Master Thesis

Knowledge and Technology Transfer Pathways for Effective Exploitation of Intellectual Property at Universities

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Graz, July 2015

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Acknowledgements

I want to thank my wife for being supportive, full of love and providing finances. Without her, my success would not be possible.

Also, I want to thank my parents, my brother and sister for encouraging me during my education and throughout my life.

Furthermore, I thank Research & Technology House for giving me this opportunity and always providing answers to my questions.

Last but not least, I would like to thank my supervisor Thomas Böhm for giving me guidance and support.

Abstract

Universities worldwide are struggling to gain profit from its innovations. There has been an increase in patent applications, but these patents are frequently left unused or there is a problem with its commercialization. Currently the most frequent way of technology transfer is by telephoning companies that might be interested in patent rights, which is ineffective and time consuming. Further issue is the lack of resources and employees in technology transfer offices. Universities in the USA are gaining more profit and have more resources than the rest of the world, but even they are struggling with commercialization with only average of 5% of patents being licensed. Constant increase in patents results in technologies in various stages of development that need effective and efficient methods for commercialization.

Aim of this thesis is to find technology transfer methods that enable more effective and efficient exploitations of technologies in various technology fields and stages of development. In this purpose, a statistical overview of patent application trends in Austria, Germany, Switzerland, the UK and the USA is shown to examine the increase of patents from various technology fields that need to be commercialized. For the first time, there has been more than 200.000 international patent applications worldwide, which is evidence that the innovators are focusing more on going outside of their countries' borders.

Easy Access IP is the solution that provides licenses for patents for free of charge, which reduces companies' investment risk. Furthermore, in the last years online marketplaces have emerged and made it easier to sell or license technologies by uploading them in a database on a website. In that way, companies have a single place to look for interesting innovations. Patent auctions are a novelty for universities, but represent a technology transfer method from which universities can profit in managing their patent portfolios. Creating a spin-off company is a method that can bring profit for the university in the long-run and further develop scientific knowledge.

Exhibitions are an excellent method to market innovations by connecting with companies as they ensure exposure of university-made innovations. Finding partners for research projects is facilitated with the use of Enterprise Europe Network whose aim is to help universities make impact on European economy. Non-practicing entities or "patent trolls" are companies that buy patent rights only to legally sue their misuse by others. Hence, selling patents to such organizations might bring short term profit to university, but as "patent trolls" are not promoting technology transfer *per se,* in the long term it is not a preferable option and it might affect university's reputation.

Using these methods is possible without a significant increase in budget which makes them very attractive. These methods provide more efficient and effective technology transfer for innovations in every stage of development which will increase spread of knowledge and technology throughout the world for gain in profit and reputation of universities.

Table of Content

1 Introduction

Scientific and technological advancements greatly depend on knowledge exchange and technology transfer pathways between universities and the industry. In the last years due to the fast increase in technology developments, universities are in need of more effective and efficient methods of knowledge transfer. Hence, next chapters of Introduction will discuss initial situation and current problems universities are facing with technology transfer and main objective will be set in detail. Furthermore, a description of Research & Technology House, a technology transfer office of the Technical University of Graz, will be given.

1.1 Initial situation

The relationship between science and industry is considered as a large factor contributing to high innovation performance at university or industry level. That relationship is stronger with exchanging technologies and knowledge, which is known as technology transfer (TT). TT is the process of transferring skills, knowledge, findings and technologies between universities, governments, research institutions, and companies to ensure that technological and scientific advancements are accessible to a wide range of users who have the ability to further develop technology, make new products, processes and applications.[1]

Even though companies are publicly known to innovate and make new technologies, universities as well create many valuable technologies. The problem is that these technologies are often ignored for the lack of initiative, or they are wrongly and badly commercialized. When a new technology or invention is created at the university, the technology transfer office (TTO) is responsible to commercialize these inventions and technologies. Often the financial aspect is important and the budget of the university and its TTO often makes a difference. A larger budget will help obtain a higher rate of technology exploit.

TT activities should not be only the responsibility of the TTO, the university should play a key role here. The university has guidelines and policies, which define and enforce ways new inventions should be exploited in best interest of all parties: public's, inventor's, and the university's. Universities often must decide between basic research and commercially oriented work, which influences university's performance and reputation. [2]

[1] Cf. Grosse (1996), p. 782
[2] Cf. Artley (2003), p. 142

Exploitation of technology could be done by a number of key players: the inventors alone, TTO, external TT agency and a combination of all three.

Inventors are known to exploit technology by famous myth „invented in the garage“, but university's researchers have different way of TT. In Austria, since 2002[3], the university is the owner of intellectual property (IP). After the inventor reports to the university about the invention, the university has three months to decide if it intends to claim the title of its invention. Otherwise the inventor will be entitled to IP rights.

If the university decides to claim the rights, exploitation of the invention will be the job of the TTO. The TTO aims to generate return on public funds invested in university and respective invention. This is the most common way of TT at universities which is taken without much consideration, since university wants to retain control of the invention.

An external TT agency is a company that has funds and experience in TT and provides services to universities and companies in commercialization of technologies.

In these modern, fast-changing times, universities should concentrate on newer and quicker ways of transferring technologies, which will provide faster way of return of investment and will increase university’s reputation.

1.2 Research & Technology House

The Research & Technology (R&T) House is a TTO, which is part of Graz University of Technology (TUG), Austria. R&T House provides many different services for the university’s researchers by supporting their projects from the early idea to a successful conclusion and transfer of the results. Since it has connections with the industry, businesses and other TTOs, R&T House provides services for all parts of knowledge and TT[4].

Furthermore, R&T House provides consulting and custom-made services, which can be adapted individually depending on the project based on its volume, complexity and costs. Those services are quality management, management of resources and finances, communication with the European Union and project partners, and administration of the complete project form the start until the end report.

Since August 2014, TUG and R&T House are coordinating the “Knowledge Transfer Centre Austria South”. Aim of Knowledge Transfer Centre is to provide an overview of research projects and appraise them in order to determine their commercial value. Six universities are part of the Knowledge Transfer Centre South, and they need to share

[3] Cf. Universities Act (2002), https://www.ris.bka.gv.at, date of access: 03.05.2015.
[4] Cf. Research & Technology House (2015a), http://portal.tugraz.at, date of access: 03.05.2015

resources and knowledge to increase know-how about TT, which will help in commercialization of inventions.[5]

Since universities decide which inventions are commercialized and which are left to inventors, all inventions must be reported to the Rectorate of the university. At TU Graz inventors must report inventions to R&T House, which evaluates inventions internally or with the help of external TT agencies. Based on these evaluations, R&T House decides if the invention is patented.

1.3 Problem statement

Objective of TU Graz is to increase the university's reputation through knowledge sharing and gaining profit from research projects and technologies created at the university. Since R&T House is the TTO of the TUG, it is a very important part in fulfilling these objectives.

Intellectual property (IP) is a creation of the mind, such as technological inventions. Invention is a process or a product that provides a new way of doing something. It can be protected by the law with patent rights, copyrights and trademarks to earn recognition or financial gains. A patent is an exclusive right which is granted for an invention[6]. In this thesis, focus will be placed on patents.

Along with the increase of application for patents in Austria[7], including in a leading technical university in the country TU Graz, there is a need for more effective and efficient method to transfer patents to companies. Currently, R&T House is offering patents directly to companies. This direct method is only effective in case R&T House is aware of technologies needed in specific companies, which is very rare. Furthermore, it could take long time to find the right company and specially the right person within the company that can provide needed information.

Since the number of innovations created daily throughout the world is quite large, universities need to increase effectiveness to become bigger players on the market with more efficient TT. Frequently, universities have many innovations, which are in an early stage of development or are not being used. That means they failed in the market in one way or the other. Reviving unused patents or finding funds to further develop early-stage technologies is not an easy task. But, it is another very promising avenue of innovation and should be further pursued.

[5] Cf. Research & Technology House (2015b), http://portal.tugraz.at, date of access: 03.05.2015
[6] Cf. Boyle et. al. (2014), p. 6
[7] Cf. Boyle et. al. (2014), p. 27

A further problem is that some patents are presumed as not highly profitable, so R&T House does not want to spend large amounts of funds to transfer these patents. And since R&T House is publicly funded, finances are always in the center of attention and there are no possibilities to increase the low yearly budget. It is also not easy to know the values of patents, and using an external agency for the value assessment is not an option, because those can be very costly.

1.4 Objectives

Based on the problems mentioned in the previous chapter, the objective of this thesis is to find effective and efficient ways for exploitation of IP at universities.

With these new ways, best practice examples should be described. Since, TU Graz is from Austria, the scope is to concentrate on German-speaking countries (Germany, Switzerland and Austria), United Kingdom (UK) and United States of America (USA).

Universities aim to transfer technologies to worldwide operating companies. Furthermore, an overview of business perspective from companies about TT and examples which TT ways they use is an objective that should be provided.

Additional objectives should be TT ways that do not need extra investments, finding ways to transfer technologies in every stage of development, easier search for research project partners, and a way to make stronger connections in industry and other universities.

1.5 Approach

To achieve above objectives, different methods will be used. Technology transfer will be discussed in detail by searching through published articles and books. By interviewing experts and professionals from universities and companies, detailed information and experiences will be given about effective and efficient TT ways. To obtain more information about the performance of certain TT ways, reviews about its success will be examined. Since some TT ways exist for many years, finding possibilities to improve it will be necessary.

2 Technology transfer

In order to find technology transfer methods that enable more effective and efficient exploitations of technologies in various technology fields and stages of development a statistical overview of patent application trends in Austria, Germany, Switzerland, the UK and the USA is shown to examine the increase of patents from various technology fields that need to be commercialized.

2.1 Technology transfer and technology transfer office

The most popular way of TT is considered to be a direct contact with the company, but it is also the hardest way since it is not easy to find the right person within the company. The organizational structure of each company is different, with distinct departments and ways of doing business. Some companies are currently not doing any project with universities and perhaps do not trust innovations from universities. Getting into contact with companies is one of the jobs of TTO. Activities of TTO include eight basic functions:[8]

1. Helping create entrepreneurial culture
2. Sourcing and capturing technologies: patenting
3. Evaluation: find significant commercially viable applications
4. Marketing: capturing buyers / investors
5. Doing deals: licensing, selling, company formation
6. Monitoring deals
7. Self-sustainability
8. Internal reporting and publicity

One of university's aims is to have entrepreneurial culture and TTOs are supporting this initiative for entrepreneurship on an executive and operational level. There is a popular perception that entrepreneurship is about taking risks which is not correct. It is more about recognizing opportunities and seeing and identifying risks to make opportunities real.[9]

Patenting is about persuading innovators to provide information about inventions to the TTO. The core activity of the TTO is the evaluation of inventions. It is difficult to evaluate each invention precisely, but there are some common steps: timing, market research, patentability, advantages of the invention, ethical questions, asking experts opinions and finally feedback and decision.[10]

[8] Cf. Artley (2003), p. 145
[9] Cf. Artley (2003), p. 147
[10] Cf. Artley (2003), p. 152

When decision is made, marketing is the next activity. Finding buyers, investors and companies is important since companies are not constantly scanning the websites of universities for new technologies, TTOs job is to directly offer innovations, organize events to promote them or use web platforms that have many visitors to make sure that inventions are viewed.[11]

The most significant part is the connection with companies, or more precisely - doing deals. That is the part that is publicly most visible and creates impact on university's earnings and reputation. After a done deal, TTO has to make sure that deals are honored and all payments are made, which is performed by monitoring. Monitoring can be done weekly or monthly with yearly reports from the companies.[12]

Self-sustainability is important for a department of the university that is not connected to teaching and whose goal is to earn money for the university. Even though most of TTOs are losing money[13], they need to ensure its own survival. This can be done with organizing, creating values of technologies for universities and other different ways. Since TTOs are departments of university, they need to provide regular work reports to the Rectorate and externally annual reports to public.[14]

Converting technologies into money is the main focus of TTOs. Since TTO employees have to work with different kind of IP, more precisely patents, and different kinds of TT ways, a high amount of skills is needed. The motivation and work of TTOs and their management of patents will be discussed in following chapters.

2.2 Patents and patent applications

When an inventor creates something, he or she applies for a patent in the patent office, usually called receiving office. One can apply in national patent office or in one of the international offices. The application represents a formal request for patent rights at a patent office. Then, the patent office examines the application and decides to grant or refuse the patent rights protection. An application can also refer to the documents submitted by an applicant to an office.

[11] Cf. Artley (2003), p. 173
[12] Cf. Artley (2003), p. 186
[13] Cf. Abrams (2009), p 13
[14] Cf. Artley (2003), p. 176

Application for a patent consists of five documents:[15]

- Request for grant
- Description of the invention
- Claims
- Drawings (if applicable)
- Abstract.

An invention can be patented only if it is new and previously undisclosed, distinguished by an inventive step not obvious to someone expert in that technology, and capable of industrial application - if it is possible to physically create an invention.[16]

After applying for a patent, the inventor has 12 months period of time (it is called "international phase"[17]) to apply for an international patent, which is called Patent Cooperation Treaty (PCT). PCT is the international patent systems that gives inventors international patent protection. PCT consists of 148 member countries throughout the world and inventors can simultaneously seek protection for an invention in these countries. The purpose of PCT is to make it easier and cheaper to file a patent application in a large number of countries. A PCT application does not automatically lead to global patent protection.[18]

After 18 months from the filing date, patent is being published by patent office. After publication, the inventor has 12 months to decide to patent its invention in other countries and must apply in each country individually. This is called "national phase"[19]. The national phase lasts 30 or 31 months, depending on the country, from the application date. After the national phase, the patent is granted. Figure 1 shows a schematic representation of this procedure.

[15] Cf. European Patent Office (2015), https://www.epo.org, date of access: 29.06.2015
[16] Cf. European Patent Office (2015), http://www.epo.org, date of access: 16.05.2015
[17] Cf. WIPO (2015b), http://www.wipo.int, date of access: 16.05.2015
[18] Cf. WIPO (2015a), http://www.wipo.int, date of access: 16.05.2015
[19] Cf. WIPO (2015c), http://www.wipo.int, date of access: 16.05.2015

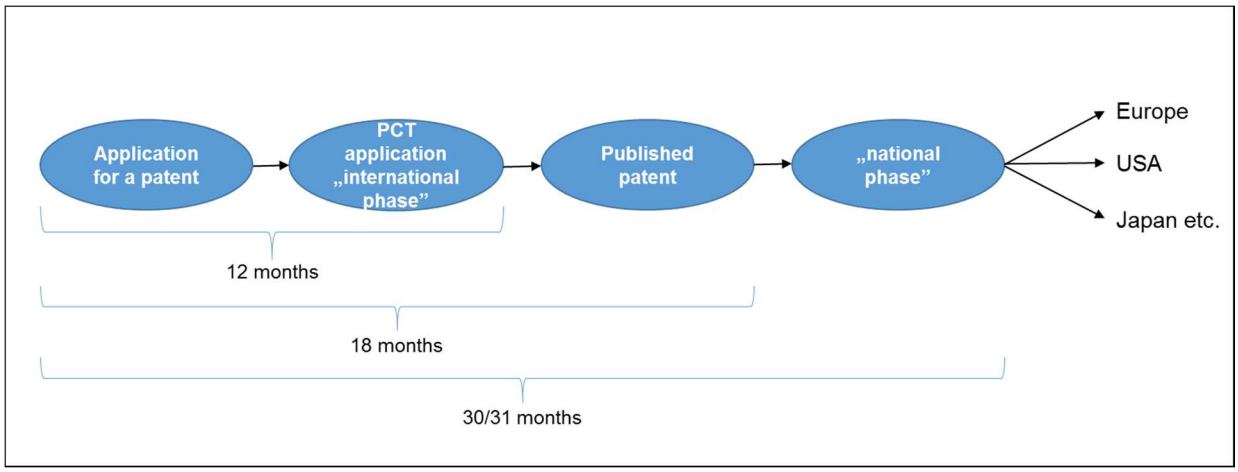

Figure 1. Schematic representation of international patent procedure[20]

Usually, the inventor of a technology is trying to license or sell the technology to potential buyers from the moment he or she applied for the patent. The goal is to find buyers before the national phase. Until that point, the inventor can see how many buyers are interested in its invention and in which countries can be patented. If buyers are not found until national phase, usually the inventor gives up on the patent rights. Giving up on the patent rights is connected with the costs of the entering in the national phase. With entering the national phase big increases in costs start, since PCT application is then converted into many national applications[21]. Each nation has different patent laws and costs differ for each country. Since each country has its own language, one reason the costs are often high, is the translation of every document concerning the invention. This can lead to not entering the national phase, which leads to dropping of the patent right.

2.3 Bayh – Dole Act

In 2002, The Economist published that the Bayh – Dole Act (BDA) was the most inspired piece of legislation that was executed in the USA in the last 50 years. BDA, executed in 1980, introduced that universities, non-profit institutions or small businesses can pursue the ownership of an invention which was funded by the government.[22] Before BDA, government funded research was owned by the government.[23]

The USA government owned around 28.000 patents in 1980, and less than 5% of that were licensed to industry. Taxpayers' money was provided for 60% of all academic

[20] Own illustration
[21] Cf. Campos-Jimenez (2014), p. 22
[22] Cf. Cornel University Law School (2015), https://www.law.cornell.edu, date of access: 05.05.2015
[23] Cf. Stevens (2004), pp. 93-99

research, but taxpayers were hardly getting anything back from it. After introduction of BDA, universities from the USA started innovating more and professors created start-ups from their inventions. BDA created more than 2.200 companies, 260.000 jobs and patents are now contributing $40 billion to the USA economy every year[24]. Also academic patenting increased drastically. In 1980, 390 patents were awarded to universities by US government, and in 2009 the number of patents awarded by the US government was 3.088. In 2012, universities in the USA had over 5.000 patents granted by United States Patent and Trademark Office (USPTO).[25]

It is highly unlikely that anyone in the TT community would dispute the success of the BDA, and foreign countries have decided to adopt the same model.[26] In 2002 Austria introduced the University Act, which is a similar model to BDA. Also, Germany introduced a model called “professors' privilege”, which came into act also in 2002[27], as in Austria. The UK does not have something similar to BDA, but with great support of the UK government, the UK works similar to the USA.[28] Switzerland has similar legislation to BDA, but the country consists of different cantons with distinct legislations.[29] Even though each of the mentioned countries have different legislations, they are somehow similar in enforcing the law about university patents.

2.4 Patent application trends 1999-2013

Since the introduction of the BDA, an increase in patent applications from universities, companies and individuals has been registered in several European countries. In the next chapters a statistical overview is given for a comparison of patent application trends in Austria, Germany, Switzerland, the UK and the USA. Furthermore, increase and/or reduction of patent applications, patent grants, PCT applications and patent applications by technology fields are discussed.

There are three different categories of applications that are taken into account in this statistical analysis:

1. Resident
2. Non-resident
3. Abroad

[24] Cf. The Economist (2002), http://www.economist.com, date of access: 05.05.2015
[25] Cf. National Science Board (2014), http://www.nsf.gov, date of access: 05.05.2015
[26] Cf. Stevens (2004), pp. 93-99
[27] Cf. Ledebur et al. (2009), p. 65
[28] Cf. Willey et al. (2010), p. 17
[29] Cf. Chardonnens (2010), p. 8

Resident applications come from inventors residing in the same country where the filing office has jurisdictions. For example, an application filed in Austrian Patent Office by a person living in Austria is considered as a resident application. Non-resident applications are filed by an applicant residing in a different country than the filing office. For example, Austrian resident filing application in USPTO. Abroad applications filed by a resident of one country in another country's patent office. It is always seen from the resident's country point of view. For example, Austrian resident filing in USPTO is filing an abroad application from Austria's point of view.

Statistical overview discusses years from 1999 to 2013, because there is evidence of patent applications only for these years[30]. Also, it shows three years before introduction of BDA in Austria and Germany, and some conclusions can be extracted on its success.

2.4.1.1 Austria

Movements of filed patent applications from 1999 to 2013 by Austrian residents and non-residents, and by Austrian residents abroad are displayed in Figure 2.

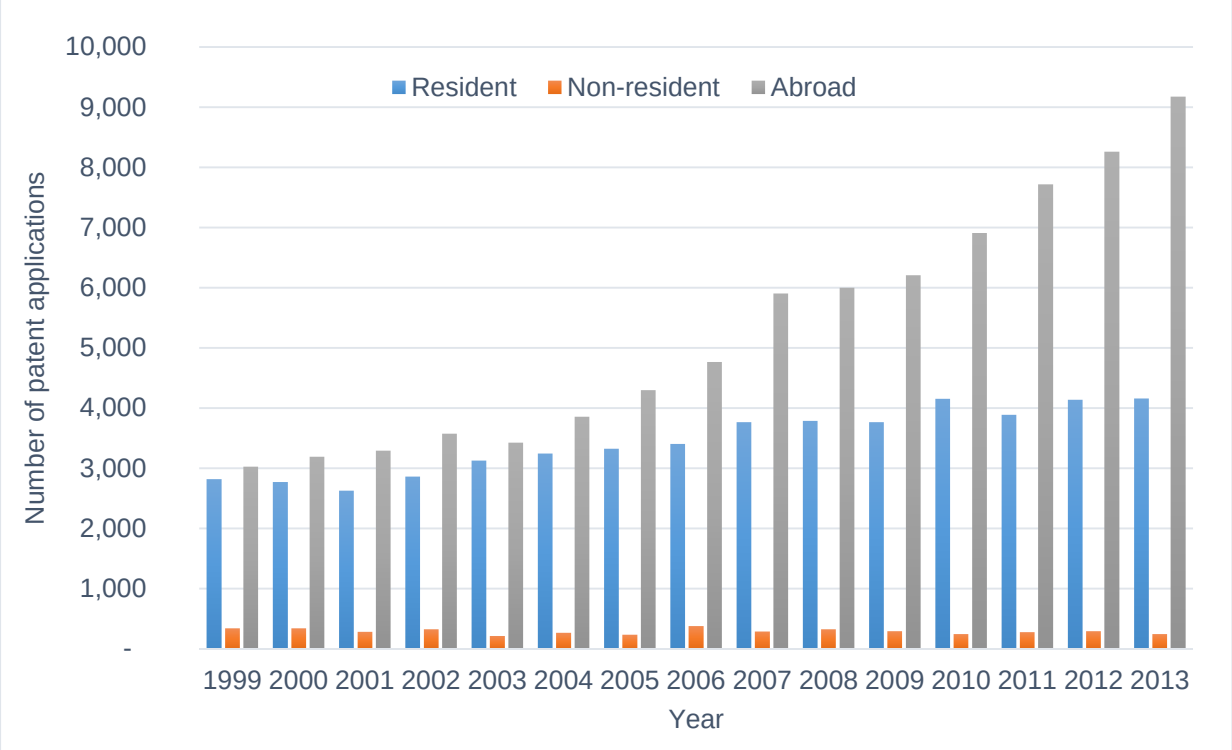

Figure 2. Patent applications in Austria and by Austrian residents abroad[31]

[30] Cf. WIPO (2015e), http://www.wipo.int, date of access: 01.06.2015
[31] Cf. WIPO (2015e), http://www.wipo.int, date of access: 16.05.2015, own illustration

From 1999 until 2004, the number of abroad patent applications was almost constant on annual basis. But from 2004, an increase is clearly seen and that year number was 3.858, but in 2013 was 9.176, which is an increase of 237%. In 2013, Austrian residents filed for 4.159 patents, which is an increase of almost 50% compared to 1999. From 2004, 2 years after introduction of University Act, patent applications by Austrian residents in Austria is in almost constant increase. From the same year, abroad applications are increasing by even higher rate. There is a distinct difference between abroad and resident applications, with former being more than 100% higher in 2013. With residents and abroad on a rise, it is interesting to see that non-resident applications are not going up, but on contrary falling down. It could be speculated that Austria is not an attractive market for non-residents, but reasons for unattractiveness of the market is unknown.

If only granted patents are taken into consideration, numbers are smaller. Nevertheless, the year-on-year basis increase is clearly visible. In Figure 3, the granted patent applications in Austria are displayed.

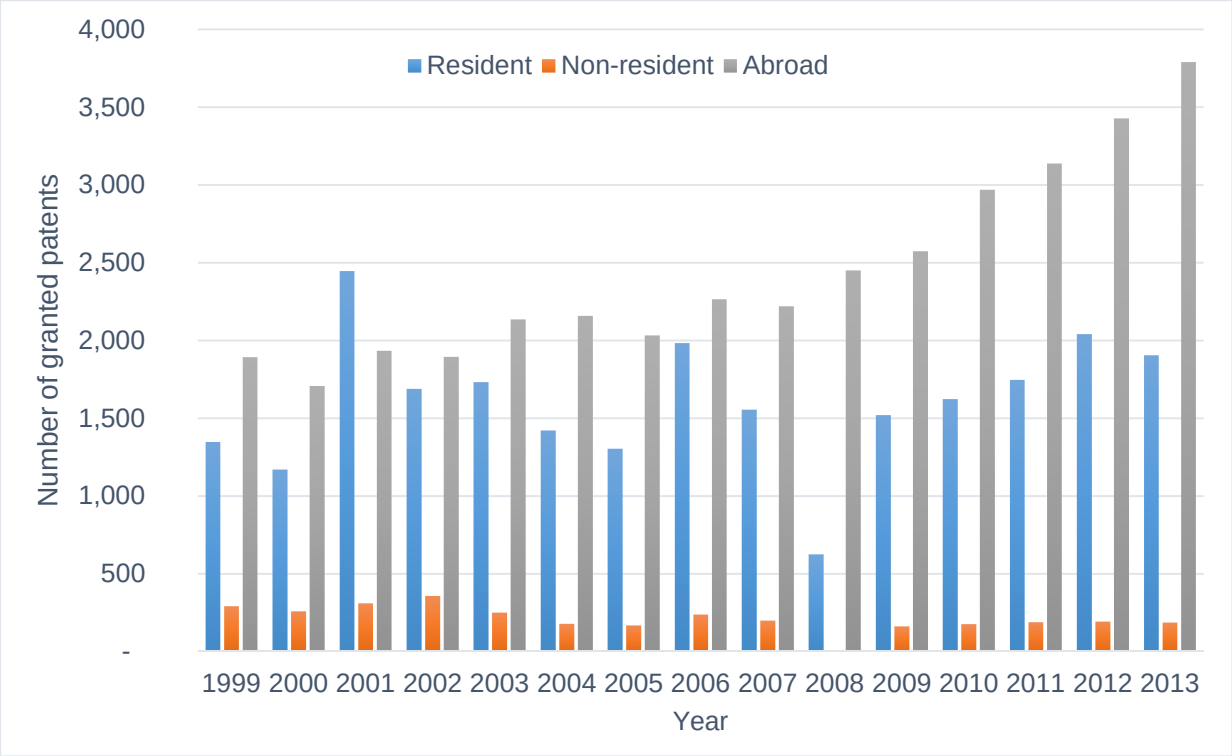

Figure 3. Granted patents in Austria and by Austrian residents abroad[32]

[32] Cf. WIPO (2015e), http://www.wipo.int, date of access: 16.05.2015, own illustration

Granted patents from Austrians abroad is on a constant growth from 2008, and has seen an increase of around 200% from 1999 until 2013. Before 2008 abroad grants are oscillating. Patent grants from Austrian residents are oscillating on an annual basis in every viewed year. Highest number of granted patents by residents was seen in 2001 with 2.447 granted patents. Non-residents granted patents are mostly decreasing. In 1999 non-residents have been granted 291 patents, and in 2013 only 187. Reasons for the decrease are unknown. For year 2008, number of non-resident patent applications is unknown.

PCT applications made by Austrian residents is shown in Figure 4. It clearly shows the year-on-year increase in PCT applications. Increase is specially seen from 2002, which is the year when University Act was introduced. Only 552 PCT applications were filed in 2002, but in 2013 there were 1.262 filled PCT applications. The year with the highest number of PCT applications was 2011. There is a slight drop in PCT applications from then, but reasons for that are not known.

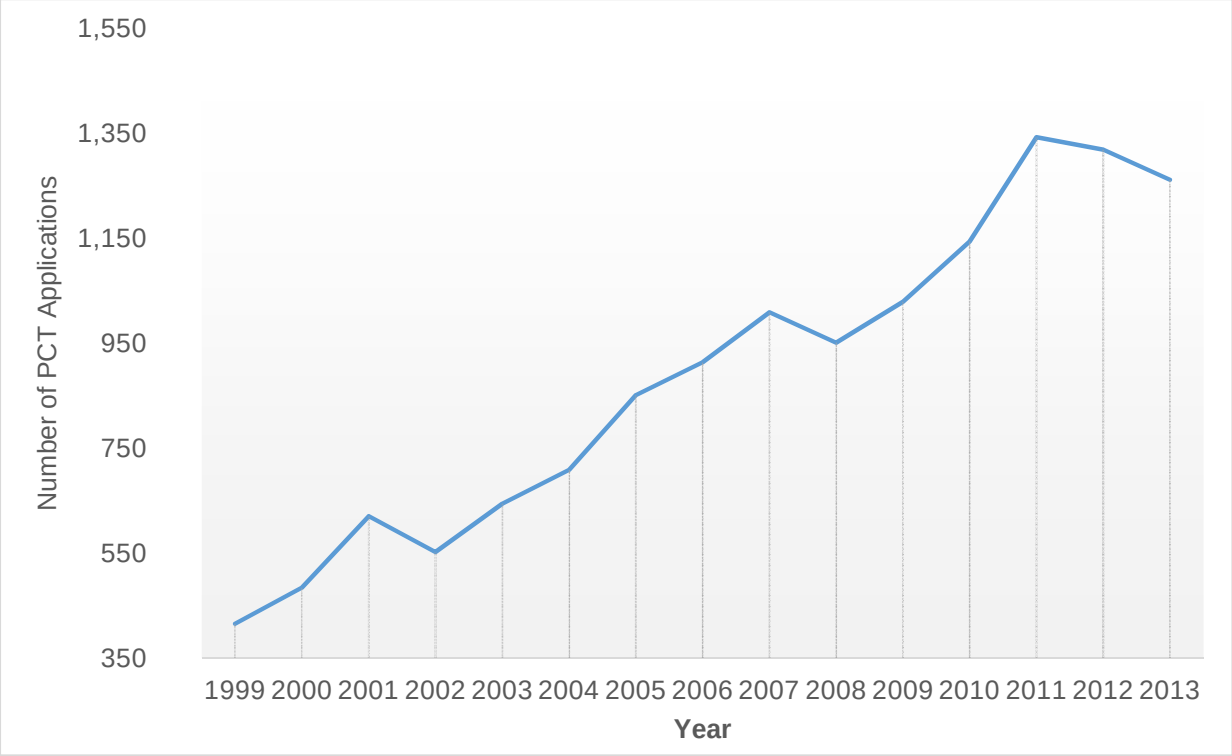

Figure 4. PCT applications by Austrian residents[33]

Each country has main focus based on the types of industry and the number of patents filled per industry. Figure 5 shows filed patents in Austria in percentages from years 1999

[33] Cf. WIPO (2015e), http://www.wipo.int, date of access: 16.05.2015, own illustration

to 2013. Most patents were filled for civil industry (8.79%), with close second electrical machinery, apparatus and energy (7.34%). Furthermore, only transport industry and other special machines see share with over 5%. Medical technology is at only 3.9%.

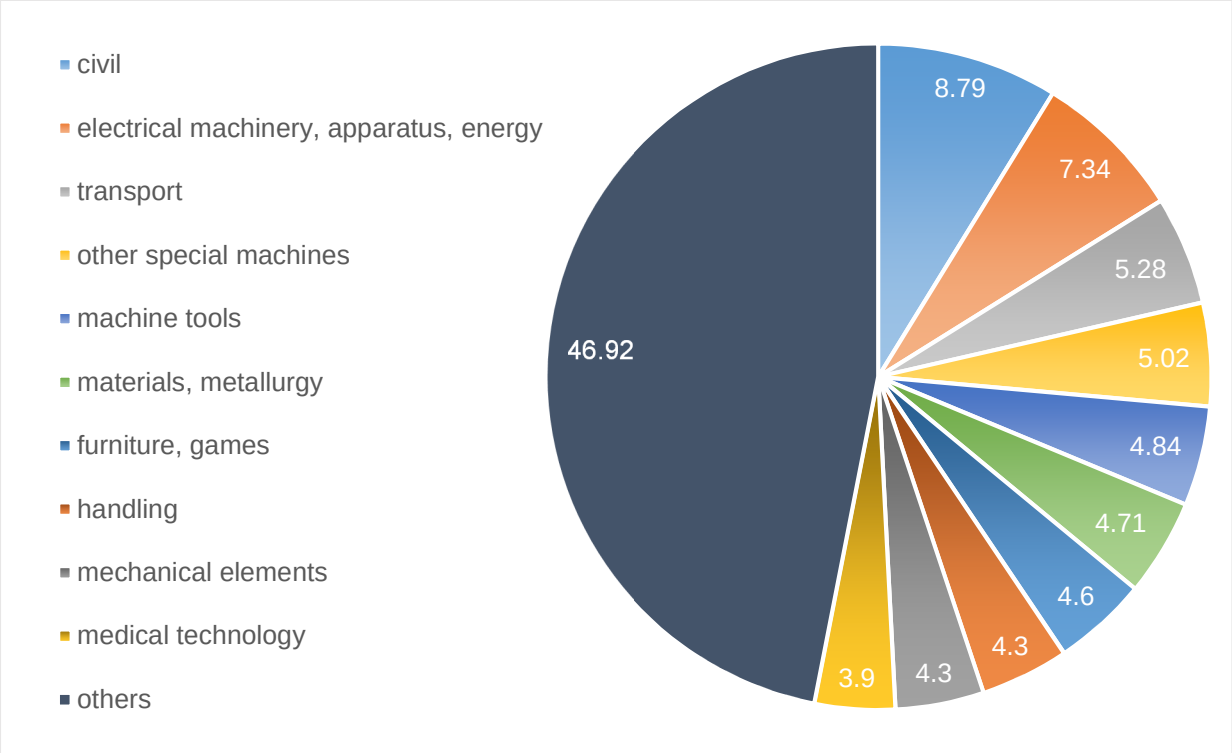

Figure 5. Patent applications in Austria by technology field given in % (1999 – 2013)[34]

2.4.1.2 Germany

Germany[35] has 10 times greater population than Austria[36], and this is reflected in patent applications made in Germany and by German residents. Applications made by residents are almost constant from 1999 onwards, but abroad applications are on a constant rise from 2003. From 1999 until 2003, abroad patent applications were around 60.000, and after 2003 started to rapidly increase. In 2013 German residents abroad made 110.546 patent applications, which is an increase of 72% from 2003. Even non-resident applications had a high increase from 10.633 in 2003, to 15.814 in 2013 which is an increase of almost 50%. Until 2004 there were more resident than abroad applications. In 2013 abroad applications were 35% higher than resident applications. Non-residents

[34] Cf. WIPO (2015e), http://www.wipo.int, date of access: 16.05.2015, own illustration
[35] Cf. Statistisches Bundesamt (2015), https://www.destatis.de , date of access: 22.05.2015
[36] Cf. Statistik Austria: (2015), http://www.statistik.at, date of access: 22.05.2015

filed 65% more applications in 2013 than in 1999. Patent applications by German residents, non-residents and abroad are shown in Figure 6.

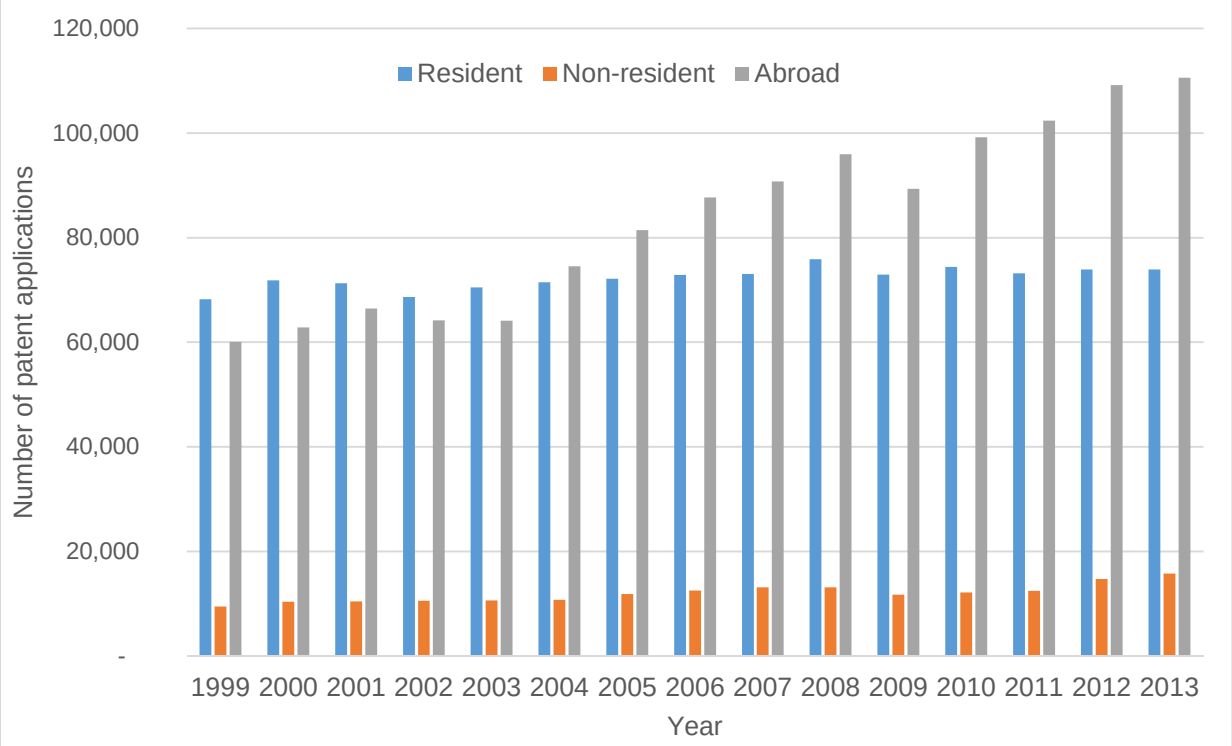

Figure 6. Patent applications by German residents, non-residents and abroad[37]

Figure 7 shows how abroad granted patents started to regularly increase on a year-on-year basis from 2009. From 2002 to 2009, number of granted patents has been oscillating but the number was always around 40.000 granted patents. Interestingly, the number of granted patents by German residents was highest in 2006 (29.731 patents), and in 2013 was 20% lower than in 2006. Non-residents had only 4.033 granted patents in 2013, which is an increase of 20% from 1999, but it is constantly oscillating with 5.577 granted patents in 2006, which is only one year with over 5.000 granted patents by non-residents.

[37] Cf. WIPO (2015f), http://www.wipo.int, date of access: 16.05.2015, own illustration

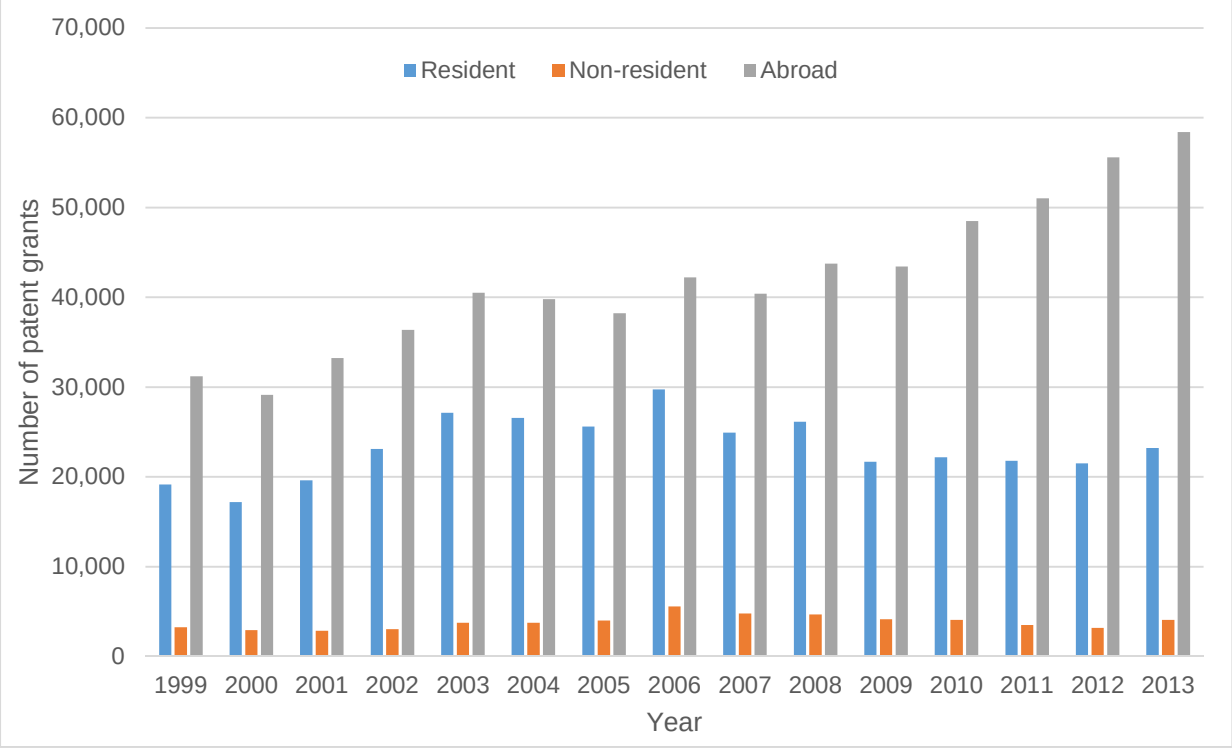

Figure 7. Patent grants by German residents, non-residents and abroad[38]

International patent applications (PCT) by German residents were constantly increasing from 1999 until 2008. In 2009 there was a drop of 12% from previous year, but that could be connected with the Global Financial Crisis in 2008[39]. Already in next year was an increase of 10%. In 2013 there were 70% more PCT filed applications than in 1999. PCT applications trends in Germany are shown in Figure 8. Austria and Germany have clear difference in comparing non-residents with other the two categories. Non-residents are filing much less applications. Reasons for this difference can only be guessed.

[38] Cf. WIPO (2015f), http://www.wipo.int, date of access: 16.05.2015, own illustration
[39] Cf. Reuters (2009), http://www.reuters.com, date of access: 22.05.2015

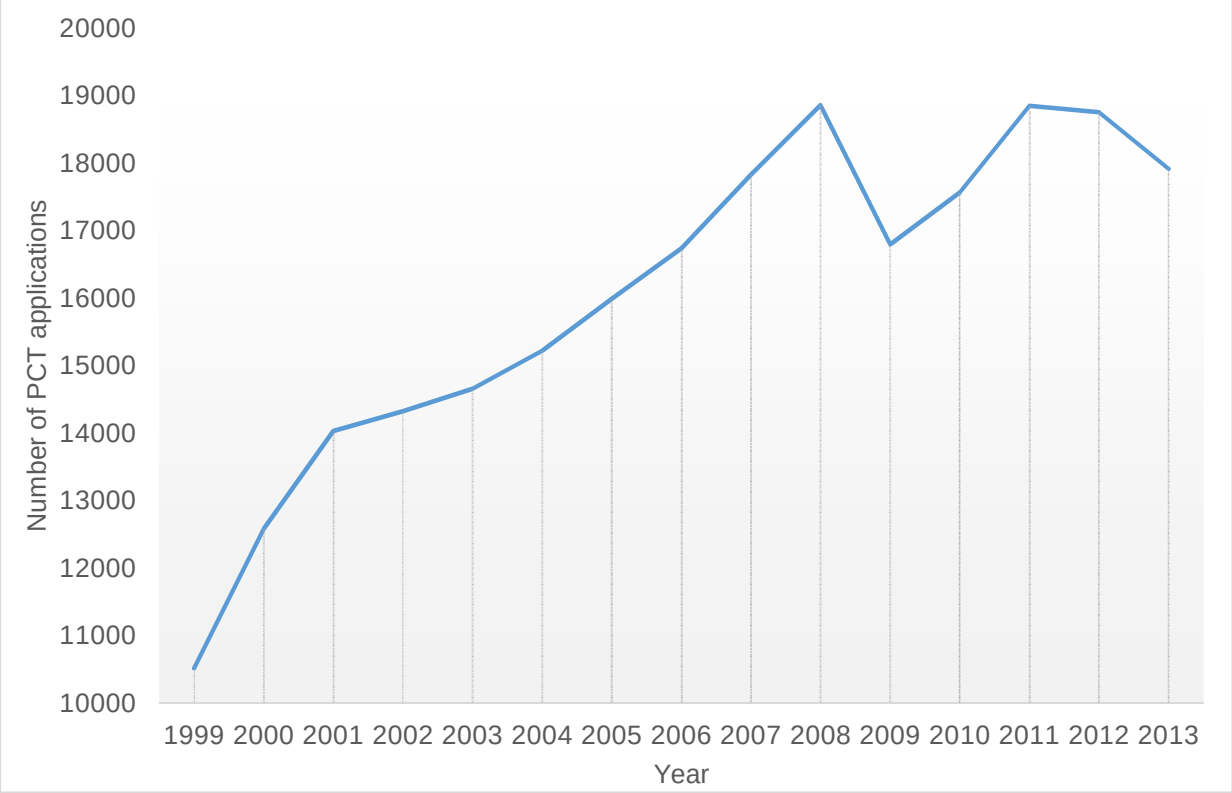

Figure 8. PCT applications by German residents[40]

Germany is well known worldwide for automotive industry, which can be also seen in Figure 9. The technical field with the most patent applications was transport with 8.49% share in counted years from 1999 to 2013. Electrical machinery, mechanical elements, engines and measurement fields are all above 5%, which are all fields that innovate technologies for automotive industry.

[40] Cf. WIPO (2015f), http://www.wipo.int, date of access: 16.05.2015, own illustration

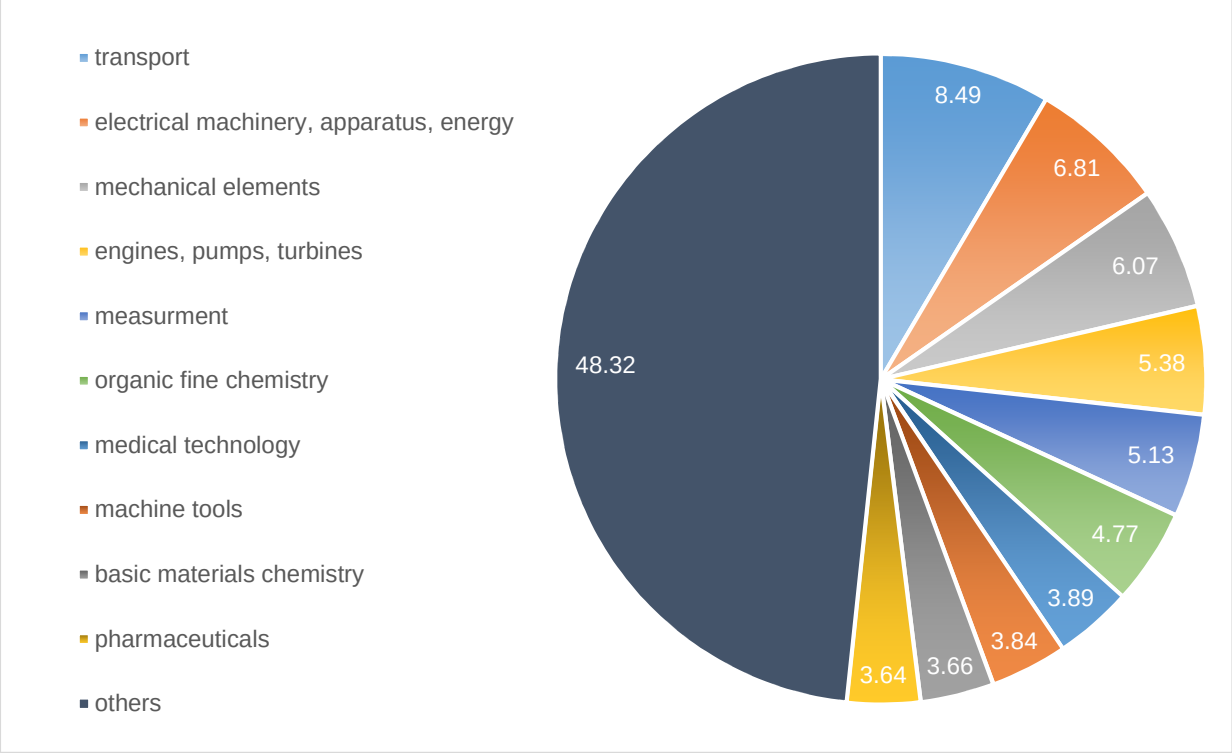

Figure 9. Patent applications in Germany by technology fields given in % (1999-2013)[41]

2.4.1.3 Switzerland

Switzerland, has 8.2 million residents[42], which is a bit fewer than Austria. Surprisingly, patent applications are much higher than in Austria. In 2013, there were 8.187 applications for a patent by residents of Switzerland and only 4.159 by Austrian residents. Switzerland had 36.809 abroad patent applications, but Austria only 9.176, which is a huge difference considering that the population of Austria is greater than in Switzerland. But Gross Domestic Product (GDP) is taken into consideration, that difference in patent applications is clearer. Switzerland GDP in 2013 was $685.4 Billion[43] which is 60%[44] more than in Austria in the same year. From 1999 until 2013 there was a constant increase in abroad patent application in Switzerland. Only in 2009, the year of Global Financial Crisis, was a slight drop in abroad patent applications. Figure 10 shows trends in patent applications in Switzerland.

[41] Cf. WIPO (2015f), http://www.wipo.int, date of access: 16.05.2015, own illustration
[42] Cf. Swiss Federal Statistical Office (2015), http://www.bfs.admin.ch, date of access: 22.05.2015
[43] Cf. The World Bank (2015a), http://data.worldbank.org, date of access: 22.05.2015
[44] Cf. The World Bank (2015b), http://data.worldbank.org, date of access: 22.05.2015

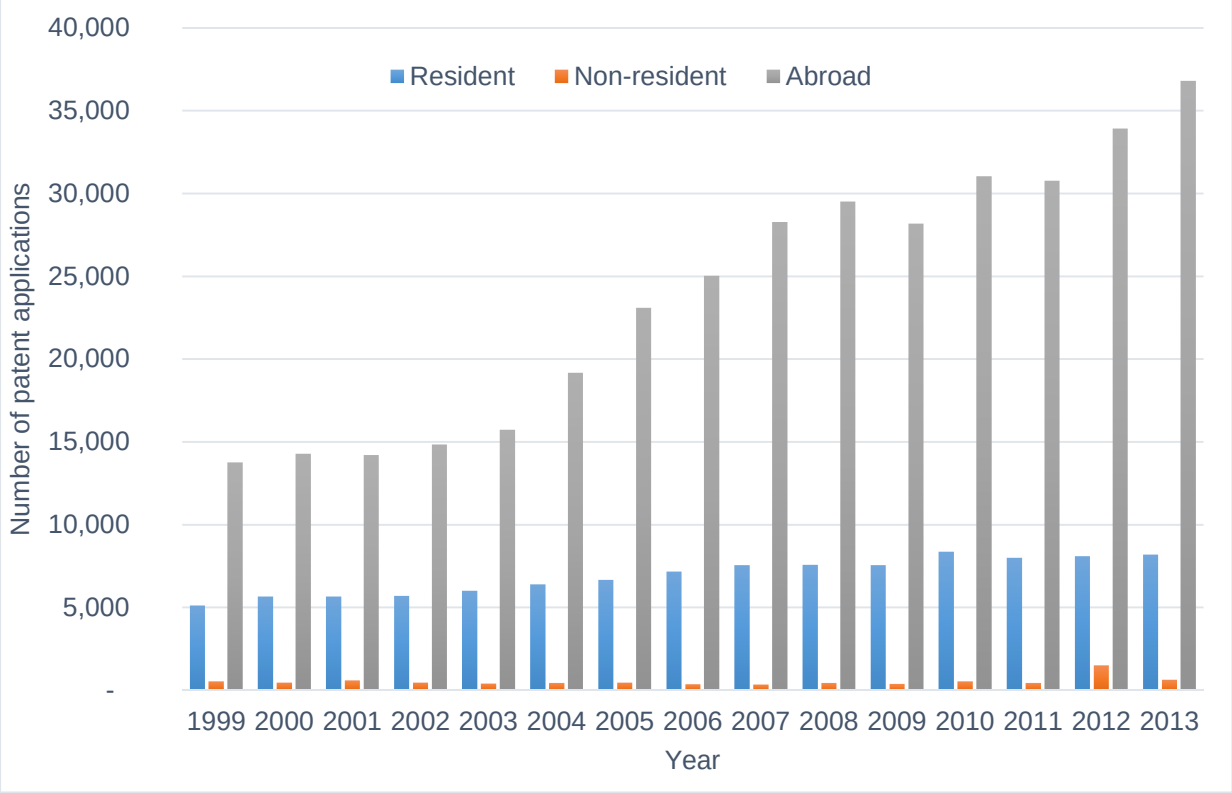

Figure 10. Patent applications in Switzerland by residents, non-residents and abroad[45]

Resident patent applications are constantly increasing with around 5% per year. There were 8.187 resident applications in 2013, and that is 60% more than in 1999. Non-residents are almost negligible when other two categories are taken into account. In 2013 non-residents had only 631 applications, which is only 2% of abroad applications. The year before was the most successful year for non-resident patent applications in Switzerland with 1.508 applications and that is the only year with over 700 patent applications by non-residents.

Movement of granted patents in Switzerland is similar as patent applications. While resident grants are on a rise, number of resident grants is much smaller than abroad grants. Abroad grants were almost 300% higher in 2013 than in 2002, which is an impressive increase. Patent grants in Switzerland are shown in Figure 11.

[45] Cf. WIPO (2015g), http://www.wipo.int, date of access: 16.05.2015, own illustration

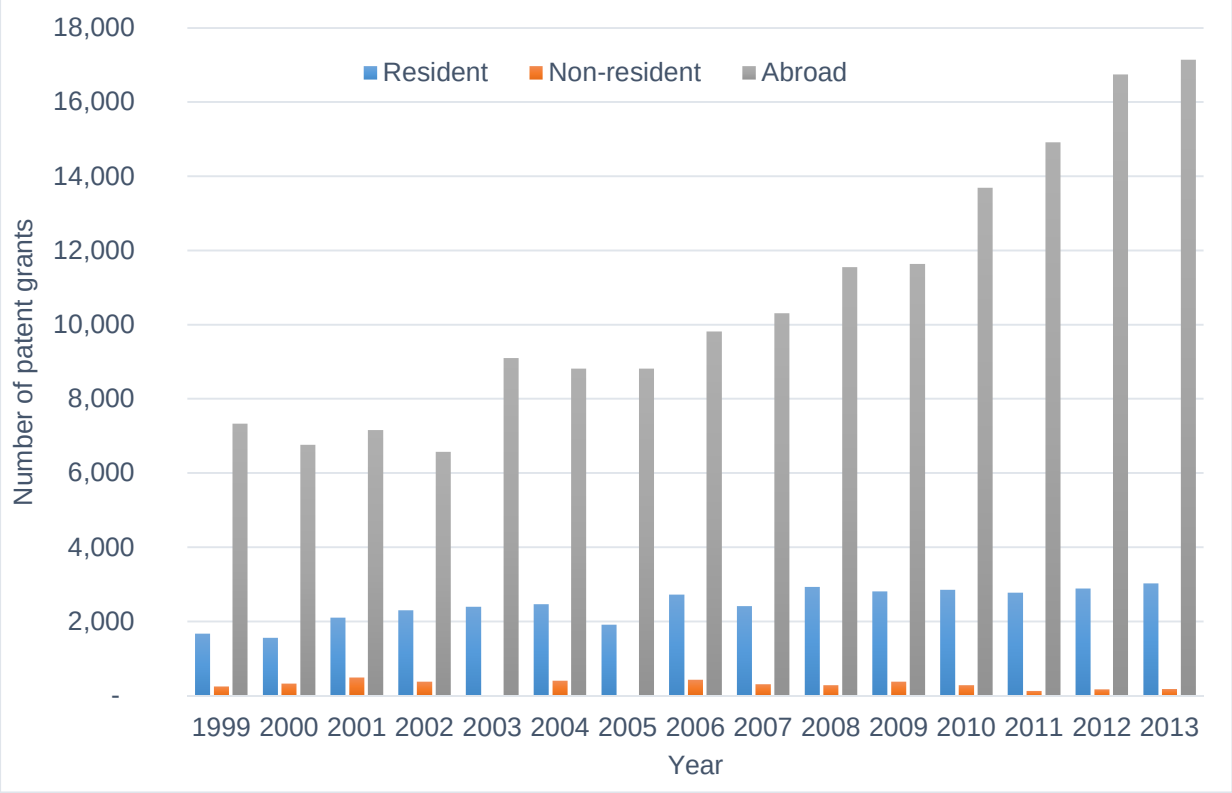

Figure 11. Patent grants in Switzerland by residents, non-residents and abroad[46]

Abroad applications and grants are interesting in Switzerland because Switzerland is the country that has had appeal of many immigrants for many decades. Currently, 24% of the population are people born in other countries.[47] That is a much higher than EU average of 9.4% measured in 2010.[48] The high percentage of foreigners in Switzerland could be connected with the high number of patent applications made by residents of Switzerland abroad.

Figure 12 shows movements of number of PCT applications made by residents of Switzerland. Except of the drop in 2008 and 2009, Figure 12 shows constant increase in number of PCT applications. Looking at the difference between 1999 and 2013, PCT applications have risen by around 250%.

[46] Cf. WIPO (2015g), http://www.wipo.int, date of access: 16.05.2015, own illustration
[47] Cf. Swiss Federal Statistical Office (2015), http://www.bfs.admin.ch, date of access: 22.05.2015
[48] Cf. MoveEurope (2014), http://www.artiszelmenis.lv, date of access. 22.05.2015

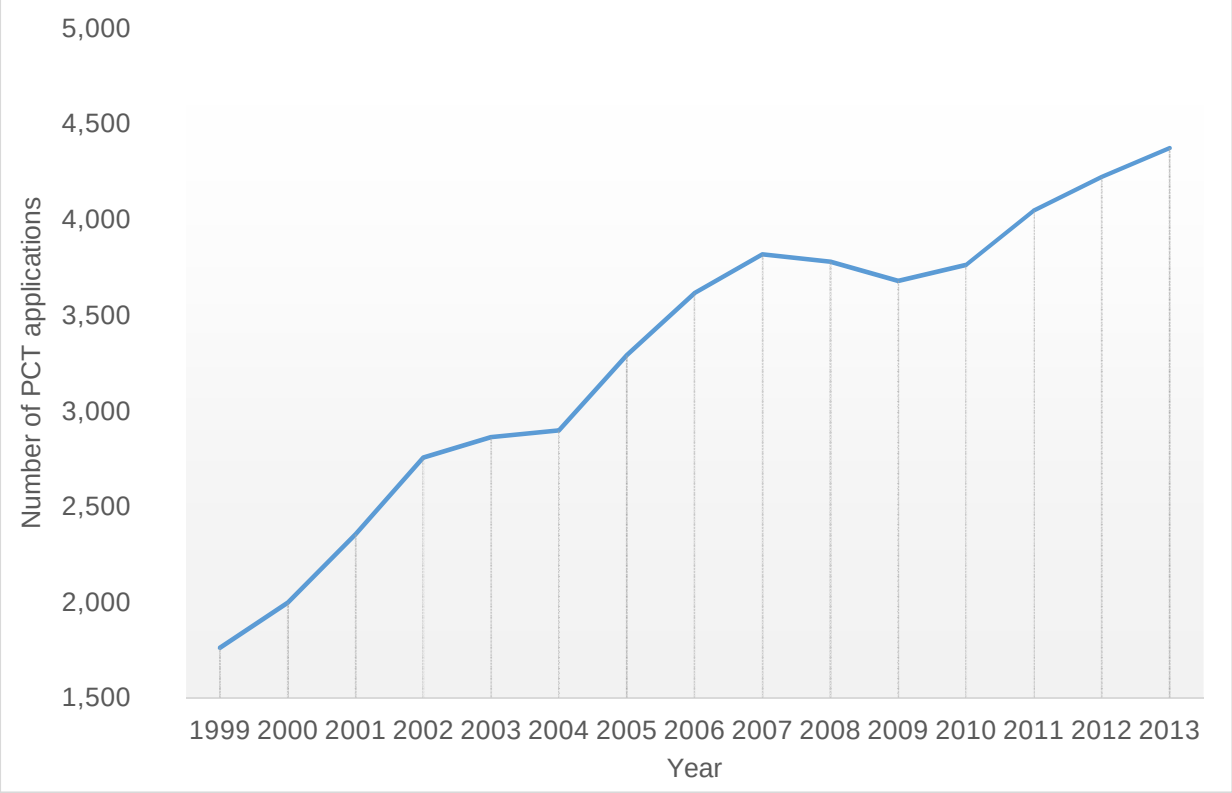

Figure 12. PCT applications by residents of Switzerland[49]

In Switzerland, technology fields with most patent applications between 1999 and 2013 were all connected to human biology. Pharmaceutical had 12.08%, organic fine chemistry 9.3% and medical technology 8.21%. Together with the mentioned three fields, only handling and measurement had share of over 5%. Other fields (see Figure 13) that are connected with the top three, are basic material chemistry, biotechnology and food chemistry. This shows that industry in Switzerland has concentrated to life science industry.

[49] Cf. WIPO (2015g), http://www.wipo.int, date of access: 16.05.2015, own illustration

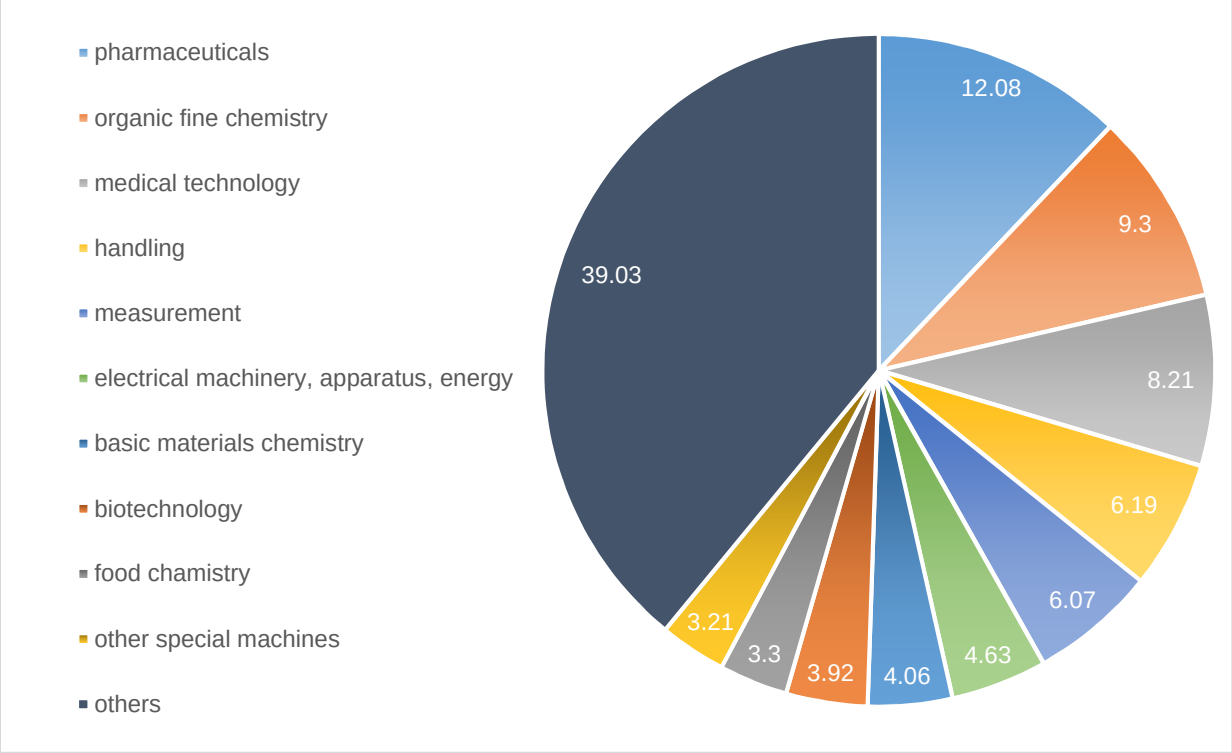

Figure 13. Patent applications in Switzerland by technology field given in % (1999-2013)[50]

2.4.1.4 United Kingdom

The UK has had a high number of patent applications from 1999 to 2013. Figure 14 shows the number of applications. Only abroad applications are on a constant rise. From 1999 to 2013, abroad applications have risen by 65% from 19.252 to 31.744. Residents and non-residents are filing many applications per year, but every year that number is lower. The official reason for that decrease is not known, it cannot be attributed with economy of the UK, since abroad applications are on a rise. In 1999, residents filed 35% more applications than abroad, but in 2013 abroad had 60% more applications than resident.

[50] Cf. WIPO (2015g), http://www.wipo.int, date of access: 16.05.2015, own illustration

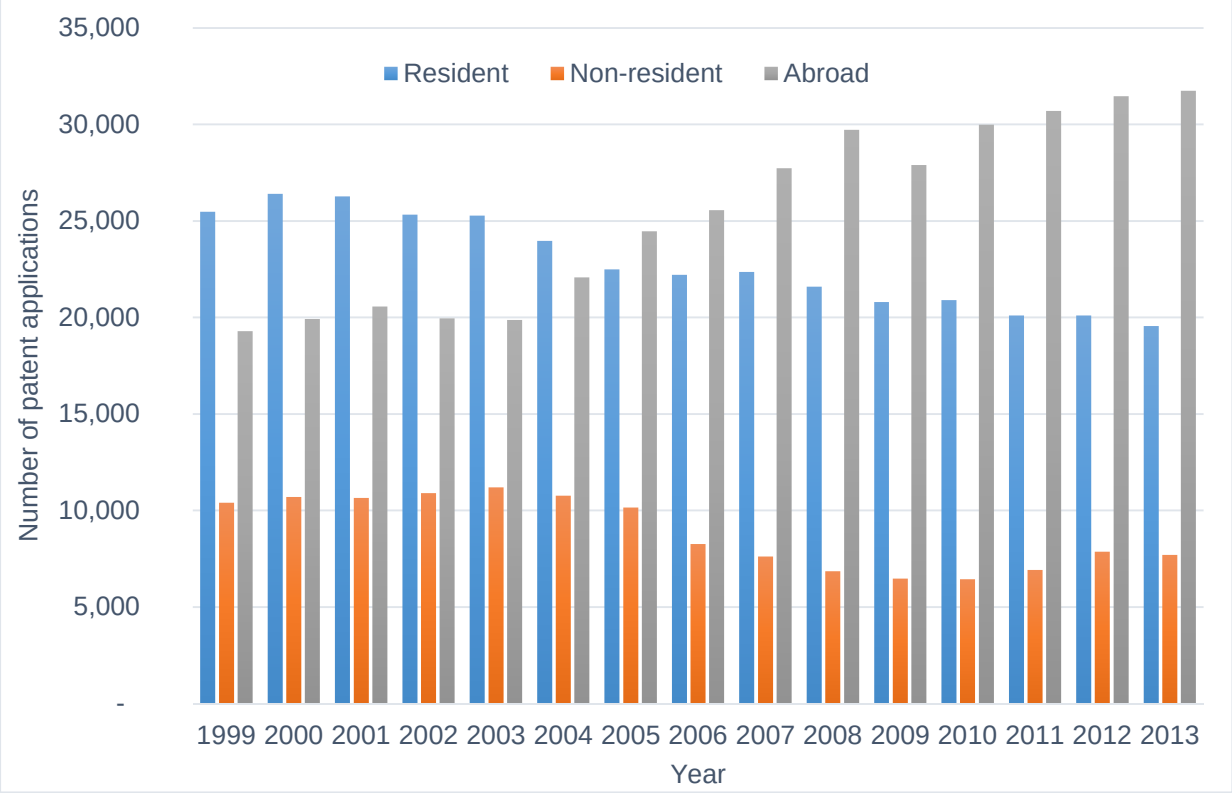

Figure 14. Patent applications in the UK by residents, non-residents and abroad[51]

Patent grants abroad in the UK (see Figure 15) are in similar manner as patent applications (see Figure 14). They are on a constant rise from 2009. Residents and non-resident are oscillating in the same manner. In 2013, abroad received 400% more grants than residents in the same year. It is an interesting due to only 60% difference in patent applications. The difference was smallest in 2005 as a result of abroad being the lowest in examined years. Reasons for low number of patent grants of residents are unknown.

[51] Cf. WIPO (2015h), http://www.wipo.int, date of access: 16.05.2015, own illustration

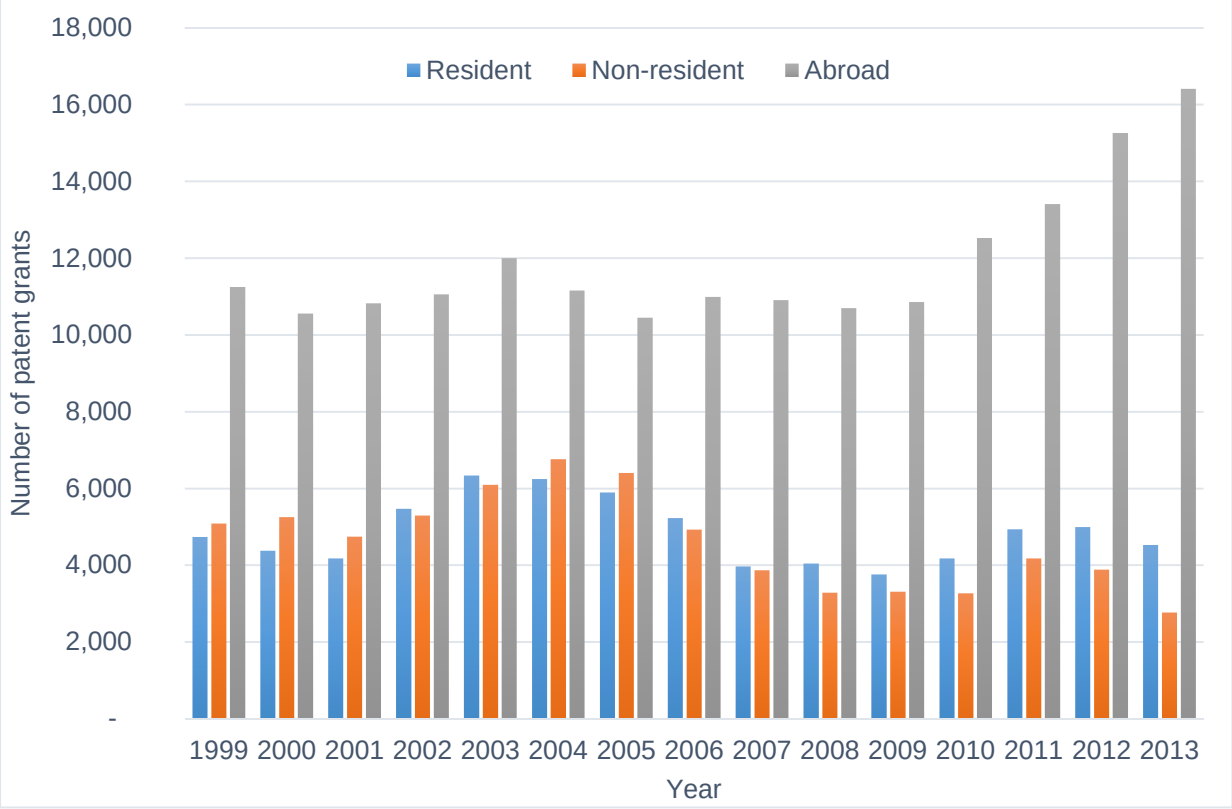

Figure 15. Patent grants in the UK by residents, non-residents and abroad[52]

PCT applications during these 15 years had its ups and downs in the UK. In Figure 16 there were 40% more PCT applications in 2001 than in 1999. The peak year was 2007, and afterwards number of PCT applications was declining. Global Financial Crisis started in 2008 and it seems that the UK never recovered from it, if focus is only on PCT applications. In 2013, the number of PCT applications was 4.847, which is the lowest number since 2000 when it was 4.808.

[52] Cf. WIPO (2015h), http://www.wipo.int, date of access: 16.05.2015, own illustration

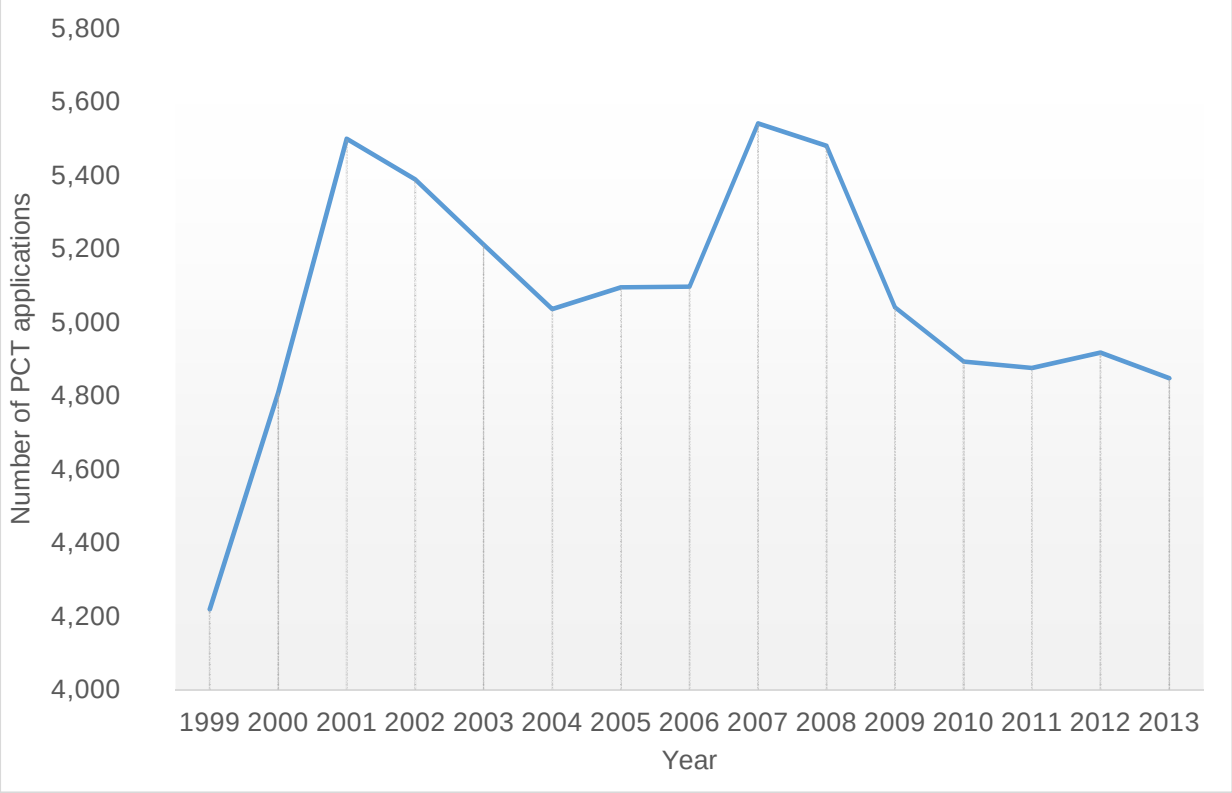

Figure 16. PCT applications by the UK residents[53]

Industry with most filed applications in the UK between the years 1999 and 2013 was pharmaceutical industry with a share of 7.75%. Organic fine chemistry and medical technology had shares of around 6%. Also, figure 17 shows that computer technology, civil engineering and measurement had shares over 5%.

[53] Cf. WIPO (2015h), http://www.wipo.int, date of access: 16.05.2015, own illustration

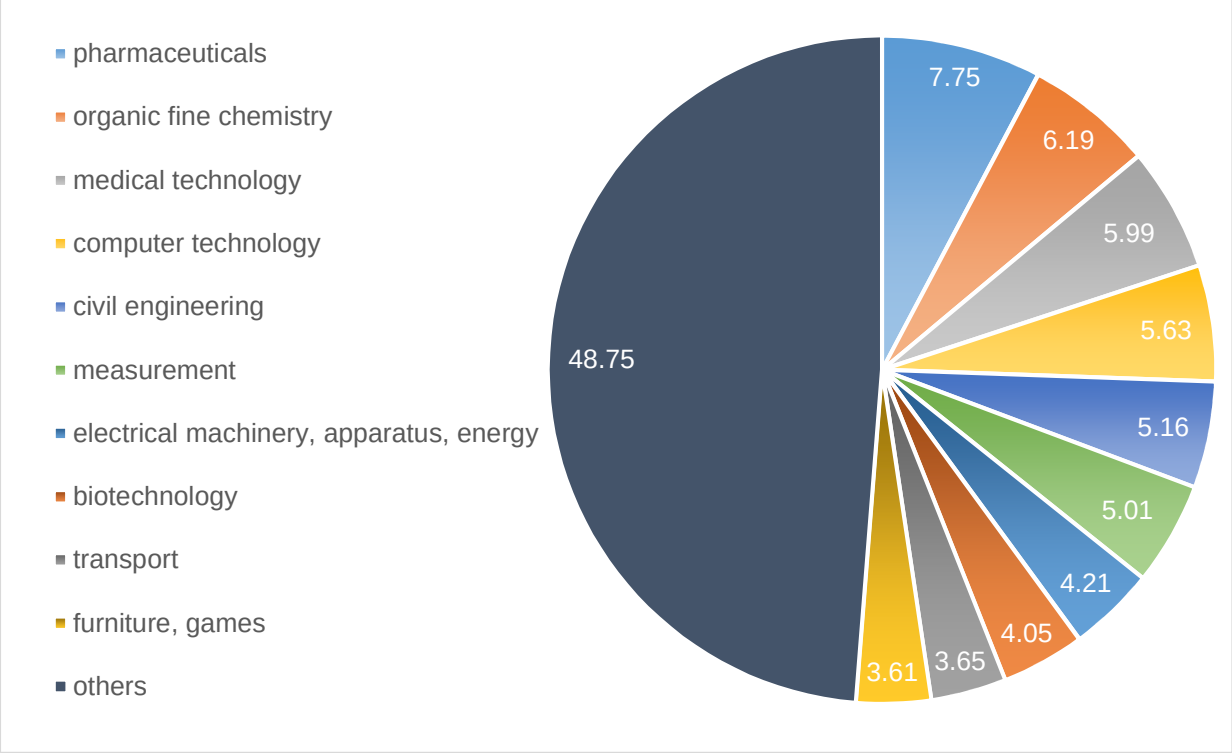

Figure 17. Patent applications in the UK by technology field in % (1999-2013)[54]

2.4.1.5 United States of America

The second biggest country in the world for filed patent applications, after China[55], is USA. From 1999 the USA had high number of filed patent applications each year in every category and the number is constantly growing every year. Figure 18 shows the movements of patent applications in the USA by residents, non-residents and abroad. From five countries taken into account in this statistical overview, only USA has more patents filed by residents than the other two categories in most of the years. From 2009 to 2012, non-residents have filed most patents. As in the other countries within this overview, abroad had the most patent applications in 2013 with almost 100% more than in 1999. For residents and non-residents 2013 was also most successful from 1999 onwards. That is shown in Figure 18 with abroad category being always the one with least filed patent applications.

[54] Cf. WIPO (2015h), http://www.wipo.int, date of access: 16.05.2015, own illustration
[55] Cf. WIPO (2015k), http://ipstats.wipo.int, date of access: 26.05.2015

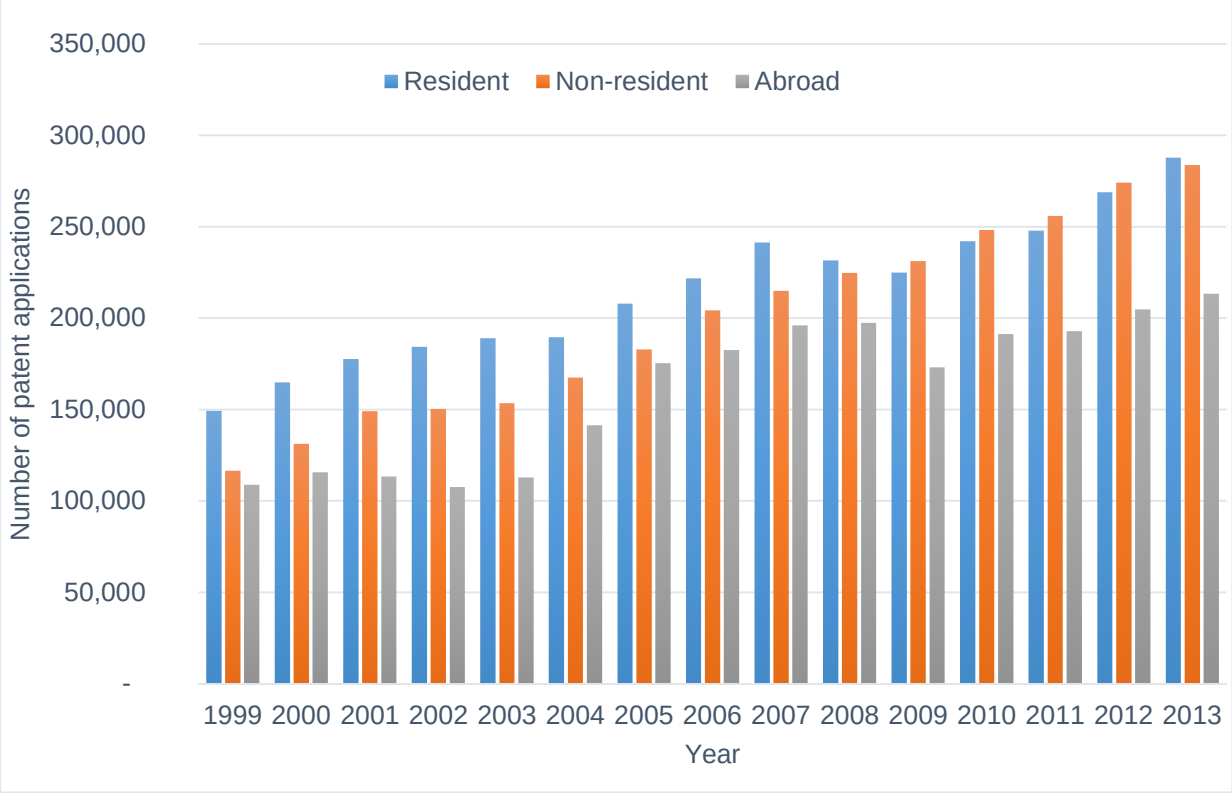

Figure 18. Patent applications in USA by residents, non-residents and abroad[56]

Granted patents in USA are quite similar with patent applications. High number of patents were granted with mostly resident being the top category. Non-residents had most patents granted from 2008, and the most successful year was 2013 with 144.242 granted patents for non-residents. Also two other categories see 2013 as most successful year. Figure 19 shows that from 1999 until 2009, number of granted patents was around 80.000, but kept on growing afterwards. In 2013 number of resident patents increased around 60%, when compared to 2009. BDA came in 1980, but it is interesting to see the growth of patent applications and grants even more than 30 years after. USA is the only country in this statistical overview that had 2013 as a year with most applications and grants in all three categories.

[56] Cf. WIPO (2015i), http://www.wipo.int, date of access: 01.06.2015, own illustration

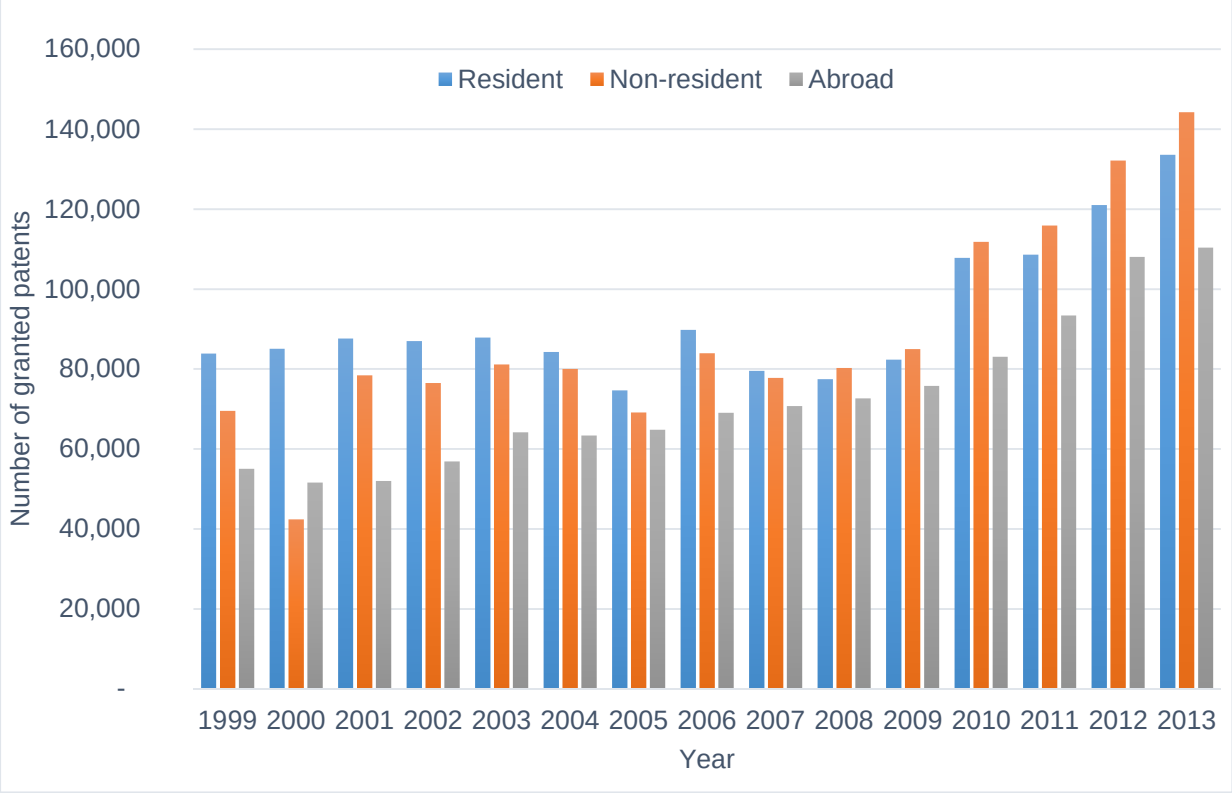

Figure 19. Patent grants in USA by residents, non-residents and abroad[57]

Even though many inventors from USA do not feel the need for going outside of USA, PCT applications are on a constant rise from 1999. There was a drop in number of PCT applications between 2008 and 2010, which can be connected to Global Financial Crisis, but from 2010 until 2013, PCT applications are increasing. In 1999 there were 31.263 PCT applications, but in 2013 the number of PCT applications was 57.441, which is an increase of 45%. In Figure 20, movements of PCT applications in USA are shown.

[57] Cf. WIPO (2015i), http://www.wipo.int, date of access: 01.06.2015, own illustration

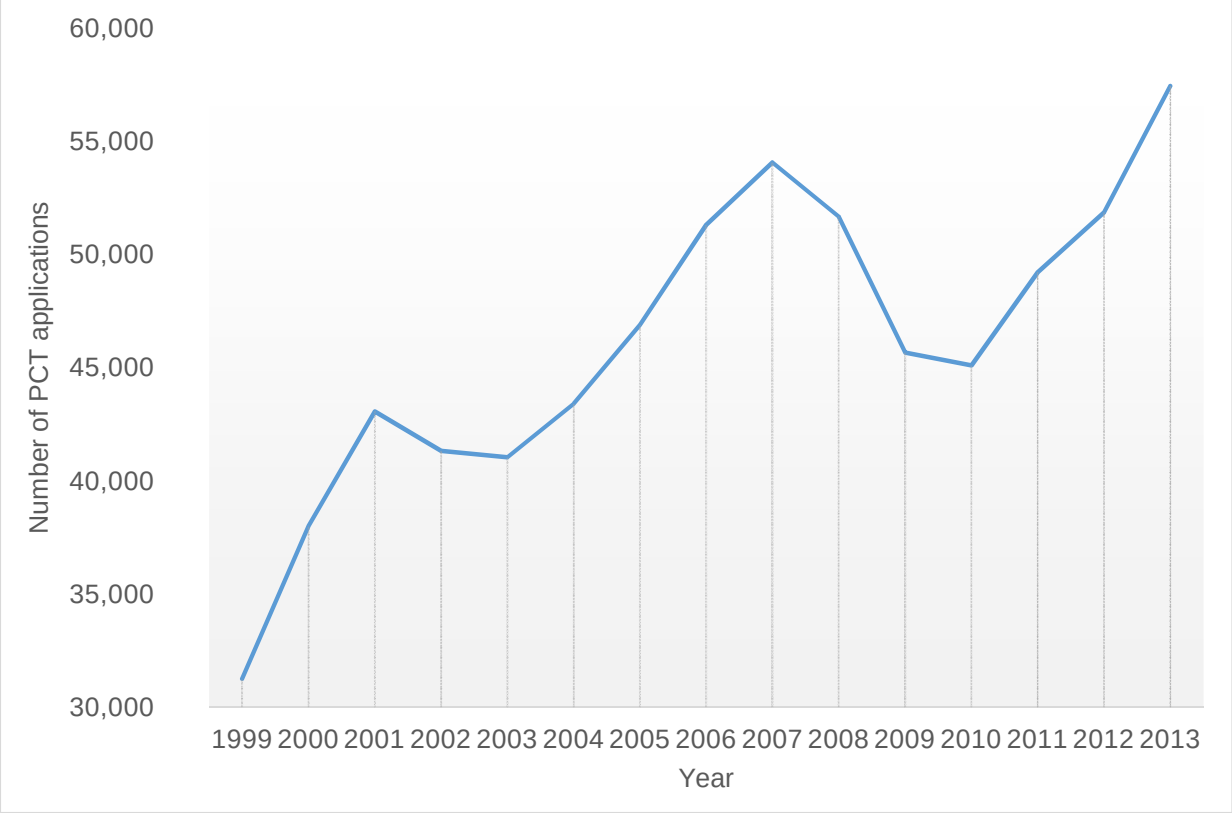

Figure 20. PCT applications by USA residents[58]

Technology field with most filed patent applications in USA between 1999 and 2013 was computer technology, which is not surprising since biggest computer companies in the world are from USA (Apple, Google and Microsoft). Share of computer technology in patent applications was 10.78%, which is the only technology field with share over 10%. Technology fields with over 5% were medical technology, pharmaceuticals and digital communications. Figure 21 shows patent applications in USA by top fields of technology given in % from 1999 to 2013.

[58] Cf. WIPO (2015i), http://www.wipo.int, date of access: 01.06.2015, own illustration

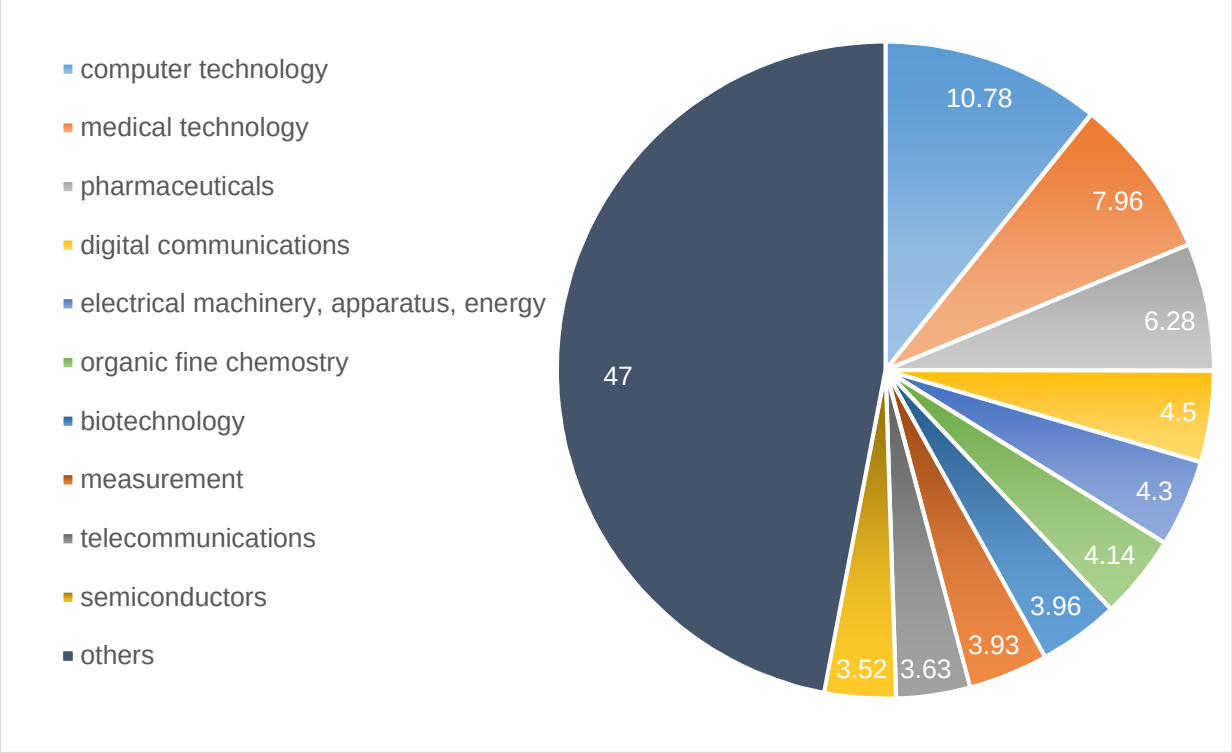

Figure 21. Patent applications in USA by technology field given in % (1999-2013)[59]

2.4.1.6 Conclusion

Figure 22 shows a graphical comparison of patent applications in Austria, Germany, Switzerland, the UK, USA and European Patent Office (EPO). It is clearly shown that the USA has the most patent applications. In 1999, in USA had been 100% more applications than in Germany, and that difference was even bigger in 2013, where USA filed over 170% more patent applications than Germany. EPO has had fewer patent applications than Germany, and Austria, Switzerland and the UK had the lowest number of patent applications.

[59] Cf. WIPO (2015i), http://www.wipo.int, date of access: 01.06.2015, own illustration

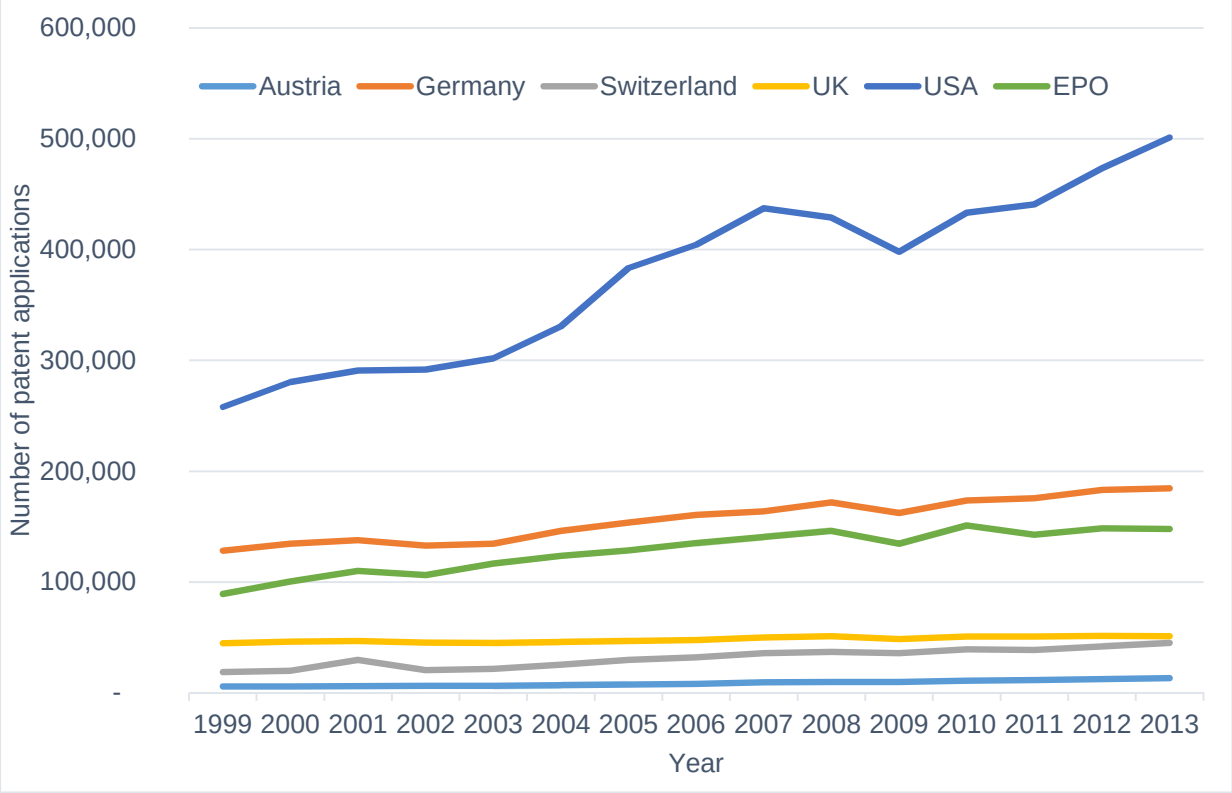

Figure 22. Comparison between patent applications (resident + abroad) in Austria, Germany, Switzerland, the UK, the USA and EPO[60]

This statistical overview clearly shows an increase in patent applications in Austria, Germany, Switzerland, the UK, USA and EPO. Difference between first year taken into account, 1999, and the last year, 2013, is up to 200%. With this increase in applications, there is a need to transfer and commercialize patents more effectively and efficiently. Means to fulfil this claim is discussed in detail in chapter 3.

2.5 Current IP facts in 2013

In the last chapter, patent trends of five chosen countries is discussed. But other facts and figures, from different industries and different parts of the world need to be shown to demonstrate significance of more efficient exploitation of IP.[60]

In the latest report from World Intellectual Property Organization (WIPO)[61], newest data available on the IP activities are from 2013. There were 2.5 million patent applications in the whole world, which is an increase of 9% from the year before. Almost 70% of patent

[60] Cf. WIPO (2015j), http://www.wipo.int, date of access: 01.06.2015, own illustration
[61] WIPO is the global forum for intellectual property services, policy, information and cooperation. They are a self-funding agency of the United Nations, with 188 member states.

applications were filed by residents, and the rest by non-residents. This shows preference to seek protection in their respective home IP offices. There were 9.45 million patents in force, which is an increase of 8.45%. Approximately 26% patents in force were in USA, followed by 19% in Japan. 2013 was the year in which China had more than one million patents in force for the first time.

Around 81% of patent applications were filed in five offices: China, USA, Japan, Republic of Korea and EPO. In China, there were 26.4% more applications than the year before. Out of the top ten IP offices worldwide, six had an increase of patent applications from year before.[62]

PCT applications were also growing each year. From 2004 to 2013, only year 2009 had a decrease in the number of PCT applications. In 2013, PCT applications were 5.1% higher than the year before, and for the first time more than 200.000 PCT applications were filed in a single year. Top PCT applicants in 2013 were big companies that do businesses worldwide. Panasonic filed for most PCT applications, 2.839, namely followed by two telecommunication giants from China, ZTE and Huawei, with 2.309 and 2110 PCT applications respectively.[62]

Universities and public research organizations have accounted for 7.5% of filed PCT applications. Universities account for 5.1% of PCT applications. USA and Europe were regions with biggest parts in university's PCT applications. In 2008, universities from USA had share of 51.1% of university's PCT applications, but in 2013 their share dropped to 40%. That does not mean that the universities from the USA were filing less applications, it means that the rest of the world is filing more, especially universities in China and Republic of Korea.[62]

Of all PCT applications made by universities, 89.9% were from universities from high-income countries. This is a decrease from 2008 when universities from high-income countries had a share of 96.4%. Even though universities from USA account for 21% of world universities, they had share of 42% of all university PCT applications from 2011 to 2013.[62]

Interestingly, most of the top five university applicants in each world region had their PCT filing grow from 2011 to 2013. Top PCT applicant in Europe was ISIS Innovation Limited from the UK, TTO of Oxford University. University with most PCT applications was University of California from USA with 398 filings in 2013. Out of ten universities with most PCT applications, nine were from USA, with number six being university from South Korea. First European university was 16th. In top 100 PCT applicants, only two were universities: University of California at the place number 43 and Massachusetts Institute

[62] Cf. WIPO (2014), http://www.wipo.int, date of access: 28.05.2014

of Technology was 95th. ISIS Innovation Limited, as the highest ranked European university, was 286th.

Electrical machinery, apparatus and energy was the technology field with most PCT applications, followed by computer technology and digital communication. Biggest change from year before had “IT methods for management” with 27.2% increase. Pharmaceuticals, the field that is regarded as most profitable, had share of 4% with 1.3% drop from previous year.[63]

Over the last few years patent applications were constantly increasing. With 9.4% more patent applications in 2013 than in 2012, and with PCT applications filing going over 200.000 for the first time, there is a need to transfer and commercialize these patents.

Even universities are increasing their share in PCT applications, with having two universities in top 100 PCT applicants. Out of the top 50 university applicants, 65% of them are climbing on the table of top PCT applicants, having the rank higher than the year before.

2.6 Models and process of technology transfer

Since the introduction of the BDA in 1980 in USA, universities are increasingly engaging in TT activities. One of the drivers of economic growth is the commercialization of technologies developed at universities. TT was mainly practiced only by biggest universities in USA, but now most of the universities in the world are in TT state of mind.

The process of TT is often difficult to simplify. Steps from invention to commercialization are simple from outside, but finding generalized model of the process is usually impossible. Models found in literature are oversimplified and somehow restricted because they follow linear flow. Since universities are becoming more entrepreneurial and are looking into non-traditional field, there needs to be a more realistic and accurate model of TT activities. A traditional model is shown in Figure 23. It clearly shows linearity of the process of TT.

[63] Cf. WIPO (2014), http://www.wipo.int, date of access: 28.05.2015

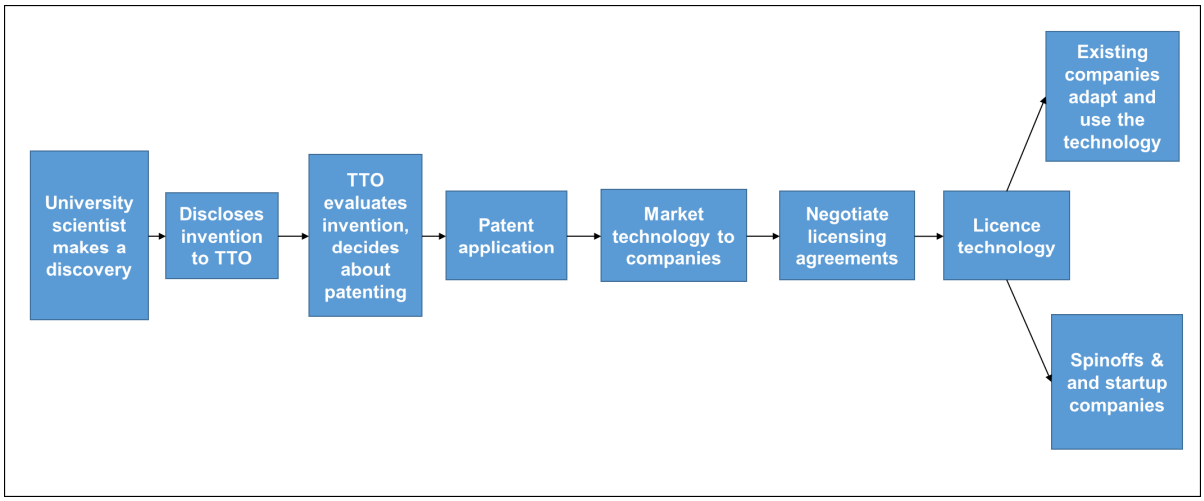

Figure 23. Traditional model of technology transfer at universities[64]

Traditional model from Figure 23 is oversimplified because it does not capture the complexity of TT in practice. It presents many limitations that can be divided in two categories: inaccuracies and inadequacies. Inaccuracies are that the model is strictly linear and oversimplified, and emphasizes too much on patents. Inadequacies are communicational mechanisms, organizational structure and reward system for TTOs employees. Communicational mechanisms can be divided in formal and informal mechanisms. Formal mechanisms are done during official meetings and negotiations, while informal are communications processes like consulting, joint publications, and interactions between university employees and industry contacts.[65]

TT process is not simple, but a simplification of the process is necessary for clarity and graphical representation. The linear model attributes the discovery process only to university scientist. Even though, that could be seen as a small problem, discoveries are rarely made by one individual. Alternative sources of discoveries can include disclosures from research staff, graduate students, and even undergraduates. Establishing spinoffs is located at the end of the line, but that step could occur much sooner.[66]

Also, the traditional model shows that all inventions are owned by university, but the ownership of the invention rights depends on the country. In Austria, University Act claims that invention is owned by the inventor if university does not claim the rights in first three months. Also, inventions made by students are owned by students, even though they were using university's funds and its facilities.[67] Frequently, research funding has an impact on the invention's rights. The traditional model does not show any indication that

[64] Cf. Siegel (2004), p. 15, own illustration
[65] Cf. Bradley et al. (2013), p. 45
[66] Cf. Bradley et al. (2013), p. 43
[67] Cf. Rechtsinformationssystem (2002), https://www.ris.bka.gv.at, date of access: 22.05.2015

the source of funding could be influential. Funds for research projects come from donations, private companies or the government.

Taking into account inaccuracies and inadequacies of traditional model, a more detailed and accurate model of university TT is shown in Figure 24.[68] This model clearly shows process of TT and influences that might occur on that process. Model is not linear and universities have many options after each step. The model shows that inventions can be claimed by universities and go through TTO, but also if the university does not claim the invention, the inventor can take the rights and start an own company, sell or license the inventions rights to other companies.

Alternative model can be easily used to show the process of TT. It shows that the process of TT is complex and non-linear. TT needs expertise from the people in TTOs and their experience makes a difference between commercial success and failure.

The model of Bradley in Figure 24 can be easily used by any university in Europe. There could be small differences between countries, since every country has different laws concerning ownership of patents and project funding. This model was originally created for universities in the USA. For Austria, the adaptation of this model could be different regarding the discovery source, namely student discoveries are owned by students, not universities as in USA.

[68] Cf. Bradley et al. (2013), p. 47

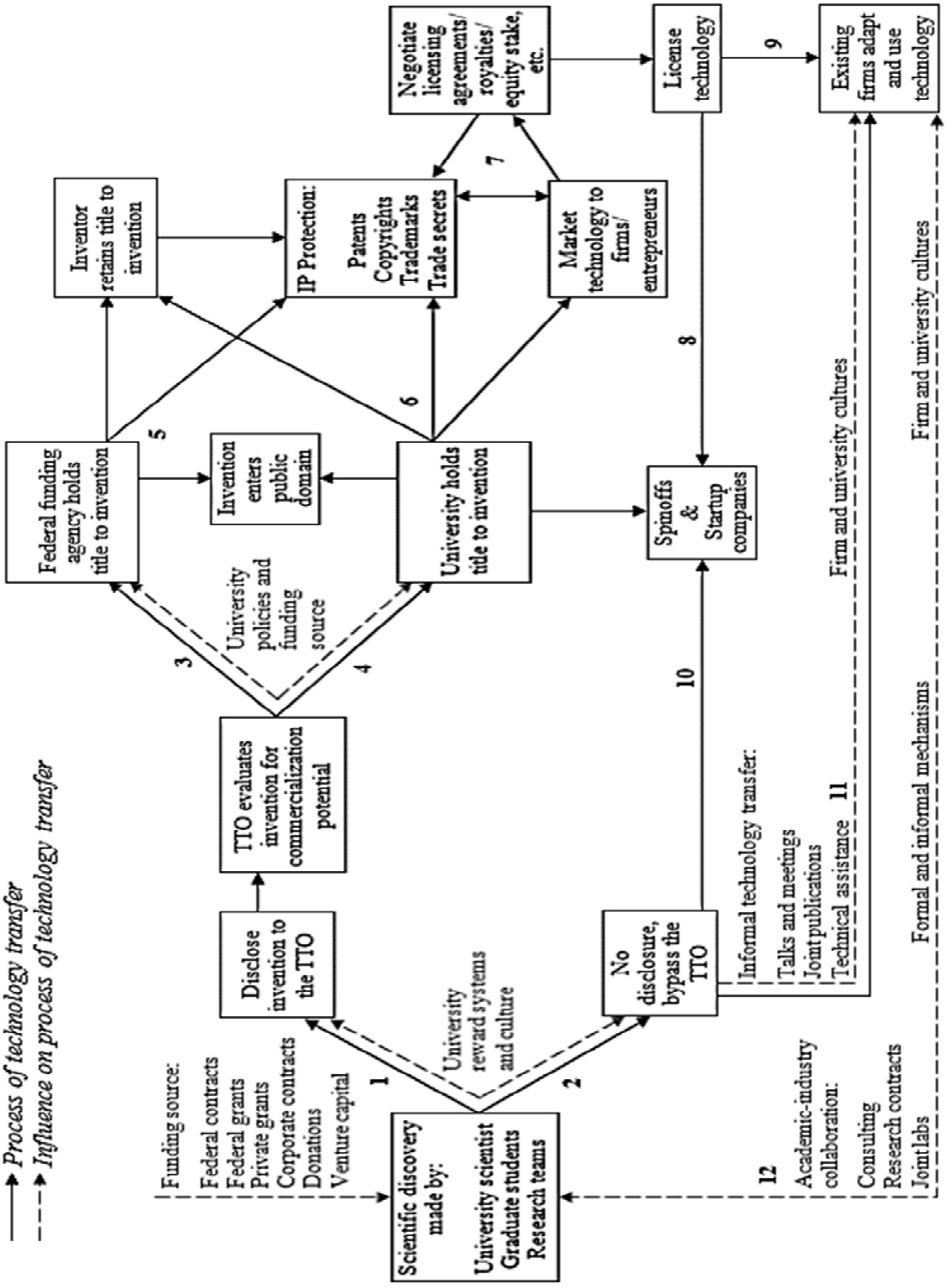

Figure 24. Alternative model of university technology transfer[69]

[69] Bradley et al. (2013), p. 47

2.7 Performance and activities of technology transfer offices in Europe

Although USA is the global leader in TT, due to major economic, political and even cultural differences TT in Europe should not necessarily follow the model from the USA. TT polices should help successful European industries like manufacturing and automotive in industry to secure the role of global leaders as the Industry 4.0 initiative in Germany and Austria.

TTOs in Europe are departments or units within university established to overcome important barriers of TT by connecting academic research with financial and physical capital, promoting social interactions and collaborative research with users and suppliers of technology. Frequently, commercialization is based on networking between researchers and industry, and TTO represents the link between university and companies that engages in networking activities. Within this technology and knowledge transfer systems, university, and the TTO play different roles. The TTO solves problems by coordinating cooperative research with industry partners and provides assistance with cooperation agreements.[70] TTOs have seven different tasks to fulfil:[71]

1. Cooperation management
2. Support with patents,
3. Licenses and exhibitions,
4. Start-up activities,
5. Consulting in general,
6. Engaging in training activities,
7. Funding and marketing activities

To measure performance of TTO, six different variables needs to be taken into account:[72]

1. Average invention disclosures
2. Employees
3. Number of students
4. University's characteristics
5. Division of labor
6. Regional aspect

The average invention disclosures is the number of inventions given by university's researchers to TTO. University and TTO employees are an important variable: number

[70] Cf. Siegel et al. (2003), p.33
[71] Cf. Hülsbeck et al. (2011), p. 203
[72] Cf. Hülsbeck et al. (2011), p. 204

of employees, their academic degrees and number of researchers that work for universities. Universities can be characterized by two main tasks: teaching and research.[73] The performance of the TTO could be influenced by universities focusing more on one task than the other. Funding per researcher, published articles per year and number of citations of the university can impact TTO's performance.[74] Looking only at the TTO, not at university, division of labor is important. Division of labor means that there are no employees that do many tasks, and that employees are divided in their own expertise fields. Last big impact on performance of TTOs is the regional aspect. Every culture has different ways of working, which influences the performance of TTOs.

A survey from 2008 with 73 German universities has considered all of the mentioned tasks and performance measurement variables. The most important aspect in TTOs as a result from that survey is the division of labor. Lack of specialization of tasks prevent high flow of invention disclosures. Researchers do not see the TTOs as a unit that has economic value, but more a "must-have" to transfer and commercialize inventions. University's managers are important in this aspect since they take care of the organization of the TTO and promote its importance. Also, it can be seen that universities lack the entrepreneurial spirit which is important to actively transfer technology.[75]

A fact that only a small number of TTO employees own a PhD (17% in Germany) shows that TTOs employees are not the adequate counterparts of university scientists. That could be a necessity in the university-industry relationship since TTO employees are "the voice" of scientists. Experience of TTOs employees in TT and commitment of the university to transfer knowledge and technology shapes the performance of TTOs. Things like networking with industry and academic entrepreneurship state-of-mind increases over time.[76]

There is a strong evidence that the organizational structure of the university, the scientific quality and the TT orientation are main driving forces behind invention disclosures, which is the most important factor in measuring TTO performance. Even though regional aspects and organization of TTO may have impact, the effects are moderate and neglectable.[77]

A study of 986 universities in USA has shown that the strategy of the university towards commercialization and application of scientific research depends on the type of the scientific field, university's policy of encouraging TT and the perceived impact on

[73] Cf. Hülsbeck et al. (2011), p. 204
[74] Cf. Hülsbeck et al. (2010), p. 25
[75] Cf. Hülsbeck et al. (2011), p. 209
[76] Cf. Hülsbeck et al. (2011), p. 210
[77] Cf. Hülsbeck et al. (2011), p. 211

traditional university mission.[78] Another study based on data of 309 Austrian university departments investigated the determinants of different forms of interaction between universities and companies (research contracts, joint research, PhD/Master thesis) as well the as sum of all interactions. Significant factors in university-industry technology and knowledge transfer are the department size, research characteristics (e.g. number of international scientific publications per researcher) and the type of scientific field.[79]

There are some other factors that explain universities tendency for knowledge and TT activities. A series of motives that could be grouped in four categories: access to industrial knowledge, access to additional resources, institutional motives and costs and time savings. Motives provide positive influence towards TT activities, obstacles provide negative influence. These are different interests and attitudes towards research, lack of confidence to business world and risk of damaging scientific reputation and lack of human resources for TT activities. Most theoretical studies conclude that there is no close relationship between the tendency for TT activities and the orientation of research activities (basic vs. applied science). The size of university, the existence of TTOs and external funds provide positive influence for TT activities.[80]

Three important channels of knowledge and TT activities are patenting, licensing and creation of new companies – spin-offs. The institute's research focus (basic vs. applied research) does not influence the tendency for patenting or spin-offs. But the focus on basic research seems to be positively connected with licensing activities. Universities with high teaching tendencies, more than on research, are negatively affecting activities such as licensing and spin-offs. Engineering and natural science institutes are more inclined to patenting. There is also small positive effect of university size on creation of spin-offs. The bigger the university, the higher the possibility to create a new company.[81]

2.8 Motivation and goals of technology transfer offices in the USA

Although the work of TTOs might be considered simple when only depending on working with commercialization of technologies, each TTO is different. With each of them having different missions and visions, their motivations and goals differ.[82]

In chapter 2.1.4, the statistical overview showed that the USA had most patent applications in different fields of industry. The USA has by far the most patent applications between countries in the statistical overview, and it is second in the world behind China.

[78] Cf. Lee (1997), p. 860
[79] Cf. Schartinger (2001), p 260
[80] Cf. Arvanitis (2006), p. 1869
[81] Cf. Arvanitis (2006), p. 1874
[82] Cf. Abrams (2009), p. 24

Because of these innovations and patents, it is useful to see how TTOs from USA are tasked and motivated, and big is the influence of the profit.

A survey conducted in 2009 at the USA academic institutions determined how are TTOs organized, tasked, financed and motivated[83]. 165 institutions participated in the survey, including 126 universities. 63 were private and 102 public institution. Every questioned institution had a TTO and 86% of TTOs were organized as units of the institution.[84] Expenses of TTO can be divided in patent costs, personnel costs and other operating costs. 78 questioned universities had separate patent and operating budget, where other had combined budgets.[85]

Institutions are financed from variety of sources. It was reported that 47% of universities from the same survey receive combined budget from the institutions and from licensing revenues. Less than 10% of universities are financed only from licensing revenues, and that percentage is even lower when only public universities are taken into account. There is a clear correlation between the size of the university and the way of financing TTOs. Over 60% of TTOs at very small universities are entirely funded by the university. In contrast, a significantly larger number of TTOs are financed entirely from licensing revenue at large and very large universities. Small universities are defined by research expenditure under $50 million and large universities over $251 million.[86]

In the same survey, there was a direct connection between the size of institution's research budget and its profitability. The larger the research budget, the more likely the TTO will be profitable. Also, private institutions are more likely to be profitable than public institutions. Over 60% of TTOs from public universities are making losses, and less than 50% of TTOs from private universities were making losses.[86]

Each TTO is differently motivated with different driving forces. The biggest driving force is the faculty service, followed by research results translation and revenue maximization. But this is influenced by the size of the university. Large universities had revenue maximization as the biggest driving force. Comparing public and private universities, faculty services are higher ranked at private universities than at public universities, and translating research results was more important at public than private universities. The survey showed that financial return is not the major factor in TTOs motivations. But to maximize the revenue, TTO's budget should depend on the income it generates. That is most indirect way of encouraging revenue maximization. It is also shown that only 11.5% of TTOs have revenue maximization as their most important driving force.[87]

[83] Cf. Abrams (2009), p. 13
[84] Cf. Abrams (2009), p. 6
[85] Cf. Abrams (2009), p. 8
[86] Cf. Abrams (2009), p. 7
[87] Cf. Abrams (2009), p. 17

Although financial return is not the most important for TTOs, that does not imply that TTOs do not care about finances. Far from it. It is important factor that comes into concern when negotiating licensing transaction. More than 86% of TTOs are connected to the institution and they will try to earn as much money as possible for the institution[88].

The same survey investigated universities' business models of licensing patents to the highest bidder, and concluded that it is unprofitable for most universities. Sometimes universities risk of alienating the private sector. The business model "license-to-the-highest-bidder" has provided high income only to a few universities. Most universities are losing money on that business model. Top 5% of earners (8 universities), took 50% of the total licensing income of the university system, and the top 10% (16 universities) took around 70% of systems' income. Out of 155 universities reporting licensing data in 2012, the top half controls about 90% of licensing revenue and research funds in terms of research expenditure.[89]

In 2012, 130 universities in the USA did not generate enough income from licenses to provide for the wages of their TT staff and for protecting patent rights. In the same year, 84% of the universities were in the red with TT revenues, but that is better than average, looking at the last 20 years, when average was 87% of universities.[90]

Even though most of TTOs are a financial loss for a university, many of them are earning a lot of money from licensing income. The top university in the world for filed patent applications, University of California, has earned $972 million in 2013, which is almost 4 times higher than the Northwestern University, which has received $256 million, and these two universities are universities with highest licensing income in 2013 in USA.[91] Oxford University and its TTO ISIS Innovation Ltd. have generated $5.6 million in 2013 from licensing income, and they were the TTO that had more patent application than any university in Europe.[92] These numbers show a huge difference between Europe and the USA. But even with these high incomes, universities in the USA are still struggling with transferring patents with only around 5% being commercialized.[93]

[88] Cf. Abrams (2009), p. 6
[89] Cf. Valdivia (2013), p. 6
[90] Cf. Valdivia (2013), p. 9
[91] Cf. Huggett (2014), p.7
[92] Cf. ISIS Innovation Ltd (2014), http://isis-innovation.com, date of access: 09.06.2015
[93] Cf. Ledford (2013), p. 472

3 Technology transfer pathways

With the constant increase in patent applications in Austria and other parts of the world, there is a need to commercialize patents more effective and efficient. Universities are creating many inventions, but they lack in the commercialization, which should be solved with introducing new TT pathways. TTOs are responsible to transfer knowledge and innovations, and their performance is being constantly revalued. Various TT ways, which will be discussed in next chapters, should provide better and more effective and efficient ways to transfer technology from universities to industries.

3.1 Easy Access IP

Universities have difficulties with commercialization of their inventions and IP. Many inventions are created and left unused. Investing time and money into creating something new and then being unused represents a problem for an institution that needs to be solved. If a company considers an innovation too uncertain or evaluates too many potential risks, it usually decides not to invest. To enable further growth of the invention one option for the university is to give it for free. Easy Access IP is a TT way to license IP for free of cost and thus, without the investment risk for a company.

Easy Access IP is an international collective of universities and research institutions, which wants to create impact from their own research via knowledge exchange. Because universities' technologies are often in an early stage of the development, they require significant investment and further growth for commercial impact in industry. Easy Access IP provides companies and individuals free access to these technologies and reduces the investment risk. [94]

As a concept, Easy Access IP was pioneered by the University of Glasgow in 2010, with the early adopters King's College London and the University of Bristol. The University of Glasgow had troubles with unexploited IP. Over 90% of their own IP was not being used. Their plan was to create a viable option for that unused IP so that it can be used again. One option was to give it for free and so they created Easy Access IP.[95]

One part of the mission of every university is to spread knowledge. By allowing universities to evaluate inventions and afterwards put it to use quickly, the amount of sheared knowledge increases and in that way the part of the mission is fulfilled.

[94] Cf. Easy Access IP (2015), www.easyaccessip.com, date of access: 08.06.2015
[95] Cf. ZDNET (2010), http://www.zdnet.com, date of access: 08.06.2015

Institutions involved in Easy Access IP are lead with four principles:[96]

1. The aim of universities is to create and share knowledge. Maximizing the rate of knowledge transfer is through exchange of the knowledge.
2. Creating impact in industry and society from university research results is more important than monetary gains.
3. Simple agreements and transactions make it easier for companies to collaborate with universities.
4. Easy Access IP agreements are the beginning of a collaborative relationship, not the end of knowledge exchange.

When a company or an individual agrees to take license for an IP in Easy Access IP way, they accept five rules:[96]

1. Licensee needs to demonstrate how it will create value for the industry and for the society.
2. Acknowledgement of the licensing institution as the originator of the IP.
3. Progress that is being made with the development of the invention has to be reported annually to the institution.
4. If licensed IP is not used and exploited within three years, the license will be revoked.
5. Owner of the IP can continue to use the IP in its own research activities without limitations.

If the IP is commercialized in the future and the company earns money from it, the university gets no royalties from that IP. Easy Access IP is completely free and there are no hidden charges. The university gets recognition as the owner of the IP which should increase its reputation.

Universities have many IP and they need to choose which ones can be offered under Easy Access IP agreement. There are two possibilities: offer IP immediately or wait until it fails to receive any commercial gains and then offer it for free. The university evaluates if technologies are in the early stage of development and offers those immediately as Easy Access IP. In that way, it is easy to find a company partner and continue the research. And because the contracts are simple, two-page agreements, there are no long negotiations. Waiting IP to fail on the market is the second option. One of the motivations for creating new technologies is to commercialize it and gain profit from it. But sometimes there is no market need for these new technologies. After market failure of the IP, university can offer it through Easy Access IP to find potential partner and continue the research.[96]

[96] Cf. Easy Access IP (2015), http://easyaccessip.com, date of access: 29.05.2015

Becoming a member of Easy Access IP is a relatively simple process, but requires the university to agree to the core principles of the Easy Access IP movement:[97]

- To create and promote an Easy Access portfolio of free IP. This way increases valid opportunities for IP that are difficult to commercialize through traditional ways.
- To license opportunities within your Easy Access IP portfolio on non-revenue bearing terms.
- To use the Easy Access Innovation legal document templates which you may adapt to your national legal framework.
- To help raise awareness of the initiative using the key principles.
- To work within the style guidelines including use of logo of Easy Access IP
- To share progress with other Easy Access Innovation universities and to meet annually.

3.1.1 Agreements

Agreements signed between universities and companies in Easy Access IP are simple, two-page agreements. There are exclusive and non-exclusive agreements and contracts are the same for each university. If a company wants to acquire free IP, it needs to sign a contract that is not negotiable. Sometimes those contracts are considered as too unspecified for company's legal department, but there is no evidence that this procedure caused any problems with signing agreements. [98]

3.1.2 Partners

Easy Access IP partners are universities and other non-organization that use Easy Access IP TT way. Since Easy Access IP started five years ago and is giving IP for free, which is not preferable option for any organization, there are not many partners in the World until today. In Europe, there are approximately 4.000 universities amongst 13 are partners of Easy Access IP. Ten universities are in the UK, where Easy Access IP was established there. Newest member in the Easy Access IP family is the Defence Science and Technology Laboratory UK, a supply specialist of Ministry of Defence UK which ensures that innovative science and technology contributes to defense and security of

[97] Cf. Easy Access IP (2015), http://easyaccessip.com, date of access: 29.05.2015
[98] Cf. University of Glasgow (2015), http://www.gla.ac.uk, date of access: 26.05.2015

the UK.[99] All over the world, there are only 26 partners, and only few of those are partners from the beginning in 2010. Table 1 shows the number of Easy Access IP partners by region.

Region	Number of partners
Europe	16
Australia	7
Canada	2
China	1
World	26

Table 1. Easy Access IP partners by region[100]

The names of the partners divided by countries are listed below:

Universities in Europe:

- Durham University (UK)
- King's College London (UK)
- Lancaster University (UK)
- Linköping University (Sweden)
- Mid Sweden University (Sweden)
- Staffordshire University (UK)
- Swansea University (UK)
- University of Birmingham (UK)
- University of Bristol (UK)
- University of Copenhagen (Denmark)
- University of Exeter (UK)
- University of Glasgow (UK)
- University of Sussex (UK)

[99] Cf. Defence Science and Technology Laboratory (2015), https://www.gov.uk, date of access: 27.05.2015
[100] Own ilustration

Universities in Australia:

- Edith Cowan University
- La Trobe University
- Macquarie University
- University of Technology Sydney
- University of Western Sydney
- University of Wollongong
- University of New South Wales

Universities in Canada:

- École de Technologie Supérieure
- University of Ottawa

University in China:

- Shanghai Jiao Tong University

Non-university partners in Europe:

- CERN (Switzerland)
- Defence Science and Technology Laboratory (UK)
- German Cancer Research Centre (Germany)

3.1.3 Partnership possibilities

When collaborating with companies, the university as an owner of IP can decide what kind of partnership it wants. Sometimes the university and the company work independently and have separate research. The lack of this approach is that the company can miss valuable input of owners or inventors of the technology. In that way, most value for that research is given by the company. Another possibility is a joint research between the company and the university. Most universities see joint research as a more attractive option and gives licenses only under conditions that company's research is done in collaboration with the university. In that way, the company and the university can share knowledge and potentially profit sooner. Relationship between the company and the university is strengthened further if they can collaborate on additional projects.

3.1.4 Successful licensing deals

In a survey about success of Easy Access IP, 18 Easy Access IP partner organizations have participated. Partner organizations reported only 68 Easy Access IP license, which is only 1.8 deals per organization. That is a small number considering that 677 non-Easy

Access IP deals were reported by the same organizations during the years in which they were Easy Access IP partners. Universities from the UK had 29 successful Easy Access IP. Previous reviews reported 18 done deals by September 2012, 25 deals by May 2013 and 31 by October 2013, which indicates steady growth in done deals through the years.[82]

The two most active universities, University of Glasgow and University of New South Wales, have carried out about 66% of done deals. On the other end, two-thirds of 18 reported organizations, which is half of the partnership, have completed and Easy Access IP deal only once or none at all. But two of those 18 organizations are partners for only some months, so would not be expected to have completed any deals yet.[101]

3.1.5 Questionnaire

In order to investigate Easy Access applications and customer complacent amongst universities, an oral questionnaire was conducted with King's College London, University of Glasgow, University of Exeter, University of Lancaster, Swansea University and University of Copenhagen. Each of the universities see many benefits with Easy Access IP and highly recommend its use. Only University of Glasgow had successful deals with companies, while others are mainly using Easy Access IP as a marketing strategy to attract companies or other universities for collaborative research. King's College London shows concern for the simple, two-page agreements, which companies might regard as insufficiently elaborated, but as previously mentioned there are no real concerns with such agreements.

Even though, five out of the six universities had no successful licensing deals, all of them see benefits for researchers involved in Easy Access IP by connecting researchers with companies or other universities. All universities have had collaborative research (some of them ongoing) with companies or other research institutions. Easy Access IP makes it easier to share knowledge between universities and industry. None of the questioned university invests lot of efforts in promoting Easy Access IP, and sees it as a low-maintenance TT way. Although universities have Easy Access IP technology offerings listed on their websites, but none of them is keeping the website up-to-date which makes it hard for potential partners to find new technologies. The questioned universities will continue to use Easy Access IP.

[101] Cf. Eggington et al. (2015), p. 29

3.1.6 Similar concepts

In 2011, Scottish Funding Council placed some of their technologies under the Knowledge Transfer Grant for free of charge. It uses similar principles as Easy Access IP, and in some cases identical contracts. Only the University of Glasgow is partner for both Easy Access IP and Knowledge Transfer Grant. Until November 2014 total of 50 technologies were on offer at Knowledge Transfer Grant.[102]

University of Manitoba in Canada has an approach named "Transformational Partnership" which offers free access to IP, but in return gets 1-2% royalty fee after the IP generates revenues. A similar method is offered by University of North Carolina with no maintenance fees for three years and fixed 1-2% royalty fees. In opposite to the simple Easy Access IP's, license agreement of University of Manitoba is 27 pages long.[103]

The University of Minnesota launched the so-called Minnesota Innovation Partnerships in 2013. In this scheme, licenses for companies are provided for "test-run" for a small fixed fee. When the trial period is over, there are pre-set licensing terms. One term is that the first $1 million of product revenue is royalty-free. Companies located in Minnesota receive discounts for the trial period and lower royalty fees. Another similar scheme is from Stellenbosch University in South Africa, which also uses simple, two-page agreements for licensing. The first three years are free of fees. After three years, 1% of the income generated from technology is paid every year to the university.[103]

From the above mentioned, only KTG scheme is similar to Easy Access IP since it involves partner universities and focus its priorities on knowledge transfer, not on universities' profit. Easy Access IP partners are located on three different continents, which makes knowledge transfer and marketing strategies much easier.[103]

3.1.7 Conclusion and recommendation for universities

Even though Easy Access IP started only five years ago, some general conclusions can be drawn. For most organizations it is too early to judge the success of the Easy Access IP transfer way because partner organizations were not very active in promoting and using Easy Access IP. For Easy Access IP to work, senior management and head of department of each partner university must support the initiative.

Applications of Easy Access IP do not only lie in licensing deals, but it can be used as a hook for industry interactions, helping students and young entrepreneurs, for engagement in local enterprises, and to control the results of collaborative research.

[102] Cf. Eggington et al. (2015), p. 31
[103] Cf. Eggington et al. (2015), p. 32

Some could expect that giving IP for free would cause industry to expect that all IP should be for free, but there is no evidence for that claim. Since it takes no effort for implementation and usage, Easy Access IP is a viable option for any university to maximize partnerships with industry partners and to transfer university's knowledge and technologies for great public benefit.

Universities that are users of Easy Access IP will continue to use it as they only see benefits. That kind of TT pathway demands minimum amount of effort and need no investment for promotion. Researchers involved in Easy Access IP projects see it as a great opportunity to connect with companies and other universities. Since it is completely free, companies see it as a possibility to improve its relationship with academia. Licensing IP for free is a viable TT option that has no downsides and many potential upsides.

3.2 Online Marketplaces

The last couple of years, there has been an increase in use of online shopping websites. Online "shopping" has nowadays spread also to TT. Since companies are in search for new technologies worldwide, places that enable easier search have emerged.

Online marketplaces represent databases of technologies on a website which anyone can access and explore. The database consists of technologies from different industries and from all over the world. Although universities list their IPs on private universities' websites, online marketplaces provide a place where all universities can list their technologies. This way should make it easier for companies to find particular innovations from different fields. The following chapters describe different online marketplaces.

3.2.1 GreenXchange

Open innovation is always connected to online marketplaces. Exchanging experiences and knowledge on ongoing collaborative research projects is the main core of open innovation. Also, exchanging knowledge and experiences need to be considered in online marketplaces. Launched in 2010 by Nike and other nine organizations, GreenXchange was an online marketplace for sharing innovations. Aim was that companies share IP to promote innovations in industries where they do not compete. Frequently, companies have innovations that they consider unusable in their own industry but see potential in other industries. Goal was to get companies to use and promote GreenXchange, and afterwards attract universities and research institutions. The premise was promising with huge world companies taking part from the beginning. Nevertheless, two years after launch GreenXchange has failed. Nike started the platform with more than 400 of their

patents, but at the end there were 463 patents all together with 444 from Nike, which shows the lack of dedication from other members[104]. In developing this kind of marketplace, three problems stand in its development:[105]

1. IP protection and management
2. Importance and visualization of patents in open innovations
3. Amount of resources for the project.

IP protection and management is not a problem unique to the GreenXchange platform. Companies see IP rights as something which provides them freedom to develop with blocking their competitors. Frequently, patent attorneys have the final decision, not the TT experts, and that prevents companies' commitment to the marketplace. One of the ways to solve this issue is to target universities, since they have a large number of patents, but they lack resources to commercialize them. Universities could see GreenXchange as a platform for their needs. Instead, universities anticipated larger a number of patents from companies on the GreenXchange platform and hesitated to join. This prevented growth of GreenXchange since the platform relied on universities patents to attract companies. Second problem was with visualization of patents. Companies and universities were more interested in the creation of the invention, and knowledge behind it, not the patent itself. Third problem was related to people committed to work on the platform. Having people work on the development of the GreenXchange and its web platform was not easy to organize since there were many partner companies. Nurturing relationships between partners needs more effort than just to moderate the marketplace's website.[106]

GreenXchange was introduced at the time when industry, academia and innovation experts started to think about the idea of a platform where innovations and technologies can be shared. Despite the initial enthusiasm it problems with IP management and the differences between scientific ideas and practice realization started to occur. After failure of GreenXchange, three clear conclusion were taken:[107]

1. Education of companies on the benefits of exchanging IP
2. Resources are needed to change the dominant visualization of patents
3. Connecting people is more important than exchanging patents

Educating companies on exchanging IP takes time, but universities will lead the way. Universities do not have economic power the companies and universities will use different ways to exchange IP and try to change the way companies think. Second conclusion is

[104] Cf. Ghafele (2012), p. 4
[105] Cf. Ghafele (2012), p. 7
[106] Cf. Ghafele (2012), p. 5
[107] Cf. Ghafele (2012), p.7

that resources in terms of manpower and financial assets are needed. Also, government should play a role in the IP exchange with incentives for companies and universities that promote open innovation and collaborations between them.

It has become clear that connecting innovators behind patents is of greater importance than simply acquiring IP rights to use a patent. More emphasis should be placed on building relationships to collaborate between companies, and especially between companies and universities. A platform to exchange innovations has limits, but focus should be widen with organizing conferences, setting up seminars and pushing with sponsoring any kind of interactions. Each institution and company needs to determine the strategy concerning innovations and IP exchange that suits its business needs. But by focusing on education on IP exchange and licensing, creating partnerships and putting the emphasis on connecting the right people, online marketplaces can have brighter future.

3.2.2 Active online marketplaces

Learning from mistakes of GreenXchange, some online marketplaces have emerged in different regions of the world. Table 2 compares online marketplaces that were active in last years. All of them are worldwide, which makes them interesting for universities that have a need for expanding beyond its country's limits. WIPO Green is a part of World Intellectual Property Organization (WIPO), IP Nexus is a fast-growing start-up, and iBridge Network is the USA based marketplace, that partners with Easy Access IP collective. In the next chapters, their advantages, disadvantages and benefits for Austrian universities are discussed in detail.

	WIPO Green	IP Nexus	iBridge Network
Market	Worldwide	Worldwide	Worldwide
Number of IPs	Around 1900[108]	Over 52000[109]	Over 17000[110]
Establishment	2013, Switzerland	2014, Hong Kong	2005, USA
Technologies listed	Green	All	All
Universities customers	Many	No data available	Many
Price for listing IP	Free of charge	Free of charge	Free of charge
Price for buying IP	Free of charge	Monthly subscription	Free of charge
Transaction fees	None	4% of deal earnings	None
Other services	None	Auctions	None
Stage of technology	Any (no IP needed)	Pending or granted patent	Any (no IP needed)

Table 2. Comparison of online marketplaces[111]

3.2.2.1 WIPO Green

WIPO Green is specific for listing only environment friendly technologies. It was established in 2013 to accelerate green technology innovation and transfer by promoting skills and technology sharing. WIPO Green is administrated by WIPO which is a global forum for IP services, policy, information and cooperation. Since it has started only two years ago and they have focused only on green technologies, there is only around 1900 listed IPs in its database. To list a technology or a product in the WIPO Green database, no patent is need. WIPO Green does not focus only on universities or private companies. The primary objective is a promotion of innovative clean technologies.[108]

[108] Cf. WIPO Green (2015), https://webaccess.wipo.int/green, Date of Access: 01.04.2015
[109] Cf. IP Nexus (2015), https://www.ipnexus.com, Date of Access: 21.04.2015
[110] Cf. iBridge Network (2015), http://www.ibridgenetwork.org, Date of Access:01.04.2015
[111] own illustration

Their partners are a range of organizations which come from public and private sectors. Partner can contribute in many ways: [112]

- Providing advice and supporting
- Directly or indirectly enabling easier transactions
- Submitting technology needs and giving expertise
- Collaborating with WIPO Green in their own actions and activities
- Working as a focal point for their part of the region or nation

Database of technologies is divided in six different categories:[112]

1. Administrative, regulatory or design aspects
2. Agriculture and forestry
3. Alternative energy production
4. Energy conservation
5. Transportation
6. Waste management

With partners, WIPO Green includes its users. A user can be any institution that contributes to the database by uploading technology or announcing the need for a technology, or an institution that provides services, which help in WIPO Green's work. Additionally a user can also be a partner and contribute in above listed ways. Becoming a user or a partner is without costs and it will remain like that in near future.[112]

3.2.2.2 IP Nexus

IP Nexus was created as a start-up in Hong-Kong. One of its partners is WIPO. It is a marketplace for patents and other IP. Goal is to connect start-ups, universities, companies and entrepreneurs to promote and accelerate successful innovation. In its IP exchange database, they offer patents, patent portfolios, copyrights, trademarks, designs, technologies and brands. Biggest part of the database are patents. Database has over 52.000 listed patents and 20.000 of them are for Europe market. IP Nexus also offer auctions to sell IP, which is covered in chapter 3.7.1.

Offering IP over IP Nexus website is free of charge. But after every successful deal, 4% of that deal goes to IP Nexus as a compensation for using their services. That 4% is for non-profit organizations like universities. Submitting interest to buy or license IP is also free, but buying IP is not free of charge and involves monthly subscription. They have divided subscriptions in two categories, Plus and Premium. Plus subscription plan costs

[112] Cf. WIPO Green (2015), https://webaccess.wipo.int/green, date of access: 03.04.2015

99$ per month, and Premium 149$. Differences between Free, Plus and Premium plans are displayed in Table 3.

Services	Free	Plus	Premium
Upload/List unlimited IP	✔	✔	✔
Browse IP (with short IP description)	✔	✔	✔
Submit interest to buy or license individual IP	✔	✔	✔
Browse IP unlimited (with full description and official registration number)	–	✔	✔
See potential buyers/licensees for individual listed IP	–	✔	✔
See IP official assignee's information	–	✔	✔
Directly bid for, buy or license IP	–	✔	✔
See legal and business information	–	–	✔
Download additional relevant business and legal information	–	–	✔
Contact IP owners directly	–	–	✔
Costs per month	$0	$99	$149

Table 3. Detailed description of IP Nexus subscription plans for IP exchange[113]

(Legend: ✔ included service, – not included service)

3.2.2.3 iBridge Network

iBridge Network promotes university-based research through its own online community by sharing knowledge, ideas and research. iBridge Network is a public centralized source for objective information about early stage technologies and inventions.[114]

[113] Cf. IP Nexus (2015), https://www.ipnexus.com, date of Access: 21.04.2015
[114] Cf. iBridge Network (2015), http://www.ibridgenetwork.org, date of access: 22.04.2014

Since iBridge Network is based in the USA, most of their organization members are universities and research organizations from the USA and its goal is to promote technologies and projects from the USA. Even though it was established in 2005, they changed leadership in 2013, when they handed the leadership to public-private Innovation Accelerator Foundation. iBridge Network has over 13.000 members from 176 organizations worldwide. Its innovation portfolio consists from more than 17.000 technologies and inventions that are from industries.[115]

3.2.3 Conclusion and recommendation for universities

Using online marketplaces represents a great and simple way to promote and showcase technologies worldwide. Listing IP is free of charge and does not require any extra marketing from universities.

Even though licensing and selling are the most attractive option, online marketplaces can be also used as a search for potential research partners. Since technology can be listed at any stage of development, use of online marketplaces has potential to accelerate technology development by connecting companies or research institutions throughout the world. Further advantage of the online marketplace is that the owner of IP rights can also restrict the offer only to a specific region or country.

A potential limitation for using online marketplaces exists for European universities, since most customers and users are from USA. This does not come as a surprise since USA is a country with most IP applications. A steady growth of patent applications is also registered from European universities in the last years, which could mean an increased interest in marketplaces to promote IP from universities based in Europe.

Using WIPO Green and IP Nexus is certainly an option for Austrian universities. WIPO Green is a part of World Intellectual Property Organization which is a main IP organization in the World. That alone gives WIPO Green reputation which ensures that innovations from universities would be recognized by wide range of world companies.

IP Nexus is new, but extremely fast growing start-up. From the beginning of 2015, number of patents listed on their website has grown from 46.000 to over 52.000, which is growth of around 15%. That is an indicator that many patent owners have great belief in IP Nexus, even though its services are not completely free of charge. From successful licensing deal IP Nexus takes 4%.[116]

[115] Cf. iBridge Network (2015), http://www.ibridgenetwork.org, Date of Access: 02.04.2015
[116] Cf. IP Nexus (2015), https://www.ipnexus.com, Date of Access: 21.04.2015

iBridge Network is interesting for being Easy Access IP partner, but there are no indicators that suggests its services would help universities from Europe, since iBridge Network is mainly focused in promoting innovations from USA. Benefits from iBridge Network could be seen, if universities from Europe have ambitions to spread in the USA, otherwise it is not an attractive option for European universities.

Actual online marketplaces seem to learn from mistakes of GreenXchange. Having a platform that is independent on any company or university and that can objectively decide and maintain relationships with industry and academia is an important factor. Since all of them have a steady flow of finances and with fast growth, it can be concluded that online marketplaces have a great future.

3.3 Exhibitions

Licensing and selling IP is not the only way to transfer technology. One way with great potential to reach many companies and potential licensees is visiting and participating in exhibitions. Exhibitions help connecting distinct parties and transferring knowledge.

When somebody creates a new technology or a new product, he or she wants to demonstrate it to as many people as possible, and especially wants to show it to companies. Companies are most attractive customers and frequently companies are the most willing for collaboration. Different companies have integrated exhibitions successfully as a mean of communication.[117]

Exhibitions are events that bring together different groups of suppliers from particular industries or technology fields with the primary goal to showcase, promote and market their products and services to buyers and other relevant target groups. In literature, exhibitions are also called trade shows, fairs, etc., but all of them have the same purpose. Exhibitions are an attractive option for universities, because companies are always present and have interest in technologies by universities. And it is an easy way to showcase a product to many customers at one place. Since universities often have more than one technology to present, visiting exhibitions are very efficient way for that kind of presentation. Exhibitions are considered as a vital communication technique for companies that operate in international markets. Universities are aiming to spread its knowledge and technologies internationally, and with the help of exhibitions, that can be accomplished.[117]

Exhibitions are regarded as one of the most effective and efficient way to inform industry and institutions about new technologies and products. Exhibitions can help gain return of

[117] Cf. Kallezi (2013), p. 467

investment. Using exhibitions as a networking tool is regarded as an important way to connect with companies. Since companies are always present, connecting with them and entering their own “network of trust” is very valuable and can be used in future searches for research partners.

University planning in participating at exhibitions needs to set goals that will make exhibitions simple and highly successful:

- Compose a list of potential customers
- Create and build interest
- Gain exposure
- Make contacts in industry

During conversations with University of Glasgow, King’s College London, University of Copenhagen, University of Lancaster and Medical University Vienna, I have found that people who work at TTOs place great value in visiting and participating in exhibitions. They see it as an important TT pathway that makes big difference in TT. Visiting exhibitions had produced many industry contacts and have started some important research collaborations to mentioned universities.

Although exhibitions are not as good as individual meetings, some consider them better than other TT ways. Academics and marketing practitioners recognize exhibitions as a significant marketing tool.[118] A strong, positive argument is the possibility to see the technology in real life and the interaction with inventors or people familiar with the technology. If individual meetings are hard to arrange, university should invite potential buyers to visit. Since universities or inventors create booths to showcase the technology, it is considered that these are the “controlled environments” for presenters that could help in interaction with companies and potential buyers. Meetings are easier to arrange in person at exhibitions and a reason for it could be that company representatives are “away from office distractions” and they do not feel the work pressure.[119]

3.3.1 Effectiveness

The process of buying a product has separate phases, where potential buyers seek certain information to move from one phase to another.[120] This information can be given through non-personal communication channel. To best achieve marketing communication objectives, there should be a mix of personal and non-personal

[118] Cf. Kallezi (2013), p. 465
[119] Cf. Artley (2003), p. 175
[120] Cf. Dekimpe (1997), p. 58

communication techniques[121]. Exhibitions are a perfect combination of direct sales and advertising, personal and non-personal communication channels. The main advantage of the exhibition is that they have the ability to involve visitors and interact with them.

There is a difference in use of exhibitions between small and big companies. Big companies not only have bigger budgets, but they have more structure in organizing booths. Small firms are sometimes unstructured and spontaneous. Considering the situation, exhibitions become an important marketing tool for these small companies and are integral part of their marketing strategy.[122]

Universities and companies that plan to use exhibitions as a tool for communication should plan activities that take place before, during and after the event. And all these plans must be integrated into company's or university's communication strategy.

Exhibition technique should follow six specific steps:[122]

1. Situation analysis
2. Definition of exhibition marketing objectives
3. Definition of exhibition marketing strategy
4. Planning of the exhibition marketing mix
5. Implementation
6. Control and evaluation

Exhibitions should not be seen as an expense, but as an investment. If the message, about the presented innovation is well coordinated, in the long run it will add value to the university or the technology presented. Exhibitions provide cost-effective opportunities for face-to-face communication. The value of exhibitions is measured in tangible and intangible benefits. Tangible benefits include acquisition of new customers, sale or licenses of innovations, new partners, etc. On the other hand, intangible benefits include genuine information, marketing communication, and relationship with companies, new idea generation. And all these benefits, both tangible and intangible, may come from formal or informal communications. Formal communication is a one way communication, which are press reviews and product demonstrations. Informal communication is the one that takes places in casual conversations. After the exhibition, there is an important part of evaluating gathered information received during the exhibition and considering how that information can be used within the organization, the university and the TTO.[123]

[121] Cf. Kallezi (2013), p. 467
[122] Cf. Kallezi (2013), p. 468
[123] Cf. Kallezi (2013), p. 469

3.3.2 Interviews

For example, visiting exhibitions have been successful for Ms Helga Kroschewski, researcher from Medical University Vienna. She went to an exhibition to talk with a company about a research project, but the company was not interested because it was doing something else. But that something else was the research of Ms Kroschewski's colleague and now that company is doing a research project with her colleague.

Science Park Graz and Innolab Graz are also exhibition supporters. They find exhibitions as the most important way of TT. They work with entrepreneurs from universities and encourage them to visit exhibitions as much as possible, as it is a way to show an invention to a great number of companies.

Start-ups and university spin-offs have strong passion and belief in their own technologies. That passion is best seen in direct contact with companies, which happens during exhibitions.

3.3.3 Conclusion and recommendation for universities

Using exhibitions is seen as an important and valuable way in TT. IP or technology owner wants to demonstrate its inventions to companies, and exhibition makes that possible. Goals, which university has when participating in exhibitions, can be easily fulfilled. Since companies are often present and willing to collaborate, university representatives should participate in exhibitions and make use of them as much as possible.

It is considered that exhibitions are an investment and its expenses (booth, logistics) should be neglected. Exhibition is a cost-effective way of communication. Visiting or organizing exhibitions has only advantages since networking and communicating with people from industry and other universities can help in the long run. Promoting research projects or new inventions is most efficiently done through exhibitions.

TTO should implement exhibitions in their marketing strategy. Having a mixture of communication during exhibition, with formal and informal conversations, TT happens faster and more efficient. Experts in marketing see high potential in exhibitions. Even though, having a booth can be sometimes expensive, in the long run, these expenses are neglectable.

Best marketing tool for promotion of university spin-offs is using exhibitions to demonstrate new technologies and network with companies to transfer knowledge through means of communication.

3.4 Pharma Licensing

Pharma Licensing, the division of IP Technology Exchange, is a company founded in 1998 that offers licensing and partnering opportunities from companies, universities and research institutions worldwide in biopharmaceutical and life science industries. The UK and Switzerland are countries that had most patent applications in pharmaceutical technology field, with Austria having 3.9% patent applications in medical devices. It clearly demonstrates that there is a need to transfer pharmaceutical and medical technologies in these countries.[124]

Pharma Licensing works as an online marketplace. It has a database with over 11.000 technologies for licensing which is growing daily. The database is divided in eight industry sectors: animal health, biotechnology, diagnostic, drug delivery, drug discovery, medical device, pharmaceutical, and research tools. One way of promoting listed technologies is its own newsletter sent every week to 24.000 different addresses worldwide. Their website registers around 200.000 unique visitors per month. Pharma Licensing has over 300 university members, including 100 European universities, and all together over 1500 members that have listed their own innovations in search for buyers, licensees or project partners. Table 4 shows percentages of Pharma Licensing users according to world region. Pharma Licensing covers most world regions with 40% of users coming from the USA.[125]

Region	Share (%)
USA	40%
Europe	28%
Asia and Australia	24%
Rest of the World	8%

Table 4. Users of Pharma Licensing[126]

3.4.1 Services and subscriptions

A subscribed membership is required to use Pharma Licensing services. Generally, memberships are divided into three different levels. Each level has different costs and different benefits. Universities, as a non-profit organizations, have to pay the lowest

[124] Cf. LinkedIn (2015), https://www.linkedin.com, date of access: 08.06.2015
[125] Cf. Pharma Licensing (2015), http://www.pharmalicensing.com, date of access: 7.4.2015
[126] Own illustration

amount, but they have the highest level of subscription. The biggest difference in the levels is number of partnering opportunities listed. Level 1 allows up to three, level 2 up to six, but level 3 allows unlimited opportunities listed. And so level 3 is the most attractive option for universities, since they have many technologies and patents in their portfolio. One more difference is in amount of professionally written reports that Pharma Licensing can offer their customers.[127]

Since level 3 has no limits in listing opportunities, Pharma Licensing has decided to limit the number of professionally written profiles. As a university, it offers only 10 professional profiles or IP descriptions, but that number can be negotiated. Every subscription level is valid for 12 months, and every level costs differently. Level one is 5.200$, level 2 costs 6.400$ and level 3 is 8.500$. Universities gets highest level for lowest costs. Subscriptions are shown in Table 5.[128]

[127] Cf. Pharma Licensing (2015), http://www.pharmalicensing.com, date of access: 7.4.2015

Service	Level 1	Level 2	Level 3
Number of partnering opportunities listed	Up to 3	Up to 6	Unlimited
List detailed company information	✔	✔	✔
List contact person and contact details	✔	✔	✔
Unlimited number of press releases	✔	✔	✔
Add company logo	✔	✔	✔
Inclusion in weekly newsletter	✔	✔	✔
Real time stats	✔	✔	✔
Professionally written profiles	✔	✔	–
Feature placement on pharmalicensing.com	✔	✔	–
Banner adverts on pharmalicensing.com	✔	✔	–
Banner adverts in weekly newsletter	✔	✔	–
Price of subscription	5.200$	6.500$	8.400$

Table 5. Subscription plans of Pharma Licensing[128]

(Legend: ✔ included, – not included)

Pharma Licensing offers help in negotiations to sell or license IP, which costs 400$ per hour. Even though their focus is on life science and biopharmaceutical industries, Pharma Licensing offers proactive consultations for all industries, including life science and biopharmaceutical industries. The consultations cost 25.000$ per IP and include finding and contacting potential partners. Only life science and biopharmaceuticals IPs are listed on Pharma Licensing website in its IP database.

[128] Cf. IP Tech Ex (2015), http://iptechex.com, date of access: 14.06.2015, own illustration

3.4.2 Conclusion and recommendation for universities

With 17 years of experience and over 300 university users, including 100 in Europe, Pharma Licensing is an attractive option as a TT pathway for pharmaceutical and life science parts of the industry, which are industries with the most patent applications in some countries.

Even though, there are online marketplaces (chapter 3.2) that Austrian universities can benefit from, Pharma Licensing stands out by focusing on certain branches of the industry. And with over 1.200 company members, these companies know where to look for in search for specific and new innovations. What further differentiates Pharma Licensing from other marketplaces, is their experience and reputation. IP Nexus and WIPO Green were incorporated less than two years ago, which makes them newcomers to the market. Pharma Licensing is 17 years in biopharmaceutical and life science market and as such is a frontier in considered online marketplaces. And even though its services are not free, these can be seen as an investment since what it offers is more than just a yearly subscription.

3.5 Technologie Allianz

Technologie Allianz is an association that connects TTOs and patent agencies within a single network. It consists of over 200 scientific institutes. As the most important service, it provides enterprises access to a big range of innovative research results from many universities and research institutions from Germany. Even though it consist of institutions only from Germany, its customers are from all parts of the World.[129]

Technologie Allianz promotes patent-protected inventions from universities and research institutions and makes those inventions available to industry. Furthermore it strongly promotes cooperation between industry and universities. Being a member of Technologie Allianz is not free of charge. Every member must pay a joining fee and afterwards yearly membership fee. Fees are publicly unknown.[129]

3.5.1 Partners

Technologie Allianz is being funded by German Federal Ministry of Economics and Energy. It is being supported under the initiative “SIGNO Deutschland” which is a

[129] Cf. Technologie Allianz (2015), http://www.technologieallianz.de, date of access: 05.04.2015

program that supports universities and enterprises in legal protection and economic utilization of their inventions.

Technologie Allianz has a strong network of cooperation with many industries and TT associations. Some of them are Association of German Industries, German Engineering Federation and Advantage Austria, which is an official representative of the private sector from Austria. Advantage Austria keeps Austrian companies up-to date in latest technologies and trends from German universities, research institutions and industry.

3.5.2 Technology offers

To offer technology for free, one must be a Technologie Allianz member. There are more than 200 members of Technologie Allianz. Non-members can also offer technology over Technologie Allianz, but each offer is being checked in detail for a fee to keep a high quality level. Offered technologies are from all of industries, from construction and architecture to pharmaceuticals and medicine. All inventions are centrally accessible, the IP rights are secured and it has professional profiles that every customers can easily understand.[130]

Technologie Allianz can also be seen as an online marketplace because it uses centralized system for all inventions. And inquiries can be easily sent over secured online system provided by Technologie Allianz.[130]

As an additional service, Technologie Allianz provides Invention Store which is an e-mail newsletter that only sends latest inventions for chosen field of interest. Current portfolio of inventions offered at Technologie Allianz consists of more than 2000 technologies which are legally protected and highly market-oriented.[130]

3.5.3 Technologie Allianz in Austria

Since Technologie Allianz is a well-established and recognized TT network, Austrian universities would benefit from joining Technologie Allianz. Regional TT centers in Austria are trying to become a member of Technologie Allianz. The goal is that each TT center joins and universities that are part of those centers will also become a part of Technologie Allianz. But individual universities, who are not part of regional TT centers or who's centers do not want to join, may also become members.

Austrian TT centers cannot be full-fledged members, since they are not from Germany, but they are able to offer their own technology over Technologie Allianz and use all of

[130] Cf. Technologie Allianz (2015), http://www.technologieallianz.de, date of access: 05.04.2015

Technologie Allianz's services. Austrian universities must also pay joining and yearly membership fees. Joining Technologie Allianz is still in negotiation phase, so those fees are currently unknown.[131]

3.5.4 Conclusion and recommendation for universities

Technologie Allianz is an outstanding opportunity for Austrian universities. Companies are very familiar with Technologie Allianz and over 200 institutions are members. The German industry is a strong player in the world and for an Austrian university being able to use the same TT tools as institutions from Germany will be beneficial.

Since Technologie Allianz has a centralized system with technology offers, it is easy for companies to find research and innovation they need. Additionally, companies are familiar with Technologie Allianz. It means that any university entering the Technologie Allianz database is getting under the view of many companies worldwide. Not only Austrian university can benefit from companies, but also from members of Technologie Allianz. Having research partners in some German universities would be beneficial for Austrian university and Technologie Allianz can be used as a networking tool to connect to universities from Germany. German universities have high reputation in the world and many European universities see some of them as role-models for TT, i.e. TU Munich. Thus, it is highly recommended to become a member and user of Technologie Allianz.

3.6 Enterprise Europe Network

Enterprise Europe Network (EEN) is an organization in EU with a strategy to help economic growth and increase the amount of jobs in EU. EEN launched at the beginning of 2008, and since then has grown to 3000 staff members who try to help with practical answers to any question.132

EEN has around 600 organizations from more than 50 countries. Organization members consist of technology centers, research institutions, development agencies and chamber of commerce and industry. For members the aim is to share their knowledge and technologies, and to collaborate in businesses across all EEN's countries.[132]

EEN wants to support small companies, since those are the strong cornerstone of the EU's drive for growth and jobs. 99% of all EU companies are small and medium-sized enterprises (SMEs), and they account for 67% of all jobs in EU. Even though they are

[131] Cf. Technologie Allianz (2015), http://www.technologieallianz.de, date of access: 05.04.2015
[132] Cf. Enterprise Europe Network (2015), http://een.ec.europa.eu, date of access: 06.04.2015

aimed for SMEs, they are competent and available for universities, research centers and all other business.[133]

3.6.1 Members and partners

EEN has teamed up with some national and European business organizations and foundations whose knowledge is particularly relevant to EEN activities. Those partners help in optimizing EEN services to each business and provide relevant information, and give advices, help in training and cooperate in joint events.[133]

Some of those European organizations are the European BIC Network, the European Confederation of Young Entrepreneurs and CERN, a European organization for nuclear research. EEN also has organizations that represent EU interest outside of Europe (Hong Kong, Malaysia, South Korea and Thailand).[133]

Each country in EU and many countries in Europe and worldwide have their own local EEN points, which provide help and knowledge for the specific countries. Austria has ten local points in seven cities, and two of those are in Graz (Steirische Wirtschaftsförderung and International Centre Steiermark). Out of 600 organizations that are members of EEN almost 50% are universities and research organizations.[133]

3.6.2 Technology transfer

EEN provides a database for technologies for their partners. Those technologies are listed on EEN website and all those technologies have profiles description of application in detail. EEN's database is the biggest technology database in Europe and consists of more than 23.000 profiles, which are updated on a weekly basis. EEN also provides a weekly newsletter containing new published profiles that helps in keeping up with cutting edge technologies developed in Europe.[133]

3.6.3 Services

EEN is an extremely capable organization in finding research partners. Its success rate is 100%, which means that they find a partner for every customer every time. Their staff is really proud of that accomplishment. EEN does not work in negotiation between owners of research projects and potential research partners.[133]

[133] Cf. Enterprise Europe Network (2015), http://een.ec.europa.eu, date of access: 06.04.2015

Additionally, EEN provides help in profile description for IPs and technologies listed in its database. EEN provides help in wording, since many people working for them are native English speakers and EEN gives templates for profiles that IP owner can use for profile description.[134]

3.6.4 Conclusion and recommendation for universities

Since 2008, EEN is providing powerful assistance in EU for non-profit organizations and SMEs. Having many members and partners in many European and world countries, gives EEN big support and the ability to grow, which can help universities in countries like Austria. EEN's database with 23.000 technology offers is growing weekly. Most customers that visit the database are companies. Certainly it is a recommendation for Austrian universities to join EEN and profit from its services, especially for finding an adequate research project partner.

3.7 Auctions

Auctions are events where one can bid for offered products and compete with other bidders. Anything can be sold in an auction, but this thesis focuses only on patent auctions where only patents are sold or licensed. Generally, transactions related to patent transfer are done confidentially, and it is difficult for buyers and sellers to gain comparative data to know whether they are paying the right price or if the price is appropriate.[135] One of the aims of auctions is to enhance transparency.[136]

The assessment of the economic value of patents has been the main point of interest of economists for long time. However, economic value of the patent is rarely observed, since it includes different components and there is little empirical value on this topic. Getting the value of the patent is one of the things that makes auctions attractive.[137]

3.7.1 Auctions in the USA

Universities based in USA license only 5% of the patents, and using auction houses to unload other 95% is one possibility. IP Offerings, a patent auction house in the USA, has handled around 20 patents from universities from 2011 to 2013, which is 7% of firm's total

[134] Cf. Enterprise Europe Network (2015), http://een.ec.europa.eu, date of access: 06.04.2015
[135] Cf. Yanagisawa et al. (2009), p. 12
[136] Cf. Odasso et al. (2009), p. 4
[137] Cf. Odasso et al. (2009), p. 5

business. Ocean Tomo, another patent auction house in the USA, has had 20% of their auctions from universities. Even though, the owner of IP can put restrictions on who can license or buy IP, sometimes universities remove those limits when they get insights how much a company is willing to pay. Limits are put to keep “patent trolls” away, but they can sometimes offer high amounts.[138]

The University of Pennsylvania (Penn State) had a patent auction in April 2014. It was an experiment from Penn State to get insights in the values of its patents. Out of 59 patent packages they offered, only 2 were licensed. These 59 offered patent packages were the patents that the university protected years ago but were not licensed. Penn State tried to get rid of inventory that was not being used for some time. Although, from outside it can be seen as a failed auction, Penn State considers the auction as a success. They have seen the commercial value of its patents and got a clear picture about patents that nobody wanted. Penn have discontinued to pay maintenance fees for failed patents and have saved over $300.000, money which will be redirected in protecting new patent rights.[139] Penn State did not want to sell to “patent trolls”, companies known for not using patents in public’s best interest, and made terms of their licenses very unattractive for “trolls”. Anyone interested in an auction had an opportunity to participate by creating an account on Penn State website. Since Penn States uses its own platform, it does not have to pay extra money to auctions houses, and the university plans to do auctions once a year.[140]

3.7.2 IP Nexus auction

Most of the patent auctions houses are based in the USA, and for using their services, owner of the IP needs an US patent, which can be expensive. IP Nexus, start-up from Hong-Kong (see chapter 3.2), offers patent auctions as one of its services. The owner of IP can decide that only companies from certain countries can participate which helps in managing whom to sell or license IP. Process of auctions on IP Nexus is done in six steps:[141]

1. Owner of IP submits a request for an auctions over IP Nexus’ website
2. IP Nexus approves the auction and lists anonymous title information on their website
3. Premium members (members with paid subscription) can see information and they can apply for an invitation

[138] Cf. Ledford (2013), p. 472
[139] Cf. Penn State News (2014), http://news.psu.edu, date of access: 26.05.2015
[140] Cf. Forbes Magazine (2014), http://www.forbes.com, date of access: 26.05.2015
[141] Cf. IP Nexus (2015), http://www.ipnexus.com, date of access: 09.06.2015

4. Owner of the IP approves invitations and can also invite other companies which are not members of IP Nexus
5. Invitees sign non-disclosure agreement and get access to a secure virtual room where they can see all legal, financial and other information about IP
6. Invitees confirm attendance and physical auction takes place at agreed location and time

The second step points out that IP Nexus does not accept all requests for auctions. Since it is providing the platform and a place for an auction, it can be assumed that IP Nexus takes a fee for using their services. It is not publicly known how much an auction may cost a university. In the third step of the auction process it is clearly stated that only premium members can see information about an auction. Premium membership costs $149 per month.[142] Nevertheless, owners of IPs can invite companies or bidders they prefer, and these invitees do not need to have IP Nexus subscription. Last step points to that physical auction takes place and there is no information about the possibility to make an auction from internet platform without physical presence. Perhaps that option could make IP Nexus auction more attractive, but there is no evidence to support this claim.

3.7.3 Conclusion and recommendation for universities

Although auctions are common for companies in USA, it is still a new field for universities. Examples like Penn State are rear, but demonstrates that some universities are indeed considering auctions. Penn State only licensed a small part of their portfolio. In the eyes of the public and industry, the auction from Penn State University was a failure, but the university itself does not look at it that way. Penn State used auctions for the first time and they managed to see the values of their patent portfolio. In the future they will consider auctions as a viable option of TT way.

Technology evaluation is the most crucial activity of TTO. Yet, it is the hardest activity. Frequently, expecting one “big hit” brings disappointment. That comes from over evaluating inventions.[143] On the other end, there are patents from universities that are old but they need maintenance fees to keep patent rights.[144] If these old patents are useless and do not provide any value to the owner, in this case university, these rights should be dropped in order to save money. Having new and potent inventions and some old patents is common for all universities. In both ways, auctions can help.

[142] Cf. IP Nexus (2015), www.ipnexus.com, date of access: 09.06.2015
[143] Cf. Abrams (2009), p. 26
[144] Cf. WIPO (2015l), http://www.wipo.int, date of access: 31.05.2015

Every university hopes for an invention it can patent and to have many potential buyers to gain as much profit as possible. If there is that kind of invention, auction is the right TT way to go. Even if it disappoints and earns less than predicted, TTO can reorganize their evaluation system and improve it further based on a failed auction. Considering the example from Penn State auction, it is clear that old and unused patents are a common problem and that needs to be solved. Using auctions to reevaluate old patents to save on maintenance fees is a one possibility that could be prove of great value in the future.

The increase in the number of patent applications all over the world implies a need for a change in TT to make it more effective and efficient. Since there are more patents every year and TTOs need to provide more options for TT. Universities are not frequent users of auctions but that should change in the future. Even in USA, which is regarded as one of the countries with best TT systems, universities struggle to earn money from patents and they need to change the model of TT.[145] Universities are filing more patent applications every year and they need to look at auctions as a viable option, especially with positive examples like Penn State. IP Nexus provides auctions and Austrian universities should consider this possibility and make more out of their patents.[146]

3.8 Non-Practicing Entities

Non–Practicing Entities (NPE) are mostly known by the name “patent trolls”. They are companies that buy IPs and sue other companies for using that IP. “Patent trolls” almost never develop their own technology. In principle, “patent trolls” may help inventors financially by buying or licensing their patent rights and then enforce lawsuits against patent abusers. Frequently, they are characterized as relying on low-quality patents, but if that was true, “patent troll” business would be terminated very quickly. Analysis of 565 patents bought by “patent trolls” from 1997 until 2006, shows that “patent trolls” acquire patents that are more likely to be infringed, thus having higher quality.[147]

3.8.1 USA

Even though “patent trolls” only enforce patents against infringers, most of “patent trolls” aim at quick settlement. Settlements are confidential, but there is evidence that roughly 90% of cases in the USA settle without judgment outside the court.[148]

[145] Cf. Huggett (2014), p. 1191
[146] Cf. Nature (2014), http://www.nature.com, date of access: 31.05.2015
[147] Cf. Fischer et al. (2012), p. 2
[148] Cf. Allison et al. (2010), p. 709

Governments are trying to ban them or make their business model more difficult. In the USA, House of Representatives passed the "Innovation Act" that would increase specifications of a lawsuit which would decrease the ability to easily sue somebody.[149] The Act would also require that the party that loses the lawsuit covers the costs of winning defendant. Innovation Act did not pass the Senate which is needed to apply the Act in practice. Innovation Act is only one of many proposed bills that are supposed to solve the "patent troll" issue. At 113th Congress in USA in 2014 were fourteen introduced bills whose goal is to deal with "patent trolls". The last Congress introduced six bills.[150]

In the USA some universities considers "patent trolls" as good partners. California University of Technology has exclusively licensed 51 of their patents in 2008 to Intellectual Ventures, a "patent troll" that has over 40.000 patents from which it collects 3 billion $ income. It is estimated that, in the USA, only 5% of IPs from universities are licensed and that forces universities to sell IPs to gain profit.[151]

Number of defenses from "patent trolls" is increasing by 22% each year in the USA. In 2005, there were 1.401 defenses, and in 2011, 5.842 defenses from unique companies. Costs from those lawsuits in 2005 were 7 billion $, but in 2011 they have increased to 29 billion $.[152]

3.8.2 Europe

It is much harder in Europe for NPEs to sue someone because of distinct law regulations. Western countries, like Austria, have an "English rule", which makes it difficult to sue patent infringers. USA does not have that rule, since every party pays their own fees. [153] Nevertheless, "patent trolls" are present also in Europe. These are companies mainly focused on mobile technologies and electronics. Table 6 shows active NPEs in USA and Europe.

[149] Cf. Library of US Congress (2014), https://www.congress.gov, date of access: 01.06.2015
[150] Cf. Patent Progress (2014), http://www.patentprogress.org, date of access: 01.06.2015
[151] Cf. Ledford (2013), p.471-472
[152] Cf. Bessen et al. (2012), p. 55
[153] English rule – party that loses in court pays other party's court expenses

	INPro Licensing	IPCom	Papst Licensing
Market	USA, Israel, Europe	USA, Asia, Europe	USA, Germany, Netherlands
Technologies	Computing, display, electronics, internet, mobile/wireless, life science, nanotechnology	Mobile	Electrical, precision engineering

Table 6. Patent trolls in Europe[154]

From all patent suits in the UK from 2000 to 2010, NPEs are responsible for 11% of patents suits during this period.[155] In the same period, 25% of patent suits in the USA were by NPEs. Conventional belief says that "patent trolls" are uniquely an American phenomenon. In comparison to the USA, 11% from the UK is indeed a small percentage, it shows that NPEs are not uniquely an American issue[156]. Some reasons why NPEs are not in Europe are:[157]

1. High barriers to patenting software
2. Steeper costs of enforcement
3. Cheaper costs of defense
4. Smaller damage awards
5. Different cultures
6. More frequent attorney's fee awards

Since there is no big problem with NPEs outside of the USA, there is also no empirical evidence to support claims regarding Europe's "patent troll" problem. But Europe also wants to change some fundamental things in its patent system. In 2013, twenty-five EU member countries agreed to found the Unified Patent Court.[158] Implementing Unified Patent Court patent owners will be able to litigate continent-wide infringement allegations in a single court, instead of taking infringers in each individual country. A similar model introduced in the USA with patent owners seeking infringement claims in one federal district without forcing suits in each state.[159] There is a fear that this "Americanization" of European patent enforcement will attract "patent trolls" to Europe.[160]

One assumption why NPEs rarely sue in Europe is for the lack of high-tech patents. This was disputed by one study from 2014. NPEs in the UK, almost exclusively, assert high-

[154] Own illustration
[155] Cf. Love et al. (2014), p. 509
[156] Cf. Love et al. (2014), p. 525
[157] Cf. Love et al. (2014), p. 512
[158] Cf. European Council (2013), http://www.consilium.europa.eu, date of access: 31.05.2015
[159] Cf. Aipla (2010), http://www.aipla.org, date of access: 01.06.2015
[160] Cf. Inside Counsel Magazine (2013), http://www.insidecounsel.com, date of access: 01.06.2015

tech patents, more precisely those related to information and communications technology.[161]

Taking into account period from 2000 to 2010, NPE litigations have roughly remained steady. There is no evidence that NPE litigations in the UK are on the rise. In contrast, NPE litigations in USA have increased significantly in the same time period.[162]

While 75% of all patent suits in USA ended in settlement[163], only 50% of the UK NPE cases ended the same way. And that can be argued that it is inflated. Almost 20% of the UK NPE cases were part of two large disputes regarding the same matter with the same company – Nokia. And out of cases that were not settled, most were unsuccessful for NPEs. Only one out of twelve ended in victory for the NPE.[164] These findings are consistent with the performance of NPEs in USA, which also fail in high rates.[165] Although these numbers are only from one European country, the UK is most similar in many things to US: large damage awards, high costs of defense, similar culture and history, and common Patent law. And even with these similarities, NPEs are extremely weak in the UK.[166]

Findings suggest that routinely awarding attorney's fees in patent suits reduce the patent suits by NPEs and that Unified Patent Court should implement mechanisms that would provide better managing of attorney and court fees that will deter NPE litigations.[167]

3.8.3 Conclusion and recommendation for universities

There is a big moral issue with selling publicly funded research to "patent trolls", companies that do not promote research and have no interest in helping universities to increase research benefits and reputation, which should be the most important motivation for any public university. "Patent trolls" may sometimes have good intentions by helping small inventors to enforce patent rights from bigger companies, but there is no evidence that European universities could have benefits from "patent trolls".

Even though, some universities in the USA have sold their IPs to "patent trolls", associating university's name with any „patent troll" is not recommended.[168] That could diminish university's reputation and probably discourage companies from collaboration with university associated with a „patent troll". Market that "patent trolls" find most

[161] Cf. Love et al. (2014), 516
[162] Cf. Love et al. (2014), p. 526
[163] Cf. Allison et al. (2010), p. 677; Cf. Love et al. (2014), p. 536
[164] Cf. Love et al. (2014), p. 537
[165] Cf. Allison et al. (2010), p. 693
[166] Cf. Love et al. (2014), p. 542
[167] Cf. Love et al. (2014), p. 541
[168] Cf. Ledford (2013), p. 471

profitable is the USA, and Austrian university with ambition to enter the USA market might also become their target.

As a defense against NPEs, companies and universities that do engage in auctions to sell patents try to control who bids by selecting ones that they prefer. Nevertheless, it is sometimes difficult to turn down NPEs due to their great offers.[169] Selling one patent to NPE to earn enough money for further development of other technologies or to pay maintenance fees for other patents is a way for universities to see NPEs as an attractive option.

NPEs are not big in Europe, and it is unknown if they will grow. But one must consider them as an option. They are willing to pay more than others, but NPEs are not the ones who will use technologies in public's best interest. Biggest driving force that TTOs in USA have is the faculty service, with revenue maximization being on the third place. And it is universally regarded that US universities are earning more money than universities from other countries. This also shows that only benefit from NPEs, high profit, is not more important than providing services for university, translating research results and working in the public's best interest.

3.9 External technology transfer agency

External agency (EA) helps universities to identify assets with highest prospects, examine their TT models, search for bottlenecks, find reasons for slow development of technologies, locate potential partners and manage negotiations. Direct use of external agency (EA) is not very common for universities and in these cases usually turns out to be a strong ownership or staffing link between the university and any independent EA. Indirect use is more common, where the university maintains the core of TT process and then purchases expert opinion on technologies, markets and processes.[170]

If a university decides to engage an EA, most activities are performed by university's TTO, and the EA is used as an extra help in marketing, negotiations, early-seed financing or just for giving advice and directing the TTO. EAs frequently have experts in certain fields whose help and advices can be of great importance in TT activities.[171]

In some countries, EAs as consultants are a preferable way for universities to transfer technology. Even though the USA is the role-model for patents, inventions and TT, surprisingly they are not frequent users of EAs. EAs are preferable models in the UK and

[169] Cf. Ledford (2013), p. 472
[170] Cf. Artley (2003), p. 143
[171] Cf. Artley (2003), p. 142

Australia. Besides personnel expertise additional advantage is that EAs services can be used outside of country borders. [172]

Using EA is an attractive option that has many benefits, not only because some TT activities like negotiations and licensing are complicated and different in various industries, but it is also challenging for universities to write comprehensive contracts that safeguard exchanges.[173]

While arranging licensing deals, sometimes a TTO is in need of additional technical or legal support. Although in-house lawyers might be roughly as skilled as external lawyers, external lawyers enjoy several advantages. For example, they are able to smooth out fluctuating transactional workloads, they possess high expertise, and they may enjoy reputational advantages which might be beneficial in negotiations.[174]

The financial aspect is very important in third party TT agencies. Since universities are not willing to pay high amounts, EAs work on a “done-deal” basis. If the deal fails, there is no financial transaction, but that is negotiated in the beginning of the deal.[175]

The pharmaceutical industry is changing. Previously, early stage drug discovery was done by the big pharmaceutical company. Instead, the focus is on universities to carry out and even fund the process of the drug development process. That can create pressure on the university, its scientists and TTO because they have to demonstrate that the funds they have been given are paying off.[176]

Some examples of EAs are companies like MRC Technology from the UK, Karolinska Development from Sweden, Brain Chain from Switzerland and ISIS Innovation Ltd. These companies have experience in supporting universities and companies in TT activities worldwide. One problem that universities have with TT is to find a proper company. EAs have industry connections and up-to date information of industry needs which makes it more efficient to find potential companies interested in the university’s offering.[175]

Each EA has different business model. While some prefer case-by-case basis, which is a short term model, others prefer long-term relationship and working with university on multiple licensing deals. Long-term relationship is the one in which the revenue during university and EA collaboration is shared, which represents a simpler method than charging for every element of service provided. Furthermore, shares in profit will depend on the status of the asset. If the patent is already been filed, EA takes less since it is not

[172] Cf. Abrams (2009), p. 26
[173] Cf. Duplat (2014), p. 3
[174] Cf. Duplat (2014), p.8
[175] Cf. Duplat (2014), p. 12
[176] Cf. MRC Technology (2015a), http://www.mrctechnology.org, date of access: 01.06.2015

in the development from the beginning. Partners in deals need to be flexible since each deal and every situation is different.[177]

3.9.1 Conclusion and recommendation for universities

Services of external TT agencies are broad and offer many benefits. Each TT case requires specific expertise from TTO's employees. Sometimes, there is not enough experts and not enough time to do the work. In this cases, EA is a preferable choice. Even though its services are not free of charge, financial questions can come at the end with paying the services after done deals. Expertise offered by EA in recognizing technologies that can be profitable is a valuable service.

From the university's TTO stand point a problem might be to recognize when or why the external support is needed. Lack of employees and their lack of knowledge can be a bottleneck in TT. Some technologies are in an early stage of development and there is a need for further funding. Some EAs offer financial support to bring the development to the end.

TTOs from larger universities have employees that are experts in many fields, from technical to legal fields, but complexities of licensing deals sometimes create extra work that needs to be outsourced for maximum effectiveness. In opposite, TTOs from smaller universities can rarely think about using EA for the lack of financial support. TTOs from smaller universities can also turn to less challenging option like Easy Access IP with offering technologies for free. Using EAs services has more benefits than disadvantages, with latter being only of financial nature.

3.10 University spin-off

There are three options regarding patent transfer: licensing, selling and making spin-offs. A university spin-off (USO) is a small, new company founded by the university's scientist.[178] Even though USO is a start-up company, it is not fully comparable with other technology-based start-ups. Academic spin-offs are receiving growing interest from both, researchers and policy-makers, because of their ability to earn money in the long run and the encouragement of the development of scientific knowledge.[179] Some studies show that USOs have more rapid growth rates than other start-ups in technological fields.[180]

[177] Cf. MRC Technology (2015c), http://www.mrctechnology.org, date of access: 01.06.2015
[178] Cf. Shane (2004), p. 27
[179] Cf. Kenney (2011), p. 1110
[180] Cf. Cooper (1986), p. 258

This might be due to better planning when comparing with other start-ups. Process of creating USO involves new ideas, making decisions, creating business plan, and going through the market until the company's establishment.[181] USOs contribute to TT in two stages: first, they transfer technology from their parent organization to themselves and, secondly, they transfer the technology to customers.[182]

Creating university spin-offs is not a new phenomenon. Entrepreneurs played an important role in creating the biotechnology industry in the USA.[183] Industry leaders in biotechnology like Genentech, Amgen, Biogen Idec and Chiron were all founded or co-founded by university professors. Academic entrepreneurs are viewed as important players in TT process from university to industry, because moving people is believed to be the most effective way to move knowledge. Spin-offs from universities have received increasing attention from researchers and industry in the last two decades, because of its ability to advance scientific knowledge to industrial application.[184]

From 1990 to 2015, there were over 140 university spin-offs founded at TU Graz, which is an average of more than 9 per year. After 2010, TU Graz founded 39 spin-offs, which is an average of 6.5 spin-offs per year.[185] European average from 2008 onwards is 1.7 spin-offs per year[186], which shows that TU Graz is high above the average. ETH Zurich has incorporated 130 spin-offs from 1998 until 2008, and these have created employment for 918 persons. On average, every spin-off from ETH Zurich has created 7.1 jobs.[187]

A survey by Higher Education Funding Council for England has covered all 164 universities in the UK in 2003. The results showed that spin-offs are being created continuously. Per every billion dollars spent on university research in the UK in the academic year 2002/2003, British universities have spun-off more than 38 new companies, which is more than three times the rate of universities in the USA. The same survey showed different results concerning licensing royalties. In the USA royalties from licensed invention pay for more than 3% of universities' research bill, but in the UK only 1%. That difference points to that universities in the UK, perhaps in whole Europe, should shift focus from licensing to creating spin-offs.[188]

Although TU Graz is known as an important source for entrepreneurial activity, and its spin-off creation is above Europe's average, there is always place for improvement. Science Park Graz (SPG) is working with university spin-offs and offer many services to

[181] Cf. Bigliardi et al. (2013), p. 180
[182] Cf. Bigliardi et al. (2013), p. 186
[183] Cf. Kenney (1986), p. 255
[184] Cf. Allen (1988), p. 35
[185] Cf. Research & Technology House (2015b), http://lamp.tu-graz.ac.at, date of access: 07.06.2015
[186] Cf. Flanders Today (2015), http://www.flanderstoday.eu, date of access: 07.06.15
[187] Cf. ETH Zurich (2008), https://www.ethz.ch, date of access: 07.06.2015
[188] Cf. Nature (2005), http://www.nature.com, date of access: 07.06.2015

support entrepreneurs. One of its services is seed funding. The main problem it encounters is having a budget for only ten spin-offs per year. Considering that SPG has around 120 initial talks with entrepreneurs wanting to create a new company, 10 supported spin-offs per year is rather a small number. There is a high potential for more spin-offs, but SPG is limited by its budget. Another problem that SPG sees is in educating people about spin-offs. There are many university scientist, but most of them lack entrepreneurial spirit which holds them back in creating own companies and making a step towards the industry. Even though SPG focuses mostly on high-tech spin-offs and ones that have potential to go beyond country limits, they see enormous potential in university scientists.[189]

3.10.1 Performance

Various studies in the last 15 years have recognized that success of university spin-offs can be influenced by many different factors. A study from 2013 has taken into consideration all other studies to identify most important factors that influence spin-off performance. Table 7 shows all factors identified to influence USO success ranked by importance.[190]

Factors that influence performance of USO	**Study**
1. Founder's need for autonomy 2. Need for leadership 3. Need for personal responsibility 4. Founder's risk taking responsibility 5. Founder's preference for flat structure 6. Formal contacts between parent and spin-off	Kriegesmann (2000)
1. Founder's need for independence and autonomy 2. Career orientation 3. Motivation 4. Professional training and education 5. Formal contacts between parent and spin-off	Egeln et al. (2003)
1. Founder's opportunity creation 2. Founder's career orientation	Gassmann et al. (2003); Beibst and Lautenschlager (2004)

to be continued…

[189] Cf. Bernhard Weber, Science Park Graz (2015)
[190] Cf. Bigliardi et at. (2013), p. 184

Factors that influence performance of USO	Study
1. Degree of innovativeness 2. Stage of development of the technology 3. Ability to patent or in general to protect the technology 4. Scope of the technology/product itself	Heirman and Clarysse (2004)
1. Financial involvement of the parent 2. Competent staff in technology transfer offices 3. Transparency and clarity of support policy 4. Access to qualified entrepreneurial skills	Smilor and Matthews (2004)
1. Mentoring 2. Professional training and education 3. Easy access to high qualified competences	Vohara et al. (2004)
1. Financial involvement of the University 2. Skills of the personnel employed within the technology transfer office 3. Relationships established with capital companies	Lockett et al. (2005)
1. Seed and venture capital availability 2. Regional infrastructure 3. University intellectual property policy 4. Industry characteristics	O'Shea et al. (2005)
1. Incubation strategies 2. Access to relevant and qualified entrepreneurial knowledge	Clarysse et al. (2005)
1. Financial involvement of the parent 2. Formal contacts between parent and spin-off 3. Excellence and network integration of the parent	Scholten (2006)
1. Founder's unique history and experience 2. Human capital of the former scientist 3. Role played by the parent organizations 4. Location of the spin-off 5. High degree of innovation and newness 6. Low technological maturity 7. Difficult judgment of the value of an innovative project 8. Easy recruiting of qualified staff members 9. Good capabilities and conditions for implementing innovations 10. Broad experience in Research and Development	Helm and Maurorer (2007)
1. Entrepreneurial origin 2. Technological knowledge	Clarysse et al. (2 011)

to be continued…

Factors that influence performance of USO	Study
1. Characteristics of the technology 2. Characteristics of the agents involved in the TT process as factors	Venturini et al. (2013)

Table 7. Success factors identified by a study from 2013[191]

In Table 8 top six factors that have greatest importance to impact the success of the university spin-offs are shown, with their importance on the scale from 1 to 7.

Factors that have impact on performance of USO	Importance (on a scale of 1 to 7)
Access to qualified entrepreneurial skills	6.8
Competent staff in TTOs	6.7
Founder's motivation	6.4
Financial involvement of the parent	6.3
Relationships established with capital companies	5.9
Seed and venture capital availability	5.9

Table 8. Success factors of the university spin-offs[192]

The same study listed eighteen different factors with importance number higher than 4. Out of these eighteen, the lowest importance had the founder's need for autonomy. Even though, there are more important factors, need for autonomy should not be neglected. All these factors can be grouped into four different characteristic groups shown in Figure 25.[193]

[191] Bigliardi et al. (2013), p. 182
[192] Cf. Bigliardi et al. (2013), p. 184, own illustration
[193] Cf. Bigliardi et al. (2013), p. 185

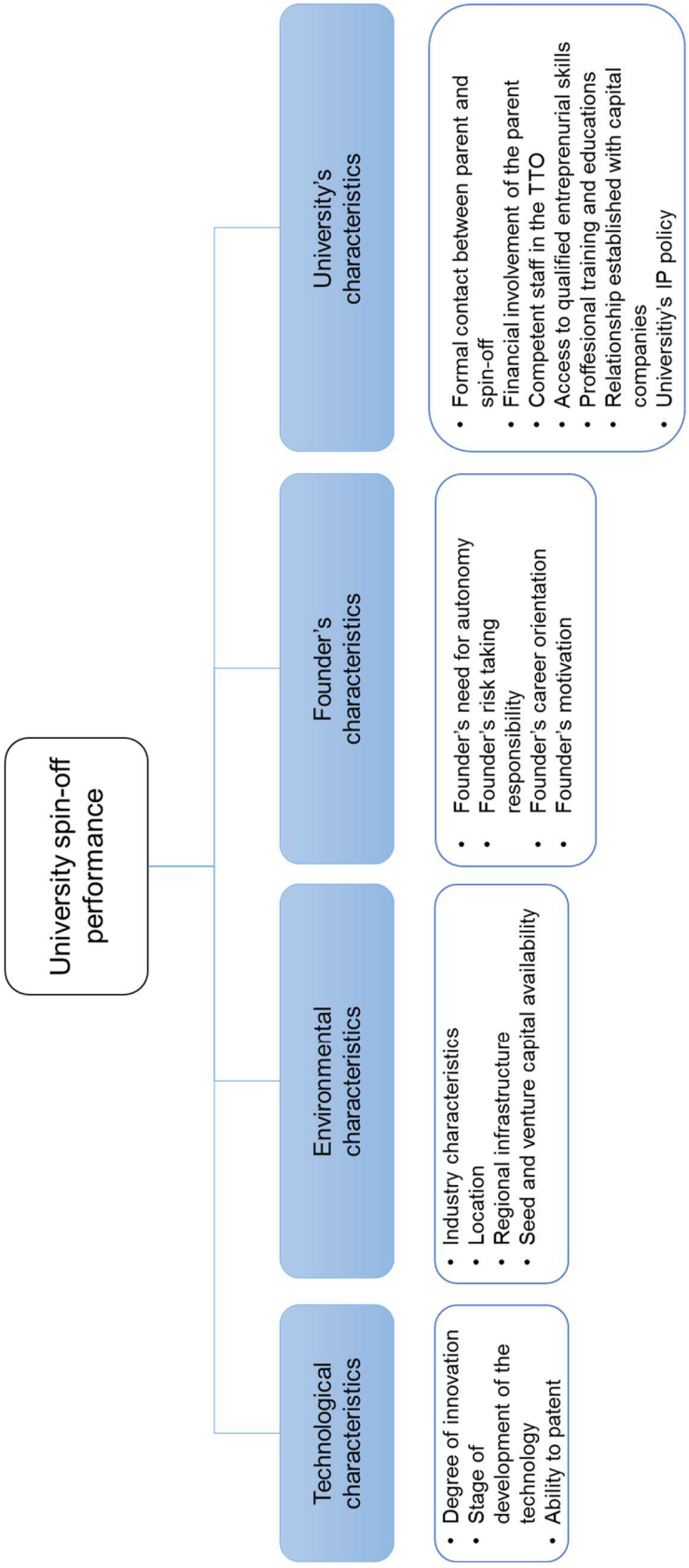

Figure 25. University spin-off performance characteristics and factors[194]

[194] Cf. Bigliardi et al. (2013), p. 185, own illustration

3.10.2 Conclusion and recommendation for universities

USOs are companies founded by an academic inventor aiming to exploit technological knowledge that was originated within a university for product or service development. It is an attractive option for TT. USOs create jobs which is very important for economy of the country. Founding spin-offs is a faster way to connect to industry since moving people is the most efficient way of TT. It is widely known that biggest companies in the world (Apple, Google, and Microsoft) usually buy smaller start-ups to get people that founded these companies, since it is the fastest way to integrate knowledge.

To succeed in founding spin-offs, the founder needs to have entrepreneurial skills and big motivation. But the support from university is also very important. Support from competent staff from TTO and financial involvement from university are crucial parts for the spin-off success. Science Park Graz sees a lot of potential in university spin-offs. The main problem they see is the entrepreneurial education of university scientists. Organizing seminars, courses, and promotion of spin-offs should be a priority for all universities that plan to transfer technology with spin-offs.

There is always the dilemma to license an innovation or incorporate a spin-off. Licensing could make more money for the university and all the further development is done by licensee, but spin-offs keep technology “in house”, create jobs and transfer knowledge faster to industry.

4 Summary and Outlook

Having more options in technology transfer can make a difference between successful and failed exploitation of IP. Universities struggle to convert innovations and patents into commercialized product or service and this thesis provides help in reaching the next level of TT.

Today, there are more patent applications in the world than ever before. PCT applications have reached more than 200.000 applications in 2013 for the first time. Universities entered the phase in which they have two representatives in top 100 patent applicants in the world. Even in this time, when innovative things happen every day, there are also struggles in commercial exploitation of these innovations.

Universities have big portfolios of unused patents for which they must pay maintenance fees to keep IP rights. Maintenance fees of unused patents represents only an expense on universities' budget and stress for TTOs, whose job is to sell or license innovations. One way to make unused patents regain value is Easy Access IP. Companies are not willing to invest into technology that is in early stage of development, and Easy Access IP has reduced the risk by giving the license for a patent for free with simple two-page agreement.

With unused patents, Easy Access IP is not the only option. Auctions can help universities decide for which patents IP rights should be dropped, and which have potential for great future. If an auction of a patent fails and no one is willing to pay for it, it is a clear sign that it does not have a future and that that patent is only an expense for the university. Using a combination of Easy Access IP and auctions can give life to many unused technologies and patents.

For patents that have been analyzed and recognized as a great opportunity to profit, there are many possibilities for commercialization. One of them is the use of online marketplaces. In this thesis four different marketplaces have been described. IP Nexus and WIPO Green are quite new, but show high potential. WIPO Green is supported by World Intellectual Property Organization, which makes them a reputable organization. IP Nexus is a start-up company which is growing at a fast pace. Lack of information in literature and news prevents high recommendation of IP Nexus, but it is a valuable marketplace because its fast growth means potential for great things. With iBridge Network focused only on the USA market, it is hard to recommend the use of it for European universities without plans to enter the USA market.

Pharma Licensing has 17 years long experience in exploitation of technology. It is a marketplace with a database of more than 11.000 technologies and more than 300 university members. For universities that have technologies in pharmaceutical and life

science fields, Pharma Licensing is a marketplace that shows great opportunity and should be the first consideration.

Sometimes, university's TTO needs help in TT and for these purposes, the use of external TT agency is recommended. Even though, there is a need to restrict the work of external agency by detailed contracts, external agencies offer great help to their clients.

Other than licensing and selling, university spin-offs are regarded as the fastest way to transfer knowledge. By transferring people, knowledge is easily spread. TU Graz has experience in this field with over 6 spin-offs per year in the last 6 years. Abilities and involvement of TTO is extremely important in success of the spin-off.

Technologie Allianz works as a combination of an online marketplace and external agency. Even though their members are only from Germany, Austrian universities plan to join soon as part-time members. Technologie Allianz has over 200 members and has earned excellent reputation among companies. Becoming a member of Technologie Allianz is a great opportunity for Austrian universities, since Technologie Allianz's marketplace is used by many companies worldwide. TU Graz might profit significantly from Technologie Allianz membership.

Enterprise Europe Network has 100% success in finding partners for research projects. EEN's aim is to support Europe's economy by helping SME's, research organizations and universities. Because every project needs support, EEN provides it to universities. Over 300 universities and research organizations are members of EEN, and serve as evidence that EEN is concentrated on providing help in creating innovations for many universities.

"Patent trolls" are not beloved companies, since they do not innovate and do not support public benefits. But sometimes they are willing to pay more than competition, which makes them an attractive option. Nevertheless, morally the university should avoid working with patent trolls due to the detrimental effects that are possible to their reputation, there is no evidence that could happen. Unlike in the USA, in Europe patent trolls are not represented in great numbers, but establishment of Unified Patent Court, continent-wide patent court, could change that. The future will show IPs if selling to patent trolls will become a viable option for universities in Austria.

Marketing is one of the activities of TTO. Even though there are many different ways to market a product or technology, universities should use exhibitions as a way to transfer and commercialize technology. Formal and informal ways of communication are equally important and many arrangements might happen in both ways. During exhibitions, there is a mix of communication ways, which has many advantages and it is a preferable choice for customers. Since exhibitions are regarded as an important tool for companies with international growing strategies, university should get into this type of TT. Experts from

marketing, academia and start-ups are find exhibitions as a TT way with high potential and importance.

This thesis demonstrates that TT is not a simple, one-way street. Constant work with old, new and future innovations can be overwhelming for TTO workers, who need to show results and gain profit for universities. Although patents are generally considered as very profitable, the way to commercialize and gain profit from patents involves many activities. Easy Access IP, online marketplaces, and auctions are new and unexplored TT ways which should provide positive movements in the industry.

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7 Interviews

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10 List of abbreviations

BDA	Bayh-Dole Act
EEN	Enterprise Europe Network
EPO	European Patent Office
GX	GreenXchange
IP	Intellectual Property
NPE	Non-Practicing Entities
PCT	Patent Cooperation Treaty
R&T	Research & Technology
SME	Small-Medium Enterprise
SPG	Science Park Graz
TT	Technology Transfer
TTO	Technology Transfer Office
TUG	Technische Universität Graz
UK	United Kingdom
USA	United States of America
USO	University Spin-Off
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization