive strategy to protect against competitors' technologies, while an offensive strategy can generate revenue by licensing competitors' patents. They can also diversify their portfolios and own patents in different areas to spread risk. Helfat and Raubitschek have argued that patent portfolios enhance a company's ability to adapt to technological change.[6] This strategic approach helps companies strengthen their innovative position in the market.

For example, the patent disputes between Apple and Samsung illustrate how patents can be used as a competitive tool. Apple used its patents on the iPhone's design and technology as a competitive weapon against Samsung.[33]

Patent evaluation and optimization

Patent valuation involves determining their commercial and technological value. A patent portfolio should be continuously optimized to serve innovative business opportunities. This process can enhance a company's efficiency by strategically utilizing patents throughout its lifecycle. Arora and Gambardella emphasized that patents help to integrate not only internal innovation but also external innovation.[34] This enables companies to form innovative collaborations.

Patent licensing and SALES

Patents can also be used to generate financial gains through licensing agreements and sales. In this context, Lanjouw and Schankerman argue that companies can create economic value by licensing and selling patents.[16] Effective management of a patent portfolio facilitates the success of such commercial activities.

A patent portfolio is a significant asset that reflects a company's technological capabilities. Not only does this portfolio strengthen a company's technological leadership, but it must also align with its market strategies. Teece and Pisano argued that patents help develop a company's dynamic capabilities, thereby enabling it to gain a competitive advantage.[5] Effective patent management allows a company to create

innovative business models, capture new market opportunities, and compete with rivals.

Helfat and Raubitschek have argued that patent portfolio management enables firms to adapt rapidly to technological change.[6] This helps companies maintain market leadership. Furthermore, aligning patent portfolios with R&D strategies contributes to the long-term introduction of innovative products.

Patent portfolio management is a critical component of a firm's innovation strategy, and when managed effectively, can solidify a company's competitive advantage and facilitate its ascent to market leadership.[5] Patents serve not only as protective instruments but also play a pivotal role in creating commercial opportunities and developing new business models.[34] The effective management of patent portfolios enables firms to cultivate dynamic capabilities, forge innovative collaborations, and achieve success in their market strategies.[6]

Significant studies in the international literature provide valuable insights into how patent portfolio management can be assessed from strategic, competitive, and financial perspectives.[16] Patents not only facilitate the integration of internal innovation but also external innovation, thereby strengthening a firm's technological capabilities and business strategies.[5]

Technology transfer offices manage the patent portfolio of a university or research institution. This involves various processes such as monitoring, protecting, and licensing patents. Portfolio management is a critical function to ensure the best commercialization of the value of patents. Technology transfer offices assess the market potential of each patent in the portfolio and determine appropriate licensing strategies.[28] Additionally, these offices are responsible for monitoring and managing the renewal processes of patents.

Tools and methods used in patent portfolio management

Software tools in patent analysis

Software used to analyze and manage patent portfolios assists in evaluating the technological and commercial value of patents. Examples of such tools include Derwent Innovation, Innography, and PatentSight.

Patent mapping

Visualizing and analyzing patents by technological fields. For example, an automotive company can map its electric vehicle patents to identify its strengths in specific areas.

Benchmarking

Making strategic decisions by comparing patent portfolios with competitors. For example, Google can direct its strategic investments by comparing its patent portfolio in the field of artificial intelligence with those of Microsoft and Amazon.

The role of patents within intellectual property rights

Patents are a cornerstone of the IPRs system, providing legal protection for inventions and thereby stimulating innovation. Intellectual property rights encompass a set of rights granted to individuals and organizations to protect the products of their creative efforts. These rights are categorized as copyright, trademark, trade secret, and patent, among others.[19]

Patents grant inventors exclusive rights for a specific period, with a particular focus on technical innovations. These rights prevent others from making, using, or selling the invention, providing the inventor with commercial advantages and returns on investment. Unlike other types of intellectual property, patents primarily protect functional and technical innovations.[22]

Within the broader framework of IPR, patents stand out for their contribution to technological and scientific advancement. While copyright primarily protects creative works such as literature, art, and software, patents support tangible technological innovations. Trademarks, on the other hand, represent commercial identity and play a role in the promotion of products or services. In this context, patents are considered one of the most important innovation-driven elements of the IPR system.[35]

Patent protection also encourages the disclosure of inventions to the public. While

granting inventors exclusive rights for a specific period, it simultaneously requires the disclosure of technical details, thereby contributing to the body of scientific knowledge.[19] In this way, the patent system balances the interests of both individual inventors and society.

UNIVERSITY-INDUSTRY COLLABORATION AND PATENT LICENSING

University-industry collaboration plays a pivotal role in R&D processes, particularly in enhancing the commercial potential of patents.[6] These collaborations offer significant opportunities to translate academic research into commercial applications, commercialize innovations, and accelerate technological advancements.[34] Patent licensing, a cornerstone of university-industry partnerships, is a mechanism to convert research findings into commercial value.[5] In this context, patent licensing is viewed as a means for universities to expedite technology transfer and generate revenue.[16] Moreover, patent licensing strategies are considered fundamental tools for integrating academic research into industry and disseminating innovations.[6] This paper examines the significance of university-industry collaboration, the patent licensing process, and strategic approaches within this context, drawing on the academic literature.

University-industry collaboration

University-industry collaboration is the process of transferring academic research and innovations to industry. This collaboration aims to create innovative solutions by combining the knowledge and technology of universities with the commercial needs of industry. University-industry collaborations play a significant role in developing innovative products and business models.

University-industry collaboration is also crucial for commercializing these innovations. Patent licensing is one of the most important tools in this process, serving as an effective method for converting university research into commercial value. University-industry collaboration and patent licensing create significant opportunities for both academic and industrial stakeholders while stimulating economic growth and innovation.

The primary objective of UIC is to bridge the gap between academic knowledge and industrial needs. Etzkowitz and Leydesdorff define UIC as the process of transforming scientific knowledge into commercial products.[26] This process enables the development of innovative products and services that provide a competitive advantage for the industry.

Industry can utilize research findings from universities to improve production processes, enhance efficiency, and develop new products. Conversely, universities can leverage industry collaborations to transform theoretical knowledge into practical applications. This mutually beneficial relationship offers advantages to both parties.

The importance and benefits of University-industry collaboration

University-industry collaboration is of paramount importance, especially in the context of accelerating technological advancements and commercialization of innovations. Such collaborations facilitate the translation of university research and innovative projects into commercial applications, while providing industrial firms with a technological competitive advantage. Both academic and industrial stakeholders derive significant benefits from these collaborations.

Teece and Pisano have argued that university-industry collaborations facilitate the development of dynamic capabilities.[5] In this context, collaborations not only enable firms to develop innovative products but also contribute to the enhancement of their technological capabilities.

University-industry collaboration models

University-industry collaboration can take various forms. These include:

- Research partnerships, where universities and industrial firms collaborate on research projects.
- Licensing agreements, through which universities license their developed technologies to industry.
- Technology transfer offices, established by universities to commercialize academic findings.

Licensing and commercialization of patents

Patent licensing is a crucial component of university-industry collaboration. Patents protect the innovative findings resulting from university research and can be licensed for commercialization. Licensing is a critical method for universities to transfer their research findings to industry and generate economic value from these findings.

Types of patent licensing

An exclusive license is a type of license whereby a patent owner grants the exclusive right to use a patented invention to a single licensee. Under this arrangement, the licensee becomes the sole authorized user of the patent for a specified period, and the patent owner is prohibited from granting licenses to other parties. In some cases, the patent owner may also waive their right to use the patent. Exclusive licenses are commonly preferred for patents with high commercial potential and incentivize licensees to make significant investments in commercializing the invention. This type of licensing is particularly prevalent in the pharmaceutical, biotechnology, software, and high-tech industries. For instance, BioNTech exclusively licensed its messenger ribonucleic acid technology patents to Pfizer for the development of the coronavirus disease 2019 (COVID-19) vaccine. Through this license, Pfizer manufactured and distributed the vaccine globally.[36] Similarly, Stanford University granted an exclusive license to Google for the PageRank algorithm, contributing to the foundation of Google's search engine technology. Exclusive licensing provides licensees with a competitive advantage while offering licensors a steady revenue stream and the opportunity to commercialize their patents. However, there are risks involved, such as the licensee's failure to effectively utilize the patent or comply with the terms of the agreement. Therefore, carefully defining the terms of the licensing agreement and protecting IPRs is crucial in the exclusive licensing process.[37]

A non-exclusive license allows a patent owner to grant the right to use a patented invention to multiple licensees. Unlike exclusive licenses, this type of license does not confer exclusive rights to the licensee; the patent owner may grant licenses to other parties and may continue to use the invention themselves. Non-exclusive licensing is often preferred when a patent owner seeks to disseminate the technology more widely and generate additional revenue. This type of licensing is particularly common in fields such as software, telecommunications, biotechnology, and standard-essential technologies. For example, Qualcomm licenses its wireless communication technology patents to numerous smartphone manufacturers under non-exclusive terms. This strategy has enabled Qualcomm to both widely distribute its technology and increase licensing revenue.[38] Similarly, in the software industry, patents for algorithms or software are often licensed non-exclusively to multiple companies, thereby fostering wider adoption. Non-exclusive licensing is particularly employed in standard-essential technologies (such as 5G or Wi-Fi) to stimulate competition and accelerate innovation. This licensing model offers licensees a more cost-effective option while providing patent holders with opportunities to generate substantial licensing revenue. However, non-exclusive licensing may limit a licensee's competitive advantage as competitors can access the same technology. Consequently, non-exclusive licensing is typically favored when patent holders aim to disseminate their technology and achieve broader market penetration.[39]

A compulsory license is a legal mechanism that allows a government to grant a third party the right to use a patent without the consent of the patent owner, in the public interest. Such licensing is typically employed in situations where public welfare, national security, or emergency circumstances take precedence. Compulsory licensing is governed by the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights and is particularly used in developing countries to increase access to essential medicines.[40] For example, in 2001, India implemented a compulsory license to reduce the high cost of a drug used to treat human immunodeficiency virus/acquired immunodeficiency syndrome, allowing a local pharmaceutical company to manufacture the drug at a lower cost.[41] Similarly, during the COVID-19 pandemic, several countries considered compulsory licensing mechanisms to accelerate access

to vaccines and treatments.[41] Compulsory licensing is often invoked when a patent holder monopolizes pricing, restricting access to essential goods. However, compulsory licensing is a controversial issue as it limits the patent holder's IPRs and is generally considered a measure of last resort. While this mechanism is a crucial tool for protecting the public interest and ensuring access to essential goods,[40] it has also been criticized for potentially undermining innovation incentives and investor confidence.[41]

Patent licensing process

Patent licensing is a complex process involving the transfer of the rights to use a patent to a third party through a licensing agreement. This process consists of a series of stages that define the rights and obligations of both the patent owner (licensor) and the licensee. The following is a detailed explanation of the fundamental stages of the patent licensing process.

Patent valuation and preparation; constitute the initial phase of the patent licensing process. The patent owner assesses the economic and technical value of the patent, analyzing its market potential, market size, technological feasibility, and competitive advantage. During this stage, legal factors such as the scope, validity, and term of the patent are also evaluated. Patent valuation is crucial for determining the license fees and terms to be negotiated during the licensing process.[39] For instance, a biotechnology patent should be analyzed in detail in terms of clinical trials and commercialization potential.

Defining the licensing strategy: The patent owner defines the licensing strategy by specifying the type of license (exclusive, non-exclusive, or compulsory), geographical scope, and sectoral applications. This strategy is shaped by the patent owner's commercial objectives. For example, exclusive licensing is preferred for projects requiring significant investments, while non-exclusive licensing facilitates the wider dissemination of the technology.[41] Additionally, the protection of IPRs and compliance with competition law are considered during the licensing process.

Identification of potential licensees: At this stage, the patent owner identifies potential licensees who could utilize the patent. Potential licensees are typically selected from among companies or organizations that can maximize the commercial value of the patent. For example, technology companies are targeted for software patents, while pharmaceutical companies are preferred for drug patents. During this process, factors such as the financial status, technical capacity, and marketing capabilities of the licensee are evaluated.[40]

Negotiation process: Negotiation is one of the most critical stages of the patent licensing process. At this stage, the licensor and licensee discuss and agree upon the terms of the license agreement. Negotiated elements include license fees, royalty rates, geographical and sectoral scope, contract duration, commercialization obligations, and the protection of IPRs. For example, a licensee of a pharmaceutical patent may request a specific period for clinical trials and manufacturing processes. To protect the interests of both parties, intellectual property experts and legal advisors are often involved in this process.[41]

Preparation and execution of the license agreement: Following the negotiation process, a license agreement is prepared between the parties. This agreement explicitly defines all the details of the licensing process and the rights and obligations of the parties. The license agreement includes elements such as the type, scope, duration, license fees, commercialization obligations, and protection of IPRs. For instance, in an exclusive license agreement, the licensee's commercialization obligations are clearly specified.[39]

Commercialization and implementation: Following the execution of the license agreement, the licensee commences the commercialization process of the patent. At this stage, the licensee undertakes production, marketing, and distribution processes to maximize the commercial potential of the patent. The licensor, on the other hand, generally monitors the licensee's compliance with the terms of the agreement. For instance, for a pharmaceutical patent, while the licensee conducts the production and distribution processes of the drug, the licensor verifies the regular payment of royalties.[40]

Renewal or termination of the agreement: The final stage of the licensing process is the renewal or termination of the agreement. Upon expiration of the contract term, the parties decide whether to renew or terminate the contract. In this process, factors such as the licensee's commercialization performance, market conditions, and the economic value of the patent are considered. For example, a software patent license agreement may be renewed or terminated depending on the currency of the technology.[41]

The patent licensing process is a carefully orchestrated endeavor aimed at maximizing the economic value of a patent and facilitating the commercialization of the underlying technology. This process encompasses a series of stages including patent valuation, defining the licensing strategy, negotiation, contract drafting, and commercialization.[39] Each stage must be meticulously planned to safeguard the interests of both the licensor and the licensee. Moreover, the protection of IPRs and compliance with competition law are paramount in this process.[40] Patent licensing serves as a pivotal instrument in fostering innovation and disseminating technology, yet it necessitates a delicate balance between the parties involved.[41]

Economic and strategic benefits of patent licensing

Patent licensing enables universities to generate financial revenue. Furthermore, licensing facilitates industry access to innovative technologies, thus aiding them in gaining a competitive advantage. Licensing allows university research to acquire commercial value.

Lanjouw and Schankerman emphasized that licensing enables companies to rapidly access new technologies and increase their market share. This highlights the strategic role of licensing for the industry.[16]

University-industry collaboration and patent licensing: A literature review

Numerous academic studies on UIC and patent licensing highlight the significance of these processes in fostering innovation, competitive advantage, and economic growth.

Teece and Pisano have argued that patent licensing helps firms enhance their technological capabilities by fostering dynamic capabilities and innovative collaborations. Additionally, patent licensing serves as a crucial vehicle for universities to commercialize their research findings.[5]

Technology transfer offices serve as a bridge between universities and industry in the commercialization of patented inventions. These offices license academic discoveries to industry, thereby accelerating the market introduction of innovations. Patent licensing enables the transfer of academic research to industry for economic gain.[41] Furthermore, TTOs play a guiding role in licensing processes by analyzing the market potential of inventions.

ACCELERATING INNOVATION AND COMMERCE

The commercialization of patents is a cornerstone function of TTOs. This process accelerates and streamlines the introduction of inventions into commercial markets. Technology transfer offices provide consultancy services to inventors, industrialists, and investors, identifying avenues to maximize the economic value of patents. Furthermore, they foster an innovation culture within academic circles and facilitate the integration of scientific research into industry.[44]

Patent commercialization plays a pivotal role in transforming academic endeavors at the University of Health Sciences (UHS) into economic and societal benefits. Through its Technopolis TTO, UHS has implemented a structured process for both protecting and commercializing patents. This paper examines UHS's practices related to the protection and commercialization of IPRs.

The UHS patent evaluation process: The patent evaluation process is coordinated by Technopolis TTO and consists of the following steps:

Disclosure of invention: The inventor completes and submits the "Invention disclosure form" provided by Technopolis TTO. This form encompasses the technical details, innovation potential, and application areas of the invention.

Preliminary evaluation: The invention's market potential, technical feasibility, and novelty are

assessed by two separate boards: the Preliminary Evaluation Board and the Technical Evaluation Board.

Final evaluation: The Intellectual Property Final Evaluation Board reviews the preliminary evaluation reports to determine whether the invention is a service or a free invention.

Rector's approval: The final decision is approved by the Rector and communicated to Technopolis TTO.

STRUCTURE OF THE TECHNOPOLIS TTO INTELLECTUAL PROPERTY RIGHTS UNIT

Technopolis TTO operates as a service unit to all employees, students of UHS, and personnel of 63 affiliated hospitals. In this context, it carries out activities related to the protection and commercialization of IPRs, as well as providing information on these processes to approximately 4,000 academic staff, 65,000 students, and affiliated hospital personnel.

In 2019, a joint program was initiated with a consultancy firm to achieve these goals. In the first phase, 11 individuals underwent a two-year applied IPRs training program, and two of them successfully passed the patent and trademark attorney exams. In the second phase, which started in 2022, Technopolis TTO personnel received practical training in global novelty searches, specification writing, and opposition proceedings.

As a result of these programs, an IPRs Unit was established in December 2023, and the following achievements were realized:

- Within the framework of the protocol signed with Technopolis İstanbul, the IPRs Unit also provides Intellectual and Industrial Property Rights support to entrepreneurial firms operating in the Technology Development Zone in accordance with Law No. 4691.
- 197 invention disclosure forms were submitted, 21 of which were classified as service inventions, and specifications were prepared for 24 of them.
- Five patents and six trademarks were registered.
- Awareness training was organized for companies located in Technopolis Istanbul and UHS Technology Development Center (TEKMER).

Contribution of the IPRs Regulation to the Commercialization Process UHS's IPRs Regulation defines in detail the rights of inventors and the sharing of commercialization revenues.

- At least 33% of patent revenues will be allocated to the inventor.
- The commercialization strategy will be determined and implemented by Technopolis TTO.
- The university will cover the costs associated with protecting and commercializing patents, and these costs will be deducted from the revenue generated.
- Education and capacity-building activities: Technopolis TTO has conducted education and capacity-building activities for a wide audience, including not only UHS but also companies in the Technology Park and TEKMER. These activities focused on practical training in patent writing, global novelty searches, and IPRs awareness, thereby expanding the intellectual property ecosystem of the university and its affiliates.

These achievements, coupled with nationally and internationally recognized patent registrations, support UHS's goal of becoming a leader in the fields of health and biotechnology.[42] Literature on the impact of university-based TTOs confirms the positive effects of such structures on the commercialization of innovations.[43]

In conclusion, this study reveals the systematic approach adopted by UHS TTO in commercializing patents and the successes achieved. The UHS TTO has made significant national and international achievements by adopting an innovative approach to protecting and commercializing academic inventions. Through training programs, awareness-raising activities, and strategic partnerships, inventors have been guided, innovations have been rapidly commercialized, and UIC has been deepened. The effective planning and implementation of training activities have played a critical role in the success of Technopolis TTO. To support

UHS's goals of leadership in health and biotechnology, it is emphasized that international collaborations should be strengthened, R&D investments increased, and an innovation culture disseminated. To expand UHS's patent portfolio and enter international markets, several strategic recommendations have been developed. First, stronger connections should be established with international patent databases to promote UHS patents globally. Second, industrial collaborations should be made more strategic through sectoral roadmaps. Customized incubation programs should be developed for entrepreneurs within the university, and the promotion of UHS's registered technologies at local and international fairs should be intensified. Additionally, Technopolis TTO should aim to position itself as a leader in providing innovative solutions in the health and biotechnology fields. Efforts in this direction will not only enhance the university's economic returns but also increase Türkiye's international competitiveness in the field of health technologies. Finally, to ensure the sustainability of this success, it is recommended to select and train a sufficient number of qualified personnel and to strengthen training modules with innovative approaches.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest: The author declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The author received no financial support for the research and/or authorship of this article.

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