Bringing university invention to the market

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ABSTRACT

Despite of the fact that primary purpose of universities is to disseminate knowledge, university research happens to be extremely important for industry development. More than 70 % of most important patents are originated from university studies. This paper addresses specifics of university intellectual property (IP) and provides strategies for successful implementation of university inventions. Practical aspects of inventing such as the patent ownership and monetary rewards for the inventors, working at the university, are discussed. We paid special attention to certain distinctions in IP laws in various countries, which is important to know due to the growth of international collaboration between universities, multi-national character of companies and their cooperation with the universities. We show IP managements in industry - academia research on a fair basis within two different models: cooperation research paid by third party such as government and contract research paid by industry.

Keyword list: patent, intellectual property, invention, academic, university, industry, sponsor, IP

1. HISTORY AND ETHICS OF UNIVERSITY PATENT LAW

The differences in handling IP between the university and industry relate very closely to their very different roles in society. Historically university scientists were convinced to be focused mainly on basic, pure research; they were intellectuals engaged in pursuits that are disconnected from the practical concerns of everyday life. Academic elitism was associated with an ethical norm of unbiased honest opinion to ensure and to contribute to a wide and free dissemination of knowledge based on the best of knowledge. This tenor still exists but is obviously changing. On the opposite, an industrial employee testifying on the material of interest to industry is assumed to be providing his company's viewpoint to achieve commercial advantage over competitors. This is considered smart and ethical for the industrial scientist. Thus university and industry operate in different ethical or value systems. However if the university professor is on industrial payroll, which is a common practice nowadays with preferences for certain disciplines such as engineering sciences and pharmaceutical industry, it creates an ethical dilemma. The outcome is in gradual change of fragile traditional university values and their shift into commercial ethics [1].

The questions of ethics were widely discussed in legal and scientific communities in 1980s. Harvard President Derek Bok wrote in 1981: "I have concluded that Harvard should not take a step [in owning shares of a private company that licenses Harvard-owned products], even on a limited, experimental basis, unless we are assured that we can proceed without the risk of compromising the quality of our education and research" [2]. Twenty years later this outlook has been largely abandoned in favor of aggressive technology transfer drive. Major universities recognize that commercial success of their inventions is essential for the university prestige and recognition; it attracts top academics, best students as well as public and private funding.

It is a fact that majority of university scientists, at least in the technical fields, are working on various projects sponsored by industry and government agencies. Here we have to distinguish between two major kinds of collaboration: contract based research as a direct and industry paid commercial activity, and cooperative research, where both sides are funded by the public hand. We will come back to that point later. Moreover, the merit of a scientist is measured not only by amount of publications, citations (h-factor), and the quality of them, but largely by amount of money brought to the university via multiple contracts. Besides the financing is arranged in a manner that assumes necessity of supporting the lab functioning, student and staff payments through contracts. Therefore it is too late to complain about the university research commercialization, since it is existing reality and plays a growing role for ranking and reputation.

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2. ROLE OF PATENTS IN COMMERCIALIZATION OF UNIVERSITY RESEARCH RESULTS

We have previously discussed a role of various types of intellectual property: patents, copyrights and trademarks in academic research [3]. Here we concentrate on patents only. By definition, patents allow excluding others from making, using and selling your invention. It does not preclude other scientist to work on the same problem and to improve existing solution. Patent verifies that you are an inventor (which an article can do as well) and the adds another reference in your list of publications.

When it comes to commercialization of the technology or material or process or device disclosed in the patent, and then the inventor has a right to request a monetary reward for using the patented invention. So the positive sides of university patenting are: (1) recognition of the scientist as an inventor; (2) another publication; (3) it is beneficial for the university and therefore improves the scientist's position there; (4) and the last, but maybe one of the most important – is monetary reward collected through licensing, which is important both for the scientist and for the university.

Many scientists have pointed out negative effect of patenting on science, which is in refusal to share information, in its contradicting to open science norm. This delay in the results publication may affect areas where advances are cumulative. This thesis is mostly related to European countries, where the patent law names "inventor" a person who first filed the patent application, in contrast with US patent law where the inventor is the first who made the invention. US patent law does not preclude publishing the results and later their patenting. In European countries, the invention needs to be patented first, and then published. European scientists often prefer to publish results and not to file a patent, since patenting requires keeping the results secret for quite a long time.

3. TIME SCHEDULE FOR PATENTING

Diagram of Fig. 1 shows the evolution of invention from general idea to a patent. Let us first consider US patent legislation. Scientists may present their results in open publications and get reviews and peer response. This publication starts the clock for the patenting. The first patent application needs to be filed within the next 12 months. It may provisional or nonprovisional publication. Provisional (or preliminary) application is a lower-cost first patent filing in the United States. It also allows the term "Patent Pending" to be applied to your product. The next, nonprovisional (or full) application must be filed within 12 month. Priority date of the nonprovisional application is the filing date of the provisional application (double benefit: for the question of this application patentability and as a reference date against other patent applications). The twenty-year patent term would be measured from the later nonprovisional application filing date. Provisional application does not have requirements for the format of submission, it may be used as an urgent solution when the material was in public domain almost 12 month, and if the patent application is not filed then you lose your opportunity to patent it. Currently the cost of provisional application filing is $110.

After another year of evaluation of the invention potential commercial success, the inventor has to make a decision whether to proceed with filing full nonprovisional application or not. If yes, then you may choose between regular application, which typically results in 3-5 years of prosecution, or an accelerated examination application, which has to be prosecuted by the US Patent Office within 12 months. The fee for a US nonprovisional application filing is about $500.

Now let us consider European Patent legislation. The requirement on the inventor as the one "first to file the patent" does not allow publishing the results prior to patenting. This excludes the stage of potential commercial success evaluation of up 24 months to make a reasonable decision on the importance of patenting. Some countries require that the invention has to be patented first in own country, others not. Basic filing fee for European application is about €5000, which does not include the lawyer's work; in total the cost exceeds €30,000 for direct EU patent filing [4] and more than €40,000 for filing via PCT application (Patent Cooperation treaty). So the intelligent decision about filing the application without prior exposure to potential commercial partners is also associated with spending of essential sum of money. It does not create a favorable atmosphere for the scientific results patenting.

If US scientist has already published his/her invention, it is too late to think of European patent and European market. Prior to publication he needs to convince the Technology Transfer Office of the university to spend $30-50K on European patent filing, which sounds almost impossible mission. Therefore European legislation in combination of US

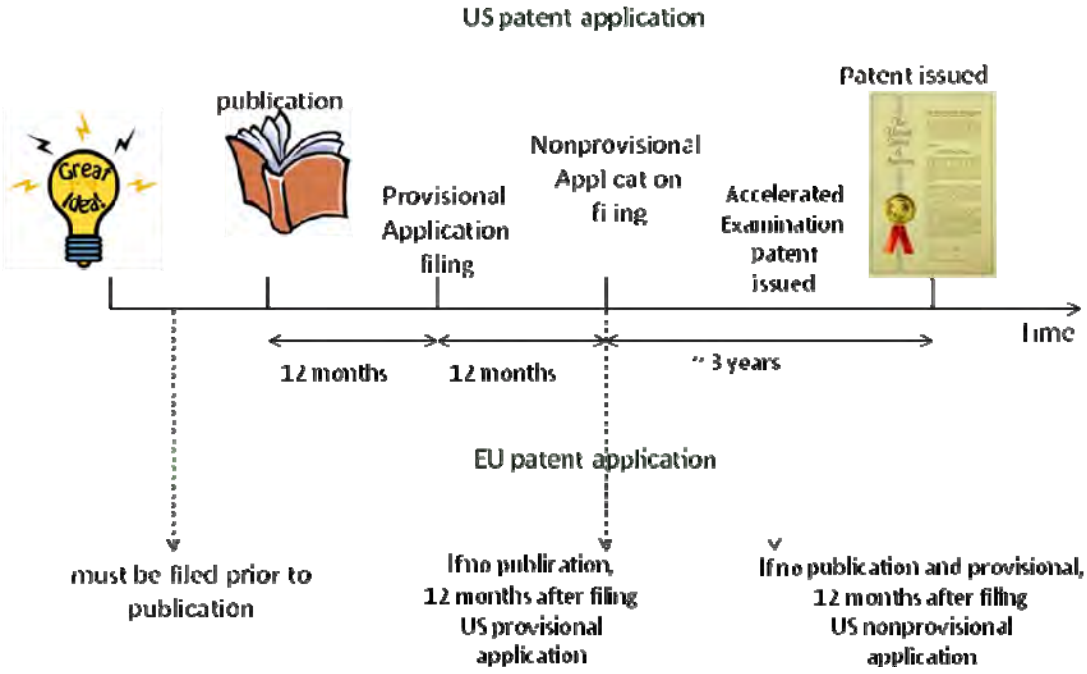

Fig.1 Time schedule from idea to patent.

University laws practically keep off US university patents from Europe. If the invention has not been published as a paper, then European patent can be filed within 12 months after US patent application, provisional or nonprovisional, whichever was first. Again, it is not allowed to share the information, neither through publications, nor through oral presentations.

Thus the European clause on the definition of inventorship limits sharing the scientific results among the whole world community during the patent filing process. Alternatively, if scientists choose to communicate, this prevents them from patenting in Europe.

Since we presenting this material in Brazil, we would like to point out the specifics of this country. Brazil was the fourth country in the world to enact a patent law (in 1809), it was a founding member of the Paris Convention in 1882 and remained a full-fledged party to such treaty since then. European rule “first to file” is applicable here [5], which provides Brazilian scientist with the dilemma similar to their European colleagues: to publish a paper or to file a patent application?

4. REASONS FOR PATENTING

Obviously, one can carry on with commercialization without patenting. In many cases, especially where extremely expensive equipment is required for the production or the complexity of the process itself makes it almost impossible to copy the product or process, to proceed without patenting would be the best option. Industry also often prefers not to file a patent for strategic reasons in case where they want to keep the topic secret.

First of all, considering all expenses on the way to mass production of the invented product or service, the cost of patent filing is relatively small. Typically university invention is patented in one country, which limits the whole cost to 10K-50K. The product development expenses are typically at the different order of magnitude. However, for the university scientist the cost of patenting is paid from university funds, while the product development is covered by the patent licensee or startup funding. University scientists pursuing their own product research and development via startups have another problem: the startups are typically funded through various agencies, and they do not allow spending on patent filings. Therefore the specific of the university patents is in fact that the patent filing is performed by the different department than the product development and sales.

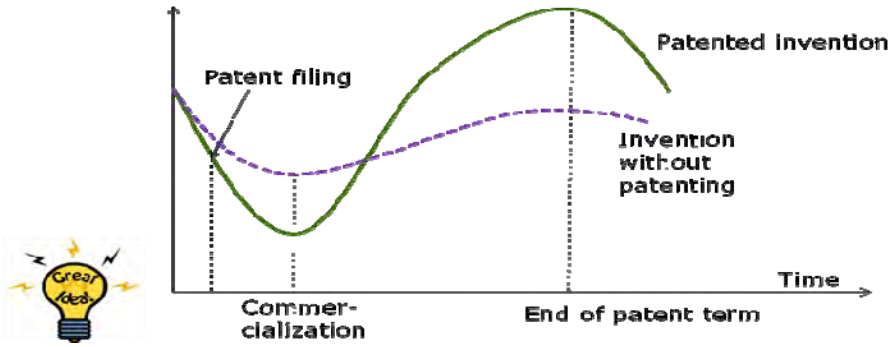

Fig. 2 Patent value

Experts think [6] that the higher the estimated value of the invention, or the higher the uncertainty of the project; the more important it is to protect the intellectual property. The value of the invention is derived from the profit from the sales of the product or service disclosed by the invention. Therefore the value of patent is associated with the future total market size, market share, and profitability. Based on these parameters one can estimate the value of the project that was powered by the enabling IP. The next step is estimating the value of the same project without this IP. It typically happens to be less than in the first case due to higher development costs, or lower market share, or potential lawsuits from the competitors, or delayed market entry, etc. The difference between the values of the project with and without the IP ultimately defines the value of the protected invention (see Figure 2). The exact method of deriving the IP value from the value of the whole project is dependent on the details of the deal: IP sold, IP licensed, venture capital raised, etc. Fig. 2 shows the general plot of money spending, when bringing the invention to the market.

In any case the rough estimation of the profit, which the patent can bring to the owner, should precede the patent filing and the amount of the benefit must be large enough to proceed with filing the application.

5. PRIOR ART SEARCH

Patents are granted on useful, novel and nonobvious inventions. The term “useful” does not require any explanations; however “novel” and “nonobvious” deserve some clarification. None of the inventions is really novel since it is build out of known parts or based on previous version of the device. It must be proven by the inventor that this new combination provides unique properties, which could not be achieved previously. The term “nonobvious” means that the differences in the new invention compared to the prior art would have been not obvious to a person having ordinary skill in the type of technology used in the invention.

Only 30% of the applications submitted to US Patent office are granted as patents. Most of them are rejected basing on obviousness, which means that the prior art teaches similar device or process, and the improvement, proposed by the inventor, is evident to the person skilled in the art. The examiner combines two known patents, combination of which creates the structure of the patenting invention, and makes a rejection based on obviousness.

In order to succeed with the patent filing and prosecution, the inventor must carefully study the prior art. The patent attorney also performs the prior art search, however the inventor is the person, who can do it the best, since he/she knows subject in details. Most useful databases for the prior art patent search are the following:

Google Patent Search http://www.google.com/patents
U.S. patent office www.uspto.gov
European patent office http://ep.espacenet.com/
Japanese patent office http://www19.ipdl.inpit.go.jp/PA1/cgi-bin/PA1INIT?1269754792218
Korean patent office http://kpa.kipris.or.kr/newps/pa/PASE0030_new.jsp

Google search has the best browser, in our view. It selects the most relevant patents first. European database allows searching the whole collection of patents worldwide. In certain fields of optoelectronics, it is absolutely necessary to perform search not only in US and worldwide databases, but also in national databases such as Japanese and Korean.

The patent search can be performed using different techniques. The most popular is a keyword search, which includes a combination of keywords linked by some connection words. When using a keyword search, keep in mind multiple meanings of the same word and narrow it down to your specific field of science. It is necessary to use as complete set of synonyms as possible. The connector words (and, or, adj, near….) allows performing the search more specifically. Once the relevant patents found, it is reasonable to perform backwards and forwards citations search for the patents of interest. Google patent browser shown above allows easily open backward and forward citations.

Though the patent examiner most likely will compare your invention with other patented inventions, nevertheless prior art includes not only patents, but all prior knowledge. This also comprises prior publication, abandoned invention, prior sale or offer for sale, prior use, and prior public and general knowledge. Secret prior art such as a secret sale is qualified as prior art in USA and not qualified in Europe. On the opposite, an oral disclosure is not qualified as prior art in USA and qualified in Europe.

US Patent office requires the inventors to list the most relevant prior art. There is no such requirement in European patent law, but it can be included in the invention description. Once the inventor knows the closest solution to his invention, it allows formulating accurately the difference and benefits of his/her invention, which eventually leads to faster and easier prosecution. Thorough prior art search saves the inventor's time and money during the patent prosecution.

6. TECHNOLOGY TRANSFER OFFICES

When the inventor has checked that the invention is novel and non-obvious and when the future profit of the invention commercialization is estimated, it is time to patent your invention. University employees have to proceed with their inventions through special departments, which are different in different countries.

United States of America

In US the inventors have to proceed through the departments called Office of Technology Transfer to commercialize their inventions. This Office receives the disclosures of inventions, assists in the registration of copyrights and trademarks, helps with the filing of patent applications (typically done by appointed law firm), determines who owns intellectual property, and handles the commercialization/licensing of intellectual property and the allocation of net royalties received.

Office of Technology Transfer at the university receives hundreds of invention disclosure forms (IDFs). It typically chooses to pursue about 1/3 of those and licenses 1/2 of these. Out of all licensed patents: about 10% break even, 5% make some money and 0.01% generates a million dollars of revenue.

Typical license fee includes: reimbursement and ongoing payment of patent prosecution costs, milestone payments,

minimum annual royalties, and a percentage royalty on sales. The revenue is typically split between the inventor(s), university and inventor's lab. For example, it could be split as follows: 34% +33%+33%; inventor share varies from 25% to 70%. In some Universities (e.g. Iowa) first $100,000.00 of net revenue is given to the inventor(s). In case of many inventors the revenue for them is typically share equally unless inventors agree otherwise in writing.

The economic impact of U.S. academia licensing results in the investments in $20 billion per year range, thus creating over 150,000 jobs per year .

Britain

The framework of the British system is similar, but not identical to that of the US. British TTOs are generally separate companies that are wholly owned by the university, rather than a department within the university. Oxford, for example, created a corporation named Isis for this task [2]. Cambridge owns the Cambridge University Technical services, Ltd. (CUTS) for its licensing work. According to British legislation, universities considered not-for-profit organizations, so they form whole owned corporation to perform licensing work and business.

The structure of payments received by the inventor is quite similar to the mentioned above US system. Typically, the inventor's share is relatively large (60-90%) from the first dozens of thousand pounds, and then it gradually drops as the revenue increases.

British patent law uses "first-to-file" principle, which means that prior publication essentially destroys the ability to patent the invention.

China

In 1990s Chinese government promotes formation of "high tech garden" at Chinese university, and according to the Shanghai Jiaotong University there are six such offices currently in China [2]. Prior to Deng Xiaoping's reforms of the Chinese economic system in 1978, all inventions belonged to the people of China. Currently China actively promotes the university inventions commercialization and payments of royalties to the inventors and universities.

China's generally accepts "first-to-file" principle with essential exceptions. In China the invention publication prevents its patentability (as in Britain). However presentation of the invention to an academic or technological meeting leaves the inventor with 6-month term in which he may apply for a patent. Additionally, for those applied for a patent abroad, there is still 12-months window of priority to patent in China.

Japan

Japan also establishes "first-to-file" rule, which is used by all other major nations except the United States. In many cases instead of reporting inventions to the university, the inventor disclosed it to a friendly corporation. Though no money exchange hands, the inventor gets certain benefits from that transaction such as a support for his research or other. A 1997 study of the Japan Bio-industry association found that 72% of genetic engineering patent applications have at least one university professor listed as an inventor. University of Tokyo' TTO reported in 1995 about the assignment of 150 inventions to private corporations rather than to the university. Japanese government is trying to combat this phenomenon and strengthen the patent assignment to the universities. To support these efforts, University of Tokyo founded CASTI (Center for Advanced Science and Technology Innovation) in 1998. Overall, CASTI handled over 1,000 inventions, and have succeeded in licensing 666 in total (as of the end of December, 2006) [7]. CASTI is a corporation, which is similar to British TTOs, however in Japan it is owned by the university professor rather than by the university.

The royalties from the patent licensing are split between the inventors, their department, CASTI and the university. Japan provides a six-month grace period during which the invention can be published prior to patenting, but only for publications by the inventor himself.

Germany

Until recently German professors has a special exemption from the patent law giving the rights to patent to the employer. Under this exemption, professors who conceived the invention held a right to patent it regardless of the source of funding for the research or the use of the university facilities to make it. Bundestag altered the law in 2002 giving universities the first right to patent. Germany uses "first-to-file" rule, which prevents patenting in case of publication. Since there were fears that professors would rather publish their inventions than transfer the right to the university, the part of this law requires academic journals to give a notice about a potential invention and give them two months to decide on the patenting. Federal Ministry of Education and research encourages introducing of a grace period between the publication and patent filing, it points out that the lack of this grace period "is a locational disadvantage Europe has with regards to the USA and Japan"[2].

The structure of the Offices of technology Transfer is different compared to US. German government supports financially Patent Valorization Agencies (Patentverwertungsagenturen/PVA). Each PVA commercializes research potential and results on behalf of a number of universities, university colleges and research institutes. Nearly all German Universities have bonds to one of the 20 PVAs.

Israel

Israel spends 3.6% of its GDP on research and development, which is third-highest in the world per capita. Israeli Intellectual Property law is quite similar to British law. Israeli universities own Technology transfer corporations, and they evaluate the commercial potential of the invention similar to the US TTO operation. The most famous is TRDF, Ltd., the TTO of Technoin University [8].

Brazil

In Brazil, a special study of TTO performance has been published in 2006 [9]. It indentified 28 TT Offices associates with the universities, mostly public universities. Brazilian TTOs perform a triple function: 1) management of university-enterprise interaction activity; 2) intellectual property register; 3) technology transfer through technologies and patent licensing. 16 Offices out of 28 are involved in patent licensing activity, which resulted in total 14 patents licensed. Despite of the difficulties, Brazilian TTOs gradually change the intellectual property landscape at the universities and promote cooperation between universities and industry.

7. IP RIGHTS OWNERSHIP AT THE UNIVERSITY

Bayh-Dole Act (1980) gave a right to universities to retain title to inventions made under federally-funded research programs. Prior to that act, the inventions belonged to the Government, however it did not have any structure to proceed with the invention commercialization, there were no mechanism to get the benefit out of those inventions. Even if nowadays we complain about the shortcoming of the current system, it was obviously a progressive step at that time.

Universities are expected to file patents on inventions they elect to own, and they are encouraged to collaborate with commercial concerns to promote the utilization of inventions arising from federal funding. The preference in licensing is given to small businesses. The government retains a non-exclusive license to practice the patent throughout the world and retains march-in rights in case of emergency.

Besides federally-funded research, almost each scientist is involved in a number of projects funded by industry or various agencies.

In case of US Government Agencies contracts such as DARPA, Department of Defense, Department of Energy and other, the right in IP are determined in the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulations (DFAR). Description of rights in technical data can be found at the web site: http://www.acq.osd.mil/dpap//dfars/html/current/252227.htm#252.227-7013 . The rights in Noncommercial Computer Software are described at this web site: http://www.acq.osd.mil/dpap//dfars/html/current/252227.htm#252.227-7014 . In brief, the university owns the rights in inventions that precede the beginning of the contract, the Government has limited

rights in the projects, which have joint funding, and the Government owns unlimited right in the research performed exclusively under the funding from the agency.

Intellectual property right in industry sponsored research usually results in the invention ownership by the university. In USA university always retains rights, at least to continue research in the same field. The sponsor may own the intellectual property if (2) the research is based on the sponsor's IP or development, or/and (2) the sponsor likely to be the only user. The university and the sponsor may jointly own the intellectual property. Joint ownership means that each owner has independent right to exploit the intellectual property. The university may sell full rights in IP to the sponsor's competitor after the end of the project without asking permission from the sponsor.

University researchers must be able to publish the results in the sponsored research. The sponsor may have a right to review the results prior to publication, which commonly takes about 45 days. The sponsor may have a right to patent innovations, which may take another 30 to 75 days. So in industry-sponsored research, the conference presentation supposed to be written in advance, giving the sponsor time to review and file the patent application if needed.

In Europe: industry may own all rights, provided they pay on a model that considers 100% of the costs including personel, equipment amortization and overheads [10].

8. SPIN-OUT COMPANIES

Increasing use of spin-out companies for the development and exploitation of the university inventions is the modern trend all over the world. These entities are jointly owned by the university and industrial investors. The IP may be assigned or licensed to the spin-outs.

According the survey of the US Association of University Technology transfer Managers [11], in 2008: 648 new commercial products introduced, 5,039 total license and options executed , 595 new companies formed, about 72 percent of new companies formed with the primary place of business in the institution's home state, total of 3,381 startup companies still operating as of the end of FY2008, $51.47 billion total sponsored research expenditures.

In USA the spin-out companies get their funding from various Government agencies, from venture capitalists (also known as a VC) and angel investing. VC is a person or investment firm that makes venture investments, and these venture capitalists are expected to bring managerial and technical expertise as well as capital to their investments. A venture capital fund refers to a pooled investment vehicle (often an LP or LLC) that primarily invests the financial capital of third-party investors in enterprises that are too risky for the standard capital markets or bank loans.
In addition to angel investing and other seed funding options, Venture capital is attractive for new companies with limited operating history that are too small to raise capital in the public markets and have not reached the point where they are able to secure a bank loan or complete a debt offering. In exchange for the high risk that venture capitalists assume by investing in smaller and less mature companies, venture capitalists usually get significant control over company decisions, in addition to a significant portion of the company's ownership, including IP ownership.

Absence of VC investment in EU spin-off funding is considered as a positive trend by some EU experts [12]. The companies have to struggle and work on a positive monetary balance right from the beginning.

9. CONCLUSIONS

The specifics of university inventing is in the following:
1) The invention ownership depends the type of financing: (a) federal, (b) government agency, (c) industrial sponsor; however university typically keeps the right to continue research in the patented field;
2) It is necessary to prosecute the application using Office of Technology Transfer (or similar organization);
3) The monetary reward is obtained via (1) the patent licensing through the Office of Technology Transfer or/and (2) the startup formation;
4) In case of the patent licensing through the university, the inventor typically receives about 1/3 of the revenue;
5) In case of startup formation, the patent revenue is often shared with the company investors;

6) Differences in Patent Law of various countries must be taken into account if international protection of the invention is sought. In majority of countries (exceptions: USA and Japan) the material publication prior to patenting is not allowed.

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